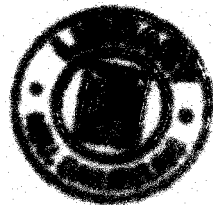


**TRENDS IN AGRICULTURAL PRODUCTIVITY IN POST-
LAND REFORM PERIOD: A STUDY OF THE IMPACT OF
AGRICULTURAL PRODUCTIVITY ON EMPLOYMENT
AND THE ECONOMY OF WEST BENGAL**

**Thesis Submitted for the
Degree of Doctor of Philosophy in Economics**

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India
2013**

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Acknowledgement

This thesis would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

I would like to express my deep and sincere gratitude to my supervisor, Professor Sanchari Roy Mukherjee, present Head of the Department of Economics, University of North Bengal. She has been incredibly generous not only with her able guidance and counselling, but also with her faith and confidence in me. She has been a true mentor throughout the entire process of writing the thesis. I am fortunate to have been under her guidance. I am truly indebted to her for her valuable suggestions, constructive criticism and knowledge on the subject.

I express my sincere gratitude to Professor Jeta Sankrityayana for his views on the topic and in-depth knowledge. I would also like to thank Professor Kanak Kanti Bagchi, Professor Anil Bhumali, Smt. Sudakshina Dutta, Dr. Govinda Chowdhury, Sri Tamash Ranjan Majumder, Dr. Kanchan Dutta and Sri. Karan Tamang of Department of Economics, for providing continuous intellectual stimulation at the Department of Economics of North Bengal. There are many more who helped me enormously during my two-year stint at Department of Economics, North Bengal University.

I owe my gratitude to Professor Ajitava Roychaudhuri, Department of Economics, Jadavpur University for his unconditional support in shaping this thesis from start to finish and for the numerous hours he invested in reading its earliest materialisations. His deep insights, enquiries and guidance were invaluable to my learning, both as a researcher and as a person.

I express my gratitude to the administration of St. Joseph's College, especially, our principal Fr. Dr. K.L. George, SJ. for allowing me to avail two-year leave under Faculty Development Programme during Eleventh Five-Year Plan period of University Grants Commission. I am highly indebted to University Grants Commission for allowing me to work as teacher-fellow in the Department of Economics, University of North Bengal and for also supporting me with contingency funds.

I am also greatly indebted to my younger sister Dr. Panchali Sengupta for her thoughtful feedback, statistical support, interesting explorations and encouragement during the preparation of the thesis.

The help rendered by Dr. Dilip Sarkar and Dr. Sawatasiddhya Sarkar also deserves a special mention. I am grateful to my friends Sri Sudeepta Chaudhuri and Sri Arjun Sarathi Das for their continuous support and encouragement. I would like to thank fellow researchers at the Department of Economics for their support and good cheer. I would like to thank Sri Subir Das Mahanata for his computer assistance.

I also gratefully acknowledge the cooperation and help from the officials of University libraries particularly, North Bengal University Library, Jawaharlal Nehru University, Library of Bureau of Applied Economics and Statistics, Government of West Bengal, Kolkata. I am highly indebted to the Documentation Officer of The Centre for Himalayan Studies, Sri Ajay Mishra for providing me huge numbers of research articles pertinent to my research work.

Finally, I owe the greatest debt to my wife Prajna, my parents for their unwavering belief in me and endless patience. Their love and encouragement was in the end what made this thesis possible.



Anjan Chakrabarti

Date: 2nd May 2013

Contents

		<i>Page No.</i>
Acknowledgement		i
List of Maps & Figures		ii – v
List of Tables		vi
List of Abbreviation		vii – viii
Glossary		vii – viii
Chapter-I	Introduction	1 – 50
1.1	Background of the Study	6
	1.1.1. Agricultural Systems in pre-Colonial and Colonial Period	6
	1.1.2. Agricultural Systems in post-Independence Period	7
1.2	Statement of the problem	11
1.3	A Review of Related Literature	16
	1.3.1. Research on Agriculture during Colonial Era	17
	1.3.2. Farm Size, Productivity and Land Reform	21
	1.3.3. Trends in Agricultural Production and Productivity in post-Independence Period in India	23
	1.3.4. Sources of Growth of Agricultural Production and Productivity	25
	1.3.5. Growth Instability in Crop Production	27
	1.3.6. Farm and non-Farm Interaction	28
	1.3.7. Institutional Reforms in West Bengal	29
	1.3.8. Trends in Production and Productivity in West Bengal	31
1.4	Research Gap	33
1.5	Research Questions	34
1.6	Hypotheses of the Study	35
1.7	Methodology	35
	1.7.1. Measuring Growth of Crop Output, Productivity and Area	36
	1.7.2. Acceleration and Deceleration of Growth	36
	1.7.3. Measuring Growth in Sub-Periods: Kinked Exponential Model	37
	1.7.4. Weather or Rainfall Adjusted Growth Rate	37
	1.7.5. Measuring Instability of Growth Rate	37
	1.7.6. Measuring Crop Diversification	38
	1.7.7. Standard Pooled Regression	39
1.8	Chapterisation of the Study	39
Chapter-II	Agrarian Relations and Agriculture in Bengal in Retrospect	51 – 83
2.1	Introduction	51
2.2	An Overview of Agriculture during pre-Colonial Era	51
	2.2.1. Tenurial Relations, Agrarian Structure, Peasantry and the Economy in the pre-Colonial Era	52
2.3	An Overview of Agriculture during Colonial Era	55
	2.3.1. Evolution of Tenancy System in Bengal during Colonial Period in pre-Permanent Settlement Era	56
	2.3.2. The Permanent Settlement	57
	2.3.3. The Impact of Permanent Settlement and Bengal Tenancy Act on Agrarian Bengal	61
2.4	Agriculture during the British Raj: A Critical Review	65
	2.4.1. The Land of Agricultural Prosperity: New Delta and the Ganges-Brahmaputra <i>Doab</i>	66
	2.4.2. The Land of Agricultural Decline: The Ecological Zone of the Old Delta	66
	2.4.3. Decline in Agriculture in Bengal in the 20 th Century: Probable Causes and Consequences	67

2.5	Post-Independence Era	70
2.5.1	Abolition of <i>Zamindari</i> System in India	71
2.5.2	Tenancy Reforms	73
2.5.3	Imposition of Ceilings on Landholdings	74
2.6	Tenancy Reforms in West Bengal in post-Independence Period	77
2.6.1	Land Reforms Act 1955: Definition of Share Cropper	77
2.6.2	Land Reforms Act (Amendment), 1966	78
2.7	Conclusion	80
Chapter-III	Trends in Agricultural Production and Productivity: An Inter-State Comparison	84 – 116
3.1	The Indian Experience	84
3.2	Agricultural Policies in post-Independence Era (1947 to 1960)	85
3.2.1	Agricultural Policies from late-1960s to 1980s	85
3.2.2	Agricultural Policies in the 1980s and during the period of Economic Liberalisation (1991 to the recent)	86
3.3	Growth Performance of Production, Productivity of Major Crops in India in post-Independence Period	88
3.3.1	Growth in Area, Production and Productivity from 1949-50 to 1964-65 (pre-Green Revolution Period)	92
3.3.2	Growth in Production, Area and productivity from 1967-68 to 1979-80 (early-Green Revolution Period)	92
3.3.3	Growth in Production, Area and Productivity from 1980-81 to 1989-90 (late-Green Revolution Period)	94
3.3.4	Growth in Production, Area and Productivity from 1990-91 to 2007-08	94
3.4	Crop Diversification at all-India Level	96
3.5	Inter-State Comparison of Growth of Major Crops in India over Different Sub-Periods	97
3.5.1	Production of Major Crops in India: An Inter-State Comparison	98
3.5.2	Compound Annual Growth Rates in Production and Productivity of Foodgrains in India: An Inter-State Comparison	102
3.5.3	Inter-State Long Term Growth Patterns in Area, Production and Productivity of Major Crops in India	105
3.5.4	Growth in Foodgrain Production and Growth of Population (1960-61 to 2007-08): An Inter-State Comparison	111
3.6	Conclusion	114
Chapter-IV	Trends in Agricultural Productivity in West Bengal: An Overview of Districts	117 – 154
4.1	Introduction	117
4.2	West Bengal: A Physiographic Description	117
4.3	Agro-climatic Zones in West Bengal	118
4.3.1	Eastern Himalayan Region	118
	a. Hills Sub-Region	
	b. Terai Sub-Region	
4.3.2	Lower Gangetic Region	119
	a. Old Alluvium Sub-Region	
	b. New Alluvium Sub-Region	
	c. Coastal Saline Sub-Region	
	d. Red Lateritic Sub-Region	
4.3.3	Eastern Plateau and Hill Region	120

4.4	Performance of West Bengal in Agriculture: A Review	122
4.5	Methodological Issues on Measurement of Growth	125
4.6	Districtwise Foodgrain Production as Percentage of State's Foodgrain Production: The Changing Scenario	127
4.7	Share of Rice Production to Total Foodgrain Production: A Districtwise Comparison	128
4.8	Districtwise Variation in Rice Production as Percentage to State's Foodgrain Production (1970-71 to 2008-09)	130
4.9	Productivity Trend in Foodgrain and Rice (1970-71 to 2008-09): Inter-District Analysis	132
4.10	Estimated Growth Rates in Agricultural Production: Cropwise and Districtwise Disaggregated Estimation	139
4.10.1	Inter-District Comparison of Growth in Production and Productivity of Foodgrain in West Bengal	140
4.11	Inter-Districts Comparison of Growth in Production and Productivity of Rice in West Bengal	145
4.12	Inter-District Comparison of Growth in Production and Productivity of Wheat in West Bengal	149
4.13	Conclusion	153

Chapter-V Agricultural Growth: Variability and Instability in Production and Productivity of Foodgrains and Non-Foodgrains in West Bengal 155 – 184

5.1	Introduction	155
5.2	Methodology of the Study	155
5.2.1	Growth Measurement over Sub-Periods	155
5.2.2	Acceleration and Deceleration in Growth Rates	156
5.2.3	Weather Adjusted Growth Rates	156
5.2.4	Measuring Instability of Growth in Agricultural Production	156
5.3	Aus, Aman and Boro in West Bengal	157
5.3.1	Trends in Production, Productivity and Area under Cultivation of Aman, Aus, Boro in West Bengal	159
5.4	Districtwise Acceleration and Deceleration in Growth in Production of select Foodgrains in West Bengal from 1970-71 to 2008-2009	163
5.5	Weather Adjusted Growth Rate	167
5.6	Growth Instability in Production and Productivity of Select Foodgrains	170
5.7	Trends in Production and Productivity of Non-Foodgrains in West Bengal	172
5.7.1	Changes in Percentage of Area under Various Non-Foodgrains in West Bengal from 1970-71 to 2008-09	172
5.7.2	Kinked Exponential Growth in Production of Select Non-Foodgrains	174
5.7.3	Kinked Exponential Growth in Productivity of Select Non-Foodgrains	176
5.7.4	Kinked Exponential Growth in Area of Select Non-Foodgrains	177
5.7.5	Acceleration and Deceleration in Growth in Production, Productivity and Area of Select Non-Foodgrains in West Bengal from 1970-71 to 2008-09	178
5.7.6	Instability in Production and Productivity of Select Non-Foodgrains in West Bengal from 1970-71 to 2008-09	180
5.8	Conclusion	180

Chapter –VI	Crop Diversification in the Districts of West Bengal: Empirical Evidences and Disaggregated Analysis	185 – 214
6.1	Introduction	185
6.2	The Dynamics of Change in Cropping Pattern in West Bengal	188
	6.2.1 Changes in Cropping Pattern	189
	6.2.2 Cropping Intensity	191
6.3	Diversification and Growth in Crop Output in West Bengal: A State Level Analysis	193
6.4	Components of Growth of Crop Output in West Bengal: Area Effect and Yield Effect	194
6.5	Magnitude and Extent of Crop Diversification in West Bengal: A Disaggregated District Level Analysis	198
6.6	Temporal and Spatial Shifts in Area Share of Major Crops at District Level in West Bengal	203
6.7	Factors Affecting Crop Diversification: Drivers and Constraints	208
6.8	Conclusion	212
Chapter-VII	Driving Factors of Agricultural Productivity in West Bengal: Agriculture, Employment and Economy Interrelationship	215 – 248
7.1	Introduction	215
7.2	Methodology to Measure the Impact of Various Factors on Foodgrain Productivity	218
7.3	Interpretation of the Regression Results (Equation 1)	220
7.4	Methodology to Measure the Simultaneous Impact of Operation Barga and Green Revolution	221
7.5	Interpretation of the Regression Results (Equation 2, 3, 4 and 5)	223
7.6	Role of Irrigation in Augmenting Agricultural Productivity	227
7.7	Agricultural Productivity and its Impact on Employment and Economy	228
	7.7.1 Sectoral Growth of GSDP (at 1993-94 Prices) from 1980-81 to 2009-10	230
	7.7.2 Districtwise Change in Employment Scenario in West Bengal	235
	7.7.3 Changing Land Holding Pattern and Emerging Agrarian Structure in West Bengal	240
7.8	Conclusion	244
Chapter-VIII	Summary and Conclusions	249 – 264
	Bibliography	265 – 278

List of Maps and Figures

Page No.

Maps

Map 1 :	West Bengal: District Map	121
Map 2 :	West Bengal: Map-Agriculture	122
Map 3 :	Districtwise Comparison of Productivity of Foodgrain in 1970-71	134
Map 4 :	Districtwise Comparison of Productivity of Foodgrain in 2008-09	135
Map 5 :	Districtwise Comparison of Productivity of Rice in 1970-71	137
Map 6 :	Districtwise Comparison of Productivity of Foodgrain in 2008-09	138

Figures

Figure 4.A :	Comparison of Foodgrain Productivity (kg/ha) between West Bengal and India	139
Figure 4.B :	Comparison of Productivity (kg/ha) of Rice between West Bengal and India	139
Figure 5.A :	Yield (kg/ha) of Aman, Aus, Boro and Rice in West Bengal from 1970-71 to 2008-09	159
Figure 5.B :	Districtwise Weather Adjusted and Unadjusted Growth Rates of Foodgrain Production in West Bengal from 1970-71 to 2008-09	168

List of Tables

	<i>Page No.</i>
Table 2.1: Types of Land Tenure and Area under different Tenurial System	60
Table 2.2: Percentage of 'Landlord', 'Tenant', 'Labourer' in the Agricultural Population of Bengal in 1921	65
Table 2.3: Decline in cultivated land (in percentage) between 1891 and 1931 in districts of West and Central Bengal	67
Table 2.4: Density (Per Square mile) of Population in the districts of East Bengal in 1931	68
Table 3.1: Exponential Growth in Production, Area and Productivity of Foodgrain, Rice, Wheat and Pulses (1970-71 to 2008-09) and Acceleration or Deceleration	91
Table 3.2: CAGR of Area, Production, Productivity of Major Crops in India between 1949-50 and 1964-65	92
Table 3.3: Compound Annual Growth Rates in Area, Production and Productivity of Major Crops in India (in percent)	93
Table 3.4: Gross Capital Formation (GCF) in Agriculture as a share of GDP from Agriculture, India from 1980-81 to 2006-07 (in percent)	95
Table 3.5: Share of Area under Major Crops of India (percentage of GCA)	96
Table 3.6: Classification of Production by Agro-ecosystem in India	98
Table 3.7: Regionwise and Statewise Contribution to Total Foodgrain Production (in percent)	100
Table 3.8: Regionwise and Statewise Contribution to Total Rice Production (in percent)	101
Table 3.9: Regionwise and Statewise Contribution to Total Wheat Production (in percent)	101
Table 3.10: Statewise CAGR in Foodgrain Production in India (1960-61 to 2007-08)	104
Table 3.11: Statewise CAGR in Productivity of Foodgrain in India (1960-61 to 2007-08)	105
Table 3.12: Compound Annual Growth rates in Area for Major Crops by States (1967-68 to 2007-08)	107
Table 3.13: Compound Annual Growth rates in Production for Major Crops by States (1967-68 to 2007-08)	108
Table 3.14: Compound Annual Growth Rates in Productivity for Major Crops by States (1967-68 to 2007-08)	110
Table 3.15: Inter-State Comparison of Growth in Foodgrain Production and Growth of Population (1960-61 to 2007-08)	113
Table 3.16: Inter-State Comparison of Food production Sufficiency or Insufficiency (1960-61 to 2007-08)	113
Table 4.1: Districtwise Share of Foodgrain Production to Total Foodgrain Production of West Bengal (1970-71 to 2008-09)	129
Table 4.2: Districtwise Production of Rice as percentage of Districtwise Foodgrain Production	130
Table 4.3: Districtwise Share of Rice Production to Total Rice Production of West Bengal	131
Table 4.4: Districtwise Comparison of Productivity of Foodgrain over the Decades	133
Table 4.5: Districtwise Comparison of Productivity of Rice over the Decades	136

Table 4.6:	Districtwise Kinked Exponential Growth in Production of Foodgrain in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)	141
Table 4.7:	Districtwise Kinked Exponential Growth in Productivity of Foodgrain in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)	143
Table 4.8:	Districtwise Kinked Exponential Growth in Production of Rice in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)	146
Table 4.9:	Districtwise Kinked Exponential Growth in Productivity of Rice in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)	148
Table 4.10:	Districtwise Wheat Production as percentage of State's Foodgrain Production	149
Table 4.11:	Districtwise Kinked Exponential Growth in Production of Wheat in West Bengal for (1970-71 to 2008-09), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)	150
Table 4.12:	Districtwise Kinked Exponential Growth in Productivity of Wheat in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)	151
Table 5.1:	Production and Area under cultivation of Aman, Aus, Boro as percentage of Production and Area under cultivation of Rice in West Bengal	158
Table 5.2:	Exponential Growth and CAGR in Production, Area and Productivity of Aman, Aus, Boro and Rice in West Bengal	160
Table 5.3:	Kinked Exponential Growth in Production, Area and Productivity of Aman, Aus and Boro in West Bengal for (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)	161
Table 5.4:	Variability in Production, Area and Productivity of Aman, Aus and Boro in West Bengal in Four Sub-Periods (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)	162
Table 5.5:	Districtwise Acceleration or Deceleration in Foodgrain Production from 1970-71 to 2008-09	164
Table 5.6:	Districtwise Acceleration or Deceleration in Rice Production from 1970-71 to 2008-09	165
Table 5.7:	Districtwise Acceleration or Deceleration in Wheat Production from 1970-71 to 2008-09	166
Table 5.8:	Districtwise Acceleration or Deceleration in Pulses Production from 1970-71 to 2008-09	167
Table 5.9:	Districtwise Weather (Rainfall Index) Adjusted Growth Rate and Exponential Growth rate in Foodgrain Production (1970-71 to 2008-2009)	169
Table 5.10:	Districtwise Measures of Instability Coefficients of Production of Various Crops in West Bengal from 1970-71 to 2008-09	170
Table 5.11:	Districtwise Measures of Instability Coefficients of Productivity of Various Crops in West Bengal from 1970-71 to 2008-09	171
Table 5.12:	Area under Various Non-foodgrains as percentage of Total Cropped Area in West Bengal from 1970-71 to 2008-09	174
Table 5.13:	Cropwise Area as percentage of Total Area under Non-foodgrain in West Bengal	174
Table 5.14:	Kinked Exponential Growth in Production in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09) of Select Non-Foodgrains	175

Table 5.15:	Kinked Exponential Growth in Productivity of West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09) of Select Non-Foodgrains	177
Table 5.16:	Kinked Exponential Growth in Area of West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09) of Select Non-Foodgrains	178
Table 5.17:	Acceleration and Deceleration in Production of select Non-Foodgrains in West Bengal from 1970-71 to 2008-09	179
Table 5.18:	Acceleration and Deceleration in Productivity of select Non-Foodgrains in West Bengal from 1970-71 to 2008-09	179
Table 5.19:	Acceleration and Deceleration in Area under Cultivation of select Non-Foodgrains in West Bengal from 1970-71 to 2008-09	179
Table 5.20:	Extent of Instability in Production and Productivity of Select Non-foodgrains in West Bengal from 1970-71 to 2008-09	180
Table 6.1:	Area under Different Crops (in 000 ha) in West Bengal (1970-71 to 2008-09)	189
Table 6.2:	Cropping Pattern Changes (Cropwise Area as Percentage of Total Cropped Area) in West Bengal (1970-71 to 2008-09)	190
Table 6.3:	Cropping Pattern Changes (Cropwise Area as percentage of Gross Cropped Area) in West Bengal (1970-71 to 2008-09)	191
Table 6.4:	Districtwise Cropping Intensity (1970-71 to 2008-09)	192
Table 6.5:	Exponential Growth in Area of Important Crops in West Bengal	194
Table 6.6:	Cropwise Exponential Growth in Output, Area and Yield in West Bengal (1970-71 to 2008-09)	197
Table 6.7:	Change in Production ('000 Tonnes) and Area ('000 Hectares) of Different Crops in West Bengal (1970-71 to 2008-09)	197
Table 6.8:	The Decomposition of the Total Increase in Output in terms of Area Effect, Yield Effect and the Crop Area-Gross Cropped Area Elasticity of Crops in West Bengal (1970-71 to 2008-09)	198
Table 6.9:	Districtwise Herfindhal Indices of Crop Diversification in West Bengal (1970-71 to 2008-09)	201
Table 6.10:	Simpson Indices of Crop Diversification in the Districts of West Bengal (1970-71 to 2008-09)	201
Table 6.11:	Districtwise Ranking of Herfindhal Indices (HI) and Simpson Indices (SI) of Crop Concentration/Diversification in West Bengal (1970-71 to 2008-09)	202
Table 6.12:	Rank Correlation Matrix of Districtwise Herfindahl Indices of Crop Diversification in West Bengal	202
Table 6.13:	Rank Correlation Matrix of Districtwise Simpson Indices of Crop Diversification in West Bengal	202
Table 6. 14:	Districtwise Share of Area of Seven Major Crops as percentage of Total Cropped Area (1970-71 to 2008-09)	204-207
Table 6. 14	A: Rice	204
Table 6.14	B: Wheat	204
Table 6. 14	C: Other Cereals	205
Table 6. 14	D: Pulses	205

Table 6. 14	E: Jute	206
Table 6. 14	F: Potato	206
Table 6. 14	G: Rapeseeds and Mustard	207
Table 6.15:	Correlation between SI Index and other factors responsible for Crop Diversification	210
Table 7.1:	Results of Estimated Parameters of Equation 1	219
Table 7.2:	Districtwise Number of Primary Credit Society per 000 sq-km Area	221
Table 7.3:	Results of Estimated Parameters of Equation 2	222
Table 7.4:	Results of Estimated Parameters of Equation 3	222
Table 7.5:	Results of Estimated Parameters of Equation 4	223
Table 7.6:	Results of Estimated Parameters of Equation 5	223
Table 7.7:	Districtwise Average Foodgrain Productivity (kg/ha), percentage of <i>Barga</i> and Average Fertiliser Use (kg/ha) from 1980-81 to 2008-09	227
Table 7.8:	Kinked Exponential Growth in Various Sectors from 1980-81 to 2009-2010 with three sub-periods, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-01 to 2009-10 (at 1993-94 Price)	233
Table 7.9:	Share of Various Sectors (in percentage) in GSDP (at current prices) from 1980-81 to 2009-10	234
Table 7.10:	Districtwise Number of Small-Scale Industrial Units Registered with Directorate of Micro and Small Scale Enterprises and Number of Registered Factories in per '000 sq-km area	234
Table 7.11:	Districtwise percentage of Total Workers to District Population (Work Participation Rate)	237
Table 7.12:	Districtwise percentage of Cultivators, Agricultural Labourers, Household Industry and Marginal Workers to Districtwise Total Workers	238
Table 7.13:	Dispossession of <i>Pattadars</i> and Eviction of <i>Bargadars</i> (in percent) from Lands between Inception of land Reforms and the year 2000	240
Table 7.14:	Number of Holdings of Major Size-Classes as percentage of Total Number of Holdings	242
Table 7.15:	Area under Operational Holdings of Major Size-Classes as percentage Total Area Operated	243
Table 7.16:	Average Land Holding (in ha) under Various Size-Classes	243
Table 7.17:	Per-Factory (Registered) Average Daily Employment	244

List of Abbreviations

- APMC: Agricultural Produce and Marketing Committee
CAGR: Compound Annual Rate of Growth
CEI: Composite Entropy Index
CIMMYT: International Maize and Wheat Improvement Center
CMIE: Centre for Monitoring Indian Economy
EI: Entropy Index
FAO: Food and Agricultural Organization of United Nations
GCA: Gross Cropped Area
GDP: Gross Domestic Product
GoI: Government of India
GSDP: Gross State Domestic Product
HI: Herfindahl Index
HYV: High Yielding Varieties
IFAD: International Fund for Agricultural Development.
IRRI: International Rice Research Institute.
MEI: Modified Entropy Index
MOSPI: Ministry of Statistics and Programme Implementation
NCA: Net Cropped Area
NCAER: National Centre for Applied Economics and Policy Research
NREGS: National Rural Employment Guarantee Scheme
NSA: Net Sown Area
NSSO: National Sample Survey Organisation
OI: Ogive Index
RBI: Reserve Bank of India
SI: Simpson Index
TCA: Total Cropped Area
WTO: World Trade Organizations

Glossary

Abwab : Illegal exaction, extra cess.

Adhi: Half-Share.

Adhiar: Sharecropper.

Banias: Merchant money changer or banker, a caste traditionally engaged in the above activities.

Bargadars: Sharecropper.

Begar: Unpaid labour, free service.

Bhet: Gifts (in terms of cash)

Bhuswamis: The old established landlords of Bengal.

Bigha: Measure of land (approximately one-third of an acre).

Dalals: Broker.

Diwani Adalat: The Civil Court.

Diwani: Rights of revenue collection.

Gomostas: Agent or representative.

Haptam: Regulation VII of 1799 introduced by the East India Company in their continuous pursuit of increasing tax collection.

Ijaradars: Revenue Farmer.

Jagir: Income from a piece of a land assigned to officers by the rulers.

Jagirdars: Holder of a *jagir*.

Jama: Total sum, total land revenue levied from an estate.

Jotedars: Landowners who used to enjoy occupancy rights to their land by paying customary rents to the *zamindars*.

Kharif: Cultivation and harvesting of any agricultural crops sown in the rainy season on the Asian subcontinent.

Khas: Estates held directly by the Government.

Khud-kast: Owner of land who cultivates with his own ploughs and bullocks and some hired labour.

Malguzar: Land holding of primary *zamindari*.

Mutsuddis: Merchant class found in medieval Bengal.

Muzarian: Sharecroppers who rented land from the *khud-kast* peasants or the *zamindars*.

Nawab: Mughal Provincial Governor.

Nazr: Traditional fee to landlord on purchase of land on obtaining tenancy or on ceremonial occasions.

Pahi or upari : Cultivator who came from the other villages to cultivate the land.

Pahikasth: Non-resident cultivator who did not have hereditary claims on land.

Paikars: Small traders.

Pancham: Regulation V of 1812 Regulation VII of 1799 introduced by the East India Company in their pursuit of increasing tax collection.

Rabi: Agricultural crops sown in winter and harvested in the summer season.

Raiyats : Subjects or payer of Land Revenue.

Sadar Diwani Adalat: The District Civil Court.

Salami: Traditional fee to landlord on purchase of land or on obtaining tenancy.

Shroffs: Banker, Money Lender.

Talukdar: Landlord or tenure holder, usually collector of rent from *raiya*.

Taqavi: Loan in case of failure of crops due to natural calamities.

Tebhaga: One-third share.

Zamindar: Landlord who was a revenue payer to the government under the Permanent Settlement of 1793.

Chapter-I

Introduction

The importance of the estimation of agricultural productivity, the inter-relationship between productivity and institutional reforms, institutional reforms as a carrier of agricultural development and economic development, has not received much attention in various development discourses in social sciences, particularly in economics. Rather, it was felt that the evolution of the theoretical discourse on development and the status of agriculture there in, was a contested issue. Therefore, the evolution of theoretical discourses on agriculture-related development and how agriculture as a basic economic activity has been placed therein, needs to be verified. Looking back at the classical age of economics, agriculture was identified as one of the prime economic activities of human civilisation that ensured food security and a way to enlarge livelihood opportunities. The interplay between agriculture and population growth was brought into debate by Malthus and Ricardo in the late 18th century and early 19th century. According to the classical paradigm, additional population is absorbed by agricultural growth at the extensive and intensive margins, both of which result in diminishing returns to labour. Extensive growth occurs through the expansion of cultivated land, which Ricardo (1817) presumed to be more distant from or of poorer quality than land already in use. Growth at the intensive margin likewise results in diminishing returns, due to the greater amount of labour and other inputs employed on the fixed quantity of previously cultivated land. As a consequence, Ricardo (1817) and Malthus (1798) theorized that wages would eventually decline towards a subsistence level, where population growth would cease due to 'positive checks' such as starvation and disease.

Cursory look at literature on economic development made it clear that if the 1950s and early 1960s were dominated by the planning approach, then the rest of the 1960s was in the sway of 'dualism'. The various models on 'dualism' justified the import protection of industry on the ground that marginal product of labour in agriculture was relatively low. A. W. Lewis formulated a structural change model (1954) that explained how a 'capitalist' sector could develop by drawing labour from a non-capitalist 'subsistence' sector. The existence of 'surplus labour' in the subsistence sector ensured that during an extended period, wages in the capitalist sector remain constant because the supply of labour to the capitalist sector exceeds demand at this wage rate. The surplus of output over wages is

captured by the capitalists as profits. Within the capitalist sector, growth occurs as the share of profits in national income rises and is directed to profitable investment. Unlimited supplies of labour (opposed to the classical assumption of fixed supply of labour) ensure that capital accumulation is sustained over time, but the dynamics of the economic forces play a vital lead towards economic transformation.

Dualistic models conceived by Lewis (1954), Ranis-Fei (1961), Jorgenson (1961, 1966) etc. also treated agriculture as catalytic agent for industrial development vis-à-vis economic development. Industrialisation was considered as synonym of development and agriculture was treated as mere agent for its 'product contribution', 'factor contribution' and 'market contribution' (Kuznets, 1961). However, it has increasingly been felt that achieving high industrial growth does not always help to remove the problems of unemployment and poverty in many less developed countries. Dependence of many people on agriculture and less emphasis on agricultural development might be one of the causes among many for the persistence of unemployment and poverty in many less developed countries (Todaro, 1977). As a consequence, role of agriculture on economic development had started gaining importance in economic literature on 'dualism'. Works of Coale and Hoover (1958), Doving (1959), Johnston and Mellor (1961), Mosher (1966), Mellor (1966), Myrdal (1968) are few among many that can be cited for ready references. It was argued by them that standard of living of the poor would not be raised if terms of trade moves against the people who derive livelihood from agriculture. In their studies, it was identified that agriculture can potentially contribute in providing firstly, food and fibre for an expanding population with increase in purchasing power; secondly, providing capital for economic transformation; thirdly, helping out to enhance rural welfare; and finally, protecting the prospect of business cycle of foreign trade and industrial production.

Walras (1874) and Pareto (1906), on the other hand, had shown that transaction helps free competitive market to reach equilibrium through a process of efficient resource allocation and redistribution of resources, thus enabling the economy to reach a socially optimum point. Here institutions are taken as sacrosanct and emphasis was only on achieving market perfection.

Mellor and Lele (1973) and Mellor and Johnston (1984) formulated their development model where the major emphasis was given on the inter linkages between agriculture and non-agricultural sector. There are production linkages – backward and forward. Backward linkages relate to the demand of farmers for inputs while forward linkages are linked to the

need for processing of agricultural commodities. Moreover, there are consumption linkages. As agricultural income rises, it creates higher demand for non-farm goods produced locally or in neighbouring villages or towns. Finally, there are linkages through the supply of labour and capital. As agricultural productivity rises, either labour is released or wages go up. Also, agricultural surpluses could finance expansion of the non-farm sector. And the latter in turn could stimulate agricultural production through lower input costs, technological change and reinvestment of profits into farming.

Keith Griffin (1974) then rightly pointed out that debate was no longer moving around industry versus agriculture rather, a whole gamut of analysis started evolving around in conceptualizing different strategies for agricultural development, especially in less developed countries. The outcome though varies considerably because each country is having her own specific structure with own political power specificity.

Development economics remained preoccupied with 'growth with equity' during the decade of seventies and failure of market was endorsed. Integrated Rural Development backed by subsidies and government intervention was mostly advocated for agricultural development, although accountability of subsidies became questionable (Binswanger, 2004). Confiscatory land reform with wide range of input subsidies was used by many countries to ensure agricultural growth and equity. Rising factor productivity and introduction of new technologies ensured growth in agriculture (Federico, 2005). As a matter of fact, prior to the publication of Schultz's *Transforming Traditional Agriculture* (1964), the general belief was that peasant farmers were tradition-driven, ignorant, lazy and backward. Schultz showed that limited resources including human capital, stagnant technology caused poverty among peasants, while slow decision making had never been the case. And in late sixties, high-yielding varieties of rice and wheat were introduced in Asia and Latin America and rapid adoption of these varieties by the farmers and concomitant changes in foodgrain yield was popularised as Green Revolution. But in the eighties, government failure in production and distribution became a much talked issue and 'privatisation and getting price right' regained prominence in development thought. Trade-led growth and outward orientation of agriculture gained more importance in developmental policies (Clarete and Roumasset, 1987; Krueger *et al.*, 1988, Gardner 1996).

While developing the above models for economic development as well as agricultural development, market has always been considered as sacrosanct.

International Fund for Agricultural Development (IFAD, 2001) rued on the fact that whole question of poverty needs to be looked at in the context of rural world and to them, 'current development efforts grossly and increasingly neglected agriculture and rural people.' Aid for agricultural development in least-developed countries was reduced by two-thirds during 1987 to 1998; in spite of the fact that world's 85 percent poor are living in least-developed countries. It was observed that since 1980 and onwards, economics of agricultural development lost its importance in development economics (Roumasset, 2006). De Soto (1989, 2000), Ostrom (1990, 1992), Dixit (2006) to name only a selected few, were of the view that *market* alone cannot take care of everything until the institutions are becoming perfect. They also opined that property rights need to be defined properly to achieve the goal of Walras and Pareto per se.

Now from institutional perspective, agrarian structure may be defined as the subset of institutions governing the distribution of rights in agriculture means of production, precisely land. These rights include not only ownership but also such arrangements as tenancy and mortgage which create a divergence between ownership and actual operation. And this divergence between ownership and actual production or putting it in larger perspective, the agrarian structures more than often affects the agricultural production. To deal with land tenure system, share cropping which is considered as integral part of feudal society has emerged as one of the most dominant agrarian relations and was in prevalence in some pre-capitalist and pre-socialist societies from ancient period. It was and it is most prominently visible in most of the third world countries. Marquis de Mirabeau observed that share tenancy is a 'deplorable method of cultivation, the daughter of necessity and mother of misery' (quoted in Higgs, 1894). The high degree of variability of effective resource endowment among the peasantry gave birth to labour-hired capitalists and rich peasants, self employed middle and small peasants and poor and hired peasants (Patnaik, 1994:156). Pearce (1983) had explained share cropping from the Marxist perspective. According to him, share cropping is a method of surplus appropriation by which surplus labour is transferred to the landlord in the form of surplus product. Even though share tenancy has always been identified as inefficient system¹ by the early neo-classical economists like Adam Smith (1937:367) and Alfred Marshall (1948:648), but to them, peasants are a homogeneous category and consist of owner and tenants.

It is, however, perceived that fixed rent tenancy (either in cash or kind) is a better option for a tenant². Bhaduri (1973)³ showed that semi-feudal landowners preferred to keep the

tenants in perpetual indebtedness and to keep the income of tenant low, they did not want to invest in technological innovation in agriculture.

To remove the inefficiency and inequity that share cropping entailed, redistributive policy was envisaged in the form of land reform or agrarian reform. In broader perspective, land reform means redistribution or reallocation of rights to establish a more equitable distribution of farm land (Boyce *et al.*, 2005:1). In addition to this, state sponsored land acquisitions, communal or collective forms of farming, and changes in land tenure pattern, that is, changes in the rent sharing arrangement between land owners and actual tillers of the land, are considered as different variants of land reforms (Griffin *et al.*, 2002: 3-4). In recent past, 'market led agrarian model' (Deininger and Binswanger, 1999:247-76) and 'negotiated' land reform that relies on voluntary land transfers between buyers and sellers with government's role restricted to establishing necessary framework for negotiation and making land purchase grant available to eligible beneficiaries, is gaining importance (Deininger, 1999:3, Ghonemy, 1999, Reidinger *et al.*, 2000).

In the context of Indian agriculture, especially in the post-independence period, many attributes of aforementioned theoretical discourses find strong relevance on changing agricultural policies in India. Most of the dualistic models though either proved to be incompatible in the Indian context but development through planning and bringing in institutional changes to ensure 'growth with equity', strong government intervention in redistribution of scarce resources, and bringing in techno-biological changes in agriculture, influenced the policy formulations in the first two and half decades in post independence period. India resorted to a policy of comprehensive economic reforms in June 1991. The reforms brought significant changes in macro economic policy including trade and exchange policy, especially in the external sector. It is assumed that once the prices were be corrected through the free play of market, farmers would be able to realised a better price for their agricultural produce and they would be encouraged to produce more.

1.1 Background of the Study

1.1.1. Agricultural Systems in pre-Colonial and Colonial Period

The agrarian structure during British administration emerged with a strong historical background (Baden Powel, 1974; Dutt, 1976; Appu, 1996). The possible beginning of the systematic efforts (measurement, classification and fixation of rent etc.) to manage the land could be traced back to Akbar's regime and was implemented by Todar Mal. Under the various pre- British regimes, land revenues collected by the state confirmed its right on land. The central feature of agrarian system in pre-British India was the extraction of surplus produce from the peasants by means of land revenue. People were primarily agriculturists or land tillers (*raiya*s) and semi agriculturalists (rural artisans, professionals) who derived their living from land. Low productivity of labour and production for survival forced the people to be tied up with the land. The pre-colonial village economy was characterised by low productive in agriculture and low forms of industries and was organised hierarchically within the framework of the subsistence economy. In agrarian structure, *zamindars* were placed at the top and *raiya*s were at the bottom and the in between place was occupied by *taludars* and *ijaradars*. Whatever agricultural surpluses were generated thus was extracted by the government through taxation. Therefore, capital accumulation and exchange were ruled out and *raiya*s were left with no option but to remain confined within simple reproduction system of self-subsistence village system. The manufacturers and artisans, who settled or were asked to settle in the Mughal cities, were allowed to do so for not to cater to the need of the expanded market but to cater the needs of aristocracies and cantonment regiments. Unlike Europe, exchange of rural surpluses with urban manufacture never evolved, as a result of which village society was subject to exploitation and urban aristocracies did not provide any protection or benefit to the village society (Islam, 2009:38-41).

British rulers took a cue from this system and allowed the existence of non-cultivating intermediaries (Deshpande, 2003). The existence of these parasitic intermediaries served as an economic instrument to extract high revenues (Dutt, 1947) as well as sustaining the political hold on the country. Three land revenue systems were used by the British where the primary intention was to define who had the liability for paying land tax to the British and consequently who had the property rights on the land. In Bengal, Bihar, Orissa, the Central Provinces (modern Madhya Pradesh State), and some parts of Madras presidency (modern Tamil Nadu and Andhra Pradesh States), landlord systems were introduced and

landlords were put in charge of collecting revenue. In Madras and Bombay Presidencies as well as in Assam, revenue collecting process had directly been settled with the *raiyat* or cultivator and this system was known as *raiyatwari* system. The village-based or *mahalwari* system was advocated in North-West Provinces and Punjab and where village bodies that jointly owned the village were responsible for revenue collection. Irrespective of type of land revenue system in practice, land revenue continued to be the major source of government revenue, as a matter of fact in 1841, land revenue constituted 60 percent of total British government revenue. As a matter of fact, the consolidation and expansion of British rule over India was started from Bengal. One of the major reasons of the British East India Company to pursue revenue collecting right in Bengal presidency was to establish a monopoly over the lucrative textile trade in Bengal and highly productive fertile land of Bengal. The statement made by Lord Cornwallis, the then Governor-General of Bengal in 1790 corroborated this fact, by stating, 'we have, by a train of most fortunate events, obtained the dominion of one of the most fertile countries on the face of globe, with a population of mild and industrious inhabitants, perhaps equal to, if not exceeding in number, that of all other British possessions put together' (Firminger, 1917: 542). Introduction of Permanent Settlement in 1793 and subsequent changes in land settlements by the British government did not succeed to bring in the private investment for agricultural development in Bengal and also failed to break the spiral of exploitation meted to the sharecroppers by the *zamindars*, *jotedars*, intermediaries of varied nature and money lenders. This adversely affected the agricultural production and productivity in Bengal. Therefore, during the British rule, the agrarian structure was controlled by parasitic, rent-seeking intermediaries, under different land revenue and ownership systems across regions. It was further characterised by few land holders holding a large share of the land, a high density of tenant cultivators, many of whom had insecure tenancy, and exploitative production relations (Appu, 1996).

1.1.2 Agricultural Systems in post-Independence Period

To achieve greater productivity and production and to ensure distributive justice for landless farmers in the post independence period till pre- Green Revolution period (1964-1965), major policy thrust revolved around land reforms. These objectives were to be achieved by 'abolishing all intermediary interests between the State and the tiller of the soil, regulating rent, conferring quasi rights to tenants to ensure security of tenure, and, eventually, ownership rights, imposing ceiling on agricultural holdings, distributing

surplus land among the landless and the small holders and bringing about the consolidation of holdings' (Report of the Task Force on Agrarian Relations of the Planning Commission). It is evident that possible inverse relationship between operational holding and output per acre (Sen, 1962), provided a logical basis for arguing that small farms exhibited higher allocative efficiency and favoured a redistribution of land to landless. In spite of the fact that the ceiling legislations which were passed by most states by 1961, till the end of 1970 not a single acre was declared surplus in large states like Bihar, Mysore, Kerala, Orissa and Rajasthan. In Andhra Pradesh, a mere 1400 acres was declared surplus but no land was distributed (Chandra *et al.*, 2007: 538). Few states indeed performed relatively better in distributing surplus land, Jammu and Kashmir has redistributed 17 percent of its operated area, West Bengal 6 percent and for Assam the figure stands at 5 percent. Expansion of minor irrigation also got the prominence. In the First Five Year Plan, about 17.5 percent of plan outlay was allocated to agriculture and about 22 percent to irrigation, multi-purpose irrigation and power projects. Therefore, between 1949-50 and 1964-65, the rise in production was mostly driven by rise in area under cultivation (Narain, 1977; Vaidyanathan, 1986). In the second Five Year Plan, however, the focus shifted from labour-intensive agriculture and small scale production to large-scale capital intensive heavy industry (Dantwala, 1986). The slow growth of irrigation contributed to the slow growth of productivity in Indian agriculture.

As a consequence, foodgrain production during the first three five year plan remained static and country was facing crisis in foodgrain production. To avert the famine like situation and to make the country self sufficient in foodgrain production through the introduction of land saving biological innovation was introduced in 1965-66. The High Yielding Varieties (HYVs) of wheat developed at CIMMYT in Mexico was introduced in the North-Western states like Punjab, Haryana and Western Uttar Pradesh. Subsequently, rice from International Rice Research Institute (IRRI), Manila and the Phillipines was introduced which made the beginning of Green Revolution in India. Government also provided incentives to expand private tube-wells and chemical fertilisers since assured irrigation and chemical fertilisers are prerequisites for HYV varieties. Since the first Green Revolution in the 1960s, the country's foodgrain production has increased significantly from 74.2 million tonnes in 1966-67 to 129 million tonnes in 1980-81. This helped the country to meet out food security and attain self sufficiency especially in the production of our staple food, rice and wheat. The period of 1980s was also identified as the period of

'wider technology dissemination' (Chand, 2004) to larger areas and more crops. In 1980s, a healthy upsurge in agricultural growth rates was observed and the rise in growth was driven by major rise in rice production in the eastern region or more precisely in West Bengal and there was major improvement in the production of oilseeds in the central Indian region. The high growth rate in foodgrain production and productivity achieved during 1980s though could not be sustained during 1990s. Growth of most of the crops was decelerated. Fall in productivity had pulled down the growth of production of rice. Wheat and pulses also experienced fall production and productivity. Consequently, the country experienced fall in the growth rate in area, production and productivity of foodgrains in the 1990s.

If turn around in Indian Agriculture is much attributed to Green Revolution, then the agricultural success story in West Bengal is primarily driven by land reforms, more precisely by the tenancy reform which is commonly known as operation *barga*. It was revealed in various studies that although the legislations of land reform were in place there was a tendency of underreporting and concealment of the tenancy status during the 1960s and 1970s (Bandopadhyay, 2003: 879; Ghosh and Dutt, 1977).

The tenancy reforms in West Bengal got impetus after the Left Front Government led by the Communist Party of India (Marxist) assumed power in 1977. In the late-1970s and early 1980s, under operation *barga*⁴ the names of the thousands of unregistered sharecroppers have been recorded and redistribution of surplus land over legal ceiling among the landless rural people have been carried over through the process of vesting of 'Patta' or a quasi land-right. The process got further impetus with the introduction of rural local self-governance through elections to three-tier *Panchayat* system (Bhattacharyya, 2001). In quantitative terms, over 1.6 million sharecroppers were recorded and got the hereditary right to cultivation. About a million acres of vested land were distributed among 2.5 million beneficiaries who were landless or land-poor peasants. Half a million households were given title to homestead plots. Land reform thus directly benefited a significant proportion of the rural population in West Bengal (Bandyopadhyay, 2003). While carrying out agrarian reforms (distribution of ceiling surplus land and tenancy reform) within the framework of three-tier *panchayat* or grass root level governance, minimum wages for agricultural labourers were also ensured (Bhattacharyya and Bhattacharyya 2007: 65). *Panchayats* also played an important role in conflict resolutions at grass root level and they resolved the matters relating to water, labour use or wage and

social disputes (Gazdar and Sengupta, 1996:175; Rawal and Swaminathan, 1998:2601; William, 1999:235). *Panchayats* also played an active role in executing centrally sponsored schemes of employment, expanding rural infrastructure, especially rural roads maintained by the *Zilla Parishads*, ensuring distribution of package of seeds, fertiliser and pesticide and maintenance of tube-wells for irrigation of both high and medium capacity. All these activities carried on by *panchayats* were bound to have an impact to enhance agricultural production and productivity in the state (Chakraborty, 2002, Bardhan and Mookherjee 2004).

However, West Bengal passed through a long spate of agricultural stagnation till the beginning of 1980s. The path-breaking study of James Boyce (1987) explored the nature and causes of agricultural stagnation in West Bengal and Bangladesh and estimated that between 1949 and 1980, the agricultural output grew at much lower rate annually in comparison to the rate of growth of rural population and total population of West Bengal and this resulted in an impasse in agricultural production and had unfavourable distributive impact on the rural population. The abysmal growth of aman rice was identified as the root cause of agricultural stagnation in West Bengal by Boyce. The Green Revolution technology also made late inroads in eastern region including West Bengal. A. Vaidyanathan (1987: 2259) based on his study on eastern region in 1977-78, reported high incidence of poverty with accompanied by sluggish performance in agriculture. However, since 1980s, a significant improvement in agricultural growth was observed in eastern region, especially in West Bengal. Studies by various scholars reaffirmed that post-eighties can be treated as the end of 'agricultural impasse' in West Bengal.

A phenomenal increase in rice production was observed during late-eighties in West Bengal. Saha and Swaminathan (1994), Rawal and Swaminathan (*op.cit.*) found that the rapid growth in rice production in West Bengal was driven by an expansion in the boro crop (which is an irrigated crop based on HYV seeds). Preliminary studies show that the share of boro rice production increased in total rice production, primarily due to expansion in area under cultivation; the yield growth was however, modest. Yield increases were significant for the aman crop, while aus (rabi) crop saw a decline in the area under cultivation. Agricultural growth performances, if it is disaggregated at district level, it was observed that during 1965 to 1980, the growth rate in foodgrain production primarily remained high in the districts which were mostly falling in Gangetic plains of West

Bengal. However, districts of Jalpaiguri, Darjeeling, Cooch Behar and West Dinajpur of northern sub-Himalayan region continued to lag behind in comparison to southern districts of West Bengal (Saha and Swaminathan, *op.cit.*: A3, A4).

During 1981 to 1990, districts like Purulia, Birbhum, Bankura and Midnapore, Howrah and Nadia had shown spectacular growth of production and productivity of foodgrain and rice. Almost all the districts barring Darjeeling and Jalpaiguri, showed improvements in their agricultural growth performances. It should be pointed out that growth of foodgrains was primarily driven by the growth of rice output. An absolute domination of rice was found in foodgrain production in West Bengal, at state level vis-à-vis districts. Among non-foodgrains, potato and mustard and rapeseeds made significant improvements during 1980s and 1990s but production of jute and sugarcane declined. Preliminary work for the proposed research work further suggests that the decade 1990s and subsequent periods, especially after the introduction of economic reforms, India and many of her agriculturally prosperous states including West Bengal are experiencing deceleration in agricultural growth of income, production and productivity but growth performance of West Bengal remained much better in comparison to agriculturally prosperous states of North-West India and other states of Eastern India.

As a matter of fact, West Bengal is the largest producer of rice in India (West Bengal Economic Review, 2008). The high growth rate in foodgrain vis-à-vis agricultural growth is achieved mostly through yield expansion. Crop diversification has also played a vital role to enhance productivity in agriculture throughout the 1980s and 1990s (West Bengal Human Development Report, 2004). In West Bengal, unlike the rest of the states in India, the growth in agricultural production and productivity were driven by small farmers. If institutional reform played a positive role in breaking the stagnation in the eighties, the role of belated Green Revolution technology can not also be ignored (Gazdar and Sengupta 1996, Banerjee *et al.*, 2002).

1.2 Statement of the problem

There has been a structural transformation in the Indian economy during the past few decades with the decline in the share of agriculture in Gross Domestic product (GDP) and gradual increase in the share of industries and services. Although share of agriculture has come down to 17 percent in 2008-09 from 55.1 percent in 1950-51, the dependence of the rural workforce on agriculture has not diminished in proportion to share of agriculture to

the GDP. In spite of being tagged as one of the fastest growing economy in rural areas nearly 63 percent of the male workers and 79 percent of the female workers are still engaged in agriculture (GoI, 2011). Introduction of economic reforms in 1991 brought considerable increase in GDP. India's GDP grew at below 6 percent during the initial years of reforms and in recent years it increased at an annual average rate of 7 percent. On the contrary, agricultural growth moved in the opposite direction. Since Ninth Five-Year Plan (1996-97 to 2001-02), India targeted more than 4 percent growth rate in agriculture but it remained hovering around 2 percent. In fact, during the reforms era, gross capital formation also declined substantially (Reddy 2006).

Therefore, the gap between agriculture and non agriculture has been increasing in the post-reform period and this is accentuating the disparities between rural and urban areas. A slow down in agricultural growth became obvious in most of the agriculturally advanced states. Since the 1990s, stagnation became prominent both in the case of rate of growth as well as productivity growth in agriculture, making it imperative to obtain a closer review of crop wise and state wise estimation of growth of area, production and productivity. It also needs to be reviewed that whether the decline in growth of production and productivity in agriculturally prosperous states has been compensated by the rise in agricultural production and productivity of the states whose performance was earlier less satisfactory. Changes in crop-mix or increase in crop diversification may also prove to be beneficial to dampen the negative fallout.

If decline (or rise) in growth of crop production and productivity occur then it must have general impact on the over all agricultural scenarios of the state and country but impact shall vary considerably when it will be disaggregated at district level. Since there is wide variation in agro-climatic conditions across the state which injects natural heterogeneity towards the agricultural growth; spread and impact of institutional changes as well as diffusion of technological changes (precisely, spread of Green Revolution technology) also vary. Variation in population growth, growth of non-farm economy also adds variation on the extent of economic stress each districts shall pass through.

In this regard, West Bengal becomes a point of interest among the researchers, it is more so because in West Bengal, overwhelming agricultural growth took off after the 1980s. It became a leading state in terms of performance in foodgrain and rice production. The positive impact of operation *barga* on production and productivity has started dissipating in the nineties and is evident from the various research findings. The rate of growth of

foodgrains in West Bengal slackened in the 1990s to 2.39 percent from 5.15 percent in 1980-90. At state level, there was a decline in the annual growth rate in rice production, from 6.28 percent in the 1980s to 2.19 percent in the 1990s (Bandyopadhyay, *op.cit.*). Thus, it is evident that growth of foodgrain and rice production and productivity has started falling since the 1990s and the success that was achieved in the 1980s become unsustainable. In spite of the fact that West Bengal's performance at all-India level remained relatively better in comparison to sluggishness experienced by the states that were identified as agriculturally prosperous states during the 1970s and 1980s. The above brings us to focus on West Bengal and the multi-dimensional nature of its problems in agriculture.

For West Bengal and for most her districts, foodgrain production was overwhelmingly dominated by rice, therefore, fall in rice production and productivity will be having a considerable impact on district wise growth of foodgrain production and productivity. It has already been seen that even in the period of agricultural stagnation (1970s) and in the 1980s, considerable inter-district variations were observed. The districts of Darjeeling, Jalpaiguri, Cooch Behar and Malda continued to lag behind in comparison to other districts in 1980s when West Bengal came out successfully from agricultural stagnation. In 1990s when over all growth of agricultural production and productivity was indicating a decline then the condition of those lagging districts was getting worse widening the gap with agriculturally prosperous districts. It has been observed that between 1980-81 and 1989-90, for foodgrain and rice production, most impressive growths were achieved by Purulia followed by Bankura, Midnapore, Howrah and Nadia, Birbhum, West Dinajpur and Burdwan. Success of Purulia and Bankura showed that agro-climatic barriers to achieve agricultural growth were successfully broken and Howrah, being traditionally an industrial district also achieved tremendous improvement in growth of production and productivity. But with a decline in growth in production and productivity of foodgrain and rice in the 1990s, a serious doubt was raised regarding the sustainability of impressive growth among the districts of Purulia, Bankura and Howrah. In addition, if the growth performances of agriculturally prosperous districts like Burdwan, Birbhum, Midnapore, 24 Parganas and West Dinajpur get worsened then over all agricultural scenario as well as the economy of the state as bound to get seriously affected. Since West Bengal and her districts predominantly produce rice and in spite of steady increase in boro rice from late-1990s, rice production and productivity is mostly dominated by local variety of aman

paddy and majority of the small and marginal farmers till date largely produce aman paddy. On the contrary, boro is a high yielding variety and is having higher yield rate but its growth of productivity remained much lower than aman and its growth of production was driven by growth of area.

Therefore, any fall in growth rate in production and productivity of aman paddy will be having a serious impact not only on over all growth and productivity of rice but it is bound to affect economic condition of small and marginal farmers. It is needless to say that more than 70 percent of the cultivators in West Bengal belong to this category. At the same time, boro, though a high yielding variety was making steady inroads, its growth of production and productivity remained a matter of concern. The doubt is also raised on the sustainability of the impact of Green Revolution technology. The impact of economic reforms on the agrarian sector became a subject of close scrutiny. Growth measurement through trend estimation of long time series certainly provides a logical basis to argue on the performance of a particular sector of an economy but functional interplay of different economic and non-economic variables remained obscured. Growth estimation along with estimation of sub-periods growth rates, nature and direction of long term acceleration or deceleration of growth, extent of stability and instability of growth which hardly get importance should get priority to make valid comments on what has been done, what ought to be done, how much has fallen short of the required result and how that required result can be reached. The magnitude of the impact of a decline in growth rate in foodgrain production and productivity in West Bengal could not be ascertained until and unless district wise acceleration and deceleration of crop wise growth, district wise status of instability and stability over a long time frame, estimation of sub-periods growth of production, area and productivity in tune with major institutional and policy changes are taken into consideration.

Since productivity is defined as the ratio of production to area, the productivity factor thus incorporates both pure yield effect and the effects of changes in cropping pattern such as a shift from low-yield to high yield crop. The area effect includes changes in net sown area and cropping intensity (ratio of gross cropped area and net sown area). Increase in agricultural production through expansion of land area under agricultural use is almost impossible in most of the districts of West Bengal because of population growth and increasing demand for land for non-agricultural uses. In a situation of fall in production and productivity growth of rice and foodgrain in West Bengal (where agriculture is largely

dominated by small and marginal farmers) and possibly in many of her districts, with continuous shrinkage in land holding size and reduction in profitability, it is observed that large farmers are in position to stick to rice since they can bear the rising cost of cultivation of input packages. But small holders may find it difficult to sustain only on rice and in that case opting for crop diversification or moving towards high valued crops by using family labour to their vantage point, can become a viable option and needs to be verified.

There are a wide array of economic and non economic factors that influence growth of production and productivity of agriculture. To be precise, agro-climatic condition including rainfall, institutional reforms especially operation *barga* and *panchayatraj* system, Green Revolution technology (use of high-yielding varieties, irrigation, fertiliser etc.), size of holdings, land distribution pattern, rural infrastructure, credit and cooperatives, population density, area under non agricultural use, wages and many more, do have considerable impact on agricultural productivity. However, to estimate the impact of these factors on productivity often create statistical impediments because more than often these explanatory variables become collinear with each other. In addition, estimation of the impact of various components of agrarian reforms on productivity also entails various computational barriers because a long time series accommodates a number of effects simultaneously and segregation of them often becomes difficult. Moreover, there are factors like sense of security of tenants and noise-free communications of bureaucrats and technocrats to farmers through the *panchayats* that are difficult to quantify (Mukherjee and Mukhopadhyay, 1996). Conflict resolutions by *panchayats*, especially resolving the disputes regarding water use or use of agricultural labour is also difficult to measure (Raychaudhuri, 2004: 11). Possibly, these statistical obstacles often deters the researchers to undertake studies that may elucidate the impact of various economic, non-economic factors, including institutional reforms of varied nature and policy intervention, on agricultural productivity. And districtwise study on West Bengal could hardly be traced in this regard.

It has further been observed that in West Bengal (in various census years), share of cultivators has declined accompanied by rise in share of agricultural labourers with landlessness is on the rise. The main occupation of agricultural labourers is to work in other people's lands. Since number of agricultural labourers is on the rise their economic condition may become worse off if commensurate rise in wages do not take place. Study

conducted by the *State Institute of Panchayats and Rural Development* in the year 2000 observed that 14.4 percent of the *bargadars* and *pattadars* lost their land and this percentage was found to be much higher (30 percent) in the districts of Cooch Behar, Dakshin Dinajpur, Uttar Dinajpur and Jalpaiguri (Chakraborti, 2003). Given the fact that when land area is more or less fixed and population is increasing and if the development policies so followed fail to create commensurate opportunities in non-agricultural sector, then absolute number of persons and households dependent on agriculture will increase (Ghosh, 1998: 2988) and at the same time the problem is likely to accentuate wherein the absorption of labour force in non-agricultural sector is less or got truncated by slower expansion of non farm sector. Increase in landlessness, if any, may increase congestion of rural workforce in the urban informal sector.

The research problems thus we are confronting are multipronged. Keeping the agrarian nature of the state of West Bengal and dependence on large number of agrarian population on small sized fragmented land, critical evaluation of long term trends in agricultural production, productivity, crop-mix, both at state and disaggregated district level and its future ramifications on the economy and employment assume paramount importance. Identification of economic as well as non-economic variables and institutional changes, their positive and negative impacts on farm productivity also become a crucial issue to achieve the goal of sustainable agriculture and dispel the uncertainty, if any, regarding future food security.

1.3 A Review of Related Literature

In tune with the above research problems, a wide array of literature on various facets of agriculture needs to be reviewed to understand the temporal and spatial changes in agricultural scenario at nation level, state level and finally for the state of West Bengal disaggregated at district level. Certainly, long term trend analysis of growth of agricultural production, productivity and crop-mix would remain at the focal point along with sources of growth as well as instability of growth but at the same time major policy changes (institutional as well as technological) and concomitant impact on the growth of agricultural output and productivity also will receive equal emphasis. Precisely, studies dealing with the impact of land reform, tenancy reform, techno-biological changes or Green Revolution, introduction of grass root governance through *panchayat* and economic reforms on agricultural production and productivity demand special attention. The importance of agriculture, especially in a predominantly agrarian country like India, as

critical research agenda over the periods also need to be validated. Studies dealing with the impact of production and productivity gain on farm and non farm employment and inter linkages of agriculture with other sectors of economy shall help us to identify the development gaps among the states as well as within the state. A selected few have been cited below.

1.3.1 Research on Agriculture during Colonial Era

During pre-colonial period, colonial period as well as immediately after the post independent periods, agriculture remained the largest single sector of the economy in India. As agriculture continued to be the dominant economic activity, it attracted the attention of the colonial administrators and researchers during colonial and post colonial era. The process was initiated during the first half of the 19th century, when the administrators of the then East India Company and later the British Government in search of collection of taxes in terms of rent, felt an urgent need to investigate into soil productivity and tax bearing capacity of agriculture.

At the dawn of independence, an estimate on the net output data between 1948-49 and 1950-51, revealed that total agricultural output accounted for about 50 percent of national income and provided employment for about 70 percent of the work force (Indian Ministry of Finance, 1954:45 & 51). Over the years, the study of agriculture and agrarian structure assumed importance in the field of social science research. A survey of agrarian studies thus acquired a fundamental importance. It was said that 'problems do not respect frontiers between conventional academic "disciplines" ' (Andreski, 1964:60) and this most aptly fits in while dealing with agrarian problem.

Enquiries into the agrarian questions were primarily initiated by the British administrators because they were the same group of people on whom the formulation of land and revenue policies was rest upon. Later came the political agitators or activists, mostly as a critique (soft and strong) of the British land and revenue policies and they are the people who unleashed the freedom struggles in various forms in pre-independent India. In that sense, British administrators and political activists in colonial India were the first scientific researchers into the agrarian questions. Afterwards, the professional social scientists took up the initiatives (Joshi, 1975:4-6). Therefore, it can be said at the outset that agrarian problems as an area of research were offshoots of the British colonial rule. However, the relationship between economic backwardness and institutional structure created by the

272018

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British rule was conveniently bypassed in all the British led official enquiries and investigations. In most of the cases the role of British created institutional structure in reshaping India as a nation was strongly advocated.

Indian freedom struggle and emergence of Indian nationalism created another spurt in research on land problems and land policy. On the questions of India's poverty and backwardness, a sharp schism became prominent between the 'nationalist' viewpoint and the imperial viewpoint. Imperial viewpoint was primarily dictated by what Myrdal called 'colonial theory' of poverty and economic backwardness (Myrdal, 1970: 17). British explanation on rural poverty and backwardness in India had bypassed the agrarian structure created by them, as Myrdal did in his exposition of 'colonial theory' of poverty and economic backwardness. Colonial theory was aptly summarised by Nehru and he said, 'If India is poor that is the fault of her social customs, her *baniyas*, and money-lenders and above all her enormous population' (Norman, 1965:556).

Although, it was not always true that scholar-administrators during colonial era always justified the British policy, some of the studies indeed portrayed Indian agrarian situation with in depth precision. Harold H. Mann (1967:XXVII) and M.L. Darling (1925: 28) were two prominent names whose studies should be referred to Darling, by interrelating credit and land system explained the social and economic life of Punjab. Similarly, Harold Mann put stress on the institutional framework of Indian agriculture and identified it as an obstacle for rural progress. He also pointed out about the methodological inadequacies of many of the studies on agrarian society carried out in the colonial era.

Looking at the methodological aspects, the shortcomings of neo-classical economics also got exposed in the hand of Myrdal (1968). He pointed out the incapability of analysing the structure and functioning of an economy which was predominantly agricultural on the one hand and pre-capitalist on the other, eminent researchers and social scientists of India studied the economic condition of the nation and also constructed national accounts. The prominent among them were Dadabhai Naoroji (1901), G. Findlay Shirras (1936), K.T. Shah and K.I. Khambatta (1924), V.K.R.V. Rao (1940) etc. They tried to trace out the income of the agricultural sector as well as income of the country as a whole. R.C. Desai (1953) during 30s tried to measure the income of agricultural sector from the consumption point of view.

However, the problem of contextualisation of agrarian problem in Indian perspective by using scientific methodologies and techniques was successfully carried out by Radhakamal Mukherjee, P.C. Mahalanobis, N.K. Bose, D.N. Majumder, D.R. Gadgil, D. P. Mukherjee, V.K.R.V. Rao, G.S. Ghurye, etc. At theoretical level, Radhakamal Mukherjee highlighted the fundamental differences between the Western and the Institutional frameworks of economic activity. The important studies of Mukherjee were –‘Land Problems of India’ (1935), ‘Democracies of East’ (1923), ‘Fields and Farmers of Oudh’ (1929), ‘Economic Problems of Modern India’ (1939), and the ‘Borderlands of Economics’ (1925).

Some of the major studies carried out in pre-Independence period addressed the agrarian problems. They are: ‘The Trends of Agriculture and Population in the Ganges Valley by Birendra Nath Ganguly (1938), ‘The Indian Rural Problems’ by M.B. Nanavati and J.J. Anjaraia (1945), ‘Poverty and Social Change in India’ by Tarlok Singh (1945) and ‘Agricultural Labour Conditions in Northern India’ by A. M. Lorenzo (1947). Indian Society of Agricultural Economics also commissioned few important studies on Indian agrarian problems and notable among those were: i) ‘Land System in Bihar and Land Problems of Gujarat’, ii) ‘Problems of Land Tenure and Population in West Bengal’, iii) ‘The Economics of Estate Farming’ and iv) Problems of Small Farmers-Report of an Enquiry into the Problems of Low-Income Farmers in Kodinar Taluka.

In brief, the research on agrarian issues in pre-independences period- especially after the East India Company made intrusion into Indian body polity – thus could be divided in four phases (Rath, 1960), as follows:

First Phase (Upto 1858): Various travel accounts, documents relating to survey and settlement reports and those were mostly helpful to gather information on land tenures, pattern and extent of land revenues in pre and post Permanent Settlement era.

Second Phase (1859-1880): In this phase, reports on enquiries into famines, Deccan riots etc., were available.

Third Phase (1880 to 1912-16): Most prominent sources of study during this phase were District Gazetteers and Voelker’s Study (1893), Irrigation Commission Report.

Fourth Phase (1912-16 to 1939-40): During this phase systematic study of the village or regional economy, specific problems like conditions of labour, indebtedness of farmers, role of financial institutions etc., were initiated.

William Burns (1944) concluded that the fluctuations in output and acreage of subsistence crops were caused by the fluctuations in seasonal weather and it was fluctuation in prices that caused variation in the production of cash crops. Dr. Baljit Singh (1947) observed that between 1921 and 1941 foodgrain output per capita declined and it was primarily caused by variations in rainfall and extension of cultivation into inadequately irrigated lands. He also observed that higher prices may encourage the farmers to produce more cash crops but even if price declines, output did not decline and the reason being that farmers did require money to repay their debt.

On similar lines, three important studies were carried out to decipher the trend in foodgrain production vis-à-vis population. George Blyn (*op.cit.*) undertook a disaggregated study and analysed the trends in foodgrains and non-foodgrains separately and while doing so he divided the entire period (1891-1947) into five sub-periods. Kshitimohan Mukerji (1965) had covered a period up to 1952-53 and concluded that area under cultivation had increased but production did not show a rising trend. S.A. Shetty (1969), while building up the production series and measuring the long term trends, both at all-India level and at the regional level, concluded that, agriculture had expanded but not grown.

Most of the studies on trends in agricultural output during colonial period concluded that an absence of upward trend in foodgrain production became a common feature after 1930s. Much of the loss in foodgrain production was compensated by the rise in growth of non-foodgrains, more precisely the cash crops. The trend varied considerably during various sub-periods between 1921 and 1965. The growth of foodgrain production got absolutely stagnated during depression and war periods. An upward trend has observed only after 1952. However, the necessity to increase foodgrain production did not receive much attention in spite of the fact that the problems of agricultural production and distribution were two important determinants of the wellbeing of an agrarian economy, the studies in this regard were found to be very scant in numbers. As George Blyn (*op.cit.*) pointed out that upto the 1930s there was hardly any concern over the trend in crop output. The general impression was that there was favourable balance between growth of food crop output and population growth (Karve, 1936; Meek, 1937; Mukherjee, 1938; Thomas and Sastry, 1939; Dutt, 1949). A.R. Sinha's (1951) study of agricultural production covering 30 years (1921to1951) revealed that foodgrain production was getting stagnated while that of cash crop was rising.

1.3.2 Farm Size, Productivity and Land Reform

Among the observations made by Amartya Sen (1962: 243-246; 1964:323-326) while analysing the 'Studies in Economics of Farm Management' (1954-55 and 1955-56) produced by the Ministry of Food and Agriculture, one of the important observations is 'productivity per acre decreases with the size of holding'. He further justified his statement by stating that increased output is related to increased inputs including human labour. The smaller farms use more inputs per acre (at imputed market value) and as a result get more output as well. The total amount of family labour applied per acre increases outstandingly as the size falls, so that 'in spite of the fact that in some areas the amount of wage labour applied falls as the size get smaller, the total amount of labour per acre is inversely correlated with the size of the farm'. This opened up a new vista in the field of empirical research in agriculture and generated huge academic debates.

Subsequent studies made by Mazumdar (1965), Khusro (1968), Saini (1971), Berry (1972), Bardhan (1973), Berry and Cline (1979) reaffirmed the inverse relation between farm size and productivity and strongly advocated land reform or redistribution of ceiling-surplus land as well as ensuring security of tenants to support the small and marginal farmers to enhance allocative⁵ efficiency and ensure equity or distributive justice. Irma Adelman (1980) sees the land reform as a guiding force towards the emergence of Asian Tigers. The successful countries all followed a process in which the asset that was going to be the major asset of production at each stage of development was redistributed before, rather than after its productivity was improved. Bhalla (1979), Cornia (1985), Taslim (1989), Binswanger and Rosenzweig (1986, 1993), Binswanger, Deininger and Feder (1993), Binswanger and Deininger (1997), Raghavendra, *et al.*, (2000) have shown through different studies that redistribution of land among landless rural people has helped to raise production and productivity in agriculture and also advocated that small farm size has enhanced agricultural productivity. Bell (1977), Sen (1981) has advocated the superiority of owner-cultivated farms over tenant farms.

Besley and Burgess (2000) concluded that land reform in India has contributed towards the reduction of poverty in Indian states. Ghimire (2001) has pointed out that if poor farmers cultivate their own land they would not compete with full time landless agricultural workers in the rural labour market and in the process it will raise rural wages. In addition to that, having a piece of land of their own will save them from various restrictive practices imposed by the landowner.

However, many researchers questioned the validity of inverse relationship and cited various reasons to invalidate or partially validate the hypothesis. Hanumanth Rao (1966) showed that the introduction of high yielding varieties in India initially had allowed the inverse relationship to disappear; over time, as farm sizes changed, the inverse relationship again resurfaced. Thus, inverse relationship might be a permanent feature of agriculture but it is also true that the farm size changes with the change in technology. Rudra (1968) said that 'there is no scope for propounding a general law regarding farm size and productivity relationship.'

Hanumantha Rao (1975) and Subbarao (1982) observed a positive relationship between farm size and productivity and their study based on large-sized farms having adequate utilisation of fertiliser and other cash-intensive inputs. Ghosh (1979) observed that with the advancement of technology, inverse relationship disappears. According to Bhalla and Ray (1988), incorporation of soil quality makes the inverse relation between farm size and productivity ineffective. Lipton (1993) came out with his findings that until Green Revolution the inverse relationship was valid (at least for rice and wheat in Asia) but after Green Revolution the relationship was reversed.

Along similar lines, Dyre (1997), based on his study on Egypt argued that the inverse relationship becomes invalid in case of technical change in the farm sector and rich small farmers and big landlords generally capture the lion's share of the credit disbursed to collect new inputs as well as technology. Foster and Rosenzweig (2010) used a model incorporating supervision costs, risks, credit market imperfections and scale economies associated with mechanisations and analysed plot level panel data of the National Centre for Agricultural Economics and Policy Research (NCAER) for the period from 1999 to 2008 proved the inefficiency of smaller farms in India. Chand *et al.*, (2011) tried to find out the relevance of inverse relationship among the small farms of 21st century India and concluded that smallholders are not lagging behind in comparison to other farm size categories in adopting improved technologies, use of fertiliser and irrigation and they are using there efficiently. And they validate the inverse relationship in changing inputs-use scenario.

1.3.3 Trends in Agricultural Production and Productivity in post- Independence Period in India

T. N. Srinivasan (1979), by using log-linear regression and log-quadratic regression estimated the growth rates estimated growth rates as well as acceleration and deceleration of area, production and yield of both foodgrain and non-foodgrain during 1949-50 to 1977-78 which was divided to two sub-periods, namely, pre-Green Revolution (1949-50 to 1964-65) and post-Green Revolution (1964-65 to 1977-78) periods. According to his study, except wheat, there were not much change in the growth of output and yield per unit area for food crops and all crops with no evidence of either acceleration or deceleration in pre and post- Green Revolution period. A decline was observed in the rate of growth of gross sown area for non-foodgrains in post-Green Revolution period except wheat. He concluded that 'there is yet no Green Revolution but still only a wheat revolution'. Barker and Pal (1979) observed the stagnation of agricultural production in Eastern region.

Alagh and Sharma (1980) measured the trend in foodgrains and select non-foodgrains between 1960-61 and 1978-79. They divided the whole period into period-I (1960-61 to 1969-70) for pre- Green Revolution and period-II (1969-70 to 1978-79) for post- Green Revolution period, to capture the change in growth rates. In period-I, they observed that the regional spread of agricultural growth was limited to Punjab and Haryana, while in period-II, spread became much wider and growth peaked up in the states like Maharashtra, Andhra Pradesh and Bihar. Growth had flattened relatively in Punjab and Haryana in period -II. It was further observed by them that growth rate in foodgrain output increased from 1.85 percent in period-I to 2.74 percent in period-II, indicating the impact of Green Revolution and for the whole period the growth rate was estimated at 2.77 percent. Consistent fluctuations in agricultural output deterred them to make any definite conclusion on acceleration or deceleration in growth rate in agricultural output. Nilkantha Rath (1980), while examining the agricultural production in India during 1955-1978 observed that total agricultural production in India grew at an average rate of 2.48 percent. The rate of growth was found to be higher, '2.95 percent, during ten years ending 1964-65, than during the subsequent period of 13 years, when it was only 2.42 percent'. And foodgrain growth for the whole period was dominated by the growth of cereals.

Ashok Rudra (1982) made an observation that there has indeed been a breakthrough in production conditions for some crops for some regions but no such thing has happened for

all crops for all regions. Rao and Deshpande (1986) also made a comparative study on growth of agricultural production, area and yield in pre- and post-Green Revolution phase. Their observations showed that in the first phase of Green Revolution (between 60s and 70s) growth rate in output improved marginally from 2.8 percent to 3.0 percent despite a decline in the growth rate in gross cropped area from 1.2 percent to 0.6 percent. On the contrary, Rao (1994) observed that first phase of Green Revolution accentuated inter-regional and inter-crop imbalances because of the restriction of high yielding variety seeds for only rice and wheat in the initial years and the adoption of these varieties only in well-endowed region.

S. Mahendradev (1988) ranked 289 districts across India on the basis of over all yields during the period 1962-65 to 1975-78 and identified the districts with compound rate of growth of less than 2 percent as low growth districts. They identified that 171 districts were falling under low growth category and among those districts, 84 were recorded either very low growth (less than 1 percent) or negative growth rates. They further noted that almost all the districts in Bihar, Orissa, West Bengal, Eastern Uttar Pradesh, Assam and Madhya Pradesh dominated the list of low growth districts.

In Acharya's (1998) observation, the policy package consisting of introduction of high-yielding varieties of wheat and rice, strengthening agricultural research and extension services, measures to increase the supply of agricultural inputs such as chemical fertilisers and pesticides, expansion of major and minor irrigation facilities, announcement of minimum support prices for major crops, government procurement of cereals to maintain a buffer stock and to meet foodgrains demand to sustain public distribution system and the provision of agricultural credit on a priority basis, had raised the rate of growth of productivity in India per hectare of all crops taken together from 2.07 percent in the decade ending 1985-1986 to 2.51 percent per annum during the decade ending 1994-1995. Similar evidence of an increase in yields, a partial measure of productivity gains given by output per unit of land area has also been observed.

Many researches though concluded that economic reform initiated in 1991 has primarily emphasised on price factors and infrastructure while institutional aspect of agriculture has grossly been neglected and as a consequence, deceleration in agricultural growth as well as decline in growth of output were accentuated since 1991 (Chadha, 2002; Majumdar, 2002; Bhalla, 2002; Kumar, 2002). A study by Kumar and Mittal (2006) observed that long term food security goal can only be attained if sustainable agriculture is practiced. At

the farmers' level, sustainability concerns are being expressed that the input levels have to be continuously increased in order to maintain the yield at the old level. This poses a threat to the economic viability and sustainability of crop production. In addition, after 1996-97, most of the states experienced decline in the area under cultivation as a consequence of urbanisation and industrialisation, stagnant crop intensity, slow progress of irrigation and fertiliser, decline in supply in electricity to agriculture and slow down in crop diversification (Chand *et al.*, 2007: 2528-30). Sharma Vijay Paul (2007) also observed that growth rates of production for most of crops were significantly lower during the period 1991-92 to 2004-05 compared to the 1970s and 1980s.

Bahlla and Singh (2009), observed that the period from 1980-83 to 1990-93 brought a turn around in India's agricultural development. At all-India level, the growth rate in crop output accelerated from 2.24 percent per annum during 1962-65 to 1980-83 to 3.37 percent per annum during 1980-83 to 1990-93. And agricultural growth penetrated to all regions in India. However, agricultural growth during 1990-93 to 2003-06 (post-reform period) decelerated both at national level as well as regional level. Except Gujarat, partly Maharashtra, all other states experienced sharp decline in their agricultural output growth rates in post reform period.

1.3.4 Sources of Growth of Agricultural Production and Productivity

In post independence period various attempts have been made to explain the growth in agricultural output in terms of area and yield components. Minhas and Vaidyanathan (1965) equated the changes in gross agricultural output to changes in four factors: area, yield, cropping pattern and the interaction of yield and cropping pattern. They decomposed agricultural growth for 28 states and 268 districts for the period 1951-54 to 1958-61. They estimated the total agricultural growth was 3.54 percent and 45 percent of the growth was attributed to area, 46 percent to yield increase, around 9 percent to cropping pattern and 1 percent to interaction effect⁶. It was further observed by them that states like Punjab, Rajasthan, Mysore and Madhya Pradesh area effect was high and agricultural growth was also higher than other states. Though Punjab was growing rapidly but yield did not improve and contribution of cropping to change in growth and output was also low. In the eastern states like Assam and West Bengal, area expansion was found to be zero, yield declined and growth of output was also found to be the lowest. Yield contribution remained substantially higher than national average.

Changes in cropping pattern though contributed substantially for the state like Gujarat, Madras and Andhra Pradesh. Same methodology of Minhas and Vaidyanathan was used by other scholars like Kaul (1966), Mishra (1971), Rojender and Karam (1975), Dharm Narain (1977), Sagar (1977, 1980), Venkataraman and Prohaladachar (1980) with minor modifications.

Vidya Sagar (1977) measured the growth of agricultural production during 1956-61 to 1969-74 by decomposing agricultural growth into area effect, yield effect, cropping pattern, price effect⁷, and interaction of yield and cropping pattern, yield and price structure, cropping pattern and price structure, yield, cropping pattern and price and structure. Compound annual rate of growth of agricultural output was estimated at 2.4 percent per annum and yield increases alone contributed around 64 percent and around 39 percent was contributed by growth of area of the total output growth. Around 8 percent growth of output was contributed by changes in relative price.

Dharm Narain (*op.cit.*) studied the changes in inter-state changes in agricultural productivity during 1952-53 to 1972-73 by dividing the period into two sub-periods, one 1952-53 to 1960-61 and 1961-62 to 1972-73 to capture the effects in the pre and post-Green Revolution period. Contribution of changes in cropping pattern, locational shifts⁸ of area under individual crops and pure increases in the yields of individual crops to the changes in growth of productivity was measured in the different states. The results of the study showed that in pre-Green Revolution phase, 70 percent increase in the productivity was contributed by the changes in cropping pattern and locational shifts and the rest by yield effect. On the contrary, in post- Green Revolution period yield effect contributed 60 percent rise in productivity and cropping pattern and locational shifts helped to raise the productivity by 40 percent.

Alagh and Bhalla (1979) showed that among high growth districts which mostly concentrated in Punjab, Haryana and Western Uttar Pradesh, the yield constituted the major component in agricultural output growth and the contribution of change in cropping pattern have much smaller impact. Vidya Sagar (1980), while decomposing the growth of output of the cereals like wheat, bajra, etc., grown in different parts of Rajasthan, brought in the element of seasonality and he showed that 60 percent growth of output was contributed by yield alone. Bhalla and Tyagi (1989) showed that the rate of change in area and yield of all crops and their relative contribution to the growth of total output from early sixties to early eighties varied widely across the states. States experiencing rapid

growth of output also experienced higher rate of increase in crop per hectare. Not much of association was found between crop area growth and output growth.

Ray (1983) while dealing with sources of change in the average annual growth of crop output at national level suggested that changes in crop area became less important to bring in changes in aggregate output and rather changes in the cropping pattern became more important. A sharp increase in yield was observed during fifties and sixties but did not change much in the subsequent decade.

Sawant (1997) tried to measure the impact of growth of yield and area on the growth of agricultural output and found that the growth of output at national level had been moderate for cereals through out the Green Revolution period, though it moved up marginally from 2.56 percent in period I (1968-69 to 1980-81) to 2.84 percent in period-II (1981-82 to 1994-95). However, contribution of growth of area to the growth of output had been negative in period II while it was positive in period I. Significant increase was noticeable in the growth of yield between the two periods.

Sidhu and Bhullar (2005), Joshi *et al.*, (2006) reaffirmed that during the period of eighties and nineties, yield effect played the major role in increasing the growth of agricultural output with a shift from low-value crops to high-value crops in various states as well as at national level. Sekar and Pal (2012) examined the total change in production decomposed into three effects- yield effect, area effect and interaction of area and yield effect of wheat and rice in the Indo-Gangetic region (Punjab, Haryana, Bihar, Uttar Pradesh and West Bengal) for Green Revolution period (1966-91) and economic reform period (1992-2008). They observed that the rate of growth in rice productivity in indo-Gangetic plain was around 3.2 percent till 1980, however, the growth rate started decelerating after 1980s and the decline became more prominent in 1990s (0.37 percent). They also observed that yield effect contributed more to overall production growth of rice in upper, middle and the lower-Gangetic plains where area effect was stronger in trans-Gangetic plain.

1.3.5 Growth Instability in Crop Production

Instability is considered as the conflict between growth and stability measures and it deals with the linkage between growth and variability of agricultural output. A number of attempts have been made to examine the extent of instability in crop production both at national and inter state level. S.R. Sen (1967) analysed the production of foodgrains and other crops in undivided India from 1900-01 to 1947-48 and for Indian Union from 1936-

37 to 1965-66. He observed that variability in production increased as cultivation was extended to marginal lands. The variability increased due to fluctuations in weather and more intensive use of fertilisers on marginal lands.

C.H.H Rao (1975) concluded that variability in yields per hectare used to be higher than that of area, and productivity driven growth had added greater variability in output. Barker *et al.*, (1981) pointed out that it resulted in greater variability in yield. He further argued that irrigation might reduce moisture stress but it was frequently associated with an intensification of crop production and input use which might add instability. Studies conducted during 1980s concluded that after the introduction of Green Revolution technology, instability in production has increased. Factors like introduction of HYV seed-fertiliser, variability in rain fall and prices caused the rise in instability (Mehra, 1981; Hazell 1982; Dev, 1987, Rao *et al.*, 1988). Sharma *et al.*, (2006) compared variability in production and yield between 1980s and 1990s and concluded that production of foodgrains became more stable during 1990s in comparison to 1980s at all-India level and in most of the states.

Chand and Raju (2009) showed that in case of relatively longer period, technology diffused to larger areas and as a result, instability that was created at initial level disappeared, at least at national level. They further observed that the yield variability in foodgrains as well as for non-foodgrains was declined in the first phase of Green Revolution (extended up to 1988) compared to pre-Green Revolution period. Variations in yield were further declined during 1989 to 2007.

1.3.6 Farm and non-Farm Interaction

Various studies have been conducted for theorisation of the interdependence between farm and non-farm activities. Lanjouw and Lanjouw (2001) opined that in recent years, given the constraints on agricultural expansion, greater attention has been given to non-farm activities in view of their potential for economic development and poverty reduction. Kochar (1999), Kijima *et al.*, (2006) viewed that even if productivity and wages or incomes in non-farm activities are not higher than those in farming, the former as an option makes a difference, as it facilitates income diversification by farmers and agricultural labourers, and helps them cope with various shocks in a risky environment and reduce poverty *ex post* in a dynamic context.

Joshi *et al.*, (2004), Gaiha and Imai (2006), had shown through their study that given the high likelihood of seasonal unemployment in agricultural economies, total household income is likely to increase if there are more choices for workers or self-employed to work in non-farm activities that are not affected by seasonality. Studies of Chand and Chauhan (1999), Chandrasekhar and Ghosh (2000), Sen (2002), Gollin *et al.*, (2002), Reddy and Mishra (2008, 2009), Vaidyanathan (2010) conclusively remarked that the over all GDP growth in the country has continually been increasing but in case of agriculture a deceleration has been observed and it may widen the income differential between rural areas and urban areas as well as between farm and non farm sector.

1.3.7 Institutional Reforms in West Bengal

Till the late-1970s, Land Reform Acts of West Bengal were either ignored or contested in the court of law (Raychaudhuri and Chakraborty, 1981). In West Bengal, land reforms took a radical turn during 1969-70 when local peasants confiscated more than 5, 00,000 acres of 'benami' land and redistributed among the landless and this was termed as forced land reform carried on outside the government framework (Dasgupta, 1984). Agrarian reform in rural West Bengal gained real momentum after Left Front led Government assumed power in 1977. The tenurial reforms initiated by the then Left Front Government involved first serious implementation of existing legal provision (Bhaumik, 1993). The reform in West Bengal was confined to the redistribution of ceiling⁹ surplus land among rural landless households and pursuance of tenurial reforms known as operation *barga* – the process of official recording of the sharecroppers or *bargadars* and providing them a legal sanction of security of tenure and higher share¹⁰ of produce for them. There was also a provision that sharecroppers can use their cultivated land as collateral to get credit from institutional sources (Dasgupta, 2005:2). The second major institutional reform initiated by the Left Front government in 1977 that was taking governance to the grass root level by introducing local self-government or *panchayat* and first election was held in 1978. It was understood that this brought bureaucracy close to the villages which centred on operation *barga* and delegating financial planning activities at village level (Bhattacharya, 1999). Webstar (1999) commented that decentralized decision making through *Panchayat* would be having an impact on the agrarian scene once funds would be available to them and village people would be given the responsibility to undertake village planning and from late-eighties this process became visible in rural West Bengal (Datta, 2001). As opined by Raychaudhuri (*op.cit.*: 17), operation *barga* provided proper incentive and right kind of

power structure to enhance investment in land through better irrigation, seeds and increased labour use.

The study carried out by Sen and Sengupta (1995), the measured input growth is not sufficient enough to explain the extent of the trend break in output growth observed in 1980s. According to them, the rate of growth of fertiliser use, percentage of area under high yielding variety (HYV) and irrigated area in West Bengal has declined in West Bengal in 1980s in comparison to 1970s. And they concluded that unmeasured part of growth of output was attributed to the implementation of tenancy reform or operation *barga* and local level governance or *panchayat*.

Studies by Mukherjee and Mukhopadhyay (*op.cit.*); Raychaudhuri and Sen (1996); Sanyal, Biswas and Bardhan (1998); Rawal and Swaminathan (*op.cit.*) highlight the role of operation *barga* in reversing the slow output growth in West Bengal. According to them, the acceleration in growth occurred during and after major changes in agrarian institutions and land relations. They argue that the establishment of the democratic *Panchayatiraj* institutions in West Bengal and the implementation of operation *barga* were the main factors behind the transition in West Bengal's agricultural performance. It also tried to ensure a just distribution of product between the landlords and sharecroppers. Quick recordings of *barga* rights and provisions for institutional credit to the sharecroppers and the assignees of vested land raised the access of the small operators to technological inputs.

Banerjee and Ghatak (1996) based on their field surveys in West Bengal in the mid-1990s have concluded that a 17-18 percent increase in productivity has been observed in the plots operated by registered sharecroppers and this is in conformity with the hypothesis that security of tenure and fair crop sharing with sharecroppers, ensures incentive to increase production. Banerjee, Gertler and Ghatak (1999 & 2002) have argued that protection of sharecropper against forceful eviction has helped West Bengal to increase the agricultural yield. The agrarian reform ensured the minimum wage rate of agricultural labourers within the framework of *panchayatiraj* institution (Govt. of West Bengal 2004).

Bhattachayya (2005), in his studies showed that operation *barga* was proved to be beneficial in breaking the interlinkage and weaken the exploitative share tenancy itself. According to Bhattachayya and Bhattachayya (2007:66) the increased land productivity in West Bengal during 1980s is the result of the increased labour intensity in

family farms belonging to small and marginal farmers and they were capable of doing so because land reform enhanced their purchasing power and enabled them to access Green Revolution technology.

1.3.8 Trends in Production and Productivity in West Bengal

Most of the studies on trends in agricultural output during colonial period concluded that an absence of upward trend in foodgrain production became a common feature after 1930s. Much of the loss in foodgrain production was compensated by the rise in growth of non-foodgrains, more precisely the cash crops. The trend varied considerably during various sub periods between 1921 and 1965. The growth of foodgrain production stagnated during the depression and war periods. An upward trend was observed only after 1952. At regional level, Punjab emerged as a progressive region, on the contrary agricultural production in Bengal and Bihar had either deteriorated or stagnated (Shah, 1975: 20-22). The trend continued even in post-independence period.

James Boyce (*op. cit.*) while exploring the nature and causes of agricultural stagnation in West Bengal and Bangladesh between 1949 and 1980, observed that agricultural output grew at a rate of 1.73 percent per annum and rural population and total population of West Bengal grew at 2.31 percent and 2.42 percent per annum respectively over the same period.

Commenting on East India (comprising East UP, Bihar, West Bengal and Orissa) and analysing the economic scenario in 1977-78, A Vaidyanathan (1987: 2259) observed that 'not only is poverty incidence high in this region but its overall agricultural performance has been disappointing. The Green Revolution Technologies do not seem to have made much of an impact here. The overall growth rate in agricultural production has averaged barely 2 percent per annum over the last 20-30 years which is in fact less than the rate of population growth'.

The limited spread of Green Revolution technology in its initial phase and poor status of eastern region also get reaffirmed in the Report of the Committee headed by S.R. Sen on Agricultural Productivity in Eastern India, Reserve Bank of India (1984), Report of Study Group on Agricultural Strategies for the Eastern Region of India, Planning Commission, Government of India (1985). It was noted in the Seventh Five-Year plan that the gap between the potential and actual yields of rice in eastern India was the highest in India (GoI, 1985).

However, a turn around in agricultural growth occurred in Eastern region, precisely in West Bengal since the 1980s. Studies by various scholars reaffirmed that the period of post-1980s can conclusively be treated as end of 'agricultural impasse' in West Bengal. Studies of Mridula Saggarr and Sundar Raghavan (1989) identified the increase in agricultural growth in eastern India in the 1980s as most notable feature in India's agricultural scenario. Harris (1993) also observed a break in stagnation in agricultural production in West Bengal through his micro level study of three villages in the districts of Birbhum and Burdwan. Abhijit Sen and Ranja Sengupta for West Bengal, Orissa and Bihar observed that a trend break was observed in the rate of growth production and productivity of rice and foodgrain in 1981-82 (Sen and Sengupta, *op.cit.*).

In another study conducted by Centre for Monitoring Indian Economy (CMIE), observed that the rate of growth of foodgrain production was highest among seventeen major states of India during the period 1980-81 to 1992-93. Saha and Swaminathan (*op.cit.*) also concluded in their district wise and crop wise study on agricultural growth in West Bengal in the 1980s that, agricultural growth was accelerated in West Bengal since 1980s and with the exception of Darjeeling and Jalpaiguri, index of aggregate crop production increased at a rate of 5 percent per annum between 1981-82 and 1990-91.

Bhalla and Singh (1997) estimated the over all growth of agricultural production during the period 1980-83 to 1992-95 and the figure stood at 5.39 percent. Rogaly *et al.*, (1995:1864) concluded that rapid growth of agricultural output since 1980s with an average rate of 4 to 5 percent. Rawal and Swaminathan (*op. cit.*) also arrived at similar conclusions while estimating the growth of agriculture in West Bengal from 1950 to 1996. Gazdar and Sengupta (*op. cit.*) observed that the turn around in agricultural growth in West Bengal is a result of belated Green Revolution, personal initiative and private investment, operation *barga*, distribution of surplus land and *panchayati raj*.

Manoj Kumar Sanyal, Pradip Kumar Biswas and Samaresh Bardhan (1998) while measuring the growth of foodgrain (disaggregated at district level) observed that between 1977-78 and 1993-94, all-crop production grew at an annual rate of 4.10 percent and yield per hectare grew at 4.97 percent and surpassed the growth of population and hence agriculture in West Bengal came out from long stagnation. They also showed that some western and central Bengal districts experiencing severe decline in agriculture during 1949-65 and a slow recovery during the period 1966-80 were finally placed at high growth trajectory. In a study that covers a period from 1977-78 to 1999-2000, it was estimated

that the production of rice and foodgrains grew at a rate of 3.2 percent and 2.6 percent respectively. It was further observed that the growth rate was marginally higher for both rice and foodgrain (3.7 percent and 3.3 percent per annum respectively) between the period 1980-81 and 1999-2000 (Chattopadhyay, 2005).

1.4 Research Gap

From the above literature survey it is evident that possible inverse relationship between farm size and productivity provided a logical basis and favoured redistribution of lands to landless and brought substantial improvement in production and productivity. Land was the only resource that such farmers did not have secured access to. Providing access to land, either through redistribution or through a secure tenancy contract would have been effective in increasing the productivity of agricultural practices. However, at all-India level as well as at regional level, impact of land reform on agricultural productivity substantially diminished since late-sixties and most of the studies got solely preoccupied with Green Revolution. The situation has however changed significantly with the introduction of economic reform in 1991 that altogether altered the basis of the input supply system facing a farmer. They are to be purchased from market, be it seeds, fertilisers, water and even labour. The poor tenants, small and marginal farmers faced a difficult situation not only in procuring the complementary inputs at affordable prices but also realizing the optimum value for the output produced.

Empirical studies to decipher long term growth pattern of agricultural production and productivity on West Bengal and disaggregated at district level as well as long term changes in crop mix are neither sufficient nor exhaustive (especially from late-90s). Most of the studies regarding trends in agricultural production and productivity remained confined to the state level in post 80s barring from the studies made by Saha and Swaminathan (*op. cit.*), Rawal and Swaminathan (*op. cit.*), Sanyal *et al.*, (*op. cit.*) and Chattopadhyay (*op. cit.*). Among these studies, Rawal and Swaminathan have dealt with relatively longer period. Sub-periods growth in tune with major institutional and policy changes did not receive adequate attention. Their studies mostly remained confined to examine the trend in productivity with an *a priori* assumption that turn around was caused by introduction of land reforms, operation *barga* and introduction of grass root level governance through *panachayat*. Very few studies feel the urgency to study the simultaneous impact of institutional reforms, Green Revolution and economic reforms on farm production and productivity.

Rising pressure of population on land, little scope for area expansion for agriculture, a decline in productivity, the negative fall out of Green Revolution technology, consistent rise in percentage of agricultural labourers as well as marginal workers, variation in the absorption capacity in non-farm sector among the districts of West Bengal, have provided the researchers as well as policy makers to undertake a composite study wherein the sustainability of agriculture will be taken care of and at the same time, the mechanism for creating employment opportunities for incremental population in the agricultural sector will be devised.

The above observations have allowed us to raise some fundamental research questions and would be addressed through this research.

1.5 Research Questions

1. How did tenancy system evolve during colonial period and what were the possible impacts of change in tenancy rules on agrarian relations and agricultural productivity in Bengal?
2. Did growth rates of production, area and productivity of foodgrain and non-foodgrain change along with the change in crop-mix in every decade started from 1960-61 and till 2007-08 in India and in her states in accordance with the introduction of land reform, Green Revolution and economic reforms?
3. If so, then how far have these changes been influenced by the changes in the rate of growth of production area and productivity of foodgrain and non-foodgrain in Eastern region or precisely West Bengal?
4. Has the growth rate in agricultural production, area and productivity of foodgrains in West Bengal and disaggregated at district level, undergone a change during 1970-71 to 2008-09 and in four sub-periods, viz. 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-2001 to 2008-09?
5. What was the nature and extent of acceleration and deceleration and instability of growth of foodgrains in West Bengal and her districts and non-foodgrains in the state from 1970-71 to 2008-09 and in four sub-periods, viz., 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-2001 to 2008-09?
6. Has West Bengal and her districts undergone any change in production of crop-mix and if so what factors have contributed towards diversification of crops?

7. Do farm size, operation *barga*, role of *panchayat*, introduction of Green Revolution technology, economic reforms have any simultaneous impact on foodgrain productivity in West Bengal over time and districts?
8. Do the changes in agricultural productivity, if any, have impact on agricultural employment and economy?

1.6 Hypotheses of the Study

1. Colonial rule in Bengal withheld the process of sub-infeudation in agrarian sector of Bengal and helped to bring positive changes in agricultural production and productivity.
2. India through institutional reforms, techno-biological changes and economic reforms have sustained high growth agricultural production and productivity and also reduced regional growth disparity in agricultural production and productivity across the states.
3. A positive trend break in foodgrain production and productivity was observed in West Bengal and her districts in the eighties and it has been sustained in subsequent decades with further acceleration and reduction in instability of growth.
4. Crop diversification has increased over time in the state of West Bengal as well as among the districts over time.
5. Growth in foodgrain production and productivity in West Bengal has been driven and sustained by small farm size, tenancy reform, namely operation *barga*, techno-biological revolution and economic reforms.
6. Growth in foodgrain productivity has increased income and employment in the farm sector and also helped in the growth of non farm sector of the economy over time and across the districts.

1.7 Methodology

The proposed study intends to explore the changes in agricultural production, productivity and area under cultivation of various foodgrains and non-foodgrains in West Bengal as a whole and also disaggregated at district level covering time span of 39 years, that is, from 1970-71 to 2008-09. The whole period was divided into four sub-periods, viz. 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-2001 to 2008-09. Sub-periods have been created keeping the broad policy interventions in mind. If the 1970 to

1980 was identified as a decade of 'agricultural impasse', then decade of 1980s to 1990s has been identified as end of 'agricultural impasse'. Here, distributive measures were like land reforms and tenancy reforms, commonly known as operation *barga*, introduction of *panchayat* as a means of grass root level governance and resource mobilisation and generation at village level and introduction of Green Revolution technology in Bengal's agricultural practices. Finally, the period between introduction of economic reforms in 1991 and its onward journey till date, was divided in two sub-periods, 1990-91 to 1999-2000 and 2000-2001 to 2008-09. This has been done to unearth the initial euphoria or pessimism that the introduction of economic reforms created in India and to capture the impact of second generation reforms where in agriculture also got more closely linked with economic reforms.

1.7.1 Measuring Growth of Crop Output, Productivity and Area

To measure the growth of agricultural output, area and productivity most frequently used tool is compound annual rate of growth or CAGR. Compound annual growth rate (CAGR) is the rate at which available (e.g. output, population, investment etc.) grows over a period of time, taking into account the effect of annual compounding¹¹.

Changes in the agricultural output may occur because of the interplay of various variables including technological, institutional change, relative prices and the weather. To begin with, the exponential (log-linear) form has been chosen to measure the growth.

In our study, to measure the long term growth (1970-71 to 2008-09) of agricultural output, area and productivity, CAGR and exponential growth are frequently used. The T-Statistics is also reported to indicate the probability levels at which the coefficients are statistically significant or not.

1.7.2 Acceleration and Deceleration of Growth

Since, the exponential form of growth curve assumes a constant growth rate, therefore, to examine, statistically, the acceleration or deceleration (or constants) of growth and/or growth rates, log-quadratic form has proved to be convenient. It can be written in the following form:

$$\ln Y_t = a + bt + ct^2 + u_t$$

If estimated value of c assumes significantly (T-ratio is used as test statistics) positive value then it shall suggest acceleration in growth rate and in case of significantly negative

value of c , it will indicate deceleration (Boyce, *op.cit.*: 262; Reddy, 1978:807; Srinivasan, 1979: 1283; Saha and Swaminathan, *op.cit.* :A2-A3).

1.7.3 Measuring Growth in Sub-Periods: Kinked Exponential Model

To calculate exponential growth rate simultaneously for the whole period (1970-71 to 2008-09) and for four sub-periods (1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-2001 to 2008-09), kinked exponential model has been used. Three kinks (k_1, k_2 and k_3) were introduced to measure the four pre-specified sub-periods.

The kinked exponential model can also be specified by re-normalizing time such that $t = 0$ at the break point k_1 , $t = 10$ at the second break point k_2 and $t = 20$ at the third break point k_3 , then equation can take the following form and which can be used to estimate the growth rates for four sub-periods with a joint intercept:

$$\ln Y_t = a_1 + b_1 D_{1t} + b_2 D_{2t} + b_3 D_{3t} + b_4 D_{4t} + u_t$$

Where, $D_1 = 1$ for 1970-1971 to 1979-1980,
 $= 0$ elsewhere.

$D_2 = 1$ for 1980-1981 to 1989-1990,
 $= 0$ elsewhere.

$D_3 = 1$ for 1990-1991 to 1999-2000,
 $= 0$ elsewhere.

$D_4 = 1$ for 2000-2001 to 2008-2009,
 $= 0$ elsewhere.

1.7.4 Weather or Rainfall Adjusted Growth Rate

Weather especially rainfall plays a crucial role in Indian agriculture. However, most of the studies while discerning growth of agricultural production have ignored the weather factor (Mahendradev, 1987: A82-83). Rainfall index is defined as actual rainfall as percentage of normal rainfall. The rainfall index is incorporated in exponential growth equation to estimate the weather adjusted growth rate or rainfall adjusted growth rate.

1.7.5 Measuring Instability of Growth Rate

In the present study the method followed by Boyce (*op.cit.*), Saha and Swaminathan (*op.cit.*) and Mahendradev (*op.cit.*) has been used to measure the instability in production.

Based on actual value of production for the period 1970-71 to 2008-09, an exponential trend line has been fitted and exponential growth rate calculated. Predicted values have been calculated for the all the successive periods from 1970-71 to 2008-09.

The difference between the actual values and predicted values of crop output are calculated and the differences are expressed as the percentage of the predicted value. The square of these percentage deviations are calculated and regressed against time. The estimated coefficient of time is considered as instability coefficient. If the estimated coefficient on time is positive, it can be concluded that the instability has increased and if the coefficients assume negative values then it can be said that instability has decreased. The T-statistics of the coefficient indicates the strength of the trend.

1.7.6 Measuring Crop Diversification

To understand the nature of changes in cropping pattern in West Bengal as well as in the districts, the rate of growth of acreage under different crops in time perspective has been considered. The annual exponential rates of growth of the area under crops were estimated. After obtaining the respective exponential growth rates of output area and productivity, the area effect and yield effect were calculated. After estimating the rate of growth and change in the rates of growth of acreage of different crops, substitution effect and expansion effect have been calculated. To ensure, whether the area under any crop has undergone change because of inter-crop shift of area or due to substitution effect or due to change in the total area under cultivation or expansion effect, the cropped area-gross cropped area elasticity (E) was measured.

While studying the crop diversification, Herfindahl Index and Simpson Index have been used to measure the extent of crop concentration/diversification both at aggregate level i.e., for the state of West of Bengal as well as at disaggregated level or at district level. It is to be mentioned that the Herfindahl index is the index of concentration and higher value of it indicates crop specialisation. Therefore, to obtain the index of diversification, it is subtracted from one, which is a simplified form of Simpson index of diversification.

To understand the spatial pattern of diversification, the computed values of indices were ranked for the districts of West Bengal. To test the consistency of the ranking patterns of the districts based on the values of Herfindahl indices and Simpson indices, Spearman's rank correlations of district wise indices between any two years along with level of significance, are also considered.

Correlation between Simpson indices and various factors that may affect crop diversification has also been considered.

1.7.7 Standard Pooled Regression

To validate (or invalidate) farm size and productivity relationship and to capture the impact of operation *barga*, introduction of *panchayat* for local level governance and to shape the development agenda at rural grass root level, impact of Green Revolution, economic reforms and simultaneous impact of Green Revolution and operation *barga*, on agricultural productivity, standard pooled regressions over districts and time have been used.

The state is divided into 19 administrative districts viz. Darjeeling, Jalpaiguri, Cooch Behar, North Dinajpur, South Dinajpur, Malda, Murshidabad, Nadia, North 24 Parganas, South 24 Parganas, Kolkata, Howrah Hooghly, Burdwan, Birbhum, Bankura, East Midnapore, West Midnapore, and Purulia. Kolkata is excluded in this study because of its non availability of agricultural areas.

To maintain temporal continuity of data, the districts of 24 Parganas, West Dinajpur and Midnapore have been taken as an undivided unit¹² and the empirical analysis evolved around 15 districts over time.

The proposed study is based on data and information collected from various secondary sources like, West Bengal Economic Review, District Statistical Handbook, Census Report, Agricultural Census, Study of Farm Management and Cost of Production of Crops in West Bengal, Directorate of Economics and Statistics, Government of India, Ministry of Statistics and Programme Implementation, Government of India, Planning Commission, Government of India, New Delhi, Reserve Bank of India (RBI), New Delhi, National Sample Survey Organisation (NSSO) etc.

1.8 Chapterisation of the Study

The proposed study has been designed in the following chapters:

Chapter-I: This chapter has introduced the evolution of theoretical discourse on development and how contested the agricultural domain remained there in. Contextualising the theoretic on development vis-à-vis agriculture in India and the regions has been placed at background of the proposed study that moves further with specific objectives and introduction of the research problem with literature reviews. Identifying the

gaps in literature keeping the research problems at the core, research questions and hypotheses are also framed. Methodology along with statistical and econometric tools are identified to find plausible answers of the research questions and to test the hypothesis that this study has proposed.

Chapter-II: In this an over view of agriculture in Bengal during pre-colonial and colonial era were presented. Tenurial relation, agrarian structure, peasantry and economy those were prevailing during pre-colonial era have also been dealt with. Further evolution of tenancy system during colonial rule in Bengal, its impact on agrarian community as well on agriculture production and productivity in Colonial Bengal have been critically examined. And finally the agrarian reforms carried on immediately after independence has also been discussed.

Chapter-III: In this chapter the policies undertaken for the development of agriculture from independence to current period have been evaluated and how the changes in policy affected the agricultural production and productivity at national level as well as at regional level have critically been analysed.

Chapter-IV: The trends in agricultural production and productivity in West Bengal and disaggregated at district level has remained the focal point of this chapter. Changes in growth rates of production and productivity of select foodgrains in the state of West Bengal as well as in her districts from 1970-71 to 2008-09 with four pre-specified sub-periods have been analysed.

Chapter-V: This chapter tries focus on district wise acceleration and deceleration in growth of Production of select foodgrains in West Bengal from 1970-71 and 2008-2009. District wise weather adjusted growth rates and unadjusted growth rates are calculated and compared to gauge the influence of rainfall over time on agricultural production and productivity. Districtwise trends in growth instability in production and productivity of foodgrains over time have been discussed and a detailed trend analysis of production, productivity and area along with acceleration or deceleration of growth and instability of select non-foodgrains in West Bengal has also been carried over.

Chapter-VI: In this chapter whole gamut of issues related to crop diversification in West Bengal disaggregated at district level over time has been explored in length and breadth.

Chapter-VII: An econometric analysis has been carried on in this chapter to verify the farm size and productivity relationship and to capture the impact of operation *barga*,

introduction of *panchayat* for local level governance, impact of Green Revolution, economic reforms and simultaneous impact of Green Revolution and operation *barga*, on agricultural productivity from 1980-81 to 2008-09. A further attempt has been made to verify the impact of change in wage rate and agricultural income on over all employment as well as employment in the farm sector.

Chapter-VIII: Summary and Conclusions, designed to improve the agrarian sector vis-à-vis economy of West Bengal and her districts.

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¹ Alfred Marshall argued that the tenant would not have incentive to cultivate the land efficiently, since the tenant would only receive a fraction of any additional output created by putting additional work effort (Marshall 1948:644). It needs to be reiterated that in share tenancy or share cropping contract tenant promises to pay the landlord a fraction (assuming as y^*) of the total output. If it is assumed that y^* is around 0.5 (empirically also proved to be so (Basu, 1994)), and the tenants who decides and bears input (e.g., water, seeds, fertiliser etc.) costs shall have no incentives to increase the output by using additional or new variants of inputs (by incurring additional costs) because under share tenancy, the tenants is not going to receive full additional output but only half of it. Therefore, the tenant will not use the new input unless the value of additional output is at least double the cost of new input. Hence, the sharecropping will be continued to be an inefficient system and there is a lesser scope of improvement in agricultural productivity and production.

² In fixed rate tenancy, tenant will be able to realise the additional output produced by him by using additional inputs. The output thus produced under fixed rent tenancy from the same amount of land is likely to be higher than that of share tenancy. The landlords were thus suggested to switchover to fixed rent contract rather relying on share tenancy.

³ Amit Bhaduri (1973) searched the causes for stagnation in a semi-feudal agrarian economy. In his theoretical model, it is assumed that the responsibility of innovations rests on the landlord and the landlord may not be interested in innovations. In a semi feudal agriculture a landlord has two sources of earnings. He earns as rental proportion of total output. This is his property income. The landlord also earns income by charging exorbitant interest rate on the consumption loan provided to his tenants. This is his usurious income. If technological innovation takes place, the tenant's income goes up; his need for consumption loan goes down. Hence it is possible that an innovation lowers the net income of landlord. For this reason, the landlord may not be interested in innovations. As a result, stagnation continues to prevail in the backward agriculture. In Bhaduri's word 'since semi-feudal landowners as a class largely maintain their economic and political control over the *kishans*, by keeping them in bondage of perpetual indebtedness, it is quite probable that they will try to restrict the level of technological improvement in such a way as not disrupt the perpetual circle of debt in which the *kishan* is caught'. A necessary condition of Bhaduri's result is that the tenant reduces his borrowings when his income increases as a result of yield raising innovation.

⁴ Barga is the local word for the share cropper.

⁵ The role of successful land reform in enhancing allocative efficiency in the agricultural sector is hardly consciously considered. Allocative inefficiency results when, given the prices of inputs and outputs, a producer cannot optimally allocate her resources to minimize the cost of production and subsequently leads to non-realization of the potential productivity of the inputs used. Such inefficiencies add considerably to the lowering of the capacity of the farmers to generate marketable surplus, thus nullifying the achievement of distributive efficiency. Providing access to land, either

through redistribution or through a secure tenancy contract, would have been effective in increasing the productivity of agricultural practices.

⁶ Area effect refers the increase in output in the absence of any changes in yield and cropping pattern, yield effect shows the changes in yield with constant cropping pattern and the third element portrays the effect of changes in the cropping pattern on the absence of yield changes.

⁷ Price effect shows how change in crop prices contributes for the growth.

⁸ Locational shift captures the effects on the shifting of crops from low yielding areas to high yielding areas or shifting of from the areas where price is low to the areas where price is high for the crop.

⁹ The current land ceiling in West Bengal is 5 hectares of irrigated land and 7 hectares of unirrigated land (Bhaumick, *op.cit.*)

¹⁰ According to West Bengal Land Reform Act (amended-1966 to 1972) *bargadars* are entitled to receive 75 percent of the produced crop except in cases when the landlord was providing all non-labour inputs and such cases tenants shall receive 50 percent of the produce (Chakrabarti, 2003).

¹¹ The compound growth is composed of two parts: principal or the initial value of variable in consideration and the amount of change in the principal over a certain time period which is called 'growth on growth' because it measures periodic growth of a value that itself is growing periodically.

$$\text{CAGR} (t_0, t_n) = (Y(t_n) / Y(t_0))^{1/n - t_0} - 1$$

$Y(t_0)$ = Initial value of Y (may stand for output, population etc.) in the year t_0

$Y(t_n)$ = End value of Y (may stand for output, population etc.) in the year t_n

$t_n - t_0$ = number of years

Since while calculating CAGR for certain number of years the initial value and the end value are considered, therefore, the growth rate so calculated does not take into account the values falling in between years and any fluctuation there in does not get reflected in CAGR.

¹² The erstwhile district of 24 Parganas was split into two districts- South and North 24 Parganas in 1986, West Dinajpur was divided into North and South Dinajpur in 1992 and the district of Midnapore was divided into West and East Midnapore in 2002.

Chapter-II

Agrarian Relations and Agriculture in Bengal in Retrospect

2.1 Introduction

Undivided Bengal was always identified as being in possession of the most fertile land because it lay in the delta created by three great rivers –the Ganges, the Brahmaputra and the Meghna. Adequate rainfall, presence of abundant surface water, under ground aquifers and the prevalence of warm temperatures throughout the year made Bengal the ideal region for the growth of agriculture. Early travelogues and various historical accounts reaffirm this fact. Ibn Battuta, the Moroccan explorer who visited Bengal in the middle of 14th century, asserted that ‘this is a country of great extent, one in which rice is extremely abundant. Indeed I have seen no region of the earth where provisions are so plentiful’ (Yule, 1866:257).

Over the passage of time, productive techniques also experienced a process of evolution. Agriculture in Bengal has passed through the various stages of hoe-cultivation, migratory agriculture, permanently-settled cultivation and in turn new areas have been brought under cultivation in the resultant changes in production and productivity.

2.2 An Overview of Agriculture during pre-Colonial Era

Irfan Habib’s in-depth study on agrarian studies in Mughal India reaffirms the facts mentioned earlier by Bernier. He also made an implicit comparison between the Mughal period and the British period. To do so, he juxtaposed the statistical data on agriculture, compiled during the British period, upon the statistical information he gathered from Abū-l Fazl’s *Ā’in-i Akbarī* which adumbrate statistics during Akbar’s reign and *Chahār Gulshan* written by Rai Chāturman that dealt with Aurangzeb’s reign. According to him, since 1595, cultivation continued to expand and this expansion continued till 1910.

Study of agricultural practices reveals that the majority of the land was single-cropped but instances of double cropping were also found. In agricultural methods, drill-sowing and dibbling were familiar practices and rice was transplanted. Agriculture was largely dependent on rainfall but references of well-irrigation are also mentioned in Abū-l Fazl’s *Ā’in-i Akbarī*. A few large canals were excavated in Northern India and Haryana during Mughal period, especially in Shājahān’s reign (Habib, 1999: 29, 35).

A large numbers of crops (almost 39 in number) were grown during the Mughal period. Rice was cultivated in Bengal, Orissa, Assam valley, and in the Tamil country and Kashmir. No reference of wheat and millet cultivation could be found in those regions. Similarly, wheat and barley were grown in abundance in the central plains and Gujarat. Maize made an appearance as a *kharif* crop in eastern Rajasthan from 1664.

Among cash crops, cotton and sugarcane were cultivated extensively during the Mughal era. Cotton was cultivated throughout northern India and also in Bengal. However, cotton cultivation declined in the later period. Bengal was also a producer of good quality sugar in large volumes during Mughal period but production declined in the subsequent period. Indigo, the dye-yielding crop was grown in Agra, Ahmadabad, Telegana and Bengal. Opium was widely cultivated in the Mughal Age but its concentration was high in Bihar and Malwa. The cultivation of tobacco was introduced in the 17th century. Bengal was also famous for growing long pepper. Sericulture was widely practiced in Bengal as well as in Kashmir. Bengal was also a producer of large quantities of mulberry silk which was one of the important items of export during the Mughal period. However, this registered a huge decline during the 19th century in the hands of the British (*ibid.*: 40-57).

It is evident from the above account that Bengal had a dominant role in agricultural production of both food and cash crops with high export quotient during the Mughal period.

2.2.1 Tenurial Relations, Agrarian Structure, Peasantry and the Economy in the pre-Colonial Era

The central feature of the agrarian system in pre-colonial and ancient India was the extraction of surplus produce from the peasants by means of land revenue. The Mughal period was also not an exception. Thus, land relations, including the nature of ownership of land, land tenure systems, the economic condition of the peasantry, and overall economic conditions of the state also need to be closely studied.

It has been estimated by various historians that in different periods of ancient and medieval India, land revenues varied in nature from 1/12 to 1/3 of the produce. Since 13th Century, two kinds of rights of the cultivator were recognised. Firstly, cultivators who enjoyed all the customary rights without the apprehension of being evicted so long as they paid the rent, were known as *khud-kast* cultivators. The other category of cultivators was identified as *pahikasth*. *Pahi* or *upari* were outsiders who came from the other villages to cultivate the land. Lastly there were the *muzarian* or sharecroppers who rented land from the *Khud-kast*

peasants or the *zamindars*. There was also a small class of landless peasants who were also enrolled as casual labours in times of harvest and sowing etc. (Chandra, 1999).

In this context, sharecropping emerged as vitally important in determining agrarian relations and condition of the peasantry. From the various accounts of sharecropping in India and Bengal, authors were unanimous that sharecropping was as old as the country itself. Old Buddhist texts and Hindu law books of the ancient period bear testimony to the prevalence of sharecropping. In the 5th Century B.C., land belonging to Buddhist monasteries was cultivated by the sharecroppers because Buddhist monks were not allowed to participate directly in cultivation. The produce was divided equally between the monastery and sharecroppers. It is also mentioned in *śloka* 166, chapter IV in Manu that non-cultivating landlords leased out their land in lieu of a share of the produce. It is also mentioned in the 'Laws of Manu' that this share was to be one-sixth of the gross produce, and Manu mentions that this share might be raised to one-fourth in times of war or other emergencies (Powell, 1876). During the Mauryan period (from 321 B.C. to 297 B.C), cultivators were employed to cultivate farms owned by the Crown or the government in lieu of share of produce. If the cultivators provided seeds and bullocks, they received half of the produce but if they offered only their physical labour then they received one-fourth or one-fifth of the produce. Kosambi (1970: 150,152) also refers to Kautīlya's *Arthasāstra*, a famous manual of statecraft of the fourth century B.C. to prove the prevalence of sharecropping in ancient India. From Megasthenes's *Indica*, it is learnt that the Mauryan king Asoka, reduced the state share of crops produced from one-sixth to one-eighth.

On the question of communal ownership in pre-colonial period, the generally accepted view is that, 'the question whether the land was owned by the Raja, the *talukdar*, *zamindar*, the cultivator or the king was not a/the real question. Each had claim based upon custom or upon grants made by the king or a raja, or upon grants made by a *talukdar* or *zamindar*. But in addition to these claims each did or did not have the power to enforce his claims or to enlarge his claims. There was no appeal if a usurper had the power to usurp. The village did not hold its land common. Common were its officials and servants' (Neale, 1969).

Organised land revenue settlements were introduced during the reign of Akbar (1556-1605). The revenue system in vogue during Akbar's period had intended to accomplish two goals: the increase of revenue - of course, not by extortion but by the increase in cultivation - and the psychological security of the peasants. This was essential because the government was entirely dependent on land for its revenue. The European travellers who visited India during

16th and 17th centuries were unanimous in the notion that 'king was the owner of the soil in India'. The state bureaucracy, *zamindars* and *zamindari* officials, religious divines and religious institutions, learned men and learned institutions, survived on land grants of various types. People were primarily agriculturists or land tillers (*raiyyats*) and semi agriculturalists (rural artisans, professionals) and derived their living from land. Low productivity of labour and production for survival forced the people to be tied up with land. The pre-colonial village economy was characterised by low-productivity agriculture and low forms of industries, and was hierarchically organised within the framework of the subsistence economy.

In the agrarian structure, *zamindars* were placed at the top and *raiyyats* were at the bottom and the place in between was occupied by *talugdars* and *ijaradars*. The lowest rung of *raiyyats* had the least rights and privileges and the highest level of obligations which was just the opposite in the case of the *zamindars*. A *zamindar* was entrusted with the responsibility of collecting rent on behalf of the state and all agricultural surplus was extracted in the form of *jama*, *abwab* or illegal exaction, *begar* or free service, *bhet*, *nazr*, *salami*, or gifts etc. In lieu of this, a *raiyyat* received lessening of rents and *taqavi* loan in case of failure of crops due to natural calamities. Through this munificence, 'self-subsistent rural order' was maintained during the pre-colonial period. Whatever agricultural surplus was generated was thus extracted by the government through taxation. Therefore, capital accumulation and exchange were ruled out and the *raiyyats* were left with no option but to remain confined within simple reproduction system of self-subsistence village system. The manufacturers and artisans who settled or asked to be settled in the Mughal cities, were allowed to do so not to cater to the needs of the expanded market but to cater the needs of aristocracies and cantonment regiments (Islam, 2009:38-41).

There is also no reason to believe that the feudal structure had undergone a change, and agrarian relations were free from subinfeudation and exploitation. Unlike Europe, exchange of rural surplus with urban manufacturing never evolved, and as a result, village society was subject to exploitation, and urban aristocracies did not provide any protection or benefit to village society (Islam, *op.cit.*:39). A few historians have argued that from the second half of the 17th century a mercantile capitalist class was emerging through a process of exchange and reproduction process, and attributes like increasing exports, large circulation of silver currency and collection of land revenue in cash were used to justify the argument (Chaudhuri, 1975, Omprakash, 1976). This proposition was invalidated by Sirajul Islam. According to

him, 'non-economic origin' of the merchant class inhibited the growth of mercantile capital in Bengal. The then capitalist class was of two categories: the *bantias*, *muttsuddis*, *gomostas*, *paikars*, *dalas*, etc., accumulated capital in association and collaboration with foreign trading companies, and the other category of capitalists who primarily dealt with the government were bankers, *shroffs*, mint-contractors, financiers to *malguzars* etc., However, both the categories were only remotely connected with 'actual production relations and exchange' and hence pre-capitalist production relations prevailed.

As a result, capital formation, technological improvement, innovations, higher wage, improved living conditions etc. remained elusive in Bengal. Textile was the major item of export in Bengal during pre-colonial period but its production was solely dependent on the supply of capital from capitalists and demand was driven by 'capitalist customers'. Weavers did not have the capital and improved technology elevate themselves from the status of artisans to entrepreneurs (Chaudhuri, 1974:162-163). The high international demand of Bengal's textile was sustained by using traditional skill and low costs of production. The commodity production and its corollary, individual land-holding, must have necessarily ruled out any kind of equality in the village (Habib, *op.cit.*: 103-112)

During Mughal era, the regions comprising Ilahabad, Awadh, Bihar, and parts of Bengal had observed an increase in cultivation from 100 percent to 300 percent. The rise in cultivation was attributed to reclamation of land from sub-mountain. The second region that experienced an increase in the rate of cultivation was Berar and that can be attributed to massive clearing of the forests of Central India. The expansion of modern canal system had allowed the cultivation to expand in the Indus basin as well.

2.3 An Overview of Agriculture during Colonial Era

One of the major reasons for pursuance of the rights of revenue collection in the Bengal Presidency by the British East India Company was to establish a monopoly over the lucrative textile trade in Bengal and on the highly productive fertile land of Bengal. The statement made by Lord Cornwallis, the then Governor-General of Bengal in 1790 corroborated this fact by stating 'we have, by a train of most fortunate events, obtained the dominion of one of the most fertile countries on the face of globe, with a population of mild and industrious inhabitants, perhaps equal to, if not exceeding in number, that of all other British possessions put together' (Firminger, 1917: 542).

It needs to be mentioned that the East India Company received the Grant of *Diwani* (rights of revenue collection) of Bengal, Bihar and Orissa from the Mughal emperor Shah Alam II in 1765, and after Awadh was annexed in 1856, the present India, Pakistan and Bangladesh become part of the British territory (Roy, 2000:1).

The importance of the colonial period is paramount on various counts. Evolution of the tenancy system, the terms and conditions of tenancy contracts, and the impact of the prevailing tenancy structure on the level of agricultural production and productivity under colonial rule in Bengal has remained a subject matter of intense debate in social science research over the years. Therefore, to deal with agriculture in post-independence India and divided Bengal, the colonial era has worked as a natural precursor.

2.3.1 Evolution of Tenancy System in Bengal during Colonial Period in pre-Permanent Settlement Era

In the initial phase the East India Company worked as a trading concern by acknowledging the authority of the *Nawab* of Bengal and the Mughal Emperor in Delhi. The Company inched towards the pinnacle of political power by winning the famous Battle of Plassey in 1757. After installing a series of client rulers, East India Company finally got the Grant of *Diwani* (revenue collecting rights) of Bengal, Bihar and Orissa from the Mughal Emperor Shah Alam II in 1765 and their attempts to collect revenue brought considerable changes in agrarian relations in Bengal. Initially, they tried to work with pre-existing institutional forms. In the pursuit of increasing the *de facto* power of the Company, they took the initiatives to create a new administrative infrastructure. Since the primary aim of the Company was to increase its land revenue collection, and land taxes were closely linked with land ownership, this prompted the East India Company to bring about certain structural changes in the land revenue system, as well as the administrative and judicial systems in Bengal. *Zamindars* collecting revenues for Nawabs of Bengal were identified as natural intermediaries by the Company for collecting revenue. The *Zamindars* were a heterogeneous group. *Zamindars* having large estates, military capacity and judicial and administrative responsibilities could be called 'feudatory chiefs' and others who operated at smaller scale could be called 'landlord' (Bose, 1993:70). The *Zamindars* were placed at the top of agrarian hierarchy and they empowered the *jotedars* to collect tax. *Jotedars* used to enjoy occupancy rights to their land by paying customary rents to the *zamindars* (Sinha, 1962: 18, 27). *Jotedars* were also powerful at the village level and used to have tenants at their disposal (Ray, 1979: 6-7). The Board of Directors of the Company first introduced a quinquennial settlement or Revenue

Farm Contracts on a 5-yearly basis in 1772, and then a decennial settlement in 1789. Rights of the collection of revenue were given to the highest bidder through auction for a period of 5 years. Economic theory suggests that revenue farming has two negative outcomes. First revenue farmers, in the short run try to extract as much surplus as possible during their lease. Second, revenue farmers get trapped into “Winner’s Curse” of auction theory i.e., they overestimate the value of asset and therefore often default. These proved to be true for the revenue farmers of Bengal (Swamy, 2011:141-142).

This system of ‘time-honoured’ practice of revenue farm contracts forced the revenue farmers to resort to rack-renting and forcible collection, and as a result, the cultivating peasantry had to face an unbearable burden. It has been argued by economic historians that bullion control measures adopted by the Government in England had put pressure on the East India Company to increase its collection of land revenue from Bengal Presidency consisting of Bengal, Bihar and Orissa. The Company in India was bestowed with the responsibility of financing the collection of locally manufactured products in Europe, and to meet the expanding military expenditure which occurred because of the continuous pursuit of the East India Company to annex and occupy more regions of this subcontinent which was known as the Investment Policy of the Company.

2.3.2 The Permanent Settlement

These experiments however proved to be disastrous for the peasantry and Bengal had to face a famine in 1770. Rack-renting by the revenue collectors raised serious discontent and unrest among the cultivators and the Sannyasi Revolt (1763-1800), Midnapore Revolt (1766-1783), Chakma Revolt (Chittagong, 1776-1787) bear testimony to this discontent. Therefore, the British Government reached the conclusion that Bengal required a more durable settlement and in 1793 the Permanent Settlement was introduced in Bengal. Through the Permanent Settlement, the British ruling power ascertained its supreme right over land. The *zamindars* or landlords were identified as agents of the State for collecting and depositing the annual revenue which was fixed by the State in perpetuity for each estate. In lieu, the *zamindars* were granted proprietary rights of the estates. They were also allowed to sell or buy estates and get unhindered rights to obtain rent from their tenants.

Lord Cornwallis had conceived the Permanent Settlement on behalf of the British government anticipating that switching over to a fixed revenue system would encourage the *zamindars* – who had the sole responsibility for rent collection, land improvement and

management – to produce more, as had happened with English farmers in England. Since revenue payments were fixed, it would provide incentives to *zamindars* to maximise their income and in the process, accrued profit by the *zamindars* would be invested in agriculture. As a result, agricultural production and extension of cultivation would improve. Cornwallis asserted, 'Land property will acquire a value hitherto unknown in Hindustan and the large capital possessed by many of the natives in Calcutta which are now employed in usury or monopolising salt and other necessaries of life will be appropriated to the more useful purpose of purchasing and improving land', *zamindars* would turn into 'economical landlords and prudent trustees of the public interest' (Guha, 1963:172-173). It would also be beneficial for the State because the settlement would guarantee stable revenue and the cost of collection of revenue would also be minimised (Cooper, 1988: 21). It would therefore become imperative to protect the property rights of the *zamindars* to have a steady flow of revenue. Therefore, a hierarchical judicial system was set up: native Commissioners were given charge to hear suits for small sums at village level, the *Diwani Adalat*, (the civil court) was set up at the district level and the apex of the system, *Sadar Diwani Adalat*, was also created. However, Indians were kept out of higher judiciary on the pretext that they were corrupt.

It was further assumed by the colonial ruler that the coercion with the cultivators should be avoided since they were not directly collecting the revenue from the tillers of the land. Therefore, the peasant unrest would be minimised. In Permanent Settlement, it was conceived that a fixed rent would also be introduced for the cultivators but this never become a reality (Bandopadhyay and Krishnaji, 1983:4). Prior to the introduction of Permanent Settlement, the categories of landlords that existed in Bengal province were as follows: i. The Old Independent Chiefs like the Rajas of Cooch Behar, parts of Assam, Tripura etc., who maintained their territorial ownership by paying tributes to the Imperial power in Delhi. ii. The old established landlords (*bhuswamis*) like Rajas of Rajshahi, Burdwan and Dinajpur who were the *de facto* rulers of their estates and regions. iii. Revenue collectors having hereditary rights of collecting revenue appointed by Mughal rulers. iv. Revenue farmers who managed their own cultivation and simultaneously collected revenue.

However, after the introduction of Permanent Settlement, the various categories of landed gentry -- through a process of relegation and elevation -- were merged into the single category called *zamindar*. All were granted perpetual, hereditary, proprietary rights to the soil, subject to the payment of permanently fixed revenue to the *raiyats*. The revenue was fixed at ten-eleventh of the assets, i.e. annual gross rental and the remainder and in the

process one-eleventh was left for the landlords or *zamindars*. A group of sturdy, rich and less enterprising peasant class with proprietary rights emerged at the top by replacing a sizeable number of old *zamindars* who became the victims of Sunset Law or Revenue Sale Law under Permanent Settlement. The ordinary *raiyyat* remained at the bottom. An estimate has observed that within two decades of the operation of the Permanent Settlement, about half of the *zamindari* lands of Bengal changed hands (Islam, 1979). Old *zamindars* found it a difficult proposition to pay revenue on time because uncertainty in agriculture was quite high due to vagaries of monsoons and hence uncertainty crept in regarding paying rent on time. Thus, when the *zamindars* defaulted, they mounted pressure on the peasants, who deserted in some regions (Chowdhury-Zilly, 1982: chapter-V).

Prior to the introduction of Permanent Settlement, the *zamindars* had enjoyed enormous administrative and judicial powers but after the introduction of the Permanent Settlement, these traditional powers were seized. Thus, by and large, the *zamindars* perceived the Permanent Settlement as a bane. Gross indignation and insecurity crept into the minds of the *zamindars*, which had a severe impact on the psyche of old *zamindars*. The *Zamindars* never felt encouraged to invest their surplus for the improvements of their estates by investing in reclamation, irrigation, *taqavi* loans, storage, better livestock etc., because they considered that the opportunity cost of investment in purchasing new estates under cultivation, money lending, purchasing government bonds or shares of Agency houses were much higher in comparison to improvements of agriculture which was fraught with uncertainty. For the *zamindars*, three preferred areas of investment were observed: first, lending money to tenants, merchants and shopkeepers was considered to bring the highest return and it also allowed the landlords to exploit the tenants for their perceived indebtedness. Second, landlords preferred to invest in government bonds and shares of Agency because these investments would assure a ready income and it would also ensure government patronage that would enhance the landlords' social prestige. Third, surplus capital was also invested in purchasing new estates because it would allow creating permanent tenure at fixed rent in lieu of handsome money or *selami* (Islam, 2009:47).

The Four types of land tenures were prevalent under British rule and classified as under:

- i. permanently settled estates (revenue-paying) which were created during the introduction of Permanent Settlement;
- ii. Revenue-free estates created by the pre-British rulers and recognised and legitimised by the Imperial ruler during the introduction of Permanent Settlement;
- iii. Temporary settled estates that were created by the state with private persons as proprietors (this category was created after the abolition of Permanent Settlement);
- iv. Estates held directly by the Government (*Khas*). These estates were created after the introduction of Permanent Settlement, where in it was overtly announced that all land belonged to the state. The Table 2.1 provides an account of area under different categories of land tenures:

Table 2.1: Types of Land Tenure and Area under different Tenorial System

Type	Number held (in thousand)	Area (in million acres)	Percentage of Total
Permanently Settled Estates (revenue-paying)	94	37.37	80.7
Revenue-Free Estates	51	1.97	4.3
Temporary Settled Estates	4	3.34	7.2
Estates hold directly by Government (<i>Khas</i>)	4	1.65	3.6
Total	153	46.33	100.0

Source: *Government of Bengal (1945), Famine Inquiry Commission, Final Report, p.437*

For any future increase in the assets resulting from the extension of cultivation or other causes, *zamindars* were also assured of additional benefits. *Zamindars*, contrary to the expectation of the authors of Permanent Settlement, failed to increase the output and improve the condition of the peasantry. But to augment their income, they preferred transfer and reallocation of their rights and as a result a chain of intermediaries or intermediate tenures with large section of rent receivers were created between *zamindars* and cultivators. This process was termed as sub-infeudation (Baden-Powell, 1892; Guha, *op.cit.*). A study of Bakarganj district mentioned that in the early twentieth century, there existed as many as twenty intermediaries between cultivators and proprietor and one hundred and sixty-two terms were used to describe various forms of tenures and sub-tenures (Raychaudhury, 1979:167).

As a result, the burden of rent for the actual cultivators increased manifold. As pointed out by Ratnalekha Ray 'a traditional mode of production controlled by a creditor class of village

landlords persisted on the basis of a backward technology. Large-scale capitalist farming through increased capital inputs and improved technique, as envisaged by the farmers of the Permanent Settlement, did not develop in Bengal' (Ray, *op.cit.*). Thus Permanent Settlement and its failure raised questions on three important unsettled issues: 'first, what level of coercion could the landlord use on tenants? Second, how much freedom did he have to raise rents? And finally under what conditions could he evict a tenant?' (Swamy, *op.cit.* :146)

2.3.3 The Impact of Permanent Settlement and Bengal Tenancy Act on Agrarian Bengal

Corporal punishment and imprisoning of defaulting tenants was common in pre-colonial Bengal (Mclane, 1977:24). In the regulations of Permanent Settlement, the landlords were stripped of this extra judicial power. Therefore, *zamindars* constantly complained of non-realisation of rents from the tenants. In response, the East India company - in their continuous pursuit of increasing tax collection - introduced the Regulation VII of 1799 (known as *Haptam*) and Regulation V of 1812 (known as *pancham*) which gave the landlords and their intermediaries absolute and unrestricted authority to use all coercive force against the cultivators (e.g. seizing the crops, personal property, arresting and physical harassment) for realising rent arrears (Bandopadhyay and Krishnaji, *op.cit.*:5). Cultivators were subject to oppression and forced eviction, and land-alienation became the order of the day. A significant rise in the proportion of landless cultivators was observed in Bengal during this period (Bandopadhyay and Krishnaji, *ibid.*: 5). Therefore, the pious intention of the colonial rulers to bring in capitalistic development in agriculture, as it was the case for England, and minimisation of peasants exploitation and unrest, remained completely unfulfilled and unaddressed through the Permanent Settlement. These facts were also accepted by the then Government of India and it was observed that the desired effectiveness of the Permanent Settlement was not 'supported by the experience of any civilised country' and under this settlement 'cultivator was rack-rented, impoverished and oppressed' (Government of India, 1902:8). According to Land Revenue Commission (Government of Bengal, 1940: 35-36), 'the Permanent Settlement imposed on the province an iron-framework which has had the impact of stifling the enterprise and initiative of all classes of people'.

The failure of the Permanent Settlement put the government under serious financial strain because the administrative cost rose every year while government revenue remained stationary. The colonial rulers increasingly felt that the failure of the Permanent Settlement to augment agricultural growth and impending agrarian unrest made it imperative to devise strategies to protect the cultivators, while curbing and containing the power to use coercive

force by the *zamindars* and other intermediaries for realising rents. To accomplish these objectives, the Rent Act of 1859 was passed by the colonial government. This law restricted the landlords' power of raising the rent arbitrarily and their power to evict the tenants at will. The right to occupancy based on twelve years continuous possession of a plot of land was also ensured by the Rent Act of 1859.

However, the protection against rent revision and forcible eviction was extended to only two types of *raiyats*, namely *Paikasht raiyat* and *khud Kasht raiyat*, leaving numerous sharecroppers in the lurch. The act created conflict between occupancy tenants and *zamindars*. Brewing discontent among the peasant community culminated into an agitation and Pabna Riots forced the British Government to enact a broad-based tenancy legislation in 1885 which was known as Bengal Tenancy Act (B.T.A). The B.T.A limited rental increase to 12.5 percent with no further increase allowed for 15 years (Rothermund, 1982:104). The prime goal of this legislation was to plug-in the loopholes observed during Permanent Settlement and Rent Act of 1859.

It may be recalled that Rent Act of 1859 as well as Bengal Tenancy Act of 1885 were enacted after the Sepoy Mutiny of 1857. The political situation underwent a rapid change after the mutiny. Dissatisfaction was widespread among various classes of society because of the adverse impact of British policies -- more specifically, land and revenue policies. This growing discontent had exploded in the form of the Mutiny of 1857 that had posed a serious threat to the newly established British rule in the country (Joshi, 1957). Further, in Joshi's words, 'the Mutiny marked an end to the era of British change and innovation in the Indian institutional structure, specially the property structure' (Joshi, 1975:6)

B.T.A of 1885 defined the rights of the *raiyats* and the transfer of holdings also received legal protection. In addition, the earlier distinction between *Paikasht raiyat* and *khud Kasht raiyat* was also abolished and both became settled *raiyats* provided, they held any land in a village for 12 years. Furthermore, this legislation added various categories of tenants to minimise the exploitation of tenants in the hands of landlords as well as various rent-seeking intermediaries to check the increasing peasant unrest against the oppressive landlords and intermediaries, and to arrest the problem of continuous sub-infeudation in agrarian Bengal.

This act also created special provisions to ensure land rights for the tribals residing in Bengal. It was mentioned in section 89 of Bengal Tenancy Act that no ejection of tribal people from their land would be allowed without an execution of decree from the civil court. This act also

initiated a process of a record of rights and settlement of land revenue. The Bengal Tenancy Act had not only put restrictions on arbitrary increase of rents but also specified the rate at which rent could be enhanced. It was mentioned in the act that for secured categories of *rai-yats*, rent could not be enhanced more than 2 annas in the rupee (i.e. 12.5%). The Bengal tenancy Act was further amended in 1928 and 1938. Some major amendments included: holdings of *rai-yats* and under-*rai-yats* were made freely transferable, though pre-emption rights were granted to the landlords; occupancy rights were given to the under-*rai-yats* for tenancy over twelve years and burden of rent could not exceed one-third of gross produce (Government of Bengal, 1940: 25-30). Though these legislations seemed to be pro-tenant, however, the plight of the sharecroppers was enmeshed in legal ambiguity.

It was stated in clause 3(3) of Bengal Tenancy Act of 1885 that sharecroppers might or might not fall into the category 'tenant' and it depended on whether the sharecropper 'held the land and delivered a share of the produce on account of its use and occupation'. Only if the sharecroppers fulfilled this clause would they would be recorded as *rai-yats* or under-*rai-yats*, but this solely depended on the interpretation of the clause (Government of East Bengal and Assam, 1909). It can be said that B.T.A had 'strengthened the position of substantial landholders in the village vis-à-vis the *zamindari* but still left the lowest tier of the agrarian hierarchy unprotected' (Swamy, *op.cit.*: 148). Agriculture during the colonial era remained solely dependent on tenant cultivation (Table 2.2) who continued to face diverse kinds of oppression at the hands of landlords, intermediaries and money lenders. In spite of the fact that share cropping was used as an oppressive mechanism, sharecropping -- more precisely, the *bargadari* system -- was on the rise in 19th century Bengal and four possible reasons were cited by Radhakamal Mukherjee while replying to the questionnaire of Bengal Land Revenue Commission (1941):

- “1. The middle-class in Bengal which do not resort to cultivation, advance money to *rai-yats* and purchase occupancy holdings, resettling the *rai-yat* on produce rent for their convenience.
2. The increase is especially noticeable in such areas as Midnapore, Dacca, Faridpur and Tippera where there were numerous upper caste Hindu estates, where landlords resorted to agricultural money lending.
3. Some agricultural castes ape the manners of *Bhadroloks* and refuse to drive the plough and have acquired the habit of employing *adhiars* as soon as they acquire more than 12 to 15 *bighas* (4 to 5 acres) of land. This is marked in West Bengal.

4. The increase of transfer of holdings to non-agriculturists, marked in the recent years of agricultural depression, has led to the rapid and persistent spread of produce-paying tenancies.”

The Bengal Provincial Kisan Sabha provided some additional reasons in their memorandum to the Commission in support of the spread of sharecropping in Bengal. It was mentioned that “the landlord does this (encourages sharecropping) as it provides a very simple way of raising rents without recourse to courts.” It was further added that “growth of a type of landlord, the money lender-cum-landlord...At the same time he is a petty trader in jute or wheat or rice, very often the village grain trader or he may be interested in transport...But he is not intending to cultivate the land himself...Now to a landlord of this type the receipt of produce rents has every advantage; not only the highest rate well worth the extra trouble of assessing and collecting his half share, but and this is most important, this new type of landlord is already a trader in grain or jute. It will pay him, therefore, to take as rent the jute or grain grown by his share cropper rather than to take cash and then have to buy these raw materials for his business in the open market. In other words, he is rationing business vertically. Consequently we find amongst these new landlords it is the usual practice to have their land cultivated by *bargadars*.”

In the early 19th century, the failure of various legislations introduced by the colonial ruler to protect the economic and social plights of tenants in Bengal resulted in movements led by sharecroppers of varying nature, which continued to occur intensified from the beginning of the 20th century. In the 1830s, the Faraizi (Muslim reformist) movements led by Titu Miyan marked the beginning of the expression of economic and social tension in eastern Bengal, followed by tribal insurrection against economic oppression in Santhal Parganas which is commonly known as Santhal rebellion. Antagonism against the planter’s systems of indigo cultivation culminated in the ‘Blue Mutiny’ and the movement continued from 1870 to 1880. In 1909, in a village of Jessore district, Muslim sharecroppers refused to cultivate the land of Hindu-landlords on demand for two-third share of produce. With increasing population pressure on land coupled with absolute scarcity of fertile land, it became necessary to reclaim of forest and infertile land for cultivation. The uncertainties in agriculture caused the sharecropper movements to become more sporadic and widespread. The scenario did not change even after independence and partition of Bengal and Tebhaga movement of 1946-47 bears testimony to it.

Table 2.2: Percentage of 'Landlord', 'Tenant', 'Labourer' in the Agricultural Population of Bengal in 1921

Districts (East Bengal)	Landlords	Tenants	Labourers
Bakarganj	4.26	87.75	7.99
Bogra	1.99	89.24	8.77
Chittagong	9.55	72.53	17.92
Dacca	5.08	89.24	5.68
Faridpur	6.61	88.84	4.55
Khulna	5.73	85.68	8.59
Mymensingh	2.49	92.12	5.39
Noakhali	3.36	82.50	14.14
Pabna	4.12	88.28	7.60
Rajsahi	4.60	84.18	11.22
Tippera	1.93	93.87	4.20
East Bengal	4.52	86.75	8.73
Districts (West & Central Bengal)			
Bankura	4.18	68.39	27.43
Birbhum	2.00	62.38	35.62
Burdwan	4.19	68.42	27.39
Hooghly	4.87	68.57	26.56
Howrah	8.89	61.06	30.05
Jessore	6.94	85.34	7.72
Malda	2.12	75.99	21.89
Midnapur	2.37	80.45	17.18
Murshidabad	4.15	68.99	26.86
Nadia	7.85	70.05	22.10
24- Parganas	4.39	76.19	19.42
West & Central Bengal	4.72	71.44	23.84

Source: *Census of India 1921, Vol.5, Bengal, Part: 2 [Quoted in Bose, Sugata (1986):31]*

2.4 Agriculture during the British Raj: A Critical Review

It has been pointed out that average productivity declined after 1910-11 and became lower than even the Mughal period. (Habib, *op.cit.*: 21-23). This was bound to have a negative impact on the agrarian community. Thus, it is necessary to explore whether agriculture had suffered during the colonial period or not.

It has been explained earlier that the introduction of Permanent Settlement and subsequent changes in land settlements did not succeed in bringing in private investment in agricultural development and to break the spiral of exploitation meted out to the sharecroppers by the *zamindars*, *jotedars*, and intermediaries of varied nature and money lenders. This adversely affected the agricultural production and productivity in Bengal. Therefore, the possible causes of decline in agriculture in Bengal which once had been considered to be the best fertile strip on earth needs to be identified. A fleeting glance through the pages of various historical documents and studies allows us to identify several non-economic and economic factors responsible for the deceleration of agricultural growth and worsening of the economic condition of the populace in Bengal.

Accepting the fact that the whole of Bengal was an alluvial plain, the early 20th century Bengal could be divided into two parts - land of agricultural decline consisting of ecological zone of the old delta including West Bengal and Central Bengal and land of agricultural prosperity consisting of the new delta comprising East Bengal and the Ganges-Brahmaputra Doab corresponding to North Bengal (O'Malley, 1917: 3-16, Mukherjee, 1938: 110-113)

2.4.1 The Land of Agricultural Prosperity: New Delta and the Ganges-Brahmaputra Doab

Most of the districts in East Bengal were created by the active deltas of the Ganges and Brahmaputra. The area was subject to flooding every year and as a consequence, the region received a fresh fertile layer of silt every year. The delta so formed by these two rivers could be divided into two sub-regions. Districts of Dacca, Mymensingh, Faridpur and Tippera lie on the upper Ganges-Brahmaputra delta and the lower part of the delta consists of the districts of Bakerganj, Noakhali, Khulna and Chittogong.

Rich alluvial tracts of Dacca, Mymensingh, Faridpur and Tippera along with the Jamuna catchment area in Rangpur and Pabna and part of Rajsahi were suitable for multiple cropping. Aman rice and jute were two principal crops that were grown in this region. Abundant moisture and inundated plains of East Bengal helped to produce aman (one of the best quality grains among the traditional varieties of rice) in large quantity. Two varieties of jute were generally grown - capsularies which grew in low flooded land and oliotorious on higher land which produced superior fibre but had to be manured in the absence of inundation silt. Other than aman and jute, sugarcane, pulses, oilseeds, wheat barley, oats and tobacco were also grown in this region. (Mukherjee, 1938:43)

2.4.2 The Land of Agricultural Decline: The Ecological Zone of the Old Delta

The West Bengal and the Central Bengal is the oldest agricultural settlement in India. Excepting the western part (Birbhum and Bankura) which contained laterite formation, rest of West Bengal and Central Bengal was identified as 'semi-aquatic rice plain' (Bose, 1987: 37-38). In fact, from the 17th century, the rivers of the region started to change their course towards the east, and from the 19th century, the shift gained momentum. This caused the silting up of the rivers and simultaneous fall in sub-soil water levels which made the West Bengal and Central Bengal a zone of agricultural decline. Foothills of Himalayas as well as the districts of Malda, Dinajpur, part of Rajsahi and Bogra were also part of alluvial zone. The crops of old alluvial zone were aus rice, sugarcane, maize, joar, millets, pulses oilseeds, wheat, barley and jute to a small extent. It must be mentioned that aus rice whose yield level

is relatively poor, grows on relatively high land and requires less water than aman rice. As a consequence, we observe dominance of aus cultivation in alluvial zone of West Bengal where there was no fresh flow of water due to salinity of the rivers. The loss of silt-laden red water resulted in a shift to inferior crops and drastic fall in yields were observed (Mukherjee, 1938: 83-84).

From the middle of 19th century, the natural drainage system was also severely affected by the construction of rail and road embankments. As a consequence, stagnant water became breeding ground of mosquitoes which resulted in series of malaria epidemics. People were dying regularly in the districts of Jessore, Hoogly, 24 Parganas, Nadia, Burdwan, Birbhum, and Howrah. This resulted in decline in rural population and serious decline in cultivated land between 1891 and 1931 (Chaudhuri, 1970: 25-60, Klein, 1972: 132-60) (Table-2.3)

Table 2.3: Decline in cultivated land (in percentage) between 1891 and 1931 in districts of West and Central Bengal

Districts	% decline
Burdwan	50
Hoogly	60
Jessore	30
Nadia	20
Murshidabad	20

Source: Mukherjee Radhakamal (1938), *Changing face of Bengal: A Study of riverine economy*: 275

2.4.3 Decline in Agriculture in Bengal in the 20th Century: Probable Causes and Consequences

However, 1920 onwards, the rapid growth and expansion of cultivation in East Bengal slowed down. Rapid population growth (Table 2.4) was the primary reason behind the agricultural slow-down. Between 1920 and 1946, the 'Bengal agriculture had reached an equilibrium at low levels of production shown by the near constancy of cultivated area and near zero-trend in yield per acre' (Islam, 1979:203, Blyn, 1966:20-27). In 1919, the settlement officer of Mymensingh reported that cultivation had almost reached its full limits. In the Settlement Report of Dacca, in 1917, it was mentioned that the cultivated land as a percentage of cultivable land reached 92 percent.

Table 2.4: Density (Per Square mile) of Population in the districts of East Bengal in 1931

Districts	Population Density
Dacca	1256
Tippera	1197
Noakhali	1124
Faridpur	1003
Bakarganj	834
Mymensingh	823
Pabna	795
Bogra	785
Rangpur	742

Source: Bose, Sugata (1986):47

Excessive population pressure in the fertile lands of East Bengal forced the people to move in search of new patches of land. Madhupur jungle located at the North-east of Dacca was reclaimed. Chunks of the agrarian community started moving up the Jamuna and the Assam valley upto Gauhati and along the left bank of Brahmaputra as far as Tejpur (Mukherjee, 1938:275). People from Bakerganj, Jessore, Khulna started moving to the Sundarban region in search of livelihood. Between 1881-1901, the lands of the less fertile barind area consisting of parts of the districts of Malda, Bogra and Rajshahi was brought into cultivation and Santhal from Chota Nagpur area were engaged because of their experience in clearing jungle and forest-land for cultivation (Cooper, 1988:27). Forest-land of the western Duars (Jalpaiguri district) was also brought under cultivation. People migrated from other districts of North Bengal and Chota Nagpur and started working as coolies in the tea-gardens of duars or as sharecroppers on agricultural lands.

Cultivation was even extended to the less fertile laterite region of districts of Bankura and Birbhum and also in Tamluk and Contai sub-divisions of Midnapore. Therefore, with the expansion of population, cultivation was extended to lesser fertile zones. Holdings were subdivided and became smaller in size. Therefore, slump in productivity and production was a natural and logical outcome in Bengal. It should further be noted that rise in population and adverse land-man ratio accentuated sharecropping on newly reclaimed land and competition for land 'forced cultivators to accept exploitative tenancy arrangement such as share contract' (*ibid.*: 28). It was also observed that price fluctuations especially for rice and jute had serious impact on Bengal's agriculture.

It is a well known fact that during the 19th century, British mercantile pursuit encouraged cultivators to produce cash crops like tea and cinchona, in the Himalayan region and its foothills. Opium and indigo were also cultivated on *khas* lands of planters and cultivators

were provided with advances which kept them permanently indebted. After the 'indigo revolt' in 1860, its cultivation declined (Kling, 1966:200-213). Subsequently, by the end of 19th century, jute emerged as most important cash crop especially in East Bengal, and rice and jute became the driving force of Bengal's agrarian economy. Cultivation of rice met not only the consumption requirement but also supplemented the cash requirement of cultivators through the selling of surplus production. Rising demand for rice both in the domestic market and for export contributed to the rise in production of rice between 19th and 20th centuries, in India and Bengal in particular (Bhatia, 1967:8).

For jute cultivation, the required money for production was supplied by the traders, in lieu of which jute cultivators hypothecated their crops to the traders. Hence, involvement in the world market also made the crops (especially jute and rice) susceptible to the fluctuations in the prices in the world market. Fall in price along with demand, as it reached the nadir during world wide depression of the 1930s, put the cultivators under serious financial stress and they became easy prey for the village scoundrels, the money lenders. As a matter of fact, between 1929 and 1933, prices of rice and jute had fallen by 68 percent and 61 percent respectively. Poorer families failed to grow enough rice to feed their family members and cultivated jute for sale. As the price of jute plummeted, poor cultivators were caught in debt trap and they were forced to sell their land or they became *bargadars* or else opted for *bhag* or *adhi* (Cooper, *op.cit.* : 37, 42). Since cultivators of Bengal had little option of growing anything which was equally remunerative like rice and jute, they continued to languish under 'traditional form cultivation and traditional form of exploitation' (*ibid.*:29). As Irfan Habib pointed out, jute was produced in Bengal during Mughal period but manifold increase in its cultivation took place during the British period at the expense of rice and sugar cultivation. This resulted in food shortage in Bengal during the colonial period (Habib, *op.cit.*). As per the report of the Bengal Banking Enquiry Committee 1929-30, average debt per family increased from Rs 112 in 1928 to Rs 187 in 1933 in spite of the fact that the availability of credit was very scanty (*ibid.* :40).

The Second World War of 1939 and subsequent rise in prices of rice, the series of natural disasters between 1942 and 1943, the lacklustre attitude of the British Government in intervening in the market to control the rise in prices of foodgrains and hoarding of foodgrains by unscrupulous traders, resulted in famine in Bengal and three million people died of starvation. This can be cited as the worst example of man-made famine in the history

of civilisation. The famine was the result not only of the shortage in the supply of food but also of the lack of purchasing power of the poorer classes (Sen, 1981: Chapter 6).

Finally, with the independence of the country and the partition of Bengal, it further crippled agriculture and worsened the situation of agrarian communities of both East Bengal and West Bengal. The process of producing bulk of the jute in East Bengal and shipping it to Calcutta was permanently halted and its negative impact can be noticed even today. The condition of Bengal's agriculture can be best explained in the words of Sir Francis Floud who headed the Bengal Land revenue Commission of 1940 who observed that instead of providing incentives to improve agriculture performance, the *zamindari* system was imposed and the proliferation of intermediate tenures 'has resulted in dissipating the responsibility for the best use of the land in the national interest among a host of rent-receivers, all of whom have to be supported by the labour of cultivator, and none of whom have either the incentive or the power to exercise any control over the use of land. The Government has done far less to develop increased production from the land than the Governments of other provinces' (Government of Bengal, 1940:25-37).

2.5 Post-Independence Era

The periods of Indian freedom struggle, emergence of Indian nationalism and finally the years immediately after India's independence remained pre-occupied with problems of land and land policy. Though, on the questions of India's poverty and backwardness, a sharp schism was prominent between the 'nationalist' and the 'imperial' viewpoints. The imperial viewpoint was primarily dictated by what Myrdal called 'colonial theory' of poverty and economic backwardness (Myrdal, 1970:17).

The British explanation of rural poverty and backwardness in India had bypassed the agrarian structure created by them, as Myrdal did in his exposition of the 'colonial theory' of poverty and economic backwardness. The Colonial theory was aptly summarised by Nehru as, 'If India is poor, that is the fault of her social customs, her *baniyas*, and money-lenders and above all her enormous population' (Norman, 1965: 556).

However, an estimate of the net output data between 1948-49 and 1950-51, reveals that total agricultural output accounted for about 50 percent of national income and provided employment for about 70 percent of the work force (Indian Ministry of Finance, 1954: 45, 51). As George Blyn (1966:20-27) pointed out that up to the 1930s, there was hardly any concern over the decreasing trend in crop output. The general impression was that there was

favourable balance between growth of food crop output and population growth. As it has been pointed out by R. Palme Dutt in 'India Today', the population of India increased by 9.3 percent while foodgrain acreage increased by 19 percent.

In addition, it was perceived, accepted and advocated by the nationalists that the problems of land were not an outcome of the inheritance of feudal land relations and social customs of the pre-British period but an outcome of British-led colonialism and the colonial institutional structure created by them. British-led colonialism had accentuated the de-industrialisation process in India, as a result of which population pressure on land kept on increasing. Landlords, money lenders and traders appropriated surplus from agriculture, but the accumulated capital in terms of surplus was not invested either in agriculture or in industry. The colonial rulers accelerated the commercialisation of agriculture without bringing any concomitant technological changes in agriculture; this added further uncertainty to the peasantry having small land holdings and there was continued agricultural backwardness. Post independent India viewed agrarian society as a set of two segments, one segment consisting of landlords, money lenders and traders and the other segment consisting of the peasants. Therefore, the Policy makers of the Nehru-led government were in complete unanimity to bring in drastic changes in the land and revenue system favouring the peasants. Institutional reforms thus became the priority and the process of land reform was initiated immediately after independence. It occurred broadly in two phases. The first phase was started shortly after independence and continued till the early 1960s.

The broad contours of the reforms so conceived were as follows: (1) abolition of intermediaries-*zamindars*, *jagirdars*, *jotedars* etc. (2) tenancy reforms that involved ensuring security of tenure to the tenants, reduction of rents as well as fixation of rents paid by the tenants and providing ownership rights to tenants, (3) imposition of ceilings on the size of landholdings, (4) enabling farmers to garner resources through the formation of cooperatives. The second phase started around the mid-or late-1960s and this phase marked the beginning of the Green Revolution and has been perceived as the phase of techno-biological reforms.

2.5.1 Abolition of *Zamindari* System in India

By 1949, *zamindari* abolition bills had been introduced in the states of Uttar Pradesh, Madhya Pradesh, Bihar, Madras, Assam and Bombay. In response, the *zamindars* in various parts of the country challenged the constitutional validity of the *zamindari* abolition in courts of law and got a favourable judgment. For example, the Patna High Court upheld the

landlords' suit. This prompted the government to bring in the first Constitutional Amendment in 1951 and the 4th Amendment in 1955 to strengthen the state legislatures for implementing *zamindari* abolition, making the question of violation of any fundamental right or insufficiency of compensation non-permissible in the courts. However, *zamindars* kept on filing cases in the High Court and Supreme Court so that the acquisition of their estates could further be delayed.

A very large proportion of tenancy was based on oral contract between landlords and tenants and remained unrecorded. This emerged as one of the major impediments in abolishing *zamindari*. In the absence of adequate land records, implementing the *zamindari* abolition acts in various states became exceedingly difficult. However, some decline in tenancy was observed after the initiation of land reforms. One estimate revealed that the area under tenancy decreased from about 42 percent in 1950-51 to between 20 and 25 percent by the early 1960s. However, the decline in tenancy did not imply that there was a sharp increase in cultivators; rather at the behest of landlords many tenants were actually evicted from the land (Chandra *et al.*, 2007: 524-526).

However, there was another serious reason behind the eviction of tenants and resorting to self cultivation. This could be attributed to the definition of 'personal cultivation', used to defend the existence of *zamindars*. Taking recourse to the loosely defined clause of 'personal cultivation' relating to the abolition of *zamindari*, the *zamindars* retained large tracts of land under their direct or indirect possession. This was possible because not only the person who was tilling his land, but also the person who was supervising the cultivation of his land, personally or through relatives, or providing capital and credit for the land – all came under the ambit of 'personal cultivation' and in the process, absentee landlords became cultivators (Khusro, 1965:189). Landlords in many parts of India, in their pursuit of bringing themselves into the category of cultivators resorted to large-scale eviction of tenants, mainly the less secure small tenants. Implementation of the law became further complicated because of the nexus between *zamindars* and the lower level revenue officials, who were primarily the former rent collecting agents of the *zamindars*, and created all possible hindrances at the legal, legislative and executive levels in thwarting *Zamindari* Abolition Act.

It has been observed by Bipan Chandra that 'despite the resistance of landlords, the process of *zamindari* abolition was essentially completed, except in certain pockets of Bihar, within a decade of the formation of the Indian Republic. The typically large 'feudal' estates were gone. While the big landlords, who lost the bulk of their lands, were the chief losers, the main

beneficiaries of *zamindari* abolition were the occupancy tenants or the upper tenants, who had direct leases from the *zamindar*, and who now became landowners. Such tenants were generally middle or rich peasants who sometimes had subleases given out to lower tenants with little rights, often called 'tenants at will' (Chandra *et al.*, *op.cit.*: 527-528). Even though the abolition of intermediaries was partly successful, but considerable areas of cultivable waste land and private forests came under the management of the Government. At the same time the extent of tenancy declined and self-cultivation became the dominant mode of production (Bhalla, 2007:27).

2.5.2 Tenancy Reforms

The second important issue of land reforms was tenancy reforms. The major objectives envisaged under tenancy reforms were ensuring security of tenure to the tenants who had cultivated a piece of land continuously for a fixed number of years, though the exact number of years varied from region to region.

Reduction of rent to a fair level was the second objective of tenancy reforms and it was decided that the maximum rates of rent must not exceed one-fourth or one-fifth of the gross produce in all states except in Andhra Pradesh, Haryana and Punjab. In states like Maharashtra and Rajasthan, maximum rents were fixed at one-sixth of the produce. In Assam, Kerala, Orissa and Union Territories, rents were generally one-fourth of the produce or less. However, in many states, rent charged on leased-in lands was one-third of the produce. And in many cases, it has continuously been observed that tenants were forced to pay much higher rent than the stipulated amount fixed through legislation. Weak social and economic position of the tenants, inability and ignorance of the tenants to seek the protection of the law, wide prevalence of oral contract between lessor and lessee made effective implementation of tenancy legislation difficult.

Legislation on security of tenure tried to achieve three principal objectives: first, no forcible eviction of tenants unless backed by law; second, land may only be resumed by any landowner provided came under the ambit of 'personal cultivation', and third, in case of 'resumption' tenants must be ensured a prescribed minimum area. However, having a strict law against forcible eviction in place did not deter the landlords from evicting tenants at their will or curtailing the chances of the tenants to get occupancy rights. The social, economic and political clout of the landlords, use of rotational transfer of occupancy rights among the

family members of the landlords, impact of market forces in determining tenancy contracts virtually made the pious intentions of 'security of tenures' ineffective (Bhalla, *op.cit.* :29).

It has been further pointed out by P.S. Appu, who headed the planning commission task-force on agrarian relations that the provisions introduced to protect the small landowners were misused by the big landlords in connivance with revenue officials (Appu, 1975: 1345). In the Third plan, it is also pointed out that the abuse of such provisions by large landowners was carried out by transferring their lands in the names of a number of relatives and others, so as to enter the category of small landowners, and then evicting tenants from such lands by exercising the right of resumption given to small owners (*ibid.*: 1347). In many states, especially in Uttar Pradesh, Orissa and Madhya Pradesh it has been observed that blanket ban on tenancy rather prompted the tenants and landlords to come to a concealed agreement. West Bengal proved to be an exception where informal tenancies were registered and protected, which would be dealt separately in the latter sections in this chapter.

Evaluative studies on tenancy reforms suggest that in India, between 1953-54 and 2002-03, leased-in operated area declined from 20.6 percent to 6.5 percent. In case of mode of payment of rent, it was observed that payment of rent with fixed money and fixed produce emerged as the most significant and these two together accounted for 49.8 percent of area under lease (Bhalla, *op.cit.* :33).

2.5.3 Imposition of Ceilings on Landholdings

To make land distribution more equitable, a major objective of the land reform measures in India was the imposition of ceilings on the size of landholdings. The Planning Commission of India, in May 1955, appointed a panel to review the progress of the implementation of the land policy. It was recommended by the panel that a family ceiling on landholdings should be introduced, the maximum of which was not to exceed three times the economic holding. It recommended payment of compensation to families from which land had to be taken, amounting to 25 percent of the market value but not exceeding aggregated land revenue for 20 years (GOI, Planning Commission, 1959:103). The recommendations were accepted by the Planning Commission and subsequently state governments were asked to formulate suitable legislations.

West Bengal was the first state to impose a ceiling on agricultural holdings by enacting the West Bengal Land Reforms Act in 1955 and uniform family ceiling of 10 hectares was introduced. The legislation resulted in vesting of 0.35 million hectares of surplus land to the

state (Das, 2000:33). By the end of 1961, all states in India had enacted ceiling laws. Ceiling limits tend to differ from state to state. For example, in Assam the limit was 20 hectares while in Bihar it was between 8 hectares and 24 hectares. The state of Andhra Pradesh set the ceiling limit between 2.5 hectares and 30 hectares, where as for Madhya Pradesh the limit was 10 hectares. For Orissa, the ceiling limit was fixed between 8 hectares and 32 hectares and in Rajasthan, there was wide divergence between lower and upper limit (i.e., 8 ha to 136 ha). Tamil Nadu set the limit between 5 hectares and 25 hectares. The state of Uttar Pradesh set the ceiling limit at 16 hectares to 32 hectares. The rate of compensation in different states also varied widely from 20 to 200 times of the land revenue of the vested land (*ibid.*: 34).

It was observed that the ceiling laws were plagued with glaring deficiencies. First, the land distribution pattern in most of the states was such that more than 70 percent of landholdings in India were under 5 acres and the ceiling fixed on existing holdings by the states were very high and hence acquiring a large-sized land and its distribution became a unrealistic proposition. Secondly, in the Second Five Year Plan, it was recommended that certain categories of land be exempted from ceilings. These were tea, coffee and rubber plantations, orchards, specialised farms engaged in cattle breeding, dairying, ship raising, etc., sugarcane farms operated by sugar factories and efficiently managed farms on which heavy investments had been made (Planning Commission, Second Five Year Plan, New Delhi, 1956: 196-197). As a consequence, large number of exemptions to the ceiling limits was allowed by most of the states on the above pretext. The terminology of 'efficiently managed farms' were grossly misused by the states, and in the process, ceiling legislation became ineffective to a large extent.

In spite of the fact that the ceiling legislations had been passed by most states by 1961, till the end of 1970 not a single acre was declared surplus in large states like Bihar, Mysore, Kerala, Orissa and Rajasthan. In Andhra Pradesh, a mere 1400 acres was declared as surplus but no land was distributed (Chandra et. al. *op.cit.*: 538). Few states indeed performed relatively better in distributing surplus land, e.g., Jammu and Kashmir redistributed 17 percent of its operated area, West Bengal, 6 percent, and for Assam the figure stood at 5 percent.

In the mid-sixties, the economic and political condition of the country had begun to deteriorate on account of multifarious factors like of inflation, devaluation, the Indo Pak war and the emergence of the Naxalite movement in West Bengal and parts of Andhra Pradesh, Orissa and Bihar. 1970 onwards, 'land grab' movements under the aegis of the Communist and Socialist parties also peaked in various parts of the country. In the above context,

Government of India took the initiative to commence the second phase of land reforms in India. Based on the recommendations made by Central Land Reforms Committee, in July 1972, new national guidelines for ceiling on land were introduced. To nullify the malafide intention of the landed class of taking legal recourse to thwart land related legislation, most of the revised ceiling laws were included in the Ninth Schedule of the constitution by the government through 34th Amendment to the Constitution in Parliament in August 1974. Some of the important features of revised Land Ceiling Acts were as follows:

- i) 'The ceiling for double- cropped perennially irrigated land was to be within the range of 10-18 acres, it was 27 acres for single-cropped land and 54 acres for inferior dry lands.
- ii) A ceiling was to be applicable to a family as a unit of five members. Additional land per additional member could be permitted for families which exceeded this number but up to maximum limit of double the ceiling for the five member unit.
- iii) In the distribution of surplus land, priority was to be given to landless agricultural workers, particularly those belonging to the Scheduled Castes and Scheduled Tribes.
- iv) Compensation payable for surplus land was to be fixed well below market price so as to be within the capacity of the new allottees' (*ibid.*).

Inspite of all the efforts taken by the Government of India and the respective state governments, the general picture that emerged at the national level appears gloomy. In fact, over a period of 35 years since the ceiling has been imposed, land redistributed is estimated to constitute less than 2 percent of the operated area (Ray, 1996). It can also be said at the outset that possible inverse relationship between farm size and productivity provided a logical basis and favoured redistribution of land to landless and might have brought improvement in production and productivity. Providing access to land, either through redistribution or through a secure tenancy contract would have been effective in increasing productivity in agricultural practices.

This argument was strongly advocated for the state of West Bengal for its revival in agriculture during late-1980s and 1990s and therefore the land reforms and more precisely the tenancy reforms in West Bengal demand special attention. In addition, wide prevalence of share-croppers, declining land-man ratio, peasant unrest and frequent incidence of sharecroppers' movements in the post-independence period, demand for higher share of the gross produce, more precisely two-third share (meaning *tebhaga*) of produce in case the

sharecropper had supplied inputs (famous as *Tebagha movement* that took place in Bengal during 1948-51), demanded some concerted efforts from the perspective of ensuring at least distributive efficiency in agrarian Bengal. Sharecropper movements were supported by the peasant organisations, especially by the *All India Kishan Sabha*, which had been under complete control of the communists since 1945 (Sen, 1979). The political divisions became sharper after independence, with land lords (*jotedars*) siding with Congress and the sharecroppers (*bargadar*) and the agricultural labourers (*khetmajur*) deriving their solace from the Communists and their allies (Mallick, 1993; Leiten, 1992)

2.6 Tenancy Reforms in West Bengal in post-Independence Period

The *Tebagha* movement had put enough pressure on Government of West Bengal to make it contemplate recognizing the rights of the share croppers and this forced the Government to enact a new legislation called the West Bengal *Bargadars* Act, 1950. The major provisions of this Act were included in the West Bengal Land Reforms Act, 1955 (Chapter-III) and subsequent amendments were also made (Ghosh, 1986:30-31). Land Reforms Act of 1955 and 1966 were introduced primarily to address the issue of land rights for the share croppers. Let us first consider some of the important features of Land Reforms Act of 1955 and its subsequent amendments in 1966, 1970 and 1971.

2.6.1 Land Reforms Act 1955: Definition of Share Cropper

A person who cultivates land owned by another, on condition of paying a share of the produce to the owner of the land is generally considered to be under the system known as *adhi*, *barga* or *bhag* (Raychaudhuri and Chakrabarti:134). These sharecroppers are dictated by the following terms and condition:

1. The produce of any land shall be divided in the proportion of 50:50 between a *bargadar* and the person whose land is cultivated by the *bargadar*, provided, plough, cattle, seeds and manure necessary for cultivation are supplied by the owner of the land. In all other situations the proportion would be 60:40.
2. The *bargadar* is liable to pay the share of the produce to the person who owned the land within the prescribed period and in lieu the land owner shall provide a receipt in the prescribed form to the *bargadar* mentioning the amount of produce received by him (land owner). West Bengal Land Reforms (Bargadars) Rules, 1956, had laid down the prescribed period which was 7 days from the date of threshing of the produce by the *bargadar*.

3. The *bargadar* shall store and thresh the produce at a place agreed upon by both *bargadar* and the owner of the land.

4. *Bargadar* may be evicted from the land on the following grounds (*ibid.* 135):

- (a) The owner of the land brings it under 'personal cultivation'.
- (b) The *bargadar* neglects the cultivation of the land or uses it for non-agricultural purposes
- (c) The *bargadar* fails to tender the share of the produce to the owner of the land.

2.6.2 Land Reforms Act (Amendment), 1966

The primary features of Land Reforms Act (Amendment), 1966 are:

1. If the *bargadar* bears the all costs of production then his share shall be 75 percent of the produce.
2. The landowner can terminate cultivation of land by the *bargadar* for *bonafide* personal cultivation, on condition that :
 - (a) The extent of land so resumed by the land owner along with any other land under his personal cultivation must not exceed 7½ acres and,
 - (b) The *bargadar* should be left with at least 2 acres for his cultivation.
 - (c) It is further mentioned that if a *bargadar* cultivates land in the excess of 7½ acres (amendment of 1972, in place of 25 acres), the share of the produce due to him as a *bargadar* in respect of the land in excess of 7½ acres shall be vested in the state by the Revenue Officer.
 - (d) Eviction of *bargadar* on the ground that the land owner wants to bring the land under 'personal cultivation', there in, certain restrictions were imposed by the amendment of 1972. A land owner could not evict a *bargadar* if the total land owned by him that was brought under personal cultivation exceeded 3 hectares. If by eviction of a *bargadar*, the total land held by the *bargadar* who reduced to below 1 hectare, then the land owner would not be able to carry out the eviction process. In the amendment of 1972, it had further been mentioned that if a land owner who evicted a *bargadar* and brought his land under 'personal cultivation' but failed to start 'personal cultivation' within two years, then the prescribed authority (Junior Land Reforms Officer) would be entitled to sell the land to the evicted *bargadar*. If the said *bargadar* expressed his unwillingness then the land would be sold to any other person who intended to buy that land (*ibid.*).

3. The *bargadar* shall be granted heritable rights for the land he cultivates.
4. A *bargadar* could not be evicted from the land on the grounds of negligence in cultivation.
5. Forcible eviction of *bargadar* was a cognizable offence.

Till 1976, however, tenancy reforms in West Bengal failed to bring in desired results. A few reasons for the above are cited below:

- (a) The recording of the rights of *bargadar* often became difficult as the *bargadar* depended upon land owners for credit and other financial requirements (Chaudhuri, 1976: 1749).
- (b) Forcible eviction and seizure of crops of *bargadar* by owners 144 crPC and 145crPC (*ibid.*: 1749, 1751).
- (c) As pointed out by Kotovsky (1964: 145-46), 'Frequent amendments to the act added to the bewilderment of the peasant and made its effectiveness slow and difficult'.

In fact, till the 1970s, the success of Land Reforms remained unsatisfactory. During mid-1950s and mid-1960s the effort to bring in ceiling-surplus land under the possession of government and its redistribution did not bring much result in West Bengal. According to one author, the decade between mid-1950s and mid-1960s is 'replete with the story of rampant *malafide* transfer of ownership holdings for evading ceiling provisions and of technical eviction of sharecroppers on an unheard-of scale making the tardy and often turbid attempts at land reform, totally infructuous for the interest of the rural people (Bandopadhyay, 1981:202).' It has been revealed in various studies that although the legislations of land reform were in place there was a tendency of underreporting and concealment of the tenancy status during the 60's and 70's (Bandopadhyay, 2003: 879; Ghosh and Dutt, 1977:187-188).

The tenancy reforms in West Bengal received impetus after the Left Front Government led by the Communist Party of India assumed power in 1977. The Land reforms Act of 1955 and its further amendments in 1966, 1970 and 1971 were further amended in 1977 by the left Front Government that conceived a pro-tenant policy and in 1978, tenancy reforms or operation *barga* was aggressively pushed to break the shackle of forces who were earlier acting as major stumbling blocks against recording of names of sharecroppers or *bargadars*. The process of granting quasi-heritable land rights to the share croppers also received the desired fillip.

While pursuing the operation *barga* the newly elected Left-Front government had taken a proactive approach. Land Reform Officials of every district were directed to conduct group meetings in the evening with the share croppers and tentative lists of *bargadars* were prepared. The lists were published the next day for verification. A provisional list was put up in all important places in the village. Objections of the landowners were also taken into consideration and on-field verifications were made. Certificates of share cropping were issued thereafter (Hanstad and Brown, 2001: 36). It was better and qualitatively different from the traditional revenue court approach which was heavily tilted towards the landlords and caused under reporting of the sharecroppers (Bandyopadhyaya & Krishnaji, 1983:16). Active and group participation of sharecroppers and proactive role played by the *Panchayat* expedited the process of *barga* recording in West Bengal. This was supported by the fact that by 1993, the number of recorded *bargadars* reached at 2.3 million or 65 percent as cumulative percentage of the total (Banerjee, Gertler and Ghatak, 2002:242).

At the same time, introduction of local self-government, i.e., three-tier elected bodies known as '*panchayat*' allowed governance to reach the grassroot level. Delegation of financial and planning responsibilities to elected local bodies created congenial environment for implementing centrally funded schemes, especially in irrigation and infrastructure. It also helped to settle the water and wage related disputes at village level. Election to three-tier *panchayats* also took place in 1978. The administrative structure of three-tier *panchayat* introduced at the apex the *Zilla Parishad* which worked at the district level, *Panchayat Samiti* which worked at the block level (consisting of large number of villages) and finally at the grass root level of *anchal* (consisting of 12 to 15 villages) it is the *Gram Panchayat* that takes care of grass root level governance.

Various studies on West Bengal reaffirm the fact that operation *barga* and the introduction of the three-tier *panchayat* played a major role in the spectacular turn around in foodgrain production and productivity in West Bengal and it also caused an economic upswing in the rural economy of Bengal (Banerjee. *et al.*.,: 267-270, Bardhan and Mookherjee, 2006:2, Bandyopadhyay, *op.cit.*, Hanstad and Brown, 2001).

2.7 Conclusion

The perspective of agricultural economic history suggests that the Permanent Settlement Regulations of 1793 had left the cultivating *raiya*s entirely at the mercy of landlords. There were sub-infeudation, eviction, and re-settlement with the *raiya*s on payment of fresh

premium or rent at enhanced rate. The need for new legislations to improve on the situation was widely felt. This led to the passing of the Rent Act of 1859. The Act sought to provide certain safeguards to some classes of cultivating tenants with regard to tenancy relations; however, the beneficial effect was usurped by the landlords. The inherent defects of the Rent Act gradually surfaced and it was replaced by The Bengal Tenancy Act of 1885. This Act was followed by a host of other Acts legislated in the subsequent period. All these Acts provided, *inter alia*, certain concessions like conferment of occupancy rights and protection against eviction in favour of certain classes of tenants. However, the Act resulted in broadening the ambit of the tenancy stratum. Despite all these measures, the Indian rural society continued to remain afflicted with low capacity of agricultural production and productivity. Precisely, agriculture-related reform measures in India vis-à-vis Bengal during the British rule were prompted not by any serious consideration for improving production and productivity.

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Chapter-III

Trends in Agricultural Production and Productivity: An Inter-State Comparison

3.1 The Indian Experience

Agricultural sector was the most dominant sector during the time of India's independence, both in terms of its contribution to gross domestic product and in providing employment to the country's labour force. In the international perspective, Indian agriculture has left a strong imprint. India is presently holding second position in the world after China in production of wheat, rice, ground nut, fruits and vegetables, sugarcane and cotton. In terms of production of pulses and jute and fibre, India holds the first position. However, in terms of inter-country comparison of productivity, India is lagging much behind. Among fourteen major rice producing countries, in 2007, India achieved 13th position in terms of productivity (3370 kg/ha). The highest productivity in rice production was achieved by Egypt having productivity of 9731 kg/ha, U.S.A holds the second position with productivity of 7672 kg/ha. The productivity of wheat production of nineteen major wheat producing countries when compared, India is positioned at 11th position. The highest productivity in wheat production was achieved by U.K. (8281kg/ha) followed by France (7101 kg/ha), Egypt (7101kg/ha), China (4762 kg/ha) respectively (FAO, 2007).

Indian economy over the years experienced a structural change with the decline in the share of agriculture in Gross Domestic product (GDP) and gradual increase in the share of industries and services. Although, share of agriculture has come down to 17 percent in 2008-09 from 55.1 percent in 1950-51, the dependence of the rural workforce on agriculture has not diminished in proportion to share of agriculture to the GDP. In spite of being tagged as one of the fastest growing economy of the world, 72 percent of population and 76 percent of the workforce were rural (Reddy & Mishra, 2008). Unlike developed countries, India failed to transfer her labour force from agriculture to non-agricultural sector, more precisely to manufacturing sector. India also failed to increase agricultural productivity and income (Gollin *et al.*, 2002). India's manufacturing sector experienced volatility in its growth rate and share of manufacturing has never exceeded 15 percent of GDP. As a result, income differential between agricultural sector and non-agricultural sector has been widening (Chand and Chauhan, 1999).

The agricultural performance and the fortune of agrarian community in India largely depend on the vagaries of monsoon. In spite of the efforts of building irrigation network initiated by the British during the 1920s, cultivation of 80 percent of the net sown area continued to depend on rainfall even after independence. As a consequence production and productivity continued to remain low. Such experience speaks for the absence of any sound agricultural policy in colonial India.

3.2 Agricultural Policies in post-Independence Era (1947 to 1960)

Agricultural policies assume paramount importance in post-independence India. If achieving self sufficiency in food production is considered as one of the basic minimum objective of a sovereign country then economic well being of two-third population of the country is equally important because they are deriving their livelihoods directly or indirectly from agriculture. India, immediately after independence, was mostly preoccupied to bring in institutional changes in the agrarian sector and the growth in production and productivity did not receive adequate attention till the 1960s. Raising public investment in irrigation also received attention because it was identified as prime carter of farm growth at least in the First Five Year Plan and 20 percent of the plan outlay was earmarked for irrigation. The allocation on irrigation, however, continued to decline since Second Five Year plan and onwards. The slow growth of irrigation contributed to the slow growth in productivity in Indian agriculture. Therefore, between 1949-50 and 1964-65, the rise in production was mostly driven by rise in area under cultivation (Narain, 1977; Vaidyanathan, 1986).

3.2.1 Agricultural Policies from late-1960s to 1980s

In the mid-sixties, the scope of increase in agricultural production through area expansion became almost saturated and agricultural production also got stagnated. Food availability for the rapidly increasing population of India remained insufficient. Situation further worsened as the food import from the United States under PL-480 scheme was about to be discontinued with the fear of impending food crisis, a number of programmes for 'intensive agricultural development' was introduced. These programmes encouraged to adopt a package of high yielding inputs, combining improved technology, credit, high yielding seeds and assured irrigation (Dantwala, 1986). After 1966-67 serious efforts were made to accentuate the 'Intensive agricultural development' across the country and this came to be known as the Green Revolution. To make this techno-biological programme a success, four types of support, viz. price support, credit support, input subsidy support and marketing support were

extended. In 1965, Agricultural Prices Commission was established and they took responsibilities to suggest two sets of administered prices: minimum support price and procurement price. Food Corporation of India was also established in 1965 to manage the procurement of foodgrains and for maintaining buffer stock. It was to be the agency that would remain responsible for ensuring food availability for the poor at affordable prices and also maintain inter-temporal price stability. The nationalisation of commercial banks in 1969 also increased the availability of credit for the agricultural sector. It also mopped up the rural liquidity and put a check on the usurious moneylenders in rural areas (Ramchandran and Swaminathan, 2001; Chavan, 2005). It was also decided during 1970s that key inputs like fertilisers, pesticides and electricity for irrigation would be available for the farmers at subsidised rates. To regulate the marketing of farm produce through suitable mechanism for minimising distortions in exchange, the Agricultural Produce and Marketing Committee (APMC) Act and Essential Commodities Act were passed. Under the APMC Act a number of regulated markets were set up across the country (Acharya and Agarwal, 1987).

3.2.2 Agricultural Policies in the 1980s and during the period of Economic Liberalisation (1991 to the recent)

The period of 1980s has been identified as the period of 'wider technology dissemination' (Chand, 2004). The agricultural GDP also attended an annual growth rate in 3.4 percent in 1980s (Bhalla, 2004). In 1986, The Technology Mission on oilseeds was launched which was aimed to reduce dependence on imports and to achieve self-reliance in oilseeds production. The agricultural policies followed during late-eighties and the early-nineties have seriously been criticised on the ground that the earlier policy deliberately kept the terms of trade against agriculture through protectionist industrial and trade policies and overvalued exchange rate (Parikh, 1997; World bank, 1986, 1991; Pursell and Gulati, 1993). India resorted to a policy of comprehensive economic reforms in June 1991. The reforms brought significant changes in macro economic policy including trade and exchange policy, especially in the external sector. While introducing economic reforms and liberalisation in 1991, agricultural sector did not receive any explicit mention; however, devaluation of rupee, moving away from fixed exchange rate policy to flexible exchange rate policy, trade liberalisation, and Indian membership of the WTO etc. had considerable impact and raised serious debate on the impact of reforms on agricultural the sector.

Pro-liberalisation economists are of the opinion that once the prices would be corrected through the free play of market, farmers would be able to realise better price for their

agricultural produce and they would be encouraged to produce more. It was pointed out by Gulati and Sharma (1997), agricultural income would have increased by 16 to 25 percent had domestic prices aligned with international prices. Liberalisation of agricultural trade has been accepted on the argument that free trade and opening up of economy would maximise efficiency and gains. It was advocated that India has comparative advantages in producing high valued export oriented crops like fruits, vegetables and flower and therefore farmers should be encouraged to diversify their crops in favour of high valued crops. Pro-reformists also concluded that input subsidies and output support prices had suppressing effects on domestic prices and in turn kept the terms of trade against agriculture. As one author pointed out that agricultural subsidies were, 'fiscally unsustainable...inefficient and costly to farmers' (Parikh, *ibid.*: 11). It was also pointed out by Gulati and Sharma (1995) that cut down in agricultural subsidy would arrest the long term declining trend in public investment in agriculture. It was further suggested that government should withdraw from procurement of food as 'government can not manage commodity trade in an efficient way'. Government should cut down the buffer stock and instead private trade should be encouraged. Import and export should be promoted in a manner so that the requirement of tightness or slackness in the domestic market could be regulated (Parikh, *op.cit.* : 12). In fact trade reforms intensified since 1995 immediately after the introduction of the WTO agreement on agriculture. Targeted agricultural subsidies were suggested in lieu of universal subsidies in agriculture (Jha and Srinivasan, 2004). The agricultural sectors experienced consequent policy changes e.g., agricultural credit was deregulated, contract farming was conceived to expedite crop diversification in agriculture. Therefore, it was urgently felt that land ceiling should be raised so that rich farmers, agri-business firms, corporate bodies can lease-in lands.

The decade of 1990s also experienced declining trend in public investment in agriculture. However, terms of trade became highly favourable for agricultural sector and this happened because of substantial rise in cereal prices through government support, trade liberalisation, and exchange rate devaluation and through removal of protection to industry. Contemporary researches argue that economic reforms primarily emphasised on price factors and infrastructure, however, institutional aspect of agriculture has grossly been neglected and as a consequence, deceleration in agricultural growth as well as decline in growth of output were accentuated since 1991 (Chadha,2002; Majumdar,2002; Bhalla,2002; Kumar, 2002). The public sector gross capital formation in agriculture declined to one-third in 1999-2000, in comparison to the level attained in 1980-1981 (Reddy 2006b). Other studies also revealed

that fall in public sector investments in agriculture had adversely affected the agricultural productivity and growth (Chand, 2001; Gulati and Bathla, 2001; Shangen *et al.* 1999). According to the observations of Planning Commission, Government of India (GoI, 2001) during the 10th Five Year Plan, agricultural GDP grew at an annual rate of mere 2.1 percent against the targeted growth rate of 4 percent and this was possibly as a consequence of stagnation and decline in agricultural productivity over the past decade. Agriculture Strategy for Eleventh Plan (GoI, 2007) has focused that a particular area of concern is foodgrains, whose production during 10th Five Year Plan was less than that of 9th Five year Plan. Per capita annual production of cereals had declined from 192 kg in 1991-1995 to only 174 kg in 2004-2007 and of pulses from 15 kg to 12 kg in India. As a cumulative effect, in the recent past food security has emerged as a matter of concern in the national as well as in international level.

After 1995, India had to remove quantity restrictions on agricultural imports as per WTO agreements and in 1997 as international prices started falling, it put downward pressure on domestic prices of most of the agricultural commodities. Since, mid-2000s, various development programmes like Interest Subvention on Crop Loans, the National food Security Mission, the National Agricultural Development Programme (*Rashtriya Krishi Vikas Yojana*) and the Pulses Development Programme were initiated to revive agricultural growth. A synoptic view on different policy interventions during different phases in post-independence India, may help reveal growth in agricultural production, productivity of major crops, changing in cropping pattern over the periods.

3.3 Growth Performance of Production, Productivity of Major Crops in India in post-Independence Period

To begin with, the exponential (log-linear) form is generally chosen to measure the growth. The rationale behind choosing log-linear form instead of linear form that in case log-linear form, is the change of in output at a given time is more likely to be a constant percentage of the output in the preceding year, where as in case of simple linear form, the change in output in a particular year is constantly diminishing percentage of the preceding year. The Linear growth curve can be expressed in the following form:

$$Y_t = a + bt$$

This curve implies if $b > 0$, there is growth (G_t).

Since growth $G(t) = (1/Y_t) * (dY_t / Y_t)$ or $Y_{t+1} - Y_t / Y_t$

The growth rate at period t is given by

$$G(t) = b / Y_t$$

Therefore, if $b > 0$, the simple linear growth curve will characterise falling growth rates as stated by Boyce earlier and as a result exponential form (log-linear) of growth curve received more acceptance.

In addition, larger errors in statistical sense of deviations of actual values from fitted trend values are associated with larger output and hence that a multiplicative error term (for log-linear) is more appropriate than an additive one (linear growth curve) (Boyce 1987:258). Exponential form of growth curve can be projected as

$$Y_t = ae^{bt}v_t$$

This can be transformed linearly as follows

$$\ln Y_t = a + bt + u_t$$

Where Y_t = Output

a = Constant term

t = time (in years)

$u_t = \ln v_t$

= error term such that $\ln v_t \sim IND(0, \sigma^2)$

By deducting one (1) from the antilog of the estimates of the coefficient of b and multiplying it by 100 the growth rate may be calculated.

$$\text{Growth rate} = (\text{antilog of estimated } b - 1) * 100$$

Or, growth $G(t) = (1/Y_t) * (dY_t / Y_t) = b$ which implies that if $b > 0$ growth rates are constant over time. The accepted fact is that the trend estimation is 'a convenient way of summarising a long term series' (Vaidyanathan, 1980:3-4) and 'analysis of the output-time relation serves a useful purpose' (Boyce, *op. cit.*).

The exponential form of growth curve assumes a constant growth rate; therefore it is difficult to ascertain any acceleration, deceleration in the growth rates over time. To overcome this problem log-quadratic form is proved to be convenient. It can be written in the following form:

$$\ln Y_t = a + bt + ct^2 + u_t$$

If estimated value of c assumes significantly (t-ratio is used as test statistics) positive value, it will be having accelerating growth rate and in case of significantly negative value of c that

will indicate deceleration (Boyce, *op.cit.*:262, Reddy, 1978: 807, Srinivasan, 1979: 1283, Saha and Swaminathan, 1994: A2-A3)

Now taking the functional form of log-quadratic equation ($\ln Y_t = a + bt + ct^2$)

$$\begin{aligned} \text{the growth rate } G(t) &= (1/Y_t) * (dY_t / Y_t) \text{ or } Y_{t+1} - Y_t / Y_t \\ &= b + 2ct \end{aligned}$$

To measure the acceleration or deceleration, change in growth rate is to be considered and it will be as follows (Reddy, *op. cit.*: 708):

$$dG(t) / dt = 2c$$

If $b > 0$ and $c > 0$, this implies that growth rate is increasing over time.

If $b < 0$ and $c > 0$, this implies that $G(t)$ may be negative but growth curve is accelerating provided $t > -b/2c$

Now, if $b > 0$, $c < 0$, the conclusion is that $dG(t)/dt$ is negative that is growth rates are falling.

Finally, $b < 0$ and $c < 0$, this implies retardation or deceleration of growth rates.

The incorporation time squared on the right hand side of (3), may give rise to problem of multicollinearity. This is avoided by the normalization of time in mean deviation form, that is, by setting $t = 0$ at the mid point of the series and this allows the time (t) and its square (t^2) to become orthogonal (Boyce, *op. cit.*: 262, 278). As it is further pointed out by Boyce that the normalization of time affects only the estimate of b (coefficient of t), the estimate of c (coefficient of t^2) remains unaffected with respect to the normalization (*ibid.* 278).

By using the above mentioned statistical tools, it has been observed that from 1970-71 to 2008-09 (Table 3.1), foodgrain production and productivity grew at exponential rates of 2.24 percent and 2.3 percent per annum and growth rates are found to be statistically significant at 1% level.

To analyse the growth performances in different sub-periods, the whole period (from 1949-50 to 2007-08) has been sub-divided into five sub-periods, viz. 1949-50 to 1964-65, 1967-68 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-01 to 2007-08. The sub-period of 1949-50 to 1964-65 was considered as pre-Green Revolution period, the period 1967-68 to 1979-80 has defined as period of early-Green Revolution and that of 1980-81 to 1989-90 as late-Green Revolution period. On similar line, the era of economic reforms has been subdivided into two parts, the period between 1990-91 and 1999-2000 was considered as early phase of economic reforms while the period from 2000-2001 has been identified as second stage of economic reforms. These sub divisions have been precisely done to explore

the correlation between agricultural policies conceived and implemented in different time periods and their concomitant impact on agricultural production, productivity at national level.

While identifying long term acceleration and deceleration of growth in production and productivity, coefficient of t^2 for both growth in production and productivity if assumes significantly (T-statistics ascertain the significance at 1 % level) negative value suggests long run deceleration. Exponential growth in area from 1970-71 to 2008-09 assumed negative value (significant at 1% level) and the estimation of log-quadratic form further reveals that coefficient of t^2 has turned out to be negative and implied deceleration of growth in area under foodgrain production. Therefore, it can also be said that growth in production was primarily driven by growth in productivity. In case of rice, the growth estimation shows similar trend as observed for foodgrains. Growth in production and productivity are found to be positive and significant between 1970-71 and 2008-09 but long term significant deceleration was observed. Though the growth area was positive but deceleration has become significant.

For wheat, high and significant (at 1% level) growth in production was achieved and it was achieved through positive and significant growth in both productivity and area. Deceleration was observed for growth in production and productivity of wheat, however, growth in area under wheat is showing acceleration but not statistically significant. The growth scenario of pulses at all-India level is not that satisfactory. In spite of achieving positive growth rates for both production and productivity, the growth rates remained below 1 percent and exponential growth in area turned out to be negative. In addition, long term deceleration was observed for the growth in production, productivity and area under pulses.

Table 3.1: Exponential Growth in Production, Area and Productivity of Foodgrain, Rice, Wheat and Pulses (1970-71 to 2008-09) and Acceleration or Deceleration

	Exponential Growth in Production	Acceleration/ Deceleration	Exponential Growth in Productivity	Acceleration/ Deceleration	Exponential Growth In Area	Acceleration/ Deceleration
Foodgrain	2.24 (20.4)*	-0.00031 (-3.1)*	2.3 (26.4)*	-0.00023 (-2.7)*	-0.09 (-2.49)*	-0.000832 (-2.27)*
Rice	2.5 (18.3)*	-0.00033 (-2.5)*	2.03 (19.33)*	-0.00022 (-2.1)*	0.44 (10.64)*	-0.00011 (-2.9)*
Wheat	3.46 (21.77)*	-0.000739 (-7.17)*	2.4 (20.8)*	-0.000504 (0.02)	1.02 (15.14)*	0.024236 (0.02)
Pulses	0.73 (4.97)*	-0.000105 (-7.17)*	0.80 (7.09)*	-0.0005 (-6.10)*	-0.06 (-0.92)	-0.00024 (-4.1)*

*T stats are shown in parentheses. * implies significance at 1% level*

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

3.3.1 Growth in Area, Production and Productivity from 1949-50 to 1964-65 (pre-Green Revolution Period)

It was observed that between 1949-50 and 1964-65, the rise in production was mostly driven by rise in area under cultivation (Narain, 1977; Vaidyanathan, 1986). The above observations of Narain and Vaidyanathan get reaffirmed from Table 3.2. It was observed that between 1949-50 and 1964-65 compound annual growth rates (CAGR) in area under foodgrains and non-foodgrains were 1.40 percent and 2.50 percent respectively and for the same period growth rates for yield were calculated to be 1.40 percent and 0.90 percent respectively. CAGR for area and productivity for all crops were 1.60 and 1.30 respectively. Crop-wise disaggregation further revealed that growth in area remained higher than the growth in productivity for wheat, maize, pulses, oilseeds and fruits and vegetables. The general conclusion thus followed that during 1950s to 1960s, growth in production was primarily driven by expansion of area.

Table 3.2: CAGR of Area, Production, Productivity of Major Crops in India between 1949-50 and 1964-65

Crops	Area	Production	Productivity
Foodgrains	1.40	2.90	1.40
Cereals	1.20	3.40	1.90
Rice	1.30	3.50	2.10
Wheat	2.70	4.00	1.30
Jowar	1.00	2.50	1.50
Bajra	1.10	2.30	1.20
Maize	2.70	3.90	1.20
Pulses	1.90	1.40	-0.20
Oilseeds	2.60	3.40	0.60
Fruits and Vegetables	5.90	7.90	1.80
Non- Foodgrains	2.50	3.50	0.90
All Crops	1.60	3.10	1.30

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

3.3.2 Growth in Production, Area and productivity from 1967-68 to 1979-80 (early-Green Revolution Period)

The period between 1967-68 and 1979-80 is generally identified as early Green Revolution period. The rate of growth of agricultural production in early Green Revolution period was, however, not impressive and was lower in comparison to the early planning years. Crop-wise comparison of growth rate in area, production and productivity between pre-Green Revolution period (1949-50 to 1964-65) and early-Green Revolution period (1967-68 to 1979-80) would strengthen this argument. Growth in area, production and productivity for rice, pulses, oilseeds and foodgrain were found to be higher in pre-Green Revolution period in comparison to early-Green Revolution period. Only noticeable change was found for

wheat. When compared with pre-Green Revolution period the compound annual growth rates in area, production and productivity showed a substantial increase over early-Green Revolution period (Tables 3.2 & 3.3). In the initial years of Green Revolution, the success was primarily confined to Punjab, Haryana and Western Uttar Pradesh. Impressive growth of agricultural production in those regions failed to push up the national agricultural growth because of stagnation in other crops and regions. It was also observed that Punjab, Haryana and Western Uttar Pradesh were well endowed with irrigation in comparison to other regions of the country and sections of peasantry were in a position to mobilise the investment necessary for adopting 'Green Revolution' technology. Inadequacy in implementation of land reform measures also hindered the spread of Green Revolution technology because diffusion of technology and structure of property rights are closely linked. As pointed out by Mohan Rao (1994:13), 'failure of planners...to see agriculture as a strategic, system transforming sector that would have required a focus away from the supply side to the centrality of property relations and mass demand as a propellant for the whole economy.' In addition, the success was limited to two crops i.e., rice and wheat. In spite of slow national growth in agriculture, initial years of Green Revolution were successful in bailing out the country from severe food insecurity in the 1960s. According to M.S. Swaminathan, Green Revolution established the linkage between national sovereignty and food self-sufficiency'.

Table 3.3: Compound Annual Growth Rates in Area, Production and Productivity of Major Crops in India (in percent)

Crops/Year	Area				Production				Yield			
	1967-68 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-2000	2000-01 to 2007-08	1967-68 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-2000	2000-01 to 2007-08	1967-68 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-2000	2000-01 to 2007-08
Rice	0.74	0.41	0.68	-0.11	1.84	3.62	2.02	1.9	1.09	3.19	1.34	2.01
Wheat	2.87	0.46	1.72	1.25	5.03	3.57	3.57	1.38	2.10	3.10	1.82	0.13
Coarse Cereals	-0.98	-1.34	-1.83	-0.47	1.11	0.04	-0.48	3.52	2.11	1.39	1.37	4.01
Pulses	0.71	-0.1	-0.6	1.93	-0.26	1.49	0.67	3.31	-0.97	1.59	1.28	1.35
Total Cereals	0.39	-0.26	0.12	0.14	2.16	2.26	1.72	2.20	1.77	2.52	1.59	2.05
Foodgrains	0.43	-0.23	-0.08	0.48	2.19	2.73	2.26	2.01	1.75	2.97	2.34	1.53
Groundnut	0.01	1.65	-2.31	-0.4	1.64	3.76	-1.25	3.0	1.64	2.08	1.08	3.41
Rapeseeds & Mustard	1.05	1.94	0.62	6.15	0.64	7.29	0.73	8.22	-0.40	5.24	0.11	1.95
Oilseeds	0.76	2.44	0.15	3.43	1.88	5.46	2.27	7.44	1.11	2.95	2.12	3.88
Fibre crops	-0.34	-1.50	2.44	1.08	3.44	1.52	2.03	9.68	3.79	3.07	-0.40	8.51
Cotton	0.38	3.50	2.34	0.42	-0.41	5.19	2.69	3.21	-0.79	6.01	0.34	2.79
Sugarcane	1.41	1.26	1.67	1.91	1.99	2.71	3.05	2.39	0.57	1.43	1.36	0.47
Potatoes	4.08	2.93	3.84	3.46	8.07	5.17	5.44	1.65	3.83	2.18	1.54	-1.74

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

3.3.3 Growth in Production, Area and Productivity from 1980-81 to 1989-90 (late-Green Revolution Period)

Indian agriculture experienced a turn around after 1980-81; the poor growth rate in early-Green Revolution period was reversed and this phase was termed as late-Green Revolution period. Table 3.3 clearly reveals that highest CAGR figures of production and productivity were reached from 1980-81 to 1989-90 for rice, wheat, pulses, foodgrains, Rapeseeds and mustards, oilseeds, potato, sugarcane. For all these crops deceleration of growth in area were observed and therefore, the growth in production was primarily driven by the growth in productivity. It can safely be concluded that the period of the 1980s was characterised by the spread of Green Revolution to larger areas and more crops (Bhalla and Singh, 2001). Even these figures when compared with the decade (1990-91 to 2008-09), registered to be the highest. The upsurge in agricultural growth rates was driven by two factors: first, there was a major rise in agricultural production, especially rice in the eastern region or more precisely in West Bengal and second, there was major improvement in the production of oilseeds in the central Indian region. The Technology Mission on Oilseeds launched in mid-1980s had put emphasis on raising productivity of oilseeds and reducing yield gaps between experimental stations and farmers' fields by adopting improved package of practices. Increase in cropping intensity and crop diversification also contributed positively towards the increase in agricultural output and enhanced agricultural growth in the country.

3.3.4 Growth in Production, Area and Productivity from 1990-91 to 2007-08

The growth rate so achieved during the eighties could not be sustained during the nineties or precisely between 1990-91 and 1999-2000. Growth in most of the crops decelerated. Crop by crop account would show that there was marginal rise in the growth in area under rice but fall in productivity had pulled down the growth in production of rice. Wheat and pulses had experienced the similar growth scenario like rice. The cumulative impact was that country experienced fall in the growth rate in area, production and productivity of foodgrains. Drastic fall in growth in productivity and yield was observed for Rapeseeds and mustards and also for oilseeds. Sugar and potato were the only exceptions. In fact for both sugar and potato, growth in area has offset the fall in growth of yield and pulled up the growth in production for these two crops at national level (Table 3.3).

There were some improvements in the growth in production and yield of some crops from 2000-01 to 2007-08 in comparison to the initial periods of economic reforms (1990-91 to 1999-2000). For rice, inspite of the growth in area under rice, fall in the growth in

productivity has pulled down the growth in production. For wheat, however, the rise in yield level has negated the impact of fall in cultivated area while pulling the growth in production. There was a substantial rise in yield level for coarse cereals and growth in area was also marginally improved, as a result, there was significant growth in production. From 2000-01 to 2007-08, there was striking growth in area under pulses and productivity had also increased and consequently impressive growth in production of pulses was noticed. But yield growth of foodgrain had decelerated and as a result, growth in production had also experienced a deceleration. For Rapeseeds and mustards as well as for oilseeds, growth in area along with growth in productivity had pushed up the growth in production. Again, for fibre crops and cotton, impressive growth in productivity had contributed to the rise in the growth in production. Potato experienced simultaneous fall in growth in area, productivity and production. For sugarcane, fall in yield level had pushed down the production growth in spite of marginal rise in growth in area.

Agrarian investment scenario precipitated further with the decline in the growth of private investment in agriculture. Gross capital formation increased by 2 percentage point between 1980-81 and 2006-07. Public sector investment has consistently declined during that period (Table 3.4). NSS 59th Round (2003), revealed that almost 50 percent of the farming households are indebted. The rise in prices of various agricultural inputs has raised the cost of cultivation across the country. As a matter of fact, the fertiliser price index increased from 99 in 1990-91 to 228 in 1998-99 at a compound annual rate of growth of 11 percent (Acharya, 2004).

Table 3.4: Gross Capital Formation (GCF) in Agriculture as a share of GDP from Agriculture, India from 1980-81 to 2006-07 (in percent)

Period/Year	GCF in Agriculture as a Share of Agricultural GDP		
	Public Sector	Private Sector	Total GCF
1980-81 to 1984-85	5.0	5.5	10.5
1985-86 to 1989-90	3.5	5.2	8.7
1990-91 to 1994-95	2.4	5.9	8.4
1995-96 to 1999-2000	2.0	5.9	5.9
2000-01	1.8	7.8	9.6
2001-02	2.0	9.1	11.1
2002-03	2.0	9.8	11.8
2003-04	2.1	8.0	10.2
2004-05	2.8	8.3	11.1
2005-06	3.2	8.5	11.7
2006-07	3.7	8.9	12.5

Source: *GoI, 2008*

3.4 Crop Diversification at all-India Level

After evaluating the cropwise growth pattern, the changes in the cropping pattern needs to be examined. The given circumstances for Indian agriculture were that first, she has to feed ever rising population, second, rapid urbanisation is usurping agricultural land and third, famers need incentives to stay with agriculture and for that reason either agriculture has to be remunerative or viable alternatives ought to be available with the farmers outside agriculture. A close look at the changes in cropping pattern (Table 3.5) from 1970-71 to 2007-08 reveals that area under foodgrains in gross cropped area (GCA) has declined from 75.54 percent to 63.52 percent. This decline however, primarily caused by the decline in the area under cultivation of coarse cereals and as a matter of fact, between 1970-71 and 2007-08, the area under coarse cereals as percentage of GCA has declined by 13.34 percent. During the same period, a marginal fall was observed for rice and for wheat area under cultivation as percentage of GCA has increased by almost 4 percentage points. A marginal fall was also observed for cereals. It has also been observed that during the period of study, area under non-foodgrains has increased. Cultivation of oilseeds, fruits, vegetables and non-food crops increased by 4 percent, 2.86 percent and 7.02 percent respectively between 1970-71 and 2007-08. Therefore, a strong possibility is there that farmers have shifted from coarse cereals to high value crops and this may contribute to the rise in farm income. As pointed out by Srinivasan (2005), favourable market conditions for refined oil and protein-rich soya food might have contributed to the rise in area allocation under oilseeds. However, commercial crops like cotton and sugarcane did not show much improvement in area allocation.

Table 3.5: Share of Area under Major Crops of India (percentage of GCA)

Crops	TE 1970-71	TE 1980-81	TE 1990-91	TE 2000-01	TE 2007-08
Rice	23.02	23.18	23.00	23.82	22.57
Wheat	10.42	12.98	13.04	14.28	14.18
Coarse Cereals	28.42	24.25	20.48	16.17	15.14
Total Cereals	61.93	60.41	56.53	54.27	51.88
Total Pulses	13.50	13.23	12.94	11.49	11.93
Total Foodgrains	75.54	73.67	69.47	65.32	63.52
Total Oilseeds	9.85	10.11	12.51	12.96	13.93
Groundnut	4.42	4.14	4.64	3.68	3.20
Cotton	4.70	4.27	4.08	4.70	4.68
Jute	0.42	0.51	0.39	0.45	0.41
Total Fibres	5.41	5.08	4.64	5.27	5.18
Sugarcane	1.62	1.62	1.90	2.23	2.47
Tobacco	0.27	0.25	0.22	0.21	0.19
Condiments and Spices	1.04	1.23	1.32	1.52	1.55
Potato	0.31	0.43	0.51	0.69	0.76
Onion	-	0.14	0.17	0.24	0.36
Total Fruits and vegetables	2.24	2.77	3.57	4.35	5.10
Fodder Crops	4.15	4.50	4.59	4.55	4.26

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

At macro level, India has achieved self-sufficiency in food production but at the same time confronting high percentage of malnourished children and high incidence of rural poverty. High proportion of rural folk (more than 70 percent) as a percentage of total population are confronting declining share of national income/product. No significant improvement has been observed in the rural non-farm sector employment (Reddy & Mishra, op.cit.). Since early 1990s, more precisely after the adoption of neo-liberal path of globalization, rural India has become a cause of concern with the continuing rise in rural-urban disparities (Bhalla, 2005). Since the introduction of economic reforms, there has been a substantial increase in landlessness among the rural population in India (Reddy 2006a). This indicates that the casualisation of the rural workforce and engagement in low-paid works is on the rise during the reforms period (Rao and Hanumappa, 1999). The gap between the rate of growth of foodgrain production and population growth are also narrowing down. From 2000-01 to 2007-08, the population has grown at the rate of 1.64 percent and foodgrain production has been growing at the rate of 2.1 percent, and this is indication that hard achieved self sufficiency in food is also now under threat.

3.5 Inter-State Comparison of Growth of Major Crops in India over Different Sub-Periods

India is a vast country with high degree of variation in climate and resource endowment. Before getting into detailed discussion on inter-state comparison of growth of major crops, it becomes imperative to provide classification of production by agro-ecosystem in India. Agro-climatic condition is the key determinant for the crops to be grown in a particular region. India has been divided into five agro-climatic regions: arid, coastal, irrigated, rainfed and hill and mountain. Heterogeneity in agro-climatic condition may occur within a state or within a country and therefore, it also brings variations in the nature and type of crops produced within a state or country. The following table (Table 3.6) will provide us with systematic information on various crops grown in various states falling under above mentioned agro-climatic zones.

However, for crop-wise and statewide analysis of growth, geographical categorisation of states will be used. For this, India has been divided into four regions: North-Western India that includes Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab and Uttar Pradesh; Eastern India comprises Assam, Bihar, Orissa and West Bengal; Central India consisting of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan and the Southern Region includes states of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. Regional variation in cropping

pattern and growth of crop output is considerably impacted by variation in climate and moisture adequacy including irrigation. In addition, it can safely be presumed that rising population and rapid urbanisation and industrialisation is putting huge stress on land and water resources. Against this backdrop, we would analyse the inter-state changes in the cropping pattern and growth of some important crops in India.

Table 3.6: Classification of Production by Agro-ecosystem in India

Agro-Ecosystem	Crop Production System	States
Arid	Millets and oilseeds Millet	Gujarat and Rajasthan Rajasthan
Coastal	Rice and groundnuts Coconut and rice	Andhra Pradesh, Tamil Nadu and Orissa Karnataka, Kerala, Goa, Maharashtra and Tamil Nadu
Irrigated	Rice and Wheat Cotton and wheat Sugarcane and Wheat	Bihar, Haryana, Punjab, Uttar Pradesh and West Bengal Haryana, Punjab and Rajasthan Haryana and Uttar Pradesh
Rainfed	Rice Coarse Cereals Oilseeds Cotton	Assam, Bihar, Madhya Pradesh, Maharashtra, Orissa and West Bengal Karnataka and Maharashtra Andhra Pradesh, Gujarat, Madhya Pradesh, Rajasthan, Tamil Nadu and Uttar Pradesh Gujarat and Maharashtra
Hill and Mountain	Rice, maize and fruits Rice, wheat and fruits Horticulture	North-Eastern states, Assam and West Bengal Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir Himachal Pradesh and Jammu and Kashmir

Source: *National Centre for Agricultural Economics and Policy Research, New Delhi, 2001*

3.5.1 Production of Major Crops in India: An Inter-State Comparison

Let us now consider region-wise and statewide contribution to Indian food basket. To understand the changes in contribution over the periods, four sub-periods have been considered and they are respectively 1970-71, 1980-81, 1990-91 and 2007-08. In addition, among various crops grown in different parts of the country, only foodgrains, rice and wheat have been considered because for majority of the states, foodgrains occupy more than half of the area under cultivation.

As the Table 3.7 reveals, North-west India continues to be the highest contributor in India's foodgrain production. The contribution of this region to the total foodgrain production continues to increase since 1970-71 (29.2 percent) and reached its peak in 2000-01 (41.3 percent). The state of Uttar Pradesh acts as prime mover in foodgrain for this region as well as for the country. Even at all-India level, Uttar Pradesh continues to occupy the number one position in terms of its contribution to national foodgrain production. In 1970-71, the contribution was 18.1 percent and continued to increase in the two subsequent decades, the eighties and nineties, and finally tapered off in 2007-08.

Second highest contribution to India's foodgrain production is from central India consisting of Gujarat, Madhya Pradesh, Rajasthan and Maharashtra. In 1970-71, the contribution to total foodgrain production of this region was 27.4 percent, which however, declined to 16.7 percent in 2000-01 and improved thereafter and the share reached to 22.3 percent in 2007-08. Eastern India includes Assam, Bihar, Orissa and West Bengal and Southern region consisting of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu are almost having the same share to national foodgrain production. In 1970-71, the contribution of eastern India and southern India were respectively 20.8 percent and 20 percent. In 1980-81 and 1990-91, the share of eastern region was higher in comparison to southern region of India and they were 20.8 percent and 19.2 percent respectively where as, the figures for southern regions in the two sub-period were respectively 17.5 percent and 15.5 percent.

From foodgrains, if we turn to rice, the picture that emerges from Table 3.8, is that Uttar Pradesh from north-west region, West Bengal, Orissa, Bihar from eastern region, Andhra Pradesh and Tamil Nadu from southern region are contributing bulk of the production of rice for the country. Among the states, West Bengal and Andhra Pradesh are occupying first and second position in terms of share to rice production of the country. One of the prime reasons for high production of rice in West Bengal is that it is located in Indo-Gangetic plain and the river Ganges and its tributaries through continuous deposition of silts created soils which is very fertile and conducive to rice production. Similarly, the rivers Krishna, Godavari and Penner had created similar favourable condition for growing rice in Andhra Pradesh.

Another important feature which should be pointed out that contribution to total rice production for the state of Uttar Pradesh was rising from 1980-81 and reached at its peak between 1990-91 and 2000-01. Same trend was also observed for other north-western state, Punjab. However, for West Bengal and Andhra Pradesh, the share remained almost static during the eighties and nineties. And between 1990-91 and 2007-08, West Bengal increased its share marginally where as for Andhra Pradesh a marginal decline has been observed. Other eastern-Indian states like Orissa and Bihar experienced a slow but consistent decline in share. Since 1990 and onwards, a sharp fall in share in rice production was also observed for central Indian state of Madhya Pradesh. However, since the 1990s, most of the states experienced a fall in their share to the national rice production as well as total foodgrain production.

If we shift attention from rice to wheat (Table 3.9) then the scenario that emerges is the complete domination of north-west region of India. In 1970-71, the share of north-west

region to total wheat production was 23.1 percent. It continued increasing by leaps and bounds in every subsequent decade. In 1980-81, the share stood at 33.4 percent and in 1990-91, it further went up to 54.2 percent. It reached the peak in 2000-01, when the share of north-west region to total wheat production reached 72.3 percent. However, deceleration observed thereafter and the share came down to 65.7 percent in 2007-08. As a matter of fact, Uttar Pradesh and Punjab together are growing more than half of the wheat grown in the country. In eastern India, other than Bihar, rest of the states are producing negligible amount of wheat while share of West Bengal, Assam and Orissa in total wheat production in the country remained static as well as nominal. The southern states hardly produce wheat and all southern states together are contributing less than 0.5 percent of the national wheat output. However, in central India, the production of wheat has increased over the periods under consideration. In 2007-08, Gujarat, Madhya Pradesh, Maharashtra and Rajasthan together are contributing 24.3 percent of total wheat produced in India. In 1970-71, the contribution was only 9.1 percent and since then it is continuously increasing. The increase in share is more pronounced in Madhya Pradesh and Rajasthan.

Table 3.7: Regionwise and Statewise Contribution to Total Foodgrain Production (in percent)

Region	State	1970-71	1980-81	1990-91	2000-01	2007-08
North-West	Haryana	4.4	4.7	5.4	6.8	6.6
	Punjab	6.7	9.2	10.9	12.9	11.6
	Uttar Pradesh	18.1	19.0	20.2	21.7	18.2
	TOTAL	29.2	32.8	36.6	41.3	36.5
Eastern	Assam	1.9	2.1	2.0	2.1	1.5
	Bihar	7.3	7.6	6.9	6.1	4.7
	Orissa	4.7	4.6	3.9	2.5	3.5
	West Bengal	6.9	6.4	6.4	7.0	7.0
	TOTAL	20.8	20.8	19.2	17.8	16.7
Central	Gujarat	4.1	3.5	2.7	1.3	3.6
	Madhya Pradesh	10.1	9.5	10.2	5.2	5.2
	Maharashtra	5.2	7.5	6.9	5.1	6.6
	Rajasthan	8.2	5.0	6.2	5.1	7.0
	TOTAL	27.4	25.5	26.1	16.7	22.3
Southern Region	Andhra Pradesh	6.8	7.7	7.0	8.1	8.4
	Karnataka	5.5	4.5	3.6	5.6	5.3
	Kerala	1.2	1.0	0.6	0.6	0.2
	Tamil Nadu	6.4	4.3	4.2	4.4	2.9
	TOTAL	20.0	17.5	15.5	18.7	16.7

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

Table 3.8: Regionwise and Statewise Contribution to Total Rice Production (in percent)

Region	State	1970-71	1980-81	1990-91	2000-01	2007-08
North-West	Haryana	1.1	2.3	2.5	3.2	3.7
	Punjab	1.6	6.0	8.8	10.8	10.8
	Uttar Pradesh	8.8	10.1	13.8	13.7	12.2
	TOTAL	11.5	18.4	25.1	27.7	26.8
Eastern	Assam	4.7	4.7	4.4	4.7	3.4
	Bihar	9.8	10.5	8.8	6.4	4.6
	Orissa	10.3	8.1	7.1	5.4	7.8
	West Bengal	14.5	13.9	14.0	14.6	15.2
	TOTAL	39.4	37.2	34.4	31.2	31.0
Central	Gujarat	1.4	1.0	1.1	0.6	1.5
	Madhya Pradesh	8.8	7.5	7.7	1.2	1.5
	Maharashtra	3.9	4.4	3.1	2.3	3.1
	Rajasthan	0.3	0.3	0.2	0.2	0.3
	TOTAL	14.4	13.2	12.1	4.2	6.4
Southern Region	Andhra Pradesh	11.34	13.07	13.00	14.66	12.20
	Karnataka	4.6	4.1	3.3	4.5	3.5
	Kerala	3.1	2.4	1.5	0.9	0.8
	Tamil Nadu	12.6	7.8	7.8	8.7	7.1
	TOTAL	31.6	27	25.5	29	23.5

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

Table 3.9: Regionwise and Statewise Contribution to Total Wheat Production (in percent)

Region	State	1970-71	1980-81	1990-91	2000-01	2007-08
North-West	Haryana	3.56	4.84	9.38	13.88	13.03
	Punjab	7.82	10.67	17.71	22.32	20.01
	Uttar Pradesh	11.69	18.20	27.10	36.12	32.68
	TOTAL	23.1	33.7	54.2	72.3	65.7
Eastern	Assam	0.02	0.16	0.15	0.12	0.09
	Bihar	1.91	3.20	5.19	6.37	5.66
	Orissa	0.03	0.17	0.08	0.02	0.01
	West Bengal	1.32	0.66	0.77	1.52	1.17
	TOTAL	3.3	4.2	6.2	8.0	6.9
Central	Gujarat	1.43	1.80	2.10	0.93	4.88
	Madhya Pradesh	3.94	4.24	8.50	6.99	7.68
	Maharashtra	0.69	1.29	1.34	1.36	2.65
	Rajasthan	2.97	3.31	6.28	7.96	9.07
	TOTAL	9.0	10.6	18.2	17.2	24.3
Southern Region	Andhra Pradesh	0.02	0.01	0.01	0.01	0.01
	Karnataka	0.14	0.25	0.18	0.35	0.33
	Kerala	0.00	0.00	0.00	0.00	0.00
	Tamil Nadu	0.00	0.00	0.00	0.00	0.00
	TOTAL	0.2	0.3	0.2	0.4	0.3

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

3.5.2. Compound Annual Growth Rates in Production and Productivity of Foodgrains in India: An Inter-State Comparison

In the above presentation, the region-wise contribution of foodgrain, rice and wheat production has been attempted. Let us consider the region-wise growth in production of foodgrain, rice and wheat in major Indian States. As we know that major contribution to foodgrain output is coming from the states of north-west region of India, therefore, growth in production and productivity of foodgrain assume special importance in maintaining self-sufficiency in foodgrain production as well as food security for the people of the country. It has been observed that since 1990-91, deceleration was observed both in production and productivity among all the states of north-west region (Table 3.10 & 3.11). Deceleration was most pronounced in the state of Uttar Pradesh in the north-west region. During the 1960s, foodgrain production grew at a rate of 3.3 percent; it decreased to 2.3 percent between 1970-71 and 1980-81. Highest growth in foodgrain production was achieved from 1980-81 to 1990-91 and foodgrain production grew at a rate of 3.8 percent per annum. Since 1990, the growth rate in production started declining and between 2000-01 and 2007-08, the growth rate became negative; it grew at a rate of -0.8 percent per annum for the state of Uttar Pradesh. The other agriculturally prosperous state of North-west region, Punjab experienced a high growth of foodgrain production from 1970s to 1990s and there after it started decelerating and it reached to a plateau between 2000 and 2008, where the annual growth rate had been just 0.8 percent. Haryana showed an upsurge in growth in foodgrain production between 1990-91 and 2000-01 and thereafter decelerated. If we look at the growth figures of productivity for the north-western states of India, it became prominent that acceleration or deceleration of growth in productivity was primarily driven by the acceleration or deceleration in productivity. At the outset it needs to be mentioned that since late-sixties, area under foodgrains had either become static or had declined. Therefore, acceleration or deceleration of growth of foodgrain was primarily driven by the growth in productivity. Uttar Pradesh, Punjab and Haryana, three major contributors of foodgrains, experienced deceleration in the growth in productivity since 1990s and the deceleration was sharper for the state of Uttar Pradesh and Punjab.

If we look at the states of eastern India, then it was observed that the growth of foodgrain production increased between 1980s and 1990s and since then it is decelerating. Assam experienced negative growth from 2000-01 to 2007-08 while for Orissa; the growth rate became negative in the decade of 1990s as well as from 2000-01 to 200-08. The scenario was relatively better for West Bengal. In West Bengal, the decade of the 70s experienced negative

growth in foodgrain production (-0.75 percent), the turn around started since 1980s and the growth rate picked up. The growth of foodgrain production grew at 3.2 percent per annum from 1980-81 to 1990-91 and from 1990-91 to 2000-01 and it grew at a rate of 3.1 percent per annum. However, deceleration in growth of foodgrain started from 2000. The growth rate in foodgrain production from 2000-01 to 2007-08 plummeted to 1.78 percent. If we look at the growth figures of productivity of foodgrain in eastern India, we would see that Assam was having lowest growth rate in productivity among all the eastern Indian states, however, Orissa experienced negative growth in productivity of foodgrain in the three decades, the decades of sixties, seventies and nineties and highest growth rate was achieved from the period 2000-01 to 2007-08. Excepting Gujarat, no other Indian states had experienced such growth in productivity in foodgrains. For West Bengal, the decades of eighties and nineties had observed acceleration on growth of foodgrain production and it only started decelerating since 2000-01. In West Bengal, the decade of eighties experienced highest growth rate in productivity (3.27 percent per annum) of foodgrain.

Most of the states of central India had experienced growth in foodgrain production and productivity which passed through serious ups and down since 1960s. The fluctuations were more prominent for the central Indian states excepting Madhya Pradesh where fluctuations were relatively moderate. Gujarat had experienced a growth rate in 9.8 percent per annum between 1960s and 70s and then it had sharply reduced to 0.2 percent during the decade of 70s. It became negative in the nineties and thereafter, between 2000-01 and 2007-08, it sharply increased to 18.2 percent. Similar trends were also observed for the state of Maharashtra, though unlike Gujarat, it experienced negative growth during the decade of 60s. For the state of Rajasthan, the decades of 1970s and 1990s experienced positive growth in foodgrain production, rest of the decades under study experienced negative growth rates.

Among the southern states, Andhra Pradesh emerged as most consistent performer. If we look at growth figures of production and productivity of foodgrain, we observe that in Andhra Pradesh, foodgrain production grew at a rate of 2.1 percent in the decade of 60s, while it increased to 3.1 percent in the decade of 70s and then it declined to 2.1 percent from 1980-81 to 1990-91 and then again it increased and continue to grow at a rate of 2.7 percent per annum from 1990-91 to 2000-01 and 2000-01 to 2007-08. The growth in productivity of foodgrain production in Andhra Pradesh reached the highest level during the period of 1970-71 to 1980-81, where the productivity grew at a rate 3.85 percent; it slightly declined from 1980-81 to 1990-91, when it grew at a rate 3.38 percent per annum. The decade of 90s

observed further slowing down in the growth rate in productivity in foodgrain production (2.78 percent), however a revival of growth in productivity was observed for Andhra Pradesh since 2000-01 when growth rate was again increased to 3.25 percent.

The next important state of southern region, Tamil Nadu, experienced negative growth in foodgrain production and productivity from 1970-71 to 1980-81 and 2000-01 to 2007-08 and the highest growth was achieved from 1980-81 to 1990-91. During this period foodgrain production had grown at a rate of 3.3 percent per annum and productivity grew at a rate of 3.63 percent. The state of Karnataka experienced highest rate of growth in production and productivity of foodgrain from 1960-61 to 1970-71. During this period, the production and productivity grew at 5.5 percent and 5.2 percent per annum respectively. However, in Karnataka, the decades of 80s and 90s observed severe deceleration in growth in production and productivity of foodgrain. However, from 1990-91 to 2000-01 both production and productivity growth registered significant upturn but again was sluggish from 2000-01 to 2007-08. Kerala's contribution to total foodgrain production remained very low and declined over the periods and the growth in production continued to remain negative from 1960-61 to 2000-01 and excepting the period 1990-91 to 2000-01 productivity remained at a very low level.

Table 3.10: Statewise CAGR in Foodgrain Production in India (1960-61 to 2007-08)

Region	State	1960-61 to 1970-71	1970-71 to 1980-81	1980-81 to 1990-91	1990-91 to 2000-2001	2000-01 to 2007-08
North-West	Haryana	-	2.4	4.7	3.4	2.0
	Punjab	1.7	5.0	4.9	2.8	0.8
	Uttar Pradesh	3.3	2.3	3.8	1.8	-0.2
Eastern	Assam	2.0	2.9	2.4	1.9	-2.6
	Bihar	0.8	2.3	2.2	-0.2	-1.5
	Orissa	2.5	1.6	1.5	-3.3	7.3
	West Bengal	3.0	-0.75	3.2	3.1	1.8
Central	Gujarat	9.5	0.2	0.8	-6.3	18.2
	Madhya Pradesh	1.4	1.2	3.9	-5.5	2.5
	Maharashtra	-2.5	5.7	2.2	-1.8	6.0
	Rajasthan	-3.0	5.3	-0.8	6.9	-2.5
Southern Region	Andhra Pradesh	2.1	3.1	2.1	2.7	2.7
	Karnataka	5.5	-0.1	0.9	5.6	1.5
	Kerala	0.0	-1.7	-0.2	-9.5	4.5
	Tamil Nadu	2.8	-2.3	3.0	1.5	-3.8

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

Table 3.11: Statewise CAGR in Productivity of Foodgrain in India (1960-61 to 2007-08)

Region	State	1960-61 to 1970-71	1970-71 to 1980-81	1980-81 to 1990-91	1990-91 to 2000-2001	2000-01 to 2007-08
North-West	Haryana	-	2.08	4.45	2.69	1.60
	Punjab	8.12	2.81	3.28	1.75	0.77
	Uttar Pradesh	2.57	1.97	3.67	1.93	0.67
Eastern	Assam	0.68	0.98	1.67	1.42	-0.80
	Bihar	1.00	2.20	2.78	2.68	-1.30
	Orissa	-0.17	-0.16	1.44	-0.54	6.57
	West Bengal	1.49	-0.57	3.27	2.61	1.24
Central	Gujarat	7.94	1.48	0.46	-2.34	12.03
	Madhya Pradesh	0.23	0.73	3.69	-0.57	1.78
	Maharashtra	-2.97	4.85	1.99	-1.10	6.15
	Rajasthan	5.39	-2.58	5.04	0.22	4.23
Southern Region	Andhra Pradesh	0.99	3.85	3.38	2.78	3.25
	Karnataka	5.24	0.69	0.24	4.49	1.33
	Kerala	0.89	1.13	1.62	4.72	-4.08
	Tamil Nadu	2.25	-0.06	3.63	2.59	-2.08
All India		2.08	1.61	3.04	1.66	1.94

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

3.5.3 Inter-State Long Term Growth Patterns in Area, Production and Productivity of Major Crops in India

To add further, that how growth in area, production and productivity for various crops in the various states are changing over the years, especially after the introduction of Green Revolution, compound annual growth rates were calculated for the period 1967-68 to 2007-08 and growth rates were classified into four groups, viz., high (> 4%), medium (2-3.9%), low (0-1.9%) and negative (< 0%). From Table 3.12, it is evident that in terms of growth in area, oil seeds crops like Rapeseeds and mustard, sunflower, sesamum and coconut experienced growth in area exceeding 4 percent per annum. In many states, area under onion also registered a growth of more than 4 percent. In north-western region, Haryana, in eastern India West Bengal, Gujarat, Maharashtra, Rajasthan in central India, in southern region, Andhra Pradesh, Karnataka and Tamil Nadu. Onion registered high growth in area in Gujarat, Karnataka and Maharashtra. Potato in West Bengal has shown high growth in area along with Rapeseeds and mustard and sesamum. In Tamil Nadu, coconut registered highest growth in area expansion under cultivation. Among all the major states, the growth in area under rice exceeded 4 percent only in the state of Punjab. During 1967-68 to 2007-08, at all-India level, only sunflower registered area growth of more than 4 percent.

If we look at the statewise and crop-wise growth in area under cultivation then it becomes apparent that most of the states has achieved moderate rate of growth (2.0 -3.9%) in area under cultivation of oilseeds and other commercial crops like arecanut, sugarcane, potato, onion, pigeon peas. Haryana and Andhra Pradesh have shown medium growth in area under

cotton. Kerala is the only state that showed medium growth in area under pepper cultivation. The crops that showed medium growth in area at all-India level are respectively coconut, onion, arecanut, pepper, Rapeseeds and mustard and potato.

Most of the foodgrains across the states, however, achieved negative growth in area during the period 1967-68 to 2007-08. Negative growth in area under foodgrains are prominent among Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Orissa and this indicates that crop diversification is gradually tilting towards commercial crops. The area under coarse cereals and small millets are being substituted by commercial crops in these states. However, in West Bengal, no crops have achieved negative growth in area and thus reflect that cropping pattern has remained relatively uniform over the years. All-India scenario shows that cereals, pulses, small millets, oilseeds like groundnut, linseed, sunflower and sesamum have registered negative growth in area.

If we follow the long term growth (1967-68 to 2007-08) of production of different crops across the states (Table 3.13), we observe that oilseeds, especially Rapeseeds and mustard have grown at more than 4 percent in most of the states. These states are namely, Haryana, West Bengal, Gujarat, Madhya Pradesh and Maharashtra. At all-India level also Rapeseeds and mustard have achieved growth rate in production which was more than 4 percent per annum from 1967-68 to 2007-08. Along with Rapeseeds and mustard, sesamum production was growing more than 4 percent in West Bengal and Gujarat. High growth in production of sunflower was observed in Andhra Pradesh, Karnataka and Maharashtra. Along with the states of Punjab, Uttar Pradesh and West Bengal potato have registered high growth in production at all-India level .

Table 3.12: Compound Annual Growth rates in Area for Major Crops by States (1967-68 to 2007-08)

Region	State	High (>4%)	Medium (2.0-3.9%)	Low (0-1.9%)	Negative (< 0 %)
North-West	Haryana	Rapeseeds & Mustard	Wheat, Cotton	Total Foodgrains, Total Cereals	Bajra, Barley, Gram, Sugarcane
	Punjab	Rice	Potato	Wheat, Cotton, Total foodgrains, Total Cereals	Barley, Sugarcane, Sunflower
	Uttar Pradesh	-	Potato	Rice, Wheat, total Foodgrains, Sugarcane, Total Cereals	Bajra, Maize, Total Pulses, total Oilseeds, Barley, Gram, Linseed, Rapeseeds & Mustard, Sesamum, Pigeon Pea
Eastern	Assam	-	Areanut, Onion, Potato	Rice, Total Foodgrains, Rapeseeds & Mustard	Jute
	Bihar	-	-	Wheat, Jute, Onion, Potato, Tobacco	Rice, Ragi, Maize, Barley, Total Foodgrains, Linseed, Total Cereals
	Orissa	-	Pigeon Pea	Rice, Onion	Ragi, Total Pulses, Total Foodgrains, Total Cereals
	West Bengal	Potato, Rapeseeds & Mustard, Sesamum	-	Rice, Wheat, Total Foodgrains, Total Cereals	-
Central	Gujarat	Onion, Rapeseeds & Mustard, Sesamum	Pigeon Pea	Maize, Cotton, Total Oilseeds, Groundnut	Bajra, Tobacco
	Madhya Pradesh	-	Total Oilseeds, Rapeseeds & Mustard	Wheat, Maize, Cotton, Total Pulses, Gram	Rice, Total Foodgrains, Groundnut, Linseed, Safflower, Sesamum, Total Cereals
	Maharashtra	Onion, Sunflower	Gram, Sugarcane, Pigeon Pea	Total Pulses, Total Oilseeds, Cotton	Bajra, Ragi, Jowar, Total Foodgrains, Groundnut, Linseed, Safflower, Sesamum, Total Cereals
	Rajasthan	Total Oilseeds, Rapeseeds & Mustard	Total Pulses	Bajra, Wheat, Maize, Total Foodgrains, Total Cereals	Barley, Gram, Sesamum
Southern Region	Andhra Pradesh	Sunflower	Maize, Cotton, Onion, Pigeon Pea	Groundnut, Rice, Total Pulses, Total Oilseeds	Total Foodgrains, Ragi, Jowar, Sesamum, Tobacco, Total Cereals
	Karnataka	Onion, Sunflower, Maize	Areanut, Total Oilseeds, Coconut, Sugarcane, Tobacco, Pigeon Pea	Total Pulses, Total Foodgrains, Groundnut, Sesamum	Ragi, Jowar, Cotton, Cardamom, Small Millets, Total Cereals
	Kerala	-	Pepper	Areanut, Coconut	Cardamom Rice, Ragi, Jowar, Cotton, Cardamom, Total Foodgrains, Groundnut, Sesamum, Small Millets, Tobacco, Tur, Total Cereals
	Tamil Nadu	Coconut	Sugarcane	Total Pulses, Onion	Bajra, Barley, Total Foodgrains, Gram, Groundnut, Jowar, Linseed, Safflower, Sesamum, Small Millets, Tobacco, Total Cereals, Total Pulses, Ragi
India	Sunflower	Areanut, Coconut, Onion, Pepper, Potato, Rapeseeds & Mustard	Cardamom, Cotton, Jute, Maize, Sugarcane, Pigeon Pea, Rice, Wheat, Total Oilseeds		

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

Table 3.13: Compound Annual Growth rates in Production for Major Crops by States (1967-68 to 2007-08)

Region	State	High (>4%)	Medium (2.0-3.9%)	Low (0-1.9%)	Negative (< 0 %)
North-West	Haryana	Wheat, Cotton, Rapeseeds & Mustard, Total Cereals	Total Foodgrains	Bajra, Sugarcane	Barley, Gram
	Punjab	Potato, Rice	Wheat, Total Foodgrains, Total Cereals	Cotton, Barley, Sugarcane	Sunflower
	Uttar Pradesh	Potato	Wheat, Total Foodgrains, Total Cereals, Rice, Sugarcane	Bazra, Maize	Total Pulses, Total oilseeds, Barley, Gram, Linseed, Rapeseeds & Mustard, Sesamum, Tur
Eastern	Assam	Onion, Potato	Rapeseeds & Mustard, rice Wheat, Total Cereals	Total Foodgrains Rice, Maize, Total Foodgrains, Jute, Potato, Onion, Tobacco	Ragi, Jute Ragi, barley, Linseed
	Bihar				
	Orissa	Pigeon Pea		Total Foodgrains, Total Cereals, Rice, Onion	Ragi, Pulses
	West Bengal	Potato, Rapeseeds & Mustard, Sesamum	Jute, Total Cereals, Rice	Total Foodgrains	
Central	Gujarat	Onion, Rapeseeds & Mustard, Sesamum, Pigeon Pea	Maize, Cotton, Total Oilseeds	Groundnut, Tobacco	Bajra
	Madhya Pradesh	Total Oilseeds, Rapeseeds & Mustard	Wheat, Maize, Gram	Pulses, Total Foodgrains, Total Cereals	Rice, Linseed, Small Millets, Pigeon Pea
	Maharashtra	Total Oilseeds, Gram, Onion, Sunflower	Bajra, Cotton, Pulses, Sugarcane, Pigeon Pea	Total Foodgrains, Total Cereals, Jowar	Ragi, Groundnut, Linseed, Sesamum
	Rajasthan	Wheat, Total Oilseeds, Rapeseeds & Mustard	Total Foodgrains, Total Cereals, Bajra, Maize	Pulses, Sesamum	Barley, Gram
Southern Region	Andhra Pradesh	Cotton, Maize, Pulses, Onion, Sunflower, pigeon pea	Total Foodgrains, Rice	Groundnut, Oilseeds, Tobacco, Cereals	Jowar, sesamum, ragi
	Karnataka	Maize, Onion, Sunflower	Areanut, Pulses, Oilseeds, Coconut, Sesamum, Sugarcane, Tobacco	Ragi, Cotton, Total Foodgrains, Cereals, Groundnut, Pigeon pea	Jowar, Cardamom, Small Millets
	Kerala	Cardamom Coconut	Pepper Pulses, sugarcane	Arecanut, Coconut Total Foodgrains, Rice, Groundnut, Onion, Cereals, Sesamum	- Ragi, Jowar, Cotton, Cardamom, Small millets, Tobacco, Tur
	Tamil Nadu				
India		Cardamom, Onion, Potato, Rapeseeds & Mustard, Sunflower	Rice, Wheat, Arecanut, Cotton, Pepper, Total Foodgrains, Maize, Jute, Sugarcane, Total Cereals, Total Oilseeds	Bajra, Gram, Groundnut, Sesamum, Pulses, Tobacco, Pigeon pea	Barley, Jowar, Linseed, Small Millets, Ragi

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

During the period 1967-68 to 2007-08, high growth in production for onion was achieved at all-India level and by the states of Assam, Gujarat, Maharashtra, Andhra Pradesh and Karnataka. Under foodgrains, only rice in Punjab, wheat in Rajasthan, pigeon pea in Orissa, Gujarat and Andhra Pradesh achieved growth in production more than 4 percent. Medium growth in production (2-3.9 %) of foodgrain has been achieved by Andhra Pradesh, Haryana, Punjab, Rajasthan and Uttar Pradesh and other states achieved a growth in foodgrain production even less than 2 percent per annum from 1967-68 to 2007-08. This has started posing doubts on the ability of the country to sustain food sufficiency in the long run.

Proliferation of industrial poultry in Karnataka and Andhra Pradesh has enhanced growth of maize in these two states because maize is primarily used as feed for the poultry industry. In comparison to other states, Uttar Pradesh and Tamil Nadu have highest number of crops that have registered negative growth; however, expansion of area under potato and sugarcane in Uttar Pradesh and coconut and sugarcane in Tamil Nadu might be responsible for this change.

Table 3.14: Compound Annual Growth Rates in Productivity for Major Crops by States (1967-68 to 2007-08)

Region	State	High (>4%)	Medium (2.0-3.9%)	Low (0-1.9%)	Negative (< 0 %)
North-West	Haryana	-	Wheat, Bajra, Barley, Total foodgrains, Rapeseeds & Mustard, Total Cereals	Cotton, Gram, Sugarcane	-
	Punjab	-	Wheat Barley, Total Foodgrains, Total Cereals	Rice, Cotton, Potato, Sugarcane, Sunflower	
	Uttar Pradesh	-	Rice, Wheat, Bajra, Maize, Total Oilseeds, Barley, Total Foodgrains, Total Cereals, Potato, Rapeseeds & Mustard	Total Pulses, Gram, Linseed, Sesamum, Sugarcane	Pigeon pea
Eastern	Assam	-	-	Rice, Total Foodgrains, Jute, Potato, Rapeseeds & Mustard	Arecanut
	Bihar	-	Maize, Barley, Total Cereals	Rice, Wheat, Ragi, Total Foodgrains, Jute, Linseed, Tobacco	Potato
	Orissa	-	-	Rice, Total Foodgrains, Total Cereals, Pigeon pea	Ragi, Total Pulses
	West Bengal	-	Rice, Rapeseeds & Mustard, Total Cereals	Total Food gains, Jute, Potato, Sesamum	
Central	Gujarat	-	Cotton, Rapeseeds & Mustard	Bajra, Maize, Total Oilseeds, Groundnut, Sesamum, Tobacco, Pigeon pea	
	Madhya Pradesh	-	Wheat, Total Oilseeds, Total Foodgrains, Total Cereals, Rapeseeds & Mustard	Rice, Maize, Total Pulses, Gram, Linseed, Small Millets, Tur	
	Maharashtra	-	Bajra, Cotton, Total Oilseeds, Total Cereals, Gram	Ragi, Jowar, Total Pulses, Total Oilseeds, Total Foodgrains, Ground nut, Linseed, Sesamum, Sunflower, Pigeon Pea	Sugarcane
	Rajasthan	Total Oilseeds	Wheat, Bajra, Barley, Total Foodgrains, Total Cereals, Rapeseeds & Mustard, Sesamum	Maize, Gram	Total Pulses
Southern Region	Andhra Pradesh	-	Cotton, Total foodgrains, Rice, Maize, Total Pulses, Total Cereals, Sunflower	Groundnut, Ragi, Jowar, Total Oilseeds, Sesamum, Tobacco, Pigeon pea	
	Karnataka	Safflower	Cotton	Ragi, Jowar, Total Pulses, Total Oilseeds, Total Foodgrains, Total Cereals, Sesamum, Small Millets, Sugarcane, Tobacco	Maize, Cardamom, Coconut, Sunflower, Pigeon Pea, Arecanut
	Kerala	Cardamom	-	Arecanut, Coconut, Pepper	-
	Tamil Nadu	-	Groundnut	Rice, Ragi, Jowar, Cotton, Total Pulses, Coconut, Total Foodgrains	Cardamom
India	Cardamom	-	Rice, Wheat, Arecanut, Cotton, Barley, Bajra Total Foodgrains, , Total Cereals, Rapeseeds & Mustard	Arecanut, Coconut, Jowar, Gram, Jute, Linseed, Potato, Small Millets, Total Pulses, Total Oilseeds, Groundnut, Pulses, Tobacco, Sugarcane	Sunflower, Pigeon Pea, Ragi

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

If we look at the cropwise and statewise figures of compound annual rate of growth in productivity (Table 3.14) from 1967-68 to 2007-08, sunflower in Karnataka, Cardamom in Kerala, total oilseeds in Rajasthan and cardamom at all-India level attained growth rate that exceeded 4 percent mark. Rest of the crops (both foodgrain and non foodgrains) have achieved medium growth ranging between (2-3.9%) and negative growth (< 0 percent).

Importantly, rice growing states like Assam, Bihar, Madhya Pradesh, Orissa and Tamil Nadu attained yield growth less than 2 percent. At all-India level, foodgrains like rice, wheat, maize, barley and bajra showed medium growth and sunflower, pigeon pea and ragi showed negative growth rates. Most pulse growing states have either registered yield growth rate less than two percent or negative. Similarly, sugarcane in Maharashtra, pigeon pea and maize in Karnataka has been showing deceleration in growth in productivity.

3.5.4 Growth in Foodgrain Production and Growth of Population (1960-61 to 2007-08): An Inter-State Comparison

In the above context and also given the recent initiatives of the Central Government to ensure the rights of the people to have minimum of food intake, raising food production across the states assumes special importance. For that matter, we need to delve into the issues of the states which were gradually becoming food deficient states, and remained food deficient states from the beginning and the states self-sufficient in food production. To do so, a comparative statement has been prepared by taking into account the growth of foodgrain and growth of population in five sub-periods for major Indian states, viz., 1960-61 to 1970-71, 1970-71 to 1980-81, 180-81 to 1990-91, 1990-91 to 2000-01 and 2000-01 to 2007-08. The growth of population between 2001 and 2011 has been considered for estimating the period 2000-01 to 2007-08 (Table 3.15). If growth of foodgrain production exceeds the growth of population, we assume that the state is generating surplus in foodgrain production and if population growth surpasses the growth of foodgrain then the state is being considered as deficient in foodgrain production (Table 3.16). However, import and export of foodgrain has not been taken into account.

In north-west region, Punjab was food deficient state during sixties, and it turned out to be food surplus state by the 70's and the trend was maintained till 2000-2001. But from 2000-01-2007-08, it turned out to be a foodgrain deficient state. In Uttar Pradesh, the major contributors of foodgrain production in India, the growth of foodgrain production continued to be lower than the growth of population since 1990-91. Since the state of Uttar Pradesh continued to remain the highest contributor of foodgrain for India, deceleration in this particular state is not only a matter of concern for the state but for the country as a whole. However, the state of Haryana is still maintaining a surplus. In the eastern region, Assam turned out to be a food deficit state from 2000-2001; however, Bihar became food deficient since 1990-91. The state of Orissa remained food deficient state in the decades of 1970s,

1980s and 1990s but from 2000-01, it became a foodgrain surplus state. In West Bengal, since 1980-81, growth of foodgrain continued to remain higher than the population growth.

Among the states of Central India, Madhya Pradesh and Maharashtra experienced the longest spell of foodgrain deficit. The growth of foodgrain production remained lower than population growth from 1960-61 to 1970-71, 1980-81 to 1990-91 and 1990-91 to 2000-01 in Maharashtra and 1960-61 to 1970-71, 1970-71 to 1980-81 and 1990-91 to 2000-01. However, the trend got reversed for both the states from 2000-01 to 2007-08. Rajasthan, though, turned out to be food deficient state from 2000-01 to 2007-08. In southern region, Kerala experienced higher population growth in comparison growth in production from 1960-61 to till 2000-01. For Andhra Pradesh, except the period between 1980-81 and 1990-91, in rest of the periods, the growth in foodgrain remained higher than the growth of population. In Tamil Nadu, foodgrain production growth was outweighed by the growth of population from 2000-01 to 2007-08. At all-India level, the decade of 1970's (1970-71 to 1980-81) and 1990s (1990-91 to 2000-01) experienced a situation where in population growth exceeded the growth in foodgrain production. However, the trend got reversed from 2000-01 to 2007-08; the growth in foodgrain production remained higher than the growth of population.

Mention has been made that the contribution of agriculture to Gross Domestic Product has continuously declined and reached to just 17 percent in 2008-09 and the percentage of people relying on agriculture has marginally declined in comparison to 1950-51. Therefore, it becomes obvious that per-capita income from agriculture has declined at all-India level and this was bound to result in an increase in rural indebtedness and poverty. The Eleventh Plan had set the target for growth of agricultural GDP at 4 percent. The Eleventh Plan document stated that the growth of agricultural GDP has declined from 3.5 percent per annum from 1981-82 and 1996-97 to only around 2 percent from 1997-98 and 2004-05 (Eleventh Five Year Plan: 4). It had further declined to below 1 percent during first three years of Ninth Plan. National Sample Survey (59th Round) clearly showed the security of rural indebtedness. According to this survey, in Andhra Pradesh 82 percent of farmer households are in debt, in Tamil Nadu the percentage stood at 74.5 percent, the figures for agriculturally prosperous states like Punjab and Haryana are respectively 65.4 percent and 53.1 percent. According to this survey, eastern states are relatively better placed. However, it is not clear that to what extent the indigenous money lenders are active and to what extent farmer households are depending on them for their credit needs.

Table 3.15: Inter-State Comparison of Growth in Foodgrain Production and Growth of Population (1960-61 to 2007-08)

Region	State	CAGR-FOODGR	CAGR-POPULA	CAGR-FOODGR	CAGR-POPULA	CAGR-FOODGR	CAGR-POPULA	CAGR-FOODGR	CAGR-POPULA	CAGR-FOODGR	CAGR-POPULA
		AIN	TION	AIN	TION	AIN	TION	AIN	TION	AIN	TION
		1960-61 to	1970-71	1970-71 to	1980-81	1980-81 to	1990-91	1990-91 to	2000-2001	2000-01 to	2007-08
North - West	Haryana	-	2.83	2.40	2.56	4.70	2.45	3.40	2.53	2.00	1.83
	Punjab	1.70	1.98	5.00	2.17	4.90	1.91	2.80	1.85	0.80	1.30
	Uttar Pradesh	3.30	1.82	2.30	2.30	3.80	1.77	1.80	2.33	-0.20	1.85
Eastern	Assam	2.00	3.04	2.90	2.12	2.40	2.19	1.90	1.75	-2.60	1.58
	Bihar	0.80	1.95	2.30	2.18	2.20	-0.80	-0.20	2.55	-1.50	2.26
	Orissa	2.50	2.26	1.60	1.85	1.50	1.84	-3.30	1.52	7.30	1.32
	West Bengal	3.00	2.41	-0.75	2.11	3.2	2.23	3.10	1.65	1.8	1.31
Central	Gujarat	9.50	2.61	0.20	2.47	0.80	1.94	-6.30	2.06	18.20	1.77
	Madhya Pradesh	1.40	2.55	1.20	2.28	3.90	-0.71	-5.50	2.20	2.50	1.87
	Maharashtra	-2.50	2.46	5.70	2.22	2.20	2.32	-1.80	2.07	6.00	1.49
	Rajasthan	-3.00	2.49	5.30	2.89	-0.80	2.53	6.90	2.53	-2.50	1.96
Southern Region	Andhra Pradesh	2.10	1.92	3.10	2.10	2.10	2.19	2.70	1.37	2.70	1.06
	Karnataka	5.50	2.19	-0.10	2.40	0.90	1.93	5.60	1.63	1.50	1.47
	Kerala	0.00	2.36	-1.70	1.77	-0.20	1.35	-9.50	0.90	4.50	0.48
	Tamil Nadu	2.80	2.03	-2.30	1.63	3.00	1.44	1.50	1.11	-3.80	1.46
India	2.83	2.24	1.80	2.23	3.13	2.16	1.10	1.97	2.30	1.64	

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

Table 3.16: Inter-State Comparison of Food production Sufficiency or Insufficiency (1960-61 to 2007-08)

Region	State	1960-61 to	1970-71 to	1980-81 to	1990-91 to	2000-01 to
		1970-71	1980-81	1990-91	2000-2001	2007-08
North-West	Haryana	Surplus	Deficit	Surplus	Surplus	Surplus
	Punjab	Deficit	Surplus	Surplus	Surplus	Deficit
	Uttar Pradesh	Surplus	Surplus	Surplus	Deficit	Deficit
Eastern	Assam	Deficit	Surplus	Surplus	Surplus	Deficit
	Bihar	Deficit	Surplus	Surplus	Deficit	Deficit
	Orissa	Surplus	Deficit	Deficit	Deficit	Surplus
	West Bengal	Surplus	Deficit	Surplus	Surplus	Surplus
Central	Gujarat	Surplus	Deficit	Deficit	Deficit	Surplus
	Madhya Pradesh	Deficit	Deficit	Surplus	Deficit	Surplus
	Maharashtra	Deficit	Surplus	Deficit	Deficit	Surplus
	Rajasthan	Deficit	Surplus	Deficit	Surplus	Deficit
Southern Region	Andhra Pradesh	Surplus	Surplus	Deficit	Surplus	Surplus
	Karnataka	Surplus	Deficit	Deficit	Surplus	Surplus
	Kerala	Deficit	Deficit	Deficit	Deficit	Surplus
	Tamil Nadu	Surplus	Deficit	Surplus	Surplus	Deficit
India	Surplus	Deficit	Surplus	Deficit	Surplus	

Source: Calculation based on data collected from Directorate of Economics and Statistics, Government of India

3.6 Conclusion

Anticipating the problem of impending food scarcity, increase in the incidence of poverty and rural indebtedness in Indian agriculture, both at all-India level and state level, following areas of concern have been identified by Eleventh Plan document (Chapter-1:4) and which may be presented as follows:

- Deceleration in growth.
- Widening gap between irrigated and rain-fed areas.
- Increased vulnerability to world commodity price fluctuation following trade liberalisation.
- Uneven and slow development of technology.
- Inefficient use of available technology and inputs
- Lack of adequate incentives and appropriate institution.
- Degradation of natural resource base.
- Rapid and widespread decline in ground water table with particularly adverse impact on small and marginal farmers.
- Increased non-agricultural demand for land and water as a result of the higher overall GDP growth and urbanisation.

Having accepted the above impediments that Indian agriculture is facing, observation may be made that it is not necessarily true and uniform for all the states of India, West Bengal for example, is suitable case. Notwithstanding the fact that in West Bengal, agriculture is certainly experiencing deceleration in agricultural growth of income, production and productivity in the recent past but its situation is much better compared to agriculturally prosperous states of North-west India. Again, in West Bengal, a wide variation is bound to happen in various districts of West Bengal in agrarian scenario because of the influences of various economic and non-economic factors that affect agricultural production and productivity of a particular region.

The following chapter proposes to explore the pattern of agricultural growth that the state of West Bengal has been experiencing since 1970-71 to date, taking all the districts into consideration, for presenting unbiased and statistically qualified agrarian scenario of the state.

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Chapter-IV

Trends in Agricultural Productivity in West Bengal: An Overview of Districts

4.1 Introduction

Among the agriculturally progressive states in India, West Bengal emerged successfully as one of the leading states in terms of growth of agricultural production and productivity in foodgrain. In 2008-09, West Bengal contributed 7.6 percent of the total foodgrain production of the country and more than 15 percent of the rice was produced by West Bengal alone. The net sown area is 61 percent of the total geographical area of the state against the national average of 46 percent. The gross cropped area reached to 97.5 lakh hectares with cropping intensity of 184 percent. Small and marginal farmers account for over 95 percent of total farm population and they own about 80 percent of cultivated land. From 1980-81 to 2000-01, foodgrain production grew at a rate more than 3 percent per annum while growth of productivity of foodgrain during the same period remained close to 3 percent. Among the non-foodgrains, like potato, Rapeseeds & mustard and sesamum registered long term annual compound growth rate in production above 4 percent. Foodgrain production was primarily dominated by rice. The contribution of agriculture to Gross State Domestic Product at current prices declined from 42 percent in 1970-71 to 23.5 percent 2009-10 but it remained much higher than the all-India figure of 17 percent. Importantly, the contribution of industry to Gross State Domestic Product at current prices in 2009-10 is 18.4 percent, which is much lower than the contribution of agriculture. This exhibits the dominance of agriculture in the economy of West Bengal. To substantiate further, around 72 percent of the population live in rural areas with over 95 percent as small and marginal farmers and till date agriculture continues to be the main source of sustenance for more than 50 percent of the rural populace.

4.2 West Bengal: A Physiographic Description

The state lies between 21° 25' 24" and 27° 13' 15" north latitudes and 85° 48' 20" and 89° 53' 04" east longitudes and shares her borders with three different countries and four Indian states – on the east by Bangladesh and north-east by the state of Assam, on the north by Bhutan and the state of Sikkim, and on the north-west by Nepal, on the west by the states of Bihar and Jharkhand Chattishgarh on the south by the Bay of Bengal and the south-west by the state of Orissa (Samanta & Mallik, 2004). The spread of the state over an area of 66752 sq km. accounts for 2.7 percent of the geographical area of the country and it has turned out

to be the most densely populated state in India as per Census 2001 (903 persons per sq km as against the national average of 325 persons per sq km). West Bengal stretches between Himalayas in the north and Bay of Bengal at south. The river Ganges enters West Bengal from west near Rajmahal and flows south-east to reach Bay of Bengal. It branches off into two near north of Dhulian in Murshidabad district. One of the branches flows eastward and enters Bangladesh while the other flows through West Bengal as Bhagirathi and Hoogly rivers in southern direction. Among 19 districts in West Bengal, the districts that are located north of the Ganges – Darjeeling, Jalpaiguri, Cooch Behar, Malda, North and South Dinajpur are often referred to collectively as North Bengal. Among the districts on the south of the Ganges- Bankura, Burdwan, Birbhum, Purulia are referred as paschimanchal and Murshidabad, Nadia, Howrah, Hoogly, Kolkata, North 24 Parganas, South 24 Parganas, East Midnapore and West Midnapore are known as gangetic Bengal. Kolkata has been excluded in this study because of its non availability of agricultural areas.

4.3 Agro-climatic Zones in West Bengal

West Bengal and the central Gangetic Bengal is the oldest agricultural settlement in India. Except the western region (Birbhum and Bankura) which contained laterite formation, rest of the West Bengal and central Bengal was identified as 'semi-aquatic rice plain' (Bose, 1987: 37-38). In fact, two-thirds of the total geographical area comes under flat alluvial plains. The river Ganges has divided the alluvial plain into north and south plain lands. The northern part of the plain was created by the deposition of silts carried by the rivers Teesta, Jaldhaka, Mahananda and their tributaries and the southern part was created by the silt primarily carried by the River Ganges. Many of the areas of the plains get inundated by floods. The extreme southern part of the state is having coastal saline lowlands and gets inundated by brackish water from the Bay of Bengal. As per the classification of Planning Commission, West Bengal falls within three agro-climatic regions, viz. Eastern Himalayan region, Lower Gangetic Plain region and Eastern Plateau and Hill region out of fifteen agro-climatic regions in the country. Except in the northern hilly region, the climate of the state is tropical and humid.

4.3.1 Eastern Himalayan Region

a. Hills Sub-Region

The district of Darjeeling except the Siliguri division and a narrow part in the north of Jalpaiguri district constitutes the hills sub-region. The river Tista has divided this

mountainous region into two parts: the Singalila and Darjeeling Ranges. The hilly region consists of brown forest soil which is acidic in nature (pH 3.5-5.0) and annual rainfall varies between 2500 and 3500 mm. Poor soil quality and lack depth work as deterrent to raise crop productivity.

b. Terai Sub-Region

'Terai' which means the moist land consists of whole of Jalpaiguri District and upper region of Cooch Behar District in West Bengal. The soils of this entire region is mostly sandy or sandy loams, porous and were created by gravel and pebbles laid down by the Himalayan rivers like the Teesta, Torsa, Raidak, Jaldhaka, Sankosh and several other small rivulets. The soils are acidic in nature (pH 4.2 to 6.2) and rainfall varies from 2000-3200mm. The Teesta has divided the area into two parts - the western part is known as the Terai whereas the eastern part is known as the Dooars or Duars. The plains in the south of Jalpaiguri and Cooch Behar districts are made of new alluvium deposited by general rivers.

4.3.2 Lower Gangetic Region

The Lower Gangetic region could be divided into old-alluvium sub-region, new-alluvium sub-region, coastal saline sub-region and red lateritic sub-region.

a. Old Alluvium Sub-Region

The North and South Dinajpur and eastern part of Malda districts are part of the Lower Gangetic region and Old Alluvium sub- region. The entire part of North and South Dinajpur is silt laden plain and the soils are fairly fertile over most of the sub-regions and mildly acidic to neutral in reaction (pH 5.2-7.0). The region receives average rainfall of 1500-2000mm. The river Mahananda divides the district of Malda into two parts. It is also known as *Barind* or *Barendrabhumi*. The western part is made up of new alluvium and part of Lower Gangetic region. In this part River Kalindi meets the Mahananda River. The part of Malda lying to the north of river Kalindi is known as *Tal*. This is low land and covered with swamps and small water bodies whereas the area to the south of the Kalindi is a very fertile land and is known as *Diara*.

b. New Alluvium Sub-Region

This sub-region of Lower Gangetic region consists of districts of Murshidabad, Nadia, Hoogly, Burdwan and North 24 Parganas. Soils are deep, fertile and neutral reaction (pH 5.5-7.0). The rainfall in this region varies from 1350mm 1450mm. The river Ganga flows

through this vast area and divides the entire plain into three distinct sub-regions – the old delta, the mature delta and the active delta. Districts of Murshidabad and Nadia are the part of the old delta. The districts of Hooghly, and Howrah and part of North 24-Parganas fall under mature delta region. However, the northern segment of South 24-Parganas district is experiencing the formation of delta by the river Ganges. Ganges enters West Bengal near Rajmahal and moves towards south-easterly direction. It gets divided into two branches near north of Dhulian in Murshidabad district. One branch enters Bangladesh which is identified as river Padma and the other branch flows through West Bengal as the Bhagirathi River and Hooghly River in southern direction. Finally it empties its water into Bay of Bengal near Sagar Island in the South 24-Parganas.

c. Coastal Saline Sub-Region

The districts of South 24 Parganas, Howrah and East Midnapore together form the coastal saline sub-region of Lower Gangetic region. A part of the district of East Midnapore along the Bay of Bengal constitutes the coastal plain. The Sundarbans delta is the largest mangrove forest in the world situated in the South 24-Parganas district. A large section of the area remains under water during incoming tides. Soils in this region are mostly of heavy clay type and mostly neutral (pH 6.5-7.5). The average rainfall of this region varies between 1600mm and 1800mm. Salinity and water clogging limits good crop productivity.

d. Red Lateritic Sub-Region

Red Lateritic sub-region which is commonly known as *Rarh* Bengal is the region that intervenes between the Western plateau and high lands and the Ganges Delta. Districts of Birbhum, Bankura, and West Midnapore constitute this region. This region is believed to be created from the soil from the Deccan plateau. The area is formed by the silt brought by the tributaries of the rivers Bhagirathi, Mayurakshi, Ajay, Damodar and Rupnarayan which flow through the western plateau region made up of laterite soil which is acidic (pH 5.5 to 6.2) in nature, red in colour and erosion prone. Average rainfall varies between 1100mm to 1400mm. Moisture holding capacity of the soil is low and poor in nutrient.

4.3.3 Eastern Plateau and Hill Region

The district of Purulia falls under the eastern fringes of the Chota Nagpur Plateau. The district is having undulating lands with isolated peaks and flat plains. The region falls under tropical dry sub-humid climatic zone having rainfall ranging from 1100 mm to 1400mm which spread over only three months, mid-June to mid-September. This makes the district drought prone.

Soils are highly susceptible to erosion, acidic (pH 5.5 to 6.2) and having low water holding capacity.

Therefore, it is evident that the major part of West Bengal is endowed with favourable agro-climatic condition for growth of agricultural production. However, various studies also revealed that growth of agricultural production continued to remain low in West Bengal as well as eastern part of India.

West Bengal: District Map



Map 1

Source: www.mapsofworld.com

West Bengal: Map-Agriculture



Source: www.mapsofworld.com

4.4 Performance of West Bengal in Agriculture: A Review

Most of the studies on trends in agricultural output during colonial period concluded that an absence of upward trend in foodgrain production became a common feature after 1930s. Much of the loss in foodgrain production was compensated by the rise in growth in non-foodgrains, more precisely the cash crops. The growth in foodgrain production stagnated absolutely during depression and war periods. An upward trend has observed only after 1952. At regional level, Punjab emerged as a progressive region on the contrary to agricultural production in Bengal and Bihar that had either deteriorated or stagnated (Shah, 1975: 20-22).

The trend continued even in post-independence period. Commenting on East India (comprising East UP, Bihar, West Bengal and Orissa) and analysing the economic scenario in 1977-78, A Vaidyanathan (1985: 2259) observed that 'not only is poverty incidence high in this region but its overall agricultural performance has been disappointing. The Green Revolution Technologies do not seem to have made much of an impact here. The overall growth rate in agricultural production has averaged barely 2 percent per annum over the last 20-30 years which is in fact less than the rate of population growth'. The stagnation of agricultural production in Eastern region was also identified by Barker and Pal (1979), Report of the Committee headed by S.R. Sen on Agricultural Productivity in Eastern India, Reserve Bank of India (1984), Report of Study Group on Agricultural Strategies for the Eastern Region of India, Planning Commission, Government of India (1985). It was noted in the Seventh Five-Year plan that the gap between the potential and actual yields of rice in eastern India was the highest in India (GoI, 1985).

An in-depth study was carried out by James Boyce (1987) to explore the nature and causes of agricultural stagnation in West Bengal and Bangladesh. He estimated that between 1949 and 1980, the agricultural output grew at a rate of 1.74 percent per annum and rural population and total population of West Bengal grew at 2.31 percent and 2.42 percent per annum during the same period. This created an impasse in agricultural production and had unfavourable distributive impact on the rural population. According to Boyce (*ibid.*), between 1949 and 1980, the productivity of aman grew at a nominal rate of 0.24 percent per annum and annual growth of area under aman rice was also found to be very low (0.57 percent per annum). The abysmal growth of aman rice was identified as the root cause of agricultural stagnation in West Bengal by Boyce. However, a turn around in agricultural growth occurred in eastern region, precisely in West Bengal since the 1980s. Studies by various scholars reaffirmed that the period of post 1980s can conclusively be treated as end of 'agricultural impasse' in West Bengal. Studies of Mridula Sagar and Sundar Raghavan (1989) identified the increase in agricultural growth in eastern India in 1980s as most notable feature in India's agricultural scenario. Harris (1993) also observed a break in stagnation in agricultural production in West Bengal through his micro level studies of three villages in the districts of Birbhum and Burdwan. Abhijit Sen and Ranja Sengupta for West Bengal, Orissa and Bihar observed that a trend break was observed in the rate of growth production and productivity of rice and foodgrain in 1981-82 (Sen and Sengupta, 1995).

In another study conducted by Centre for Monitoring Indian Economy (CMIE,1993), it was observed that the rate of growth in foodgrain production in West Bengal was highest (6.5 percent per annum) among seventeen major states of India during the period 1980-81 to 1992-93. Saha and Swaminathan (1994) also concluded in their districtwise and crop-wise study on agricultural growth in West Bengal in 1980s that agricultural growth accelerated in West Bengal since 1980s except Darjeeling and Jalpaiguri district and index of aggregate crop production increased at a rate of 5 percent per annum between 1981-82 and 1990-91. Bhalla and Singh (1997) estimated the over all growth of agricultural production during the period 1980-83 to 1992-95 and the figure stood at 5.39 percent. Rogaly *et al.*, (1995:1864) concluded that there was rapid growth in agricultural output since 1980s with an average rate of 4 to 5 percent. Rawal and Swaminathan (1998) also had similar conclusions while estimating the growth in agriculture in West Bengal during 1950 to 1996. Manoj Kumar Sanyal, Pradip Kumar Biswas and Samaresh Bardhan (1998), while measuring the growth in foodgrain (disaggregated at district level) observed that between 1977-78 and 1993-94, all-crop production grew at an annual rate of 4.10 percent and yield per hectare grew at 4.97 percent and surpassed the growth of population and hence agriculture in West Bengal came out from long stagnation. They also showed that some western and central Bengal districts experiencing severe decline in agriculture during 1949-65 and a slow recovery during the period 1966-80 were finally placed at high growth trajectory. In a study that covers a period from 1977-78 to 1999-2000, it was estimated that the production of rice and foodgrains grew at a rate of 3.2 percent and 2.6 percent respectively. It was further observed that the growth rate was marginally higher for both rice and foodgrain (3.7 percent and 3.3 percent per annum respectively) between the period 1980-81 and 1999-2000 (Chattopadhyay, 2005).

Evidently, a turn around in West Bengal's agriculture took place during eighties. However, most of the studies regarding deciphering trend in growth in agricultural production and productivity remained confined to at state level in post-1980s barring from the studies made by Saha and Swaminathan (1994), Rawal and Swaminathan (1998), Sanyal *et al.*, (1998) and Chattopadhyay (2005). Among these studies, Rawal and Swaminathan have dealt with relatively longer period. In addition, sub-periods growth in tune with major institutional and policy changes did not receive adequate attention. Their studies mostly remain confined to examine the trend in productivity with an *a priori* assumption that turn around was caused by introduction of land reforms, operation *barga* and introduction of grass root level governance through panachayat.

To fill in the gaps in above studies, we intend to explore the changes in agricultural production, productivity of foodgrains, rice and select non-foodgrains in West Bengal as a whole and at district level. Here, 1970-71 has been chosen as the starting point and the time period continues till 2008-09. The whole period is divided into four sub-periods, viz. 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-2001 to 2008-09. Sub-periods have been created keeping the broad policy interventions in mind. If the 1970 to 1980 was identified as a decade of 'agricultural impasse', then decade of 1980s to 1990s has been identified as end of 'agricultural impasse'. Here distributive measures like land reforms and tenancy reforms, famously known as operation *barga*, introduction of panchayat as a means of grass root level governance and resource mobilisation and generation at village level and introduction of Green Revolution technology in Bengal's agricultural practices. Finally, the period between introduction of economic reforms in 1991 and its onward journey till date, is divided into two sub-periods, 1990-91 to 1999-2000 and 2000-2001 to 2008-09. This has been done to unearth the initial euphoria or pessimism that the introduction of economic reforms created in India and to capture the impact of second generation reforms where in agriculture also got more closely linked with economic reforms.

It is known to us that erstwhile districts of 24 Parganas was split into two districts - South and North 24 Parganas in 1986, West Dinajpur was divided into North and South Dinajpur in 1992 and the district of Midnapore was divided into West and East Midnapore in 2002. However, to maintain the temporal continuity of data, the above mentioned districts were taken as undivided unit. Hence, in our study, we consider 15 districts instead of 19 districts.

Among foodgrains and non-foodgrains in West Bengal, rice is considered both at state as well as district level and potato, jute, sugarcane, Rapeseeds and mustard, linseed and other oilseeds are considered for the state only.

4.5 Methodological Issues on Measurement of Growth

Calculation of growth in the sub-periods (dividing the whole period into sub-periods) has paramount importance in growth analysis. It helps researchers and policy makers to become more inquisitive to make an in-depth study on the impact of various policy interventions or occurrence of unforeseen events in bringing in changes in the growth rate. Three approaches are generally used by various researchers to measure the sub-period growth rates. Early scholars like Das (1978), Alagh and Sharma (1980), Rath (1980) etc., used separate growth functions for each sub-periods. It is pointed out by Srinivasan (1978) that since this method

estimates a large number of parameters, therefore loss of degrees of freedom is inevitable. Alternative to it, the most commonly used method is to fit a single trend equation with dummy variable. A log-linear trend equation with dummy variable for two sub-periods can be written as follows:

$$\ln Y_t = a + b_1 t + b_2 (t.D)$$

Here, $D = 0$ for the first sub-period and $D = 1$ for the second sub-period. Growth rates for first and second sub-periods will be b_1 and $(b_1 + b_2)$. A joint t test is carried on to test the significant differences between two sub-periods' growth rates (Chattopadhyay, 2001:33-34).

Boyce has suggested 'kinked exponential model' to estimate sub-periods growth rates. This also reduces discontinuity bias, provides better basis for growth rate comparison, reduces instability or cyclical fluctuations and uses full set of available information to estimate the growth rates for each sub-period in a single step.

A time series for the period $t = 1, 2, \dots, n$ can be disaggregated at a single point k and can be expressed in a single equation as follows:

$$\ln Y_t = a_1 D_1 + a_2 D_2 + (b_1 D_1 + b_2 D_2)t + u_t \text{ -----(A)}$$

D_j is a dummy variable which takes the value 1 in the j^{th} sub-period and 0 otherwise.

Resultant discontinuity between trend lines of two sub-periods can be removed by imposing a linear restriction such that two trend lines intersect at point k :

$$a_1 + b_1 k = a_2 + b_2 k$$

$$\text{or, } a_2 = a_1 + b_1 k - b_2 k$$

Putting the value of a_2 in equation (A), we shall get the restricted form:

$$\ln Y_t = a_1 + b_1 (D_1 t + D_2 k) + b_2 (D_2 t - D_2 k) + u_t \text{ -----(A1)}$$

If single kink is used, the kinked exponential model can also be specified by re-normalizing time such that $t = 0$ at the break point, k . Then equation (A1) can take the following form and which can be used to estimate the sub-period growth rates with a joint intercept:

$$\ln Y_t = a_1 + b_1 D_1 t + b_2 D_2 t + u_t \text{ -----(A2) (Boyce, 1987: 267,268)}$$

To calculate the exponential growth rate simultaneously for the whole period (1970-71 to 2008-09) and for four sub-periods, we use kinked exponential model. Three kinks (k_1, k_2 and k_3) are introduced to measure the four pre-specified sub-periods.

Here three kinks are used, the kinked exponential model can also be specified by re-normalizing time such that $t = 0$ at the break point k_1 , $t = 10$ at the second break point k_2 and $t = 20$ at the third break point k_3 , then we shall have the following equation which can be used to estimate the growth rates for four sub-periods with a joint intercept:

$$\ln Y_t = a_1 + b_1 D_{1t} + b_2 D_{2t} + b_3 D_{3t} + b_4 D_{4t} + u_t \text{ -----(A3)}$$

Where, $D_1 = 1$ for 1970-1971 to 1979-1980,
 $= 0$ elsewhere.

$D_2 = 1$ for 1980-1981 to 1989-1990,
 $= 0$ elsewhere.

$D_3 = 1$ for 1990-1991 to 1999-2000,
 $= 0$ elsewhere.

$D_4 = 1$ for 2000-2001 to 2008-2009,
 $= 0$ elsewhere.

Due to adjustment on the datasets, kinks arbitrarily placed on the break points (joining points of two consecutive sub-periods) will not lead to distortion in the estimated sub-period growth rates.

Multiplying estimated values of D_{1t} , D_{2t} , D_{3t} and D_{4t} we shall be having growth rates for four sub-periods, viz. 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-2001 to 2008-09.

4.6 Districtwise Foodgrain Production as Percentage of State's Foodgrain Production: The Changing Scenario

Before going into the trend analysis of production, productivity disaggregated at district level, it needs to be considered that how different districts are contributing to the state's foodgrain basket and whether the shares of various districts are changing over the years.

From the Table 4.1, it is evident that since 1970-71 to 2008-09, districts like Midnapore and Burdwan together are producing almost one-third of the foodgrain of the state. Contribution of Murshidabad and 24 Parganas continued to be around 18 to 19 percent. In 1970-71, the contribution of Birbhum to total foodgrain production of the state was 10.3 percent. However, during 1980s and 1990s the share gradually declined and in 2000-01, it reached to 6.5 percent, the share though increased to 8.1 percent in 2008-09. The contribution of West Dinajpur and Bankura to total foodgrain production continued to be between 7 and 8 percent

during the whole period under study (1970-71 to 2008-09). Malda and Nadia remain consistent in their lesser contribution from 4 to 5 and 5 to 6 percent respectively to total foodgrain production of the state since 1970-71 to 2008-09 with minimal variations. The contribution of Hoogly has shown improvement over the first decades, in 1970-71 the contribution was 4.7 percent, it increased to 6.3 percent in 1980-81, it declined to 5.6 percent in 1990-91, it further declined to 3.7 percent in 2000-01 and in 2008-09 the share reached to 5.4 percent. The contribution of Purulia, however, was around 4 percent from 1970-71 to 2008-09 and marginal increase has been observed in the 1980s and in 2008-09. Joint contribution of Jalpaiguri and Darjeeling district is however around 6 to 7 percent over the whole period. Darjeeling's contribution continued to be the lowest among all the districts of West Bengal and it is hovering around 0.8 percent to 1.2 percent during the whole period of 1970-71 to 2008-09. Difficult terrain and limited agricultural and inadequate irrigation facilities are the possible reasons behind negligible contribution to foodgrain production in these districts.

4.7 Share of Rice Production to Total Foodgrain Production: A Districtwise Comparison

It has been observed that in West Bengal, in terms of contribution to total foodgrain production in all the districts, rice has absolute dominance in most of the districts. If we accept the Boyce's argument of continuance of agricultural impasse till 1980 in West Bengal and also accept the findings of the studies conducted during late-80s and 90s where break of impasse was conclusively demonstrated, then rice should have and must have a dominant role to play. This is a historical fact that Bengal possesses vast stretch of alluvial plain created by the river Ganges that makes the region favourable for rice cultivation. We tend to focus on changing share of rice production disaggregated at district level from 1970-71 to 2008-09.

From Table 4.2, it could be seen in that 1970-71, production of rice as percentage of total foodgrain production was around 82 percent and it continued to increase and reached 92.27 percent in 2008-09. It is further evident from Table 4.2 that Burdwan, Bankura, Midnapore, Hoogly, 24 Pargans, West Dinajpur, Birbhum, Purulia, Jalpaiguri and Cooch Behar were primarily concentrating on producing rice than producing any other food crops. For all these districts, the production of rice as percentage of foodgrain was varying between 80 percent and closer to 96 percent. But the exceptional districts were Nadia, Murshidabad, Malda and Darjeeling. For these districts the production of rice as percentage of foodgrain was varying between 52 percent and 62 percent. Over the decades, the concentration of rice increased and reached closer to 99 percent of district's total foodgrain production. In 2008-09, production

of rice as percentage of foodgrain touched 99 percent mark for the districts of Burdwan, Midnapore, Bankura, Hoogly and Howrah.

It exceeds 90 percent mark for 24 Parganas, Birbhum and Purulia. For Nadia and Murshidabad, production of rice as percentage of foodgrain production increased from 52.9 percent and 52.4 percent to respectively 87.1 percent and 78.6 percent. However, the reverse trend was observed for the districts of West Dinapur, Jalpaiguri, Cooch Behar and Darjeeling. It has been observed that for the period 1970-71 to 2008-09, share of rice in total food grain production declined from 86.2 to 81 percent in West Dinajpur, from 98 to 85 percent in Jalpaiguri, from 94 to 87 percent in Cooch Behar and finally, from 60.4 to 53.1 percent for Darjeeling.

Table 4.1: Districtwise Share of Foodgrain Production to Total Foodgrain Production of West Bengal (1970-71 to 2008-09)

1970-71			1980-81			1990-91		
District	Share	Rank	District	Share	Rank	District	Share	Rank
Midnapore	15.3	1	Midnapore	15.6	1	Midnapore	13.8	1
Burdwan	11.1	2	Burdwan	12.4	2	Burdwan	12.7	2
Birbhum	10.7	3	24 Parganas	11.6	3	24 Parganas	10.5	3
Murshidabad	10.1	4	Birbhum	7.7	4	Murshidabad	8.8	4
24 Parganas	8.0	5	Bankura	7.4	5	Bankura	7.7	5
West Dinapur	7.9	6	West Dinapur	7.3	6	West Dinapur	7.5	6
Bankura	7.2	7	Murshidabad	7.2	7	Birbhum	7.5	7
Nadia	5.6	8	Hoogly	6.3	8	Nadia	7.4	8
Hoogly	4.7	9	Nadia	4.8	9	Malda	5.6	9
Malda	4.7	10	Malda	4.7	10	Hoogly	5.4	10
Cooch Behar	4.1	11	Purulia	4.3	11	Cooch Behar	3.8	11
Purulia	4.0	12	Jalpaiguri	3.9	12	Purulia	3.6	12
Jalpaiguri	4.0	13	Cooch Behar	3.7	13	Jalpaiguri	2.4	13
Howrah	1.5	14	Howrah	1.9	14	Howrah	2.1	14
Darjeeling	1.1	15	Darjeeling	1.2	15	Darjeeling	1.1	15
2000-01			2008-09					
District	Share	Rank	District	Share	Rank			
Midnapore	19.1	1	Midnapore	16.9	1			
Burdwan	11.5	2	Burdwan	11.6	2			
24 Parganas	11.3	3	24 Parganas	10.3	3			
West Dinapur	8.8	4	Murshidabad	8.8	4			
Bankura	7.4	5	West Dinapur	8.8	5			
Murshidabad	7.1	6	Birbhum	8.1	6			
Birbhum	6.5	7	Bankura	6.3	7			
Nadia	6.1	8	Nadia	5.6	8			
Malda	5.0	9	Hoogly	5.4	9			
Cooch Behar	4.2	10	Malda	5.0	10			
Purulia	3.7	11	Purulia	4.7	11			
Hoogly	3.7	12	Cooch Behar	3.5	12			
Jalpaiguri	3.2	13	Jalpaiguri	2.8	13			
Howrah	1.6	14	Howrah	1.3	14			
Darjeeling	0.8	15	Darjeeling	0.8	15			

Source: Compiled from various volumes of West Bengal Economic Review, Government of West Bengal

Table 4.2: Districtwise Production of Rice as percentage of Districtwise Foodgrain Production

Year/Dist	1970-71	1980-81	1990-91	2008-09
Burdwan	89.6	97.5	99.5	99.6
Birbhum	75.9	92.3	96.3	91.4
Bankura	95.3	96.5	97.4	99.2
Midnapore	94.5	97.4	98.1	99.2
Howrah	89.6	94.9	99.0	99.5
Hoogly	82.6	97.1	99.7	99.5
24 Parganas	89.6	95.8	97.3	97.9
Nadia	52.9	70.4	83.7	87.1
Murshidabad	52.4	70.3	78.9	78.6
West Dinapur	86.2	80.7	90.7	81.2
Malda	62.0	74.4	77.7	80.0
Jalpaiguri	98.1	92.2	90.7	85.8
Darjeeling	60.4	53.4	50.9	53.1
Cooch Behar	94.6	91.4	92.9	87.7
Purulia	93.3	96.0	92.3	97.2
West Bengal	81.94	90.15	92.58	92.27

Source: Compiled from the data collected from various volumes of West Bengal Economic Review, Government of West Bengal

4.8 Districtwise Variation in Rice Production as Percentage to State's Foodgrain Production (1970-71 to 2008-09)

Above depiction clearly reveals that rice has the overwhelming domination over the foodgrain production in West Bengal. Table 4.3 allows us to trace how different districts are performing between 1970-71 and 2008-09 towards the total production of the state. It has been observed that districts of Midnapore and Burdwan together have continued to produce almost one-third of the total rice production of the state. In 1970-71, the contribution of the districts of Birbhum, 24 Parganas, Bankura, West Dinajpur to the total rice production of the state was 35.2 percent. It marginally declined to 34.2 percent in 1980-81 and this was due to the fall in share of Birbhum and West Dinajpur.

The collective share remained static since 1991 at around 33 percent till 2008-09. For the district of Hoogly, the share increased by two percentage points in 1980-81 in comparison to 1970-71 (from 6.8 percent to 8.8 percent), while it continued to decline during 1990s and 2000-01 and marginally increased to 5.8 percent in 2008-09. For the district of Murshidabad, the share remained constant at 6.5 percent in 1970-71 and 1980-81. It increased to 7.5 percent in 1990-91 but in 2001 the share of the district to the total rice output of the state came down to 4.4 percent. However, an upsurge in production took place between 2000-01 and 2008-09 and the percentage share to total state's rice production reached 7.5 percent. The district Nadia, also improved its contribution from 1980-81 to 1990-91, to total rice output of the state reaching 6.7 percent from 3.8 percent. However, the share came down to 5.3 percent in 2008-09. The contribution of Purulia, Cooch Behar, Malda continued to remain low, mostly static and rather declined marginally over the periods.

Table 4.3: Districtwise Share of Rice Production to Total Rice Production of West Bengal

1970-71			1980-81			1990-91		
Districts	Share	Rank	Districts	Share	Rank	District	Share	Rank
Midnapore	17.6	1	Midnapore	16.8	1	Midnapore	14.7	1
Burdwan	12.2	2	Burdwan	13.4	2	Burdwan	13.6	2
Birbhum	9.9	3	24 Parganas	12.4	3	24 Parganas	11.1	3
24 Parganas	8.7	4	Bankura	7.9	4	Bankura	8.1	4
Bankura	8.3	5	Birbhum	7.8	5	Birbhum	7.8	5
West Dinapur	8.3	6	Hoogly	6.8	6	Murshidabad	7.5	6
Murshidabad	6.5	7	West Dinapur	6.5	7	West Dinapur	7.4	7
Hoogly	4.8	8	Murshidabad	5.6	8	Nadia	6.7	8
Jalpaiguri	4.7	9	Purulia	4.6	9	Hoogly	5.9	9
Cooch Behar	4.7	10	Jalpaiguri	3.9	10	Malda	4.7	10
Purulia	4.6	11	Malda	3.8	11	Cooch Behar	3.9	11
Nadia	3.6	12	Nadia	3.8	12	Purulia	3.6	12
Malda	3.5	13	Cooch Behar	3.7	13	Jalpaiguri	2.4	13
Howrah	1.7	14	Howrah	2.0	14	Howrah	2.2	14
Darjeeling	0.8	15	Darjeeling	0.7	15	Darjeeling	0.6	15

2000-01			2008-09		
Districts	Share	Rank	Districts	Share	Rank
Midnapore	20.8	1	Midnapore	18.2	1
Burdwan	12.6	2	Burdwan	12.5	2
24 Parganas	12.1	3	24 Parganas	11.0	3
West Dinapur	8.8	4	Birbhum	8.1	4
Bankura	8.0	5	West Dinapur	7.7	5
Birbhum	6.4	6	Murshidabad	7.5	6
Nadia	5.2	7	Bankura	6.8	7
Murshidabad	4.4	8	Hoogly	5.8	8
Malda	4.2	9	Nadia	5.3	9
Cooch Behar	4.2	10	Purulia	4.9	10
Hoogly	4.1	11	Malda	4.4	11
Purulia	3.8	12	Cooch Behar	3.3	12
Jalpaiguri	3.1	13	Jalpaiguri	2.6	13
Howrah	1.8	14	Howrah	1.4	14
Darjeeling	0.4	15	Darjeeling	0.5	15

Source: Compiled from various volumes of West Bengal Economic Review, Government of West Bengal

The picture depicted above clearly shows that rice dominates the foodgrain production of the state and bulk of the rice production is coming from Midnapore, Burdwan, Birbhum, 24

Parganas, Bankura, and West Dinajpur, albeit declining production in Birbhum, Bankura, and West Midnapore under red lateritic sub-region, which is less fertile in comparison to new alluvium zone of lower Gangetic region. Nadia and Hoogly are though falling under fertile new alluvium zone of lower Gangetic region, but in terms of their contribution to total rice output of the state, they are falling behind the aforementioned districts located in Red Lateritic sub-region. The table reveals that for the districts of West Dinapur, Jalpaiguri, Cooch Behar and Darjeeling, share of rice to districts' foodgrain production has declined. This indicates that farmers are either opting for other foodgrains or non foodgrains or cash crops. The reasons behind consistent decline in rice production in certain districts have not been delineated in this chapter. However, the answer has been attempted in Chapter-VI where crop diversification has been discussed at length. Wherein it has also been explored that in the districts where share of rice production has declined, whether the farmers switched to foodgrains like wheat and non foodgrains like jute, potato, oilseeds etc., or not.

However, it is necessary to mention that lower share to total output does not imply lower productivity because smaller geographical area may limit the land available for cultivation. Therefore, our thrust area automatically becomes the productivity and it is worthy to note that productivity also gets influenced either by pure yield effect or by area effect or simultaneous impact of both may influence the productivity in positive or negative direction.

4.9 Productivity Trend in Foodgrain and Rice (1970-71 to 2008-09): Inter-District Analysis

To understand the districtwise changes in absolute productivity of foodgrain production and rice since 1970-71 to 2008-09, (Table 4.4 and Table 4.5) six categories were created - high productivity (more than 2500 kg/ha), medium productivity (2000-2500 kg/ha), medium-low productivity (1500-2000 kg/ha), low productivity (1000-1500 kg/ha) and very low productivity (less than 1000 Kg/ha). In addition, figure 4.A and 4.B will provide us a comprehensive comparative picture of productivity of foodgrains and rice for India vis-à-vis West Bengal from 1970-71 to 2008-09.

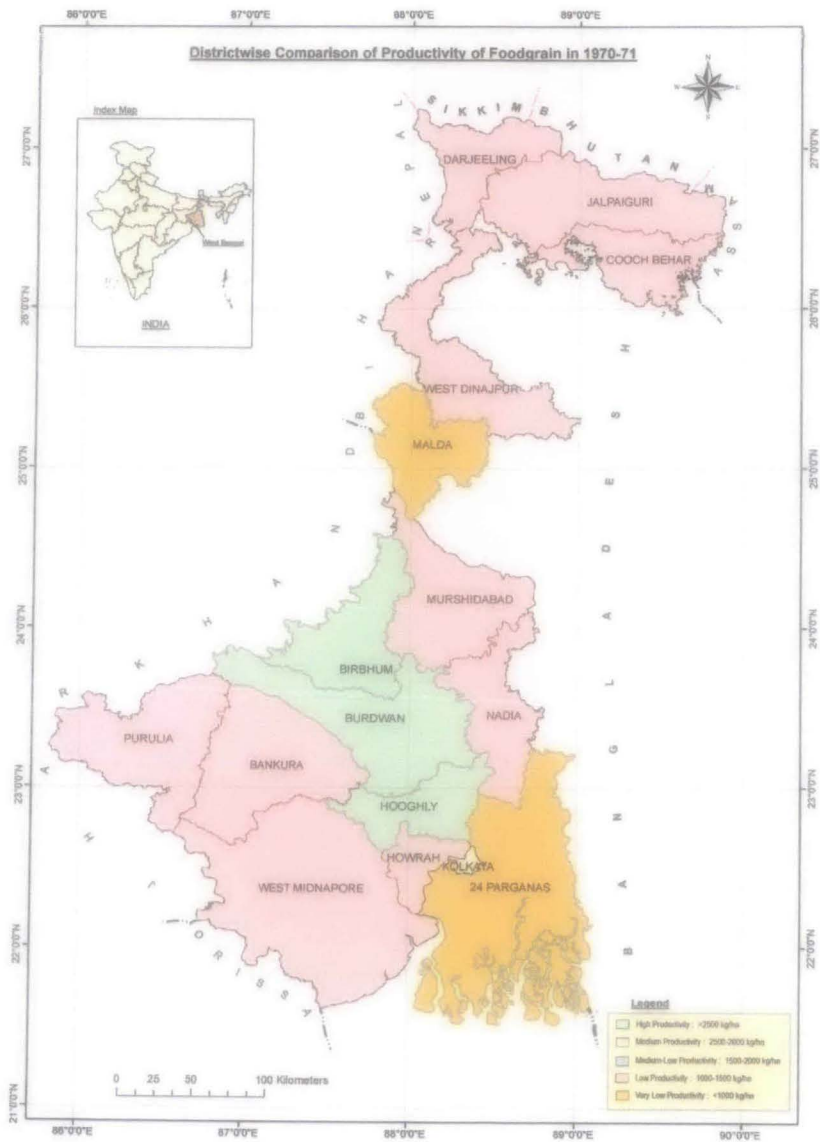
Table 4.4: Districtwise Comparison of Productivity of Foodgrain over the Decades

Range of Productivity / Year	1970-71	1980-81	1990-91	2000-2001	2008-09
High Productivity (Greater than 2500 kg/ha)				Burdwan, Hoogly	Birbhum, Hoogly, Burdwan, Murshidabad, Malda, Bankura, Nadia, West Dinajpur
Medium Productivity (2000-2500 kg/ha)			Burdwan, Hoogly, Birbhum,	Birbhum, Nadia, Midnapore, Murshidabad, Bankura, Howrah, Malda, West Dinajpur, 24 Parganas	Midnapore, Purulia, 24 Parganas, Darjeeling
Medium-Low Productivity (1500-2000 kg/ha)	Birbhum, Burdwan, Hoogly	Hoogly, Burdwan, Birbhum, Bankura	Bankura, Nadia Howrah, 24 Parganas, Midnapore, Purulia, Malda, Murshidabad	Howrah, Darjeeling, Cooch Behar, Purulia	Howrah, Jalpaiguri, Cooch Behar
Low Productivity (1000-1500 kg/ha)	Bankura, Murshidabad, Howrah, Midnapore, Jalpaiguri, West Dinajpur, Cooch Behar, Nadia	24 Parganas, Malda, Murshidabad, Midnapore, Purulia, Howrah, Nadia, Darjeeling, Jalpiaguri, West Dinajpur, Cooch Behar	Darjeeling, Jalpaiguri, West Dinajpur, Cooch Behar	Jalpaiguri	
Very Low Productivity (Less than 1000 kg/ha)	Malda, 24 Parganas				

Source: Calculation based on data on production and area collected from various volumes of West Bengal Economic Review, Government of West Bengal

It is evident from the Table 4.4 and 4.5, that in 1970-71, in foodgrain as well as in rice production, none of the districts in West Bengal has achieved medium productivity. For foodgrain, in Burdwan, Birbhum and Hoogly and for rice, Burdwan and Birbhum were having productivity between 1500 kg/ha and 2000 kg/ha and in terms of our classification it is falling under medium-low category segment. Exceptionally, 24 Parganas for foodgrain and rice and Malda for rice fell under very low productivity category (less than 1000 kg/ha), while rest of the districts achieved foodgrain productivity as well as productivity in rice between 1000 kg/ha to 1500 kg/ha. From the data available with the Directorate of Economics and Statistics, Government of India, in 1970-71, the all-India average of foodgrain productivity and rice productivity were 872 kg/ha and 1123 kg/ha vis-à-vis figures for West Bengal that stood at 1224 kg/ha and 1239 kg/ha respectively for foodgrain and rice. The over all scenarios on productivity front for foodgrain and rice did not change much in

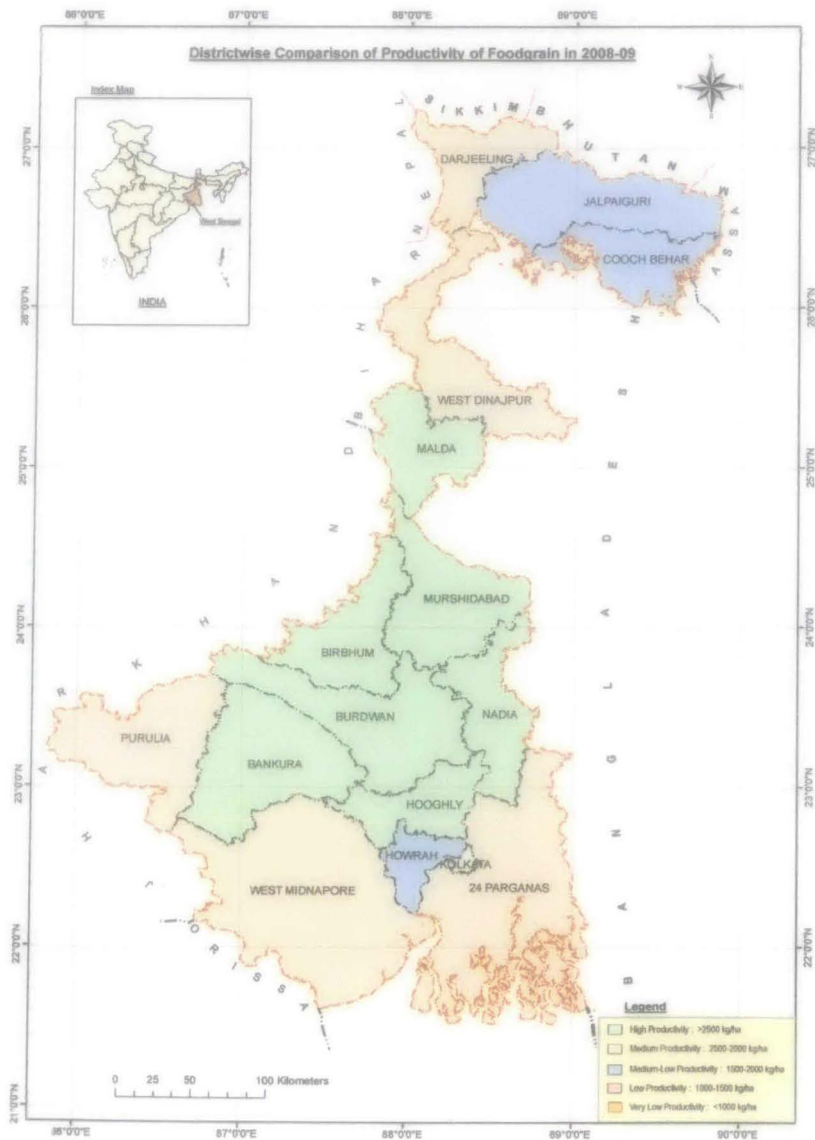
1980-81. In terms of foodgrain productivity, 24 Parganas and Malda shifted from very low productivity to low productivity category and Bankura from low productivity category to medium-low productivity category. For rest of the districts, the status remained unchanged. In terms of rice productivity, 24 Parganas, Malda, Bankura and Hoogly have made progress and had shown a rising trend. In the decade of the 1980s, foodgrain productivity and rice productivity in West Bengal remained higher than all-India average.



Map 3

Between 1980-81 and 1990-91, barring Darjeeling, Jalpaiguri, Cooch Behar and West Dinajpur, rest of the districts of West Bengal showed upward movement in productivity of foodgrain production. For the districts of Burdwan, Birbhum and Hoogly, foodgrain productivity has increased from 1500-2000 kg/ha to 2000-2500 kg/ha. 24 Paragans, Malda,

Murshidabad, Purulia and Nadia moved up from low productivity (1000-1500 kg/ha) to medium low productivity category (1500-2000 kg/ha). Increase in productivity was sharper for rice from 1980-81 to 1990-91. Rice productivity for Burdwan district crossed 2500 kg/ha. Murshidabad, Nadia, were in low productivity category (1000-1500 kg/ha) for rice in 1980-81 and these two districts reached medium productivity segment with productivity 2000-2500Kg/ha in 2000-01. Districts like 24 Parganas, Malda, Howrah, West Dinajpur, Midnapore and Cooch Behar also showed improvements in productivity and these districts moved up from low productivity segment to medium low productivity category. However, productivity for rice remained almost unchanged for the districts of Purulia, Jalpaiguri and Darjeeling.



Map 4

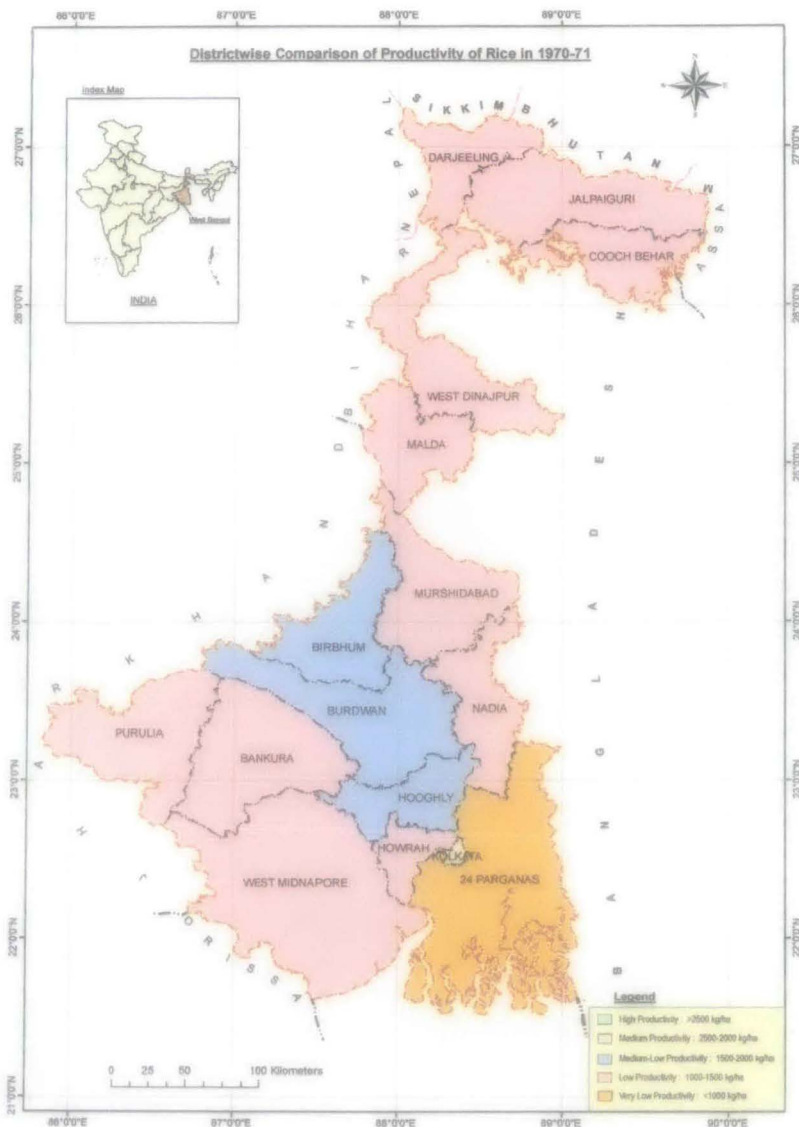
Table 4.5: Districtwise Comparison of Productivity of Rice over the Decades

Range of Productivity / Year	1970-71	1980-81	1990-91	2000-2001	2008-09
High Productivity (Greater Than 2500 kg/ha)			Burdwan	Nadia, Burdwan, Hoogly, Bankura, Birbhum	Birbhum, Malda, Nadia, Hoogly, Burdwan, Murshidabad, Bankura
Medium Productivity (2000-2500 kg/ha)		Hoogly	Murshidabad, Hoogly, Nadia, Birbhum,	Murshidabad, Malda, Midnapore, West Dinajpu, 24 Parganas	Purulia, Midnapore, 24 Parganas, West Dinajpur
Medium -Low Productivity (1500-2000 kg/ha)	Birbhum, Burdwan, Hoogly	Burdwan, Birbhum, Bankura	Bankura, , Malda, Howrah, 24 Parganas, West Dinajpur, Midnapore, Cooch Behar	Howrah, Purulia, Cooch Behar, Darjeeling	Darjeeling, Howrah, Jalpaiguri, Cooch Behar
Low Productivity (1000-1500 kg/ha)	Bankura, Murshidabad, Howrah, Midnapore, Darjeeling, Jalpaiguri, West Dinajpur, Purulia, Cooch Behar, Nadia, Malda	24 Parganas, Malda, Murshidabad, Midnapore, Purulia, Nadia, Darjeeling, Howrah, Jalpiaguri, West Dinajpur, Cooch Behar	Purulia, Jalpaiguri, Darjeeling	Jalpaiguri	
Very Low Productivity (Less than 1000 kg/ha)	24 Parganas				

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

The upward movement in productivity of foodgrain also continued between 1990-91 and 2000-01 for majority of the districts of West Bengal. Burdwan and Hoogly crossed the 2500 kg/ha mark in rice productivity. Bankura, Nadia, Howrah, 24 Parganas, Midnapore, Malda and Murshidabad moved from medium-low productivity segment to medium productivity segment. West Dinapur improved its foodgrain productivity substantially and it moved up from 1000-1500 kg/ha to 2000 kg/ha Even Darjeeling and Cooch Behar shifted from low productivity segment to medium-low productivity segment. However, Jalpaiguri, the only district of West Bengal stayed permanently in low productivity region in foodgrain productivity. The upward trend in rice productivity continued from 1990-91 to 2000-2001. Burdwan maintained consistency in rice productivity at 2500 kg/ha. The districts of Nadia, Hoogly and Birbhum joined in this category by moving up from medium productivity to the category of high productivity. Bankura showed most spectacular performance during this decade. It progressed from medium-low productivity segment to high productivity segment.

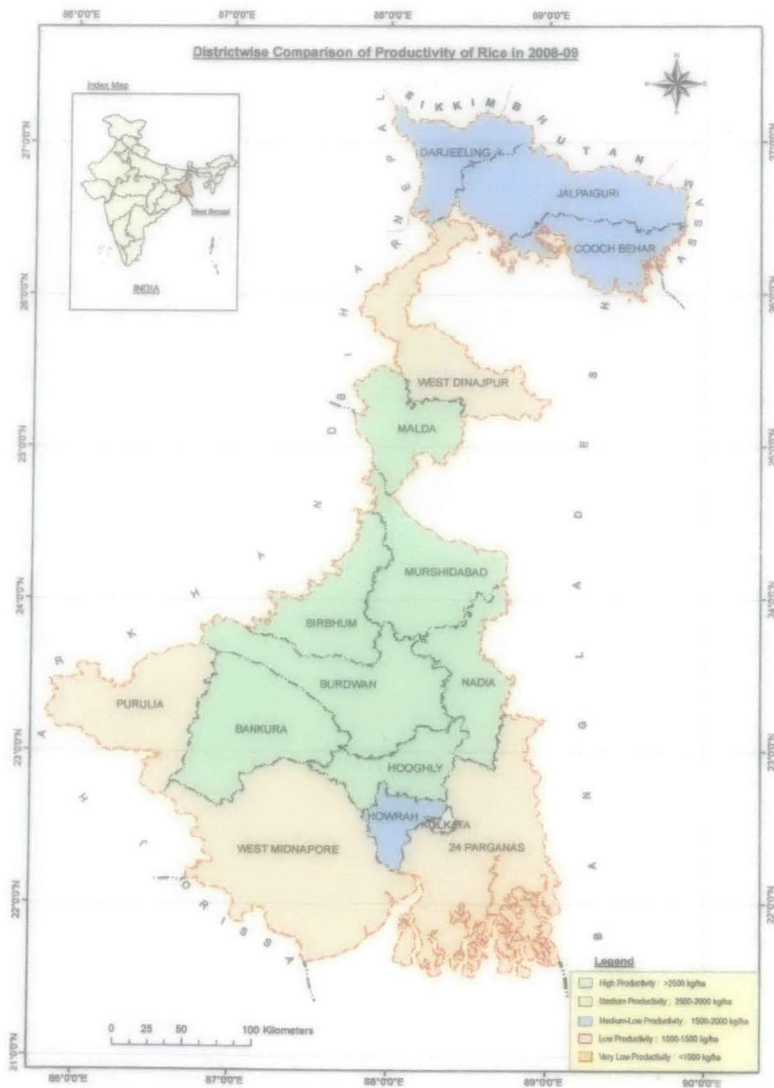
Malda, Midnapore, West Dinajpur and 24 Parganas also shifted from medium-low productivity to medium productivity range. Situation of Howrah and Cooch Behar remained unaltered. Purulia, Darjeeling also increased their productivity from medium-low productivity to medium productivity segment.



Map 5

The upward trend in foodgrain and rice productivity continued between 2000-01 and 2008-09. The statement gets substantiated on the ground that during 2000-01, only Burdwan and Hoogly were the two districts in West Bengal who achieved productivity greater than 2500 kg/ha. In 2008-09, along with Burdwan and Hoogly, Birbhum, Bankura, Malda, Murshidabad, Nadia and West Dinajpur also reached high productivity segment. In case of rice, Malda and Murshidabad moved to high productivity segment with the other consistent

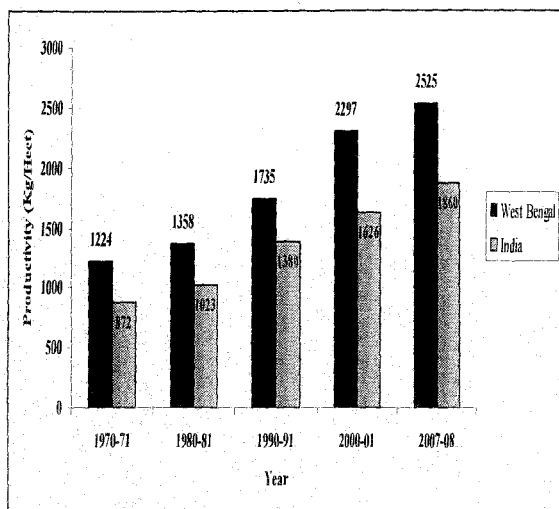
performer districts like Nadia, Burdwan, Hoogly, Birbhim, Bankura. However, Midnapore, Purulia, 24 Parganas and Darjeeling could increase their foodgrain productivity and remained at medium productivity (2000-2500 kg/ha) segment with Howrah, Jalpaiguri and Cooch Behar. In case of rice productivity, Midnapore, Purulia, 24 Parganas and West Dinajpur failed to cross the productivity level of 2500 kg/ha and continued to be in medium productivity category. Darjeeling, Howrah, Cooch Behar also failed to improve their productivity over 2000-01 and remained at medium-low productivity segment till 2008-09. Jalpaiguri improved its position and moved up from low productivity to medium-low productivity level.



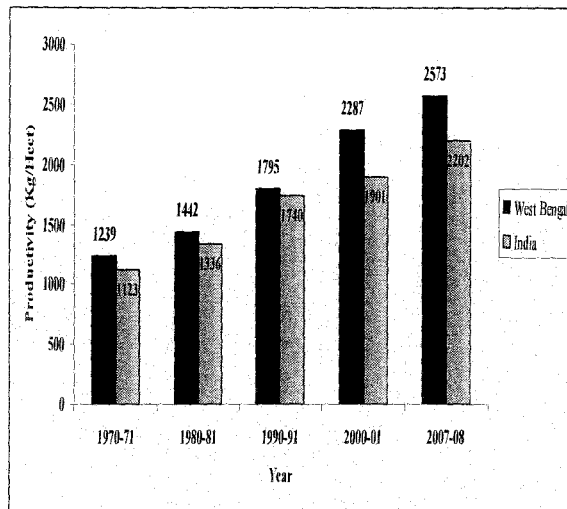
Map 6

Figure 4.A: Comparison of Foodgrain Productivity (kg/ha) between West Bengal and India

Figure 4.B: Comparison of Productivity (kg/ha) of Rice between West Bengal and India



4A



4B

Source: Directorate of Economics and Statistics, Government of India

4.10 Estimated Growth Rates in Agricultural Production: Cropwise and Districtwise Disaggregated Estimation

Growth trend in production or productivity of foodgrains, non-foodgrains, in different districts of West Bengal have undergone changes due to agro-climatic conditions, state government policies on or before reform period, and overall economic condition of the agricultural population. In consideration of the main objective of this study estimation of sub-period growth rates of foodgrains, rice and wheat in the districts has been undertaken to evaluate the performance of agriculture before and after reform period. The sub period growth rates have been estimated from the fitted kinked trend equations on the adjusted time series data, dividing the whole period into four sub-periods as mentioned earlier. Along with the sub-periods' growth rates, trend breaks have also been estimated to identify statistical difference between two sub-period growth rates. As it has been observed by Boyce that the estimated growth rates in each sub-period may be higher or lower than that in the period as a whole. The primary reason is that trend estimates are mostly affected by the extreme observations (generally considered as outlier) those at the beginning and end of the series and trend estimates are seldom affected by the values at or near the midpoint of the time series. Therefore, in case of agriculture, extreme bad or very good crop years occur near the midpoint of the time series; estimated growth rate for the whole period will hardly be affected but if the same happens at the beginning or end of any sub-periods, (if the whole period is divided into various sub-periods), then the estimated growth rates for sub-periods are bound

to differ significantly from the whole series. Therefore, growth rates for different sub-periods suffer from 'discontinuity bias.'

4.10.1 Inter-District Comparison of Growth in Production and Productivity of Foodgrain in West Bengal

Over the whole period 1970-71 to 2008-09, the exponential growth of foodgrain production for West Bengal stood at 2.6 percent per annum and significant at 1 percent level (Table 4.6). Districtwise exponential growth rates of foodgrain production from 1970-71 to 2008-09, reveal that Burdwan, Bankura, Midnapore, Howrah, Nadia, Murshidabad, West Dinapur and Purulia achieved more than 2.5 percent growth per annum and as per t-statistics growth rates for these districts are statistically significant at 1 percent level. Among these districts Nadia and Bankura achieved growth rate of 3 percent. Again, foodgrain production grew at an exponential rate between 2 to 2.5 percent in Birbhum, Malda, 24 Parganas and Cooch Behar. Jalpaiguri and Darjeeling registered lowest rate of growth in foodgrain production at 1.3 percent and 1.1 percent respectively.

To capture the changes in growth rates over different sub-periods for foodgrain production in the districts of West Bengal, the study considered four different sub-periods. The first sub-period is 1970-71 to 1979-80. This period has unanimously been identified by all the researchers as the period of absolute agricultural stagnation. And our results reiterated the fact that for almost all the districts excepting Howrah and 24 pargans the growth rates are negative for all the districts.

A massive turn around has been observed in the growth rate in foodgrain production since 1980-81. In sub-period II i.e., between 1980-81 and 1989-90, foodgrain production in West Bengal grew at an exponential rate of 4 percent per annum. Among the districts, most impressive growth was achieved by Purulia where foodgrain production grew at a rate of 6.2 percent, highest among all the districts in West Bengal. Bankura, Midnapore, Howrah and Nadia achieved growth rates between 5 and 6 percent. Growth of foodgrain production in districts like Birbhum, West Dinajpur, Burdwan were observed to be 3.5 percent to 5 percent. For Malda, Cooch Behar and 24 Parganas, foodgrain production grew at 3 to 3.5 percent, where as for Hoogly, Darjeeling and Murshidabad the growth figures stood at between 2 and 3 percent. Lowest growth rate was achieved by Jalpaiguri district (less than 2 percent). The values of trend break help us to specify the extent of gain or loss in growth rates for a particular sub-period in comparison to previous sub-period. Trend break-I reveals that in sub-period II, highest gain in growth of foodgrain production over sub-period: I was achieved by

Purulia (10 percent). Significant gains in growth rates were also achieved by Bankura (7 percent), Midnapore (6.4 percent), Birbhum (5.7 percent), Howrah (5 percent), West Dinajpur (4.6 percent) and Nadia (4.3 percent). All the districts in West Bengal had positive trend break excepting the district of Darjeeling which showed a loss in growth rate of 0.2 percent over sub-period-I. For West Bengal a net gain of 4.3 percent was achieved in sub-period II (1980-81 to 1989-90) in comparison to sub-period I (1970-71 to 2008-09).

Table 4.6: Districtwise Kinked Exponential Growth in Production of Foodgrain in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

Dist/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend break I	Trend break II	Trend break III	DW	R ²
Burdwan	2.8 (14.9)*	0.5 (0.5)	3.8 (4.4)*	4.0 (11.1)*	2.9 (12.5)*	3.4	0.2	-1.1	1.5	0.9
Birbhum	2.4 (9.5)*	-2.1 (-1.5)	3.6 (2.9)*	3.4 (6.4)*	3.1 (9.1)*	5.7	-0.2	-0.3	1.6	0.8
Bankura	2.7 (9.4)*	-1.7 (-1.1)	5.2 (3.9)*	4.7 (8.3)*	3.2 (8.6)*	7.0	-0.5	-1.5	1.9	0.8
Midnapore	3.0 (14.0)*	-1.0 (-0.9)	5.3 (5.1)*	4.4 (10.0)*	3.6 (12.6)*	6.4	-0.9	-0.8	1.6	0.9
Howrah	2.6 (9.1)*	0.9 (0.6)	5.9 (4.0)*	3.8 (6.2)*	2.8 (7.0)*	5.0	-2.1	-1.1	1.3	0.8
Hoogly	2.2 (11.4)*	-0.6 (-0.5)	2.7 (2.8)*	3.2 (7.8)*	2.6 (9.6)*	3.3	0.5	-0.7	2.1	0.8
24 Parganas	2.6 (12.3)*	1.8 (1.4)	3.4 (3.0)*	3.4 (7.0)*	2.6 (8.3)*	1.6	0.0	-0.8	1.5	0.8
Nadia	3.0 (12.8)*	1.3 (1.1)	5.6 (5.2)*	4.4 (9.7)*	3.0 (10.3)*	4.3	-1.2	-1.4	1.0	0.9
Murshidabad	2.6 (13.0)*	-0.4 (-0.3)	2.9 (3.0)*	3.4 (8.4)*	3.0 (11.5)*	3.3	0.5	-0.4	1.8	0.9
West Dinajpur	3.0 (17.6)*	-0.9 (-1.2)	3.7 (5.2)*	3.9 (13.0)*	3.6 (18.7)*	4.6	0.2	-0.3	2.0	0.9
Malda	2.5 (16.2)*	0.9 (1.1)	3.5 (4.6)*	3.5 (10.8)*	2.6 (12.6)*	2.6	0.0	-0.9	1.5	0.9
Jalpaiguri	1.3 (6.4)*	-1.2 (-1.0)	1.3 (1.3)	1.3 (3.0)*	1.9 (6.7)*	2.5	0.0	0.6	1.9	0.7
Darjeeling	1.1 (2.7)*	2.9 (1.8)**	2.6 (1.8)**	2.4 (4.0)*	0.4 (1.1)	-0.3	-0.2	-2.0	1.3	0.6
Cooch Behar	2.0 (13.0)*	0.6 (0.7)	3.0 (3.6)*	2.1 (5.8)*	2.3 (10.2)*	2.4	-0.9	0.3	1.4	0.8
Purulia	2.7 (7.8)*	-3.8 (-1.9)**	6.2 (3.5)*	4.1 (5.6)*	3.9 (8.2)*	10.0	-2.1	-0.3	2.4	0.7
West Bengal	2.6 (16.0)*	-0.3 (-0.4)	4.0 (5.1)*	3.7 (11.2)*	3.0 (14.0)*	4.3	-0.3	-0.7	1.5	0.9

T stats are shown in parenthesis

*Significant at 1% level, **Significant at 5% level, ***Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

However, in sub-period III and IV, majority of the districts failed to maintain the high growth rates in foodgrain production achieved in sub-period II. In sub-period III (1990-91 to 1999-2001), a fall in growth rates of foodgrain production between 1 and 2 percentage points was observed for Purulia, Bankura, Midnapore, Howrah, Nadia and Cooch Behar. Marginal

increase in growth rate was observed for Burdwan, West Dinajpur, Murshidabad and Hoogly. For Malda and Jalpaiguri, growth rates remained constant. Finally, in sub-period IV (2000-01 to 2008-09) growth of foodgrain production further declined for almost all the districts in West Bengal. Marginal fall (less than 0.5 percent) was observed for Purulia, Birbhum, West Dinajpur and Murshidabad. Darjeeling, Bankura, Burdwan, and Nadia experienced a fall in growth rate in foodgrain production between 1 and 2 percent. Malda, 24 Parganas and Hoogly observed a decline in growth rates of foodgrain production closer to 1 percent in comparison to sub-period III (1990-91 to 1999-2000). Marginal increase however was observed for Cooch Behar and Jalpaiguri. For the state as a whole, a fall of 0.7 percent was observed in the growth rate in foodgrain production.

During 1970-71 to 2008-09, foodgrain productivity (Table 4.7) in West Bengal grew at an exponential rate of 2.5 percent per annum and the growth rate was found to be statistically significant at 1 percent level. Districts like Midnapore, Nadia and West Dinajpur achieved 3 percent growth rate per annum over the whole period. Foodgrain productivity grew between 2.5 percent and 2.8 percent for Burdwan, Bankura, Howrah, Mursidabad, 24 Parganas and Malda. The growth rates of foodgrain productivity ranges between 2 percent and 2.4 percent for Birbhum, Hoogly and Cooch Behar. Jalpaiguri and Darjeeling occupied the lowest rung compared to other districts from 1970-71 to 2008-09 and stood at less than 2 percent.

However, the growth of productivity of foodgrain in first sub-period remained negative and insignificant for Birbhum, Bankura, Midnapore, Howrah, Hoogly, Murshidabad, West Dinajpur, Cooch Behar and Purulia. For Hoogly, Murshidabad, 24 Parganas and Darjeeling, growth rate in foodgrain productivity was found to be positive but insignificant. Only three districts, Burdwan, Nadia and Malda achieved growth rates of productivity respectively 1.6 percent, 2.2 percent and 2.7 percent, which were found to be significant. For the state, as a whole, the growth rate in productivity was only 0.2 percent and statistically insignificant.

Major turn around in growth in foodgrain productivity was observed from 1980-81 to 1989-90 or sub-period: II. Bankura, Midnapore, Howrah and Nadia experienced statistically significant (at 1 % level) exponential growth rate which was more than 5 percent per annum. Birbhum and West Dinajpur also experienced impressive growth rates of productivity and grew at rates lying between 4 and 4.9 percent. 3 to 4 percent growth rates in productivity for foodgrains was observed for Burdwan, 24 Parganas, Murshidabad, Malda and purulia. Hoogly, Jalpaiguri and Cooch Behar experienced growth rates between 2 and 3 percent.

Darjeeling achieved growth rate of 1.7 percent which was lowest among all the districts of West Bengal. In West Bengal, the growth rate stood at 3.9 percent.

Table 4.7: Districtwise Kinked Exponential Growth in Productivity of Foodgrain in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

Dist/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend break I	Trend break II	Trend break III	DW	R ²
Burdwan	2.2 (15)*	1.6 (1.9)**	3.1 (4.4)*	2.9 (9.8)*	2.1 (11.0)*	1.6	-0.2	-0.8	1.3	0.9
Birbhum	2.4 (13)*	-0.7 (-0.7)	4.4 (4.7)*	3.4 (8.7)*	2.8 (11.2)*	5.1	-1.0	-0.6	1.5	0.9
Bankura	2.7 (13.2)*	-0.9 (-0.8)	5.0 (5.0)*	4.0 (9.7)*	3.2 (11.8)*	5.9	-0.9	-0.9	1.8	0.9
Midnapore	2.6 (13.9)*	-0.7 (-0.6)	5.2 (5.6)*	3.7 (9.6)*	3.1 (12.4)*	5.8	-1.5	-0.6	1.6	0.9
Howrah	2.0 (8.6)*	-0.2 (-0.2)	5.3 (4.6)*	2.9 (6.1)*	2.3 (7.5)*	5.5	-2.4	-0.6	1.7	0.7
Hoogly	1.8 (14.1)*	0.3 (0.3)	2.8 (4.1)*	2.5 (8.8)*	2.0 (10.9)*	2.5	-0.3	-0.5	2.2	0.9
24 Parganas	2.4 (13.4)*	1.7 (1.4)	3.2 (3.1)*	2.9 (6.8)*	2.5 (9.0)*	1.6	-0.3	-0.4	1.6	0.8
Nadia	2.9 (16.7)*	2.2 (2.6)*	5.1 (6.7)*	3.9 (12.2)*	2.8 (13.8)*	2.9	-1.2	-1.0	1.5	0.9
Murshidabad	2.4 (14.4)*	0.5 (0.5)	3.2 (4.3)*	3.5 (11.2)*	2.6 (13.1)*	2.7	0.3	-0.8	1.7	0.9
West Dinapur	3.0 (18.3)*	-0.9 (-1.2)	4.0 (5.9)*	4.1 (14.2)*	3.6 (19.4)*	4.9	0.1	-0.5	2.1	0.9
Malda	3.3 (32.2)*	2.7 (4.2)*	3.6 (6.3)*	3.6 (15.0)*	3.3 (21.5)*	0.9	0.0	-0.3	1.6	1.0
Jalpaiguri	1.5 (7.6)*	-2.4 (-2.4)*	2.0 (2.3)*	1.9 (5.3)*	2.3 (9.6)*	4.4	-0.1	0.3	2.5	0.8
Darjeeling	1.7 (6.1)*	1.7 (1.2)	1.7 (1.3)	2.9 (5.5)*	1.5 (4.4)*	-0.1	1.2	-1.4	1.7	0.7
Cooch Behar	2.0 (13.9)*	-0.7 (-0.9)	2.6 (4.1)*	2.2 (8.1)*	2.6 (14.8)*	3.3	-0.5	0.4	1.6	0.9
Purulia	2.4 (9.2)*	-2.0 (-1.3)	4.7 (3.5)*	3.0 (5.3)*	3.3 (9.1)*	6.6	-1.7	0.3	2.5	0.8
West Bengal	2.5 (18.8)*	0.2 (0.2)	3.9 (6.0)*	3.3 (12.3)*	2.8 (15.9)*	3.7	-0.5	-0.6	1.6	0.9

T stats are shown in parenthesis

Significant at 1% level, ** Significant at 5% level, *Significant at 10% level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

It is observed that the period from 1980-81 to 1989-1990 (sub-period II), was identified as period of agricultural turn around in West Bengal. Significant rise in growth of foodgrain was observed during this period and rise in productivity thus a natural corollary. In West Bengal, the growth of productivity increased from 0.2 percent in sub-period I (1970-71 to 1979-80) to 3.9 percent in sub-period II (1980-81 to 1989-90). Bankura, Midnapore, Howrah and Nadia achieved growth rate in productivity at 5 percent and above. Foodgrain productivity in districts of Birbhum and West Dinajpur grew at exponential rates of 4.4 percent and 4 percent per annum respectively. Burdwan, 24 Parganas, Murshidabad, Malda and Purulia improved their growth performance in foodgrain productivity and grew at rates between 3 and 4 percent. Hoogly, Jalpaiguri, Cooch Behar achieved a growth rate between 2 and 3 percent and Darjeeling continued reeling at the bottom with growth rate in foodgrain productivity of less than 2 percent. From the values of trend break-I, it was found that Purulia made highest addition (6.1 percent) to the growth rate in productivity from 1980-81 to 1989-90 over its previous decade of 1970-71 to 1979-80. The addition to growth in productivity for Bankura was 5.9 percent, for Midnapore it was 5.8 percent, for Howrah and Birbhum the addition to growth were respectively 5.5 percent and 5.1 percent. The district of Jalpaiguri, inspite of being placed at almost at the bottom of the productivity growth table, made a gain of 4.4 percent in growth of foodgrain productivity. Darjeeling not only achieved lowest growth in productivity in sub-period II (1.7 percent) but its growth rate remained constant over the previous decades.

In sub-period III, excepting Murshidabad, West Dinajpur and Malda and Darjeeling, decline in growth in foodgrain productivity was observed for all the districts as well as for the state. In fact, for Darjeeling, the growth in productivity increased by 1.2 percent in sub-period III in comparison to sub-period II. Decline was more prominent for Howrah (by 2.4 percent), Midnapore (by 1.5 percent), Nadia (by 1.2 percent) and Birbhum (by 1 percent); for rest of the districts the decline in growth rates was marginal and less than 1 percent. Declining growth in foodgrain productivity continued into sub-period IV (2000-01 to 2008-09). The proportion of decline was varying between 0.1 percent and 0.9 percent for most of the districts, for Darjeeling and Birbhum the growth rates declined by 1.4 percent and 1 percent respectively. For the state of West Bengal, a decline in growth of productivity was observed at 0.6 percent.

4.11 Inter-Districts Comparison of Growth in Production and Productivity of Rice in West Bengal

Rice being the dominant crop in the state as well as for the districts, it is expected that the growth in production and productivity of rice would strongly influence the foodgrain production and productivity. In the following section attempted is made to validate or invalidate the above hypothesis. Looking at Table 4.8 and considering the sub-period I (1970-71 to 1979-80), exponential growth rates in production of rice were positive and significant in the districts of Nadia (4.5 percent per annum) and Malda (2.2 percent per annum). Growth of rice production was found to be positive but insignificant for the districts of Burdwan, Howrah, Hoogly, 24 Parganas and Murshidabad. Districts of Birbhum, Bankura, Midnapore, West Dinajpur, Darjeeling and Cooch Behar achieved growth rates in rice production which were negative and insignificant. For Jalpaiguri and Darjeeling the growth rates of rice productivity were not only negative but also statistically significant. For the state as a whole, growth rate in rice production was found to be negative and insignificant. Therefore, the decade of 1970s experienced absolute stagnation in growth of rice production. In Sub-period II (1980-81 to 1989-90), a significant turn around in growth of rice production was observed for the state of West Bengal as well as for most of the districts as it happened for growth of foodgrain production. Thus, it can be stated that a significant improvement in the production of rice have led to higher growth rates in the production of total foodgrains. A close look reveals that in districts of Nadia, Howrah, Purulia, Birbhum and Midnapore, rice production grew at exponential rates of 7 percent, 6.9 percent, 6.3 percent, 5.8 percent and 5.7 percent respectively. Rice production in districts of Birbhum, Burdwan, Murshidabad, West Dinajpur, Malda and Cooch Behar grew at exponential rates between 4 percent and 5 percent. 24 Parganas and Hoogly registered growth rates in rice production at 3.8 percent and 3.3 percent and Darjeeling and Jalpaiguri remained at the bottom with growth rates of 2.1 percent and 1.9 percent respectively. From the values of trend break-I, it could further be seen that Purulia made highest gain of 10 percent in growth rate in sub-period II over sub-period I. Bankura, Midnapore, Howrah, West Dinajpur, Cooch Behar and Purulia also gained in growth rate in rice production by more than 6 percent. Rest of the districts also made positive gain in growth of rice production in sub-period II in comparison to sub-period I.

Table 4.8: Districtwise Kinked Exponential Growth in Production of Rice in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90),(1990-91 to 1999-2000) and (2000-01 to 2008-09)

Dist /Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend break I	Trend break II	Trend break III	DW	R ²
Burdwan	3.1 (16.2)*	1.2 (1.2)	4.3 (4.9)*	4.3 (11.9)*	3.1 (13.3)*	3.1	0.1	-1.2	1.6	0.9
Birbhum	2.9 (12.3)*	-0.4 (-0.3)	4.4 (3.6)*	3.9 (7.5)*	3.3 (10.0)*	4.8	-0.6	-0.6	1.7	0.8
Bankura	2.2 (10.1)*	-1.7 (-1.1)	5.8 (4.3)*	5.1 (9.0)*	3.4 (9.4)*	7.5	-0.7	-1.7	1.9	0.8
Midnapore	3.2 (14.7)*	-0.8 (-0.7)	5.7 (5.4)*	4.6 (10.5)*	3.7 (13.2)*	6.5	-1.1	-0.9	1.7	0.9
Howrah	3.0 (9.6)*	0.9 (0.5)	6.9 (4.5)*	4.4 (6.8)*	3.2 (7.5)*	6.0	-2.5	-1.3	1.4	0.8
Hoogly	2.6 (13.3)*	0.5 (0.4)	3.3 (3.2)*	3.6 (8.4)*	2.8 (10.1)*	2.8	0.3	-0.8	2.2	0.9
24 Parganas	2.8 (12.7)*	2.1 (1.6)	3.8 (3.2)*	3.7 (7.4)*	2.8 (8.6)*	1.7	-0.1	-0.9	1.6	0.8
Nadia	4.4 (14.1)*	4.5 (3.0)*	7.0 (5.3)*	5.9 (10.7)*	4.0 (11.0)*	2.5	-1.1	-2.0	1.3	0.9
Murshidabad	3.9 (14.1)*	1.9 (1.1)	4.8 (3.2)*	4.9 (7.9)*	3.9 (9.9)*	2.9	0.1	-0.9	1.8	0.9
West Dinapur	3.4 (16.1)*	-1.6 (-1.6)	4.9 (5.7)*	4.8 (13.2)*	4.0 (17.1)*	6.5	-0.1	-0.8	2.1	0.9
Malda	3.1 (16.1)*	2.2 (2.2)*	4.6 (5.1)*	4.2 (11.2)*	3.0 (12.4)*	2.4	-0.4	-1.2	1.7	0.9
Jalpaiguri	1.2 (5.4)*	-2.8 (-2.3)*	1.9 (1.8)**	1.6 (3.7)*	2.0 (7.0)*	4.7	-0.3	0.4	2.1	0.6
Darjeeling	0.6 (2.1)*	-0.3 (-0.2)	2.1 (1.4)	0.5 (0.8)	0.8 (2.1)*	2.3	-1.6	0.3	1.2	0.2
Cooch Behar	2.2 (11.9)*	-1.5 (-1.5)	4.9 (5.5)*	3.1 (8.2)*	2.8 (11.9)*	6.4	-1.8	-0.2	1.8	0.9
Purulia	2.9 (8.2)*	-3.7 (-1.9)**	6.3 (3.6)*	4.3 (5.8)*	4.0 (8.5)*	10.0	-2.0	-0.3	2.4	0.7
West Bengal	3.0 (17.1)*	0.0 (0.1)	4.8 (5.8)*	4.3 (12.3)*	3.3 (14.9)*	4.8	-0.5	-0.9	1.6	0.9

T stats are shown in parenthesis

Significant at 1% level, ** Significant at 5% level, *Significant at 10% level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

In sub-period III (1990-91 to 1999-2000) and sub-period IV (2000-01 to 2008-09), most of the districts and the state as a whole, experienced deceleration in growth rate in production of rice. For the state, the exponential growth rate reduced to 4.3 percent in sub-period III and reached at 3.3 percent in sub-period IV in comparison to 4.8 percent in sub-period II. The fall in growth is sharper during the period 2000-01 to 2008-09. At district level, in sub-period III, growth rate remained unchanged for the district of Burdwan with respect to sub-period II, Hoogly and Murshidabad showed marginal increase and for rest of the districts, fall in growth rates was observed. Fall was sharp for the districts of Howrah (2.5 percent), Purulia (2.0 percent), Cooch Behar (1.8 percent), Darjeeling (1.6 percent), Nadia (1.1 percent) and Bankura (1.1 percent). In sub-period IV, Darjeeling and Jalpaiguri experienced marginal increase in growth rate and rest of the districts experienced decline in growth rates in production. Decline is quite significant for the districts of Nadia (2 percent), Bankura (1.7 percent) and the fall in growth rates by more than 1 percent was observed for districts of

Burdwan, Howrah, and Malda. Therefore, it is evident that in sub-period IV, growth of production for rice has not only declined for the state but also most of the high growth districts experienced a decline.

Considering the growth of production of rice to productivity of rice at state level and at district level (Table 4.9), it has been observed that over the whole period (1970-71 to 2008-09), highest growth rate in rice productivity (4.4 percent) was achieved by Nadia. Murshidabad followed with growth rate of 3.9 percent per annum, followed by West Dinajpur with 3.4 percent, Malda and Burdwan with 3.1 percent and Howrah 3 percent. From 1970-71 to 2008-09, productivity of rice for districts of Hoogly, 24 Parganas and Purulia grew at rates of 2.9 percent, 2.8 percent and 2.6 percent respectively. Cooch behar, Jalpiguri and Darjeeling were placed at the bottom in descending order in terms of their growth rates of rice productivity. As far as the productivity of rice was concerned, sub-period: I (1970-71 to 1979-80) presented gloomy picture for the state as well as for the districts. Rice productivity for the state as a whole stood at 0.3 percent and statistically insignificant. As many as nine districts of the state (Birbhum, Bankura, Midnapore, Howrah, Jalpaiguri, Darjeeling, Cooch Behar and Purulia) for which the growth rates of productivity of rice were found to be negative and insignificant between 1970-71 and 1979-80. The districts of Hoogly, 24 Parganas and Murshidabad though achieved positive growth rates, however, proved to be statistically insignificant. Nadia achieved the highest growth rate in rice productivity at 4.4 percent (also significant at 1 % level as per T statistics) per annum during sub-period I and Burdwan and Malda also achieved growth rates of 1.8 percent and proved to be statistically significant.

In sub-period II, a significant rise in growth rate in rice productivity was observed both for the state of West Bengal and her districts. Productivity of rice in districts of Bankura, Midnapore, Howrah, Nadia and Purulia grew at more than 5 percent per annum. Birbhum, West Dinajpur, Malda and Cooch Behar achieved 4 percent plus growth rate in rice productivity. 24 Parganas, Murshidabad achieved growth rate in rice productivity more than 3 percent in sub-period II and productivity grew closer to 3 percent for the district of Burdwan. Rice productivity in Jalpiguri grew at an exponential rate of 2.2 percent and Darjeeling failed to add to its growth rate in rice productivity. In sub-period II, the districts which make substantial addition to their growth rate in rice productivity (as given by trend break-I) were Purulia (7.5 percent), Bankura (6 percent), Cooch Behar (6 percent), Midnapore (5.6 percent), West Dinajpur (5.5 percent), Howrah (5.4 percent) and Jalpaiguri (5.1 percent). For the state

of West Bengal, the growth in rice productivity increased from 0.2 percent in sub-period I (1970-71 to 1979-80) to 4.0 percent in sub-period II (1980-81 to 1989-90) and therefore a net addition of 3.8 percent has been achieved during sub-period II over sub-period I.

Table 4.9: Districtwise Kinked Exponential Growth in Productivity of Rice in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

DIST/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend Break I	Trend break II	Trend break III	DW	R ²
Burdwan	3.1 (16.2)*	1.8 (2.2)*	2.9 (4.0)*	2.8 (9.1)*	2.0 (10.1)*	1.1	-0.1	-0.8	1.3	0.9
Birbhum	2.9 (12.3)*	-0.3 (-0.3)	4.2 (4.2)*	3.2 (7.7)*	2.8 (10.2)*	4.5	-1.0	-0.5	1.4	0.8
Bankura	2.9 (10.1)*	-0.9 (-0.8)	5.1 (4.9)*	4.1 (9.5)*	3.2 (11.6)*	6.0	-1.0	-0.9	1.8	0.9
Midnapore	3.2 (14.7)*	-0.6 (-0.5)	5.1 (5.3)*	3.6 (9.0)*	3.0 (11.7)*	5.6	-1.5	-0.6	1.6	0.9
Howrah	3.0 (9.6)*	-0.1 (0.0)	5.3 (4.2)*	2.7 (5.1)*	2.1 (6.3)*	5.4	-2.6	-0.5	1.9	0.7
Hoogly	2.6 (13.3)*	0.5 (0.6)	2.7 (3.8)*	2.5 (8.2)*	2.0 (10.2)*	2.2	-0.3	-0.5	2.3	0.9
24 Parganas	2.8 (12.7)*	1.8 (1.4)	3.1 (2.9)*	2.8 (6.3)*	2.5 (8.4)*	1.3	-0.3	-0.4	1.7	0.8
Nadia	4.4 (14.1)*	4.0 (4.0)*	5.3 (6.0)*	4.0 (10.9)*	3.0 (12.5)*	1.3	-1.3	-1.1	1.4	0.9
Murshidabad	3.9 (14.1)*	1.9 (1.6)	3.2 (3.0)*	3.7 (8.3)*	2.9 (10.2)*	1.2	0.5	-0.8	1.7	0.9
West Dinajpur	3.4 (16.1)*	-1.2 (-1.4)	4.4 (5.8)*	4.4 (13.8)*	3.7 (18.0)*	5.5	0.0	-0.7	1.9	0.9
Malda	3.1 (16.1)*	1.8 (2.3)*	4.1 (6.0)*	3.8 (13.5)*	3.5 (19.4)*	2.3	-0.2	-0.3	1.6	1.0
Jalpaiguri	1.2 (5.4)*	-3.0 (-2.9)*	2.2 (2.4)*	2.1 (5.4)*	2.4 (9.6)*	5.1	-0.1	0.3	2.5	0.8
Darjeeling	0.6 (2.1)*	-0.2 (-0.2)	0.0 (0.0)	0.8 (1.8)**	1.7 (6.1)*	0.2	0.7	0.9	1.8	0.7
Cooch Behar	2.2 (11.9)*	-2.0 (-2.4)*	4.0 (5.4)*	2.8 (9.4)*	2.9 (14.9)*	6.0	-1.1	0.1	1.6	0.9
Purulia	2.9 (8.2)*	-2.3 (-1.5)	5.2 (3.9)*	3.1 (5.5)*	3.4 (9.2)*	7.5	-2.1	0.3	2.5	0.8
West Bengal	3.0 (17.0)*	0.2 (0.3)	4.0 (5.7)*	3.4 (11.4)*	2.8 (14.8)*	3.8	-0.6	-0.6	1.6	0.9

T stats are shown in parenthesis

Significant at 1% level, ** Significant at 5% level, *Significant at 10% level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Therefore, it is quite evident that the turn around that took place in foodgrain production in West Bengal took place during 1980s, much of it contributed by the growth in rice production and productivity in the state. In sub-period III and IV, a deceleration in growth of rice productivity was observed for the state as well as for most of the districts. The growth rate in productivity for the state declined to 3.4 percent and 2.8 percent in sub-period III (1990-91 to 1999-2000) and IV (2000-01 to 2008-09) from 4.0 percent in sub-period II (1980-81 to 1989-90). In sub-period III, the growth in productivity of rice marginally increased for the district of Murshidabad which is remained constant for West Dinajpur. For rest of the districts, the

growth rates declined. From the values of trend break-II, it was observed that fall in growth was prominent in Howrah, Purulia, Midnapore, and Nadia. In sub-period IV growth in productivity declined for all the districts excepting Jalpaiguri, Darjeeling and Cooch Behar. For these districts marginal rise was observed.

4.12 Inter-District Comparison of Growth in Production and Productivity of Wheat in West Bengal

The contribution of West Bengal to total wheat production of the country was 1.32 percent in 1970-71 and in 2007-08, it reduced to 1.17 percent only, making it evident that wheat is not a major crop in West Bengal. From Table 4.10, it is evident that the share of wheat in total foodgrain production in West Bengal reduced substantially in 2008-09 in comparison to 1970-71. If we look at districts, the same trend is visible for all the districts in West Bengal. The districts of Nadia and Murshidabad have shown an increase in their share of wheat in total foodgrain production in the state in 1985-86 and 2000-01.

Table 4.10: Districtwise Wheat Production as percentage of State's Foodgrain Production

Year/Dist	Burdwan	Birbhum	Bankura	Midnapore	Howrah	Hoogly	24 Parganas	Nadia
1970-71	0.94	2.37	0.23	0.35	0.10	0.71	0.41	1.64
1975-76	0.99	1.51	1.01	0.79	0.11	0.72	0.68	1.67
1980-81	0.21	0.40	0.19	0.13	0.02	0.15	0.19	0.87
1985-86	0.23	0.42	0.31	0.23	0.03	0.13	0.19	1.74
1990-91	0.05	0.22	0.11	0.08	0.00	0.01	0.17	0.72
1995-96	0.07	0.34	0.10	0.18	0.01	0.02	0.09	0.86
2000-01	0.11	0.56	0.15	0.23	0.02	0.03	0.29	1.07
2008-09	0.03	0.60	0.05	0.04	0.00	0.02	0.12	0.52

Year/Dist	Murshidabad	West Dinapur	Malda	Jalpaiguri	Darjeeling	Cooch Behar	Purulia	West Bengal
1970-71	3.35	0.67	0.63	0.01	0.01	0.15	0.02	11.59
1975-76	2.92	1.20	0.85	0.48	0.06	0.49	0.33	13.82
1980-81	1.43	1.09	0.47	0.20	0.03	0.24	0.03	5.64
1985-86	2.62	0.93	0.69	0.18	0.02	0.31	0.05	8.08
1990-91	1.55	0.60	0.79	0.15	0.03	0.20	0.02	4.70
1995-96	2.16	0.54	0.75	0.19	0.02	0.23	0.07	5.63
2000-01	2.70	0.81	0.90	0.34	0.05	0.36	0.05	7.66
2008-09	1.58	0.66	0.74	0.20	0.02	0.10	0.01	4.69

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

From Table 4.11 and Table 4.12, a clearer picture emerges regarding the growth of wheat production and productivity in the state as well as in the districts during the period of study i.e., 1970-71 to 2008-09 as well as for four sub-periods, viz. sub-period I (1970-71 to 1978-80), sub-period II (1980-81 to 1989-90), sub-period III (1990-91 to 1999-2000) and sub-

period IV (2000-2001 to 2008-09). Over the whole period of study i.e., 1970-71 to 2008-09, exponential growth in wheat production and productivity are found to be less than 1 percent and statistically insignificant. Among the districts, in sub-period I, Jalpaiguri and Darjeeling achieved impressive and significant growth rate in production and in case of productivity, along with Jalpaiguri and Darjeeling, Cooch Behar also achieved a significant growth. For rest of the districts, growth of production and productivity remained either negative and significant or positive and insignificant. In sub-period II, growth rate for production of wheat for Jalpaiguri, Darjeeling and Cooch Behar however turned out to be negative. Nadia, Murshidabad and Malda reversed their negative growth rates and achieved positive and significant growth in wheat production. However, their growth of productivity although remained positive but statistically insignificant. Therefore, the growth of production possibly has increased because of the positive growth of area or through area expansion under wheat cultivation. Positive and significant growth in productivity has also been observed for the districts of Birbhum and Bankura.

Table 4.11: Districtwise Kinked Exponential Growth in Production of Wheat in West Bengal for (1970-71 to 2008-09), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

DIST/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend Break I	Trend break II	Trend break III	DW	R ²
Burdwan	-6.93 (-9.72)*	-10.1 (-2.9)*	-12.1 (-3.9)*	-10.6 (-8.1)*	-5.9 (-6.9)*	-2.0	1.5	4.8	0.8	0.9
Birbhum	-0.67 (-0.86)	-12.9 (-3.8)*	-3.1 (-1.0)	-1.3 (-1.0)	2.0 (2.5)*	9.8	1.8	3.3	1.0	0.6
Bankura	-2.54 (-3.45)*	-1.4 (-0.4)	-6.1 (-1.9)**	-4.8 (-3.6)*	-3.4 (-3.9)*	-4.6	1.3	1.4	1.2	0.5
Midnapore	-1.70 (-2.26)*	-7.4 (-1.7)	-6.3 (-1.6)	-1.3 (-0.8)	-0.8 (-0.8)	1.1	5.0	0.4	1.1	0.3
Howrah	-7.53 (-5.91)*	-10.6 (-1.5)	-22.1 (-3.5)*	-12.6 (-4.8)*	-6.6 (-3.9)*	-11.5	9.5	5.9	0.9	0.7
Hoogly	-10.96 (-12.62)*	-10.0 (-1.9)**	-15.8 (-3.4)*	-15.9 (-8.1)*	-11.0 (-8.7)*	-5.8	0.0	4.8	1.5	0.9
24 Parganas	-1.43 (-2.81)*	-3.5 (-1.2)	-1.9 (-0.7)	-3.2 (-3.0)*	-0.5 (-0.8)	1.6	-1.3	2.7	1.2	0.4
Nadia	0.15 (0.39)	-2.1 (-0.8)	2.1 (0.9)	0.7 (0.7)	0.6 (1.0)	4.2	-1.4	-0.1	1.1	0.0
Murshidabad	1.28 (4.22)*	-2.5 (-1.4)	1.2 (0.7)	2.0 (3.0)*	1.9 (4.4)*	3.7	0.8	-0.1	1.0	0.5
West Dinapur	1.20 (3.28)*	4.4 (2.2)*	-2.3 (-1.3)	-1.0 (-1.3)	0.9 (1.9)**	-6.8	1.3	2.0	1.7	0.4
Malda	2.87 (8.78)*	-0.4 (-0.2)	2.7 (1.6)	4.1 (5.7)*	3.2 (6.9)*	3.1	1.4	-0.9	1.0	0.7
Jalpaiguri	4.97 (4.28)*	33.8 (6.2)*	-8.0 (-1.7)***	-1.7 (-0.8)	-0.2 (-0.1)	-41.8	6.3	1.5	0.5	0.6
Darjeeling	3.17 (2.88)*	32.9 (7.3)*	-18.8 (-4.7)*	-3.1 (-1.9)**	-2.6 (-2.4)*	-51.7	15.6	0.5	1.4	0.7
Cooch Behar	0.69 (0.86)	17.4 (3.9)*	-6.0 (-1.5)	-3.5 (-2.1)*	-2.1 (-2.0)**	-23.4	2.5	1.4	0.7	0.3
Purulia	-1.29 (-1.29)	-1.2 (-0.2)	-7.6 (-1.3)	-2.6 (-1.1)	-1.3 (-0.8)	-6.4	5.0	1.3	1.1	0.1
West Bengal	0.16 (0.46)	-2.6 (-1.3)	-1.4 (-0.8)	-0.1 (-0.1)	0.8 (1.6)	1.2	1.4	0.8	0.7	0.2

T stats are shown in parenthesis

* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

In sub-period III, Birbhum, Murshidabad and Malda made an impressive growth in wheat production whereas in productivity, positive and significant growth was achieved by Burdwan, Birbhum, Midnapore, Murshidabad, West Dinajpur and Malda. Finally in sub-period IV, Birbhum, Murshidabad, West Dinajpur and Malda made positive and significant growth in wheat production and in productivity front, Burdwan, Birbhum, Bankura, Midnapore, Murshidabad, West Dinajpur, Malda, Jalpaiguri and Purulia registered positive and statistically significant growth.

Table 4.12: Districtwise Kinked Exponential Growth in Productivity of Wheat in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80)(1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

DIST/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II(1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-00)	Sub-Period IV (2000-01 to 2008-09)	Treand break I	Treand break II	Treand break III	DW	R ²
Burdwan	0.23 (1.09)	-2.5 -2.1*	-0.1 -0.1	0.4 1.0	0.7 2.6*	2.4	0.5	0.3	1.6	0.3
Birbhum	1.33 (7.85)*	-2.0 -2.2*	1.7 2.2*	2.1 6.6*	1.8 8.6*	3.7	0.4	-0.3	1.2	0.8
Bankura	0.86 (1.86)***	-2.8 -1.8**	3.4 2.5*	1.3 2.3*	0.6 1.7***	6.2	-2.1	-0.7	1.9	0.2
Midnapore	0.12 (0.43)	-5.4 -3.5*	1.5 1.1	1.3 2.3*	1.0 2.8*	6.8	-0.2	-0.3	1.6	0.3
Howrah	0.03 (0.06)	1.2 0.4	-2.9 -1.2	-2.7 -2.6*	0.4 0.6	-4.2	0.3	3.0	2.4	0.3
Hoogly	-0.24 (-0.97)	-1.2 -0.7	-1.0 -0.7	-0.4 -0.8	0.0 -0.1	0.2	0.5	0.4	2.3	0.1
24 Parganas	0.21 (0.99)	0.8 0.6	0.9 0.8	-0.1 -0.2	0.2 0.7	0.2	-1.1	0.3	1.5	0.1
Nadia	-0.11 (-0.52)	-1.4 -1.1	1.1 0.9	0.3 0.6	0.1 0.3	2.5	-0.7	-0.2	1.3	0.0
Murshidabad	0.40 (2.05)***	-1.8 -1.5	0.9 0.9	1.1 2.4*	0.7 2.5*	2.7	0.2	-0.4	1.4	0.2
West Dinapur	0.60 (2.37)**	-2.2 -1.4	1.0 0.7	1.3 2.3*	1.0 2.7*	3.1	0.3	-0.3	1.9	0.2
Malda	1.06 (4.78)*	0.7 0.5	0.4 0.3	1.2 2.2*	1.1 3.1*	-0.3	0.8	-0.1	1.3	0.4
Jalpaiguri	0.73 (2.74)**	3.5 2.4*	-3.3 -2.5*	-0.7 -1.3	0.3 0.9	-6.8	2.6	1.1	1.6	0.4
Darjeeling	0.35 (0.87)	8.7 3.9*	-5.0 -2.6*	-2.2 -2.6*	-1.0 -1.9*	-13.8	2.9	1.2	2.0	0.7
Cooch Behar	-0.03 (-0.12)	1.8 1.4	-2.5 -2.2*	-1.0 -2.1*	-0.3 -0.9	-4.2	1.5	0.7	1.7	0.2
Purulia	0.80 (2.73)**	0.8 0.5	-1.3 -0.8	0.6 0.8	0.7 1.7***	-2.2	1.9	0.2	1.8	1.8
West Bengal	0.23 (0.92)	-1.5 -1.0	0.7 0.6	0.9 1.6	0.5 1.3	2.2	0.1	-0.4	1.6	0.1

T stats are shown in parenthesis

*Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

4.13 Conclusion

Aforementioned empirical investigations reveal that rice dominates the foodgrain production of the state. Burdwan and Midnapore and 24 Parganas continue to remain as most consistent performer in terms of their contribution to total foodgrain and rice production in the state. A stable upward trend in production and productivity for foodgrain and rice was maintained by these districts over the entire decade of eighties and nineties and performed relatively better in comparison to rest of the districts during the era of agricultural stagnation in West Bengal. Birbhum, which was the major contributor in foodgrain and rice production in the state with steady rate of growth in production and productivity started losing its strength in terms of its share in foodgrain production as well as growth of production and productivity since 1990s and onwards. Hoogly's performance however remained relatively unsatisfactory. It was adequately evident that the turn around in agriculture that occurred in West Bengal during eighties and onwards was driven by the fact that few districts performed poorly because of agro-climatic barriers or other economic and non-economic factors till 1980s, but from 1980 and onwards their growth performances improved tremendously. Purulia, Howrah, Bankura, Nadia, West Dinajpur, Cooch Behar, Murshidabad and Malda were among those districts. Birbhum, one the major contributors in foodgrain and rice production in the state, however, started losing its strength in terms of its share in foodgrain production and growth of production and productivity since 1990s and onwards. Darjeeling and Jalpaiguri continued to remain at the bottom of the ladder in terms of both production and productivity of foodgrain and rice. It is also observed that percentage share of wheat production in the state remained low and declined further over the decades. However, production of wheat remained statistically significant for Murshidabad, West Dinajpur, Malda, Jalpaiguri and Darjeeling. Another important feature that emerged from above analysis is that, the productivity of foodgrain and rice in absolute terms continued to grow even in the decade of nineties as well as between 2000-01 and 2008-09. In other words, more number of districts has been successful to overcome the agro-climatic barrier to enhance productivity. Therefore, the empirical results as depicted above reaffirmed two major observations on agriculture in West Bengal. First, the persistence of stagnation due to negligible growth in agricultural production and productivity was observed from 1970-71 to 1980-81 and second, an overwhelming turn around from stagnation in agricultural production and productivity in West Bengal since late-eighties. Since this study has moved well beyond the decade of 1980s and estimated the growth trend till 2008-09, the question as to, how far the success of agricultural turn around

achieved during the decade of eighties could be sustained, can well be validated. The overall agrarian scenarios that emerged during post-1990 period were indeed not encouraging. For the state as well as for the districts growth rate in production and productivity has reduced. Reduction was prominent especially in Purulia, Howrah that attained addition in growth rates of production and productivity in foodgrain and rice from 1980-81 to 1989-90. All major rice producing districts experienced reduction in growth rates both in production and productivity in the decade of 1990s and post-90s except Murshidabad and the districts placed at the bottom of growth tables displayed marginal improvements in their growth performance. This scenario makes it imperative to probe deeper into couple of issues. First, since foodgrain is mostly dominated by rice, therefore, reduction in growth is closely associated with the changes occurring in production and productivity in three rice growing seasons in West Bengal. Decline in growth is pronounced but rate of change in growth rate would provide a measure to gauge the long term impact on the agrarian scenario in West Bengal and the districts. It also becomes imperative to see whether the changes in growth of agricultural production and productivity are bringing stability or instability in agricultural production in the state as well as in the districts. Finally, non-foodgrain component needs to be looked into along with foodgrains because that indicates the changing approach of farmers towards cash crops. These issues have been taken up for further empirical investigations in the following Chapter.

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Chapter-V

Agricultural Growth: Variability and Instability in Production and Productivity of Foodgrains and Non-Foodgrains in West Bengal

5.1 Introduction

The preceding chapter attempted to examine the dominance of rice in agricultural production, especially foodgrain production in West Bengal. Therefore, rice demands a deeper probe. In this connection, the present chapter deals with the changing share of aman, aus and boro to total rice production, absolute change in their productivity over the periods, the growth in production, area and productivity of aus, aman, boro, in pre-defined different sub-periods, viz. sub-period I (1970-71 to 1979-80); sub-period II (1980-81 to 1989-90); sub-period III (1990-91 to 1999-2000); sub-period IV (2000-01 to 2008-09). In the periodic analysis, variability in production, area and productivity at state level have taken into consideration in this chapter. Further, to note that growth rate in production and productivity of foodgrain as well as rice has been taken declining since 1990-91 and the decline becomes more prominent since 2000-01. It has further been attempted has also been made to identify the nature of acceleration or deceleration of production of foodgrain, rice and wheat at the state level as well as at district level in pre-defined sub-periods and for the whole period. An analysis has also been carried out to understand the nature and extent of growth in production, area and productivity, variability in the sub period growth rates of production and productivity as well as the changing dynamics in the trend of growth rates of production and productivity of foodgrain and non-foodgrain in West Bengal since 1970-71 to 2008-09. The present chapter makes an attempt to study the impact of weather variable such as rainfall on production of different crops, and to differentiate the growth rates of crops.

5.2 Methodology of the Study

The following statistical techniques and tools are used in this chapter.

5.2.1 Growth Measurement over Sub-Periods

Kinked Exponential model has again been used here to study the sub-period growth rates of production, area and productivity for aman, aus and boro rice and also for select non-foodgrains.

5.2.2 Acceleration and Deceleration in Growth Rates

The acceleration or deceleration (or constants) of growth and/or growth rates or changes in the growth rates of any major components has also been measured. The method followed here has also been undertaken and explained in Chapter-III.

5.2.3 Weather Adjusted Growth Rates

A question is raised in various growth literature that the extent to which growth as estimated earlier could be due to exceptionally good rainfall or weather conditions or does the rainfall¹ factor could impact the production level of agricultural output.

An attempt has been made in this study to develop an improved and updated weighting scheme in constructing a rainfall index for foodgrains.

Unadjusted and weather adjusted growth rates in foodgrains production have been estimated by using the following log-linear functions, respectively.

$$\ln y_t = a + bt \quad (1)$$

$$\ln y_t = a + ct + d \ln w_t + u_t \quad (2)$$

Where y_t is the foodgrain production, w_t is the production rainfall or weather index, coefficient b in equation (1) gives the unadjusted trend growth rate and coefficient c is the weather adjusted trend growth rate, while coefficient d can be interpreted as the weather elasticity of production with respect to rainfall. This equation has been estimated using the index of total agricultural output for all districts.

5.2.4 Measuring Instability of Growth in Agricultural Production

An analysis of fluctuations in agricultural production, apart from growth, is of importance for understanding the nature of food security at the regional level. Instability² is considered as the flip side of stability measures and it deals with the extent and nature of fluctuations in agricultural production.

In this study, the method followed by Boyce (1987), Saha and Swaminathan (1994) and Mahendradev (1987) have been used to measure the instability in production. Similar method has been adopted for the calculation of districtwise instability coefficients of production of foodgrains, rice, wheat, pulses and other cereals for the period 1970-71 to 2008-09. Based on actual value of production for the period 1970-71 to 2008-09, an exponential trend line was

fitted and exponential growth rate has been calculated. Predicted values are calculated for the successive periods from 1970-71 to 2008-09.

The difference between the actual values and predicted values, crop output are calculated and the differences are expressed as the percentage of the predicted value (see Boyce, *op.cit.*: 273).

$$z_t = \frac{Y_t - \hat{Y}_t}{\hat{Y}_t}$$

Y_t = Actual output at period t

\hat{Y}_t = Predicted value of output at period t.

The square of these percentage deviations are calculated and regressed against time. The estimated coefficient of time (t) is considered as instability coefficient. If the estimated coefficient on time is positive, it may be considered that the instability has increased and if the coefficients assume negative values then it can be said that instability has decreased. The t-stat of the coefficient indicates the strength of the trend.

5.3 Aus, Aman and Boro in West Bengal

In West Bengal, one normally finds three principal rice growing seasons. During spring season, from late-April to July, aus is grown. With the onset of monsoon in June (kharif season), aman is cultivated and it ends in October and November with the harvest of aman rice. During winter, in rabi season (beginning in November), boro is cultivated and generally in March the harvest process starts. In the dry rabi season, irrigation helps or allows farmers to switch from relatively low-yielding unirrigated crops to higher yielding irrigated crops (Boyce, 1987:11).

In terms of percentage of production and area under cultivation of rice in West Bengal (Table 5.1), aman has overwhelming domination in terms of production and area under cultivation. In 1970-71, more than 75 percent rice production in the state was alone contributed by aman and more than 75 percent area under cultivation of rice was utilised for growing aman rice. It was continued to increase till 1980-81 and there after a fall in contribution of aman to total rice production as well as area under cultivation was observed. In 2000-01, the share of aman production to total rice production and area under cultivation as percentage of area under rice production reached the lowest level but an upsurge in share of production and area was

observed between 2000-01 and 2008-09. So far as aus is concerned, it has never been a major contributor to the rice production in the state, its share to total rice production as well as area under cultivation as percentage of area under total rice production consistently declined since 1970-71. In 2008-09, the percentage share of aus to total rice production and area under aus as percentage of total area under aus stood at mere 4.02 percent and 4.95 percent respectively.

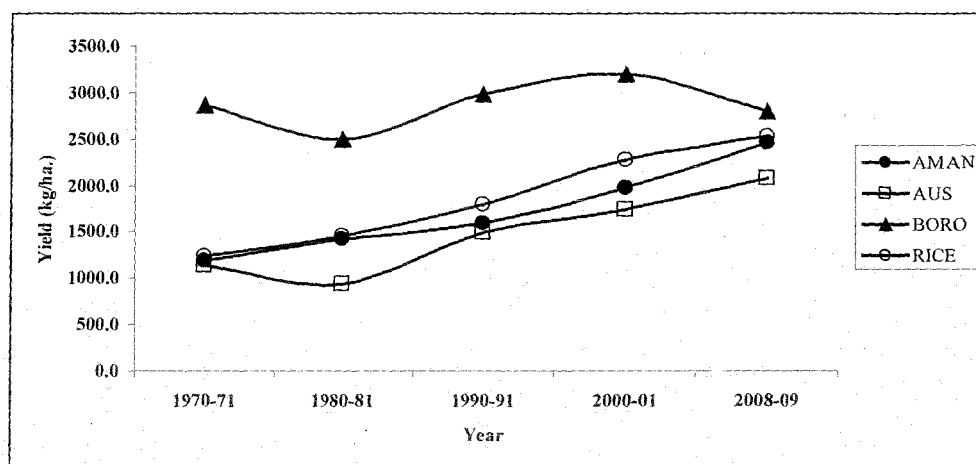
The fall in percentage share of aman and aus to total rice production and total area under rice, especially after 1980-81, were compensated by the rise in production as well as area under cultivation of boro. In comparison to 1980-81, production increased by 1.6 times and area under cultivation of boro increased almost four times. Boro is primarily a high-yielding variety and needs to be supported by irrigation. Comparison of productivity or yield of aman, aus and boro reveals that during 1970-71, the productivity of aman and aus was much lower in comparison to boro rice. But a close look suggests that productivity of aman and aus gradually increased over the periods while for boro, the yield increased and reached a peak (3020 kg/ha) in 2000-01, thereafter it started declining. But from 1970-71 to 2008-09, the productivity of boro remained much higher in comparison to the productivity of aman and aus.

Table 5.1: Production and Area under cultivation of Aman, Aus, Boro as percentage of Production and Area under cultivation of Rice in West Bengal

Year	Aman	Aus	Boro	Aman	Aus	Boro
	Production (in percentage)			Area (in percentage)		
1970-71	76.46	14.82	8.72	80.11	16.13	3.76
1975-76	75.93	10.88	13.18	78.16	15.93	5.91
1980-81	79.89	8.64	11.48	81.42	11.88	6.69
1985-86	73.78	8.74	17.48	80.40	9.51	10.09
1990-91	65.78	8.69	25.53	74.09	10.50	15.42
1995-96	64.06	7.19	28.75	71.94	8.58	19.49
2000-01	58.19	5.53	36.29	66.96	7.25	25.79
2005-06	67.94	4.17	27.89	71.12	4.98	23.90
2008-09	67.00	4.02	28.98	68.85	4.93	26.23

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Figure 5.A: Yield (kg/ha) of Aman, Aus, Boro and Rice in West Bengal from 1970-71 to 2008-09



Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

5.3.1 Trends in Production, Productivity and Area under Cultivation of Aman, Aus, Boro in West Bengal

The exponential growth rates vis-à-vis compound annual growth rates during 1970-71 to 2008-09 (Table 5.2) reveals that production of aman grew at an annual rate of 2.4 percent per annum while aus achieved negative and insignificant rate and boro grew at a phenomenal rate of 6.3 percent and is statistically significant at 1 percent level (as per T-stat). For aman, growth in area turned out to be insignificant, for aus it achieved high negative value and for boro, growth in area was found to be 5.8 percent per annum. In productivity frontier, both aman and aus grew at exponential rates of 2.4 percent and 2.8 percent respectively, where as, the growth in productivity of boro was much less and it was a mere 0.5 percent. Therefore, the picture so emerged suggests that growth in production for Aman was primarily driven by the growth in productivity where as for boro, growth in area became the driving force. For aus, declining area under cultivation has offset the positive impact of growth in productivity and hence growth in production became negative and insignificant.

It has been observed that the estimated growth rates in each sub-period may be higher or lower than that in the period as a whole and therefore, to calculate the exponential growth rate simultaneously for four sub-periods, viz. sub-period I (1970-71 to 1979-80), sub-period II (1980-81 to 1989-90), sub-period III (1990-91 to 1999-2000) and sub-period IV (2000-01 to 2008-09), kinked exponential model has been used here also.

In sub-period I, growth in production, productivity and area under cultivation achieved positive values (less than 1 percent) but remained statistically insignificant. For aus, growth

in production, area and productivity achieved negative growth rates and these rates are statistically significant at 1 percent level. So far as boro is concerned, in the first sub-period, it achieved positive growth rates of production, area and productivity but they remained statistically insignificant. And as a cumulative impact, we observed that in the growth rate for rice for the first sub-period was meagre and statistically insignificant.

Table 5.2: Exponential Growth and CAGR in Production, Area and Productivity of Aman, Aus, Boro and Rice in West Bengal

	Production	Area	Productivity	Production	Area	Productivity
	Exponential Growth			CAGR		
Aman	2.4 (13.0)*	0.1 (1.0)	2.4 (15.2)*	2.03	0.08	1.95
Aus	-0.1 (-0.5)	-2.9 (-18.7)*	2.8 (13.8)*	-1.07	-2.61	1.58
Boro	6.3 (18.8)*	5.8 (17.2)*	0.4 (2.4)*	5.67	5.74	-0.07
Rice (Total)	3.0 (17.1)*	0.5 (8.1)*	2.5 (17.9)*	2.39	0.48	1.90

*T Stat are shown in parenthesis, * Significant at 1 percent level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

In sub-period II, a trend break was observed for the growth in production and productivity of Aman and for area and production of boro. In comparison to sub-period I, the growth rate in production and productivity of aman was increased by 2.8 percent and 3.1 percent respectively in sub-period II. Growth in area for aman remained at less than 1 percent and also statistically insignificant, and therefore, growth in production was primarily attributed to growth in productivity. For aus, there was impressive rise in growth in production that took place in sub-period II. In fact, growth in production increased by 10 percent in comparison to sub-period I, and it was solely driven by the growth in productivity. As a matter of fact, growth in area under aus was negative and statistically significant during sub-period II. Again, in comparison to sub-period I, growth rate in production and area under cultivation for boro increased by 7.9 percent and 9.6 percent respectively in sub-period II, which is phenomenal by any yardstick. However, growth in productivity of boro was negative. Therefore, impressive growth in production of boro was achieved through area expansion. In sub-period III and IV aman experienced decline in growth in production and productivity although in sub-period III a marginal increase in growth of area has been observed. For aus, a decline in growth in production and productivity and area were observed, however, the decline in growth in production in sub-period-IV and decline in growth in area in sub-periods III and IV were quite substantial and significant. Drastic fall in growth in area was the

obvious reason for a significant fall in growth in production of rice. In case of boro, though a very high growth rate in production was maintained, 8.8 percent and 6.1 percent respectively in sub-period III and IV, therefore, in comparison to sub-period II, a sharp decline has been observed. A significant decline in area has also been observed. In addition, growth in productivity remained at low level and also found to be statistically significant. Therefore, the spurt in growth in production and area that was observed in sub-period-II for boro could not be sustained in sub-period III and IV.

Table 5.3: Kinked Exponential Growth in Production, Area and Productivity of Aman, Aus and Boro in West Bengal for (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

	Sub-period Exp. Growth / Crop	Sub-period I (1970-71 to 1979-80)	Sub-period II (1980-81 to 1989-90)	Sub-period III (1990-91 to 1999- 2000)	Sub-period IV (2000-01 to 2008-09)	Trend break I	Trend break II	Trend break III	DW	R ²
Aman	Production	0.8	3.6	3.0	2.6	2.8	-0.6	-0.4	1.6	0.8
	T Stat	(0.7)	(3.5)*	(7.0)*	(9.4)*					
	Area	0.2	0.1	0.2	0.0	-0.1	0.1	-0.3	2.0	0.2
	T Stat	(0.7)	(0.4)	(1.8)**	(-0.3)					
	Productivity	0.5	3.5	2.9	2.7	3.1	-0.6	-0.3	1.7	0.9
	T Stat	(0.5)	(4.1)*	(8.2)*	(11.5)*					
Aus	Production	-5.8	4.1	2.4	0.6	10.0	-1.7	-1.8	1.0	0.5
	T Stat	(-4.7)*	(3.8)*	(5.2)*	(2.0)**					
	Area	-2.5	-1.7	-2.4	-3.1	0.8	-0.7	-0.7	1.2	0.9
	T Stat	(-2.9)*	(-2.2)*	(-7.4)*	(-15.0)*					
	Productivity	-2.6	4.8	4.4	3.5	7.4	-0.4	-0.9	1.1	0.9
	T Stat	(-3.1)*	(6.6)*	(14.5)*	(17.7)*					
Boro	Production	1.9	9.8	8.8	6.5	7.9	-1.1	-2.3	1.7	0.9
	T Stat	(1.2)	(6.9)*	(14.5)*	(16.7)*					
	Area	1.8	11.4	8.2	6.1	9.6	-3.2	-2.1	1.7	0.9
	T Stat	(1.1)	(8.0)*	(13.8)*	(15.9)*					
	Productivity	0.2	-1.5	0.6	0.4	-1.7	2.1	-0.2	1.7	0.3
	T Stat	(0.2)	(-1.7)***	(1.5)	(1.5)					

*T stats are shown in parenthesis, *Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 5.4: Variability in Production, Area and Productivity of Aman, Aus and Boro in West Bengal in Four Sub-Periods (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

		Sub-Period I (1970-71 to 1979-80)		Sub-Period II (1980-81 to 1989-90)		Sub-Period III (1990-91 to 1999-2000)		Sub-Period-IV (2000-01 to 2008-09)	
		MEAN	C.V	MEAN	C.V	MEAN	C.V	MEAN	C.V
Aman	Production	4782.9	9.7	5920.9	21.6	7926.7	8.0	9428.1	9.4
	Area	4034.3	4.7	4114.6	2.6	4246.7	1.9	4060.3	4.9
	Productivity	1185.8	8.4	1439.2	20.2	1866.2	7.5	2312.2	6.7
Aus	Production	736.0	21.4	714.7	22.7	839.7	7.8	671.7	14.6
	Area	805.1	11.5	637.2	10.8	498.9	12.5	332.5	15.3
	Productivity	914.2	15.2	1121.6	18.4	1683.2	6.9	2020.1	5.6
Boro	Production	822.4	24.0	1515.0	40.6	3433.9	22.1	4396.7	5.6
	Area	298.2	23.2	542.8	34.4	1122.8	19.0	1433.6	4.2
	Productivity	2757.8	8.7	2791.5	7.9	3058.4	4.6	3068.3	4.9

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

In measuring the variability of production, area and productivity of aman, aus and boro in four sub-periods, coefficient of variations were calculated and compared (Table 5.3). Variability in production for aman increased substantially in sub-period II in comparison to sub-period I and declined significantly in sub-period III and increasing marginally in sub-period IV. Now a sharp rise in variability in production for aman in sub-period II was primarily caused by the rise in variability in productivity while the fall variability in production in sub-period III was caused by the fall in both variability of production and productivity. A rise in variability in production of aman in sub-period IV was caused by rise in variability in area under cultivation. Variability in production for aus marginally increased in sub-period II in comparison to sub-period I and it was primarily caused by the rise in variability in productivity. In sub-period III variability in aus production significantly declined and it was caused by the decline in variability in productivity of aus. Rise in variability in production of aus in sub-period IV was due to rise in the variability of area under cultivation for aus. In case of boro, variability in production registered a significant rise in sub-period II in comparison to sub-period I and this was primarily caused by the huge rise in variability in area under cultivation. In sub-period III and IV variability in production was consistently declined and this occurred because of variability in area and productivity where both had declined. Thus it is evident that sub-period II contains highest variability for aman, aus and boro but for boro it is gradually moving towards stability because of consistent fall in coefficient of variations in sub-periods III and IV, while for aman and aus stability has been marginally disrupted in sub-period IV.

5.4 Districtwise Acceleration and Deceleration in Growth in Production of select Foodgrains in West Bengal from 1970-71 to 2008-2009

It has been shown that from 1990-91, growth rate in production of foodgrain, and rice have started falling. The euphoria of high growth in the 1980s slowly dissipated. Therefore, districtwise and cropwise long term acceleration or deceleration of growth in production of major foodgrains needs to be measured. On the basis of these results it can be verified that the high growth in production of foodgrains achieved during the eighties would be sustained or not. From Table 5.5, 5.6, 5.7 and 5.8 one may comment on the nature of acceleration or deceleration in growth in production of foodgrain, rice, wheat and pulses that are taking place among the districts of West Bengal as well as for the state as a whole from 1970-71 to 2008-09. For the state as whole, acceleration in growth rate in production in foodgrain is continuing and the acceleration is significant at 1 percent level. Among the districts, acceleration in growth in foodgrain was observed for Birbhum, Midnapore, Hoogly, Murshidabad, West Dinapur, Jalpaiguri, Cooch Behar and Purulia and for all these districts rate of acceleration is significant at 1 percent level. We also observed that for these districts coefficient of time (t) as well as coefficients of time square (t^2) both are positive. For the districts of Burdwan, Bankura, Howrah, 24 Parganas, Nadia, Malda and Darjeeling, coefficients of time (measures the exponential growth rate) are positive but coefficients of time square are found to be negative which implies that growth rates are falling over time.

For rice, growth in production has shown acceleration (increasing over time) for the districts of Birbhum, Hoogly, West Dinajpur, Jalpaiguri, Cooch Behar and Purulia. The districts of Burdwan, Bankura, Midnapore, Howrah, 24 Parganas, Nadia, Murshidabad, Malda and Darjeeling have registered positive growth in production but growth rates are falling over time. Deceleration in growth in rice production was also observed for the state of West Bengal. The notable feature is that major rice producing districts Burdwan, Birbhum, Bankura, Midnapore, Murshidabad and 24 Parganas are facing deceleration in growth in foodgrain production. In spite of the fact that wheat contributes a small share in foodgrain production and also occupies a small percentage of area under cultivation as percentage of area under foodgrain in the state, most of the districts achieved negative growth in production of wheat but we observe that only Jalpaiguri, Darjeeling and Cooch Behar are showing deceleration and rest of the districts as well as the state as a whole are showing acceleration in the growth in wheat production. In case of pulses, from 1970-71 to 2008-09, only Darjeeling achieved positive and significant growth rate and rest of the districts achieved negative growth in production. However, long term acceleration (also statistically significant)

was achieved by Burdwan, Midnapore, Hoogly, 24 Parganas, Nadia, Murshidabad and Malda. Deceleration in growth in production was observed for the districts of Bankura, Howrah, West Dinajpur, Jalpaiguri, Darjeeling, Cooch Behar and Purulia. The state of West Bengal also showed acceleration in growth in production in pulses from 1970-71 to 2008-09. It needs to be clarified that for foodgrain and rice, the coefficients of time (t) are positive i.e., exponential growth rates for all the districts are found to be positive, therefore, the districts which are having negative coefficients for time square (t^2), imply that growth rates are falling over time but that does not necessarily mean that there is retardation or deceleration in growth in the strict sense, because to have such results coefficients of time (t) as well as time square (t^2) both have to be negative, which is not the case for foodgrain and rice.

Table 5.5: Districtwise Acceleration or Deceleration in Foodgrain Production from 1970-71 to 2008-09

Districts	Exp. Growth	Coef (T^2)	P VALUE
Burdwan	2.8 (14.8)*	-0.00013	0.00*
Birbhum	2.4 (10.2)*	0.00061	0.00*
Bankura	2.7 (9.3)*	-0.00014	0.00*
Midnapore	3.0 (13.8)*	0.00004	0.00*
Howrah	2.6 (9.7)*	-0.00066	0.00*
Hoogly	2.2 (11.5)*	0.00022	0.00*
24 Parganas	2.6 (12.5)*	-0.00031	0.00*
Nadia	3.0 (14.4)*	-0.00067	0.00*
Murshidabad	2.6 (13.3)*	0.00034	0.00*
West Dinapur	3.0 (19.5)*	0.00046	0.00*
Malda	2.5 (16.4)*	-0.00022	0.00*
Jalpaiguri	1.3 (7.1)*	0.00057	0.00*
Darjeeling	1.1 (3.4)*	-0.00145	0.00*
Cooch Behar	2.0 (12.9)*	0.00013	0.00*
Purulia	2.7 (8.0)*	0.00056	0.00*
West Bengal	2.6 (15.8)*	0.00004	0.00*

T stats are shown in parenthesis

Significant at 1% level, ** Significant at 5% level, *Significant at 10% level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 5.6: Districtwise Acceleration or Deceleration in Rice Production from 1970-71 to 2008-09

Districts	Exp. Growth	Coef (T ²)	P VALUE
Burdwan	3.1 (16.5)*	-0.00027	0.00*
Birbhum	2.9 (12.4)*	0.00024	0.00*
Bankura	2.9 (10.0)*	-0.00019	0.00*
Midnapore	3.2 (14.5)*	-0.00001	0.00*
Howrah	3.0 (10.4)*	-0.00076	0.00*
Hoogly	2.6 (13.1)*	0.00003	0.00*
24 Parganas	2.8 (13.1)*	-0.00039	0.00*
Nadia	4.4 (18.4)*	-0.00121	0.00*
Murshidabad	3.9 (14.0)*	-0.00009	0.00*
West Dinapur	3.4 (16.5)*	0.00035	0.00*
Malda	3.1 (18.0)*	-0.00054	0.00*
Jalpaiguri	1.2 (6.1)*	0.00064	0.00*
Darjeeling	0.6 (2.1)*	-0.00007	0.04**
Cooch Behar	2.2 (11.8)*	0.00012	0.00*
Purulia	2.9 (8.4)*	0.00060	0.00*
West Bengal	3.0 (16.9)*	-0.00009	0.00*

T stats are shown in parenthesis

Significant at 1% level, ** Significant at 5% level, *Significant at 10% level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 5.7: Districtwise Acceleration or Deceleration in Wheat Production from 1970-71 to 2008-09

Districts	Exp. Growth	Coef (T ²)	P VALUE
Burdwan	-6.9 (-11.6)*	0.00254	0.00*
Birbhum	-0.7 (-1.4)	0.00379	0.17
Bankura	-2.5 (-3.4)*	0.00057	0.00*
Midnapore	-1.7 (-2.4)*	0.00150	0.02**
Howrah	-7.5 (-6.9)*	0.00433	0.00*
Hoogly	-11.0 (-13.5)*	0.00215	0.00*
24 Parganas	-1.4 (-2.9)*	0.00105	0.01**
Nadia	0.2 (0.4)	0.00001	0.70
Murshidabad	1.3 (4.4)*	0.00057	0.00*
West Dinapur	1.2 (3.3)*	0.00053	0.00*
Malda	2.9 (8.7)*	0.00014	0.00*
Jalpaiguri	5.0 (4.7)*	-0.00292	0.00*
Darjeeling	3.2 (3.1)*	-0.00271	0.00*
Cooch Behar	0.7 (0.9)	-0.00178	0.37
Purulia	-1.3 (-1.3)	0.00082	0.21
West Bengal	0.2 (0.5)	0.00089	0.62

T stats are shown in parenthesis

Significant at 1% level, ** Significant at 5% level, *Significant at 10% level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 5.8: Districtwise Acceleration or Deceleration in Pulses Production from 1970-71 to 2008-09

DISTRICT	Exp. Growth	T stat	Coef (T ²)	P VALUE
Burdwan	-6.3 (-8.0)*		0.00115	0.00*
Birbhum	-0.3 (-0.9)		0.00250	0.39
Bankura	-8.2 (-17.5)*		-0.00156	0.00*
Midnapore	-2.6 (-6.3)*		0.00035	0.00*
Howrah	-9.6 (-10.6)*		-0.00156	0.00*
Hoogly	-8.2 (-9.2)*		0.00281	0.00*
24 Parganas	-2.3 (-5.8)*		0.00116	0.00*
Nadia	-1.9 (-5.6)*		0.00035	0.00*
Murshidabad	-2.7 (-8.0)*		0.00145	0.00*
West Dinapur	-5.3 (-7.9)*		-0.00144	0.00*
Malda	-2.5 (-5.8)*		0.00002	0.00*
Jalpaiguri	-1.2 (-2.3)*		-0.00045	0.03**
Darjeeling	1.7 (3.5)*		-0.00022	0.00*
Cooch Behar	-0.2 (-0.6)		-0.00018	0.57
Purulia	-1.1 (-2.2)*		-0.00031	0.03**
West Bengal	-2.5 (-10.3)*		0.00065	0.00*

T stats are shown in parenthesis

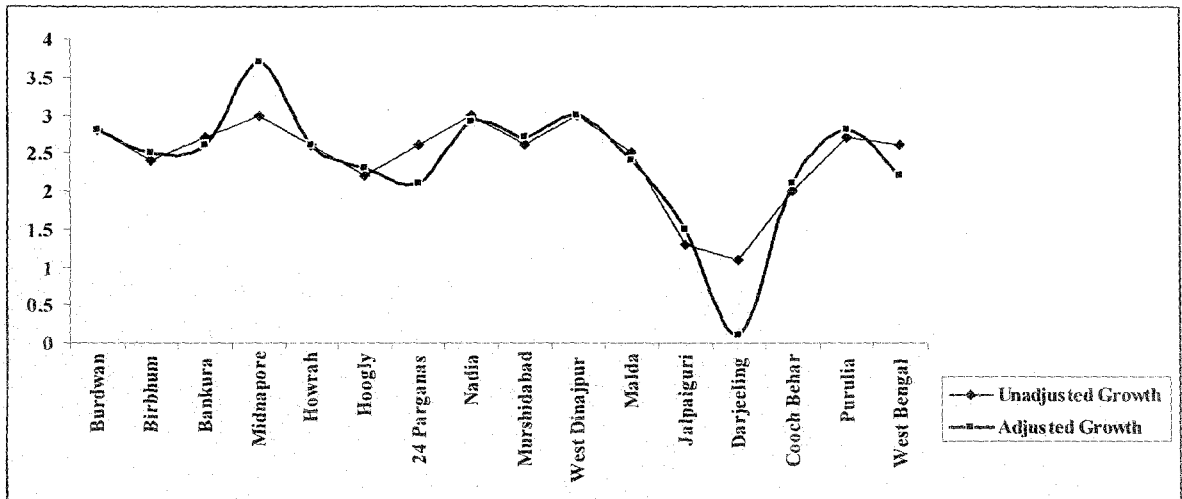
*Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

5.5 Weather Adjusted Growth Rate

In this study, rainfall data are collected for all the districts from the year 1972, instead of 1970, due to non-availability of data. For this, an index of rainfall (defined here as actual rainfall as a percentage of normal rainfall) is included in the exponential growth equation. Figure: 5.B, which gives a plot of the rainfall index along with de-trended actual foodgrain production, shows that the index has a close relationship with the actual foodgrain production.

Figure 5.B: Districtwise Weather Adjusted and Unadjusted Growth Rates of Foodgrain Production in West Bengal from 1970-71 to 2008-09



Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

The tracking of fluctuations in production is somewhat better for the district like Midnapore and worse for district like Darjeeling and 24 Parganas with the improved index calculated in this study indicating great impact of bad weather on lowering foodgrain production in Darjeeling and 24 Parganas, and that of good weather on raising foodgrain production in Midnapore.

Table 5.9: Districtwise Weather (Rainfall Index) Adjusted Growth Rate and Exponential Growth rate in Foodgrain Production (1970-71 to 2008-2009)

Districts	Unadjusted Growth	Adjusted Growth	Weather elasticity of production (foodgrain)
Burdwan	2.8 (14.9)*	2.8 (10.6)*	0.0 (0.2)
Birbhum	2.4 (9.5)*	2.5 (8.9)*	0.2 (1.3)
Bankura	2.7 (9.4)*	2.6 (7.3)*	0.2 (1.3)
Midnapore	3.0 (14.0)*	3.7 (10.8)*	-0.2 (-1.9)**
Howrah	2.6 (9.1)*	2.6 (6.6)*	0.1 (0.7)
Hoogly	2.2 (11.4)*	2.3 (10.6)*	0.0 (0.1)
24 Parganas	2.6 (12.3)*	2.1 (5.2)*	0.2 (1.5)
Nadia	3.0 (12.8)*	2.9 (12.0)*	0.4 (2.6)*
Murshidabad	2.6 (13.0)*	2.7 (10.8)*	0.0 (0.1)
West Dinajpur	3.0 (17.6)*	3.0 (11.8)*	0.1 (1.3)
Malda	2.5 (16.2)*	2.4 (11.7)*	0.1 (1.8)**
Jalpaiguri	1.3 (6.4)*	1.5 (7.2)*	-0.1 (-0.5)
Darjeeling	1.1 (2.7)*	0.1 (0.0)	0.7 (2.7)*
Cooch Behar	2.0 (13.0)*	2.1 (13.5)*	0.1 (1.2)
Purulia	2.7 (7.8)*	2.8 (6.8)*	0.2 (1.0)
West Bengal	2.6 (16.0)*	2.2 (9.5)*	0.3 (3.5)*

T stats are shown in parenthesis

** Significant at 1% level, ** Significant at 5% level.*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

But overall the result of growth estimates in Table 5.9 shows that weather elasticities were insignificant in all but the three districts (Midnapore, 24 Parganas, and Darjeeling). The estimates of growth did not change substantially when adjustments for weather were made. In other words, the growth performance of the last four decades in foodgrain production cannot be explained solely in terms of unusually good or bad weather conditions. The weather

adjusted growth rates being insignificant for most of the districts over the last four decades has been validated by the study of Saha and Swaminathan (1994).

5.6 Growth Instability in Production and Productivity of Select Foodgrains

Nature of instability of districtwise production and productivity for foodgrain, rice, wheat and pulses and other cereals has been presented in Table 5.10 and Table 5.11.

Table 5.10: Districtwise Measures of Instability Coefficients of Production of Various Crops in West Bengal from 1970-71 to 2008-09

	Foodgrain instability coefficient	Rice instability coefficient	Wheat instability coefficient	Pulses instability coefficient	Other Cereals instability coefficient
Burdwan	-5.2 (-1.0)	-5.9 (-1.1)	30.6 (1.0)	30.6 (0.7)	-10.5 (-0.5)
Birbhum	-20.5 (-1.2)	-18.0 (-0.9)	-49.4 (-3.0)*	3.4 (0.1)	47.6 (1.0)
Bankura	-29.1 (-1.3)	-29.7 (-1.2)	56.8 (1.3)	20.8 (0.7)	-24.0 (-0.7)
Midnapore	-7.8 (-0.7)	-7.6 (-0.7)	-7.7 (-0.1)	28.5 (0.9)	10.03 (0.2)
Howrah	-22.9 (-0.5)	-12.1 (-1.2)	39.6 (1.2)	25.3 (2.4)*	-12.5 (-1.8)**
Hoogly	-1.2 (-0.1)	-4.6 (-0.4)	50.3 (2.7)*	57.4 (2.5)*	-20.7 (-0.8)
24-Parganas	-11.9 (-1.6)	-14.2 (-1.8)**	-31.9 (-0.7)	8.6 (0.1)	-15.3 (-0.5)
Nadia	-6.3 (-0.9)	-11.2 (-1.5)	-68.3 (-2.2)*	-17.4 (-1.1)	12.5 (1.5)
Murshidabad	-5.3 (-0.6)	-0.5 (0.0)	-6.1 (-0.9)	35.0 (1.1)	58.0 (1.4)
West Dinajpur	-4.4 (-1.6)	-6.8 (-1.7)	-43.2 (-2.3)*	-41.1 (-1.0)	47.8 (0.7)
Malda	1.3 (0.6)	2.8 (0.8)	-18.2 (-1.3)	61.3 (0.9)	12.1 (1.0)
Jalpaiguri	-10.9 (-1.7)***	-12.0 (-1.4)	-24.6 (-2.9)*	32.5 (0.3)	10.9 (0.1)
Darjeeling	-9.0 (-0.2)	-8.2 (-0.9)	-46.0 (-1.7)***	-36.9 (-1.3)	24.1 (0.4)
Cooch Behar	-1.0 (-0.4)	-4.9 (-0.9)	-97.9 (-2.5)*	-19.7 (-0.8)	25.6 (1.3)
Purulia	-39.3 (-0.8)	-37.9 (-0.8)	-59.4 (-1.6)	-12.4 (-0.2)	-46.0 (-0.6)
West Bengal	-7.4 (-1.1)	-8.6 (-1.2)	-16.4 (-1.8)**	-2.7 (-0.2)	34.8 (2.1*)

T stats are shown in parenthesis

* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

While analysing the instability coefficients, we observe that instability of foodgrain production between 1970-71 and 2008-09 has declined for Burdwan, Birbhum, Bankura, Midnapore, Hoogly, 24 Parganas, Nadia, West Dinajpur, Darjeeling, Cooch Behar, Purulia, Howrah and for the state but instability coefficients are not statistically significant. In

Jalpaiguri district, the decline in instability in foodgrain production was found to be statistically significant at 10 percent level. Only for district of Malda, instability has increased over time but instability coefficient was not found to be statistically significant. For rice, the results remained almost the same as foodgrain. Decline in instability in rice production is statistically significant at 10 percent level only for the district of West Dinajpur. The instability scenario of wheat production is a substantially different from rice. Decline in instability was proved to be statistically significant for Birbhum, West Dinajpur, Jalpaiguri, Darjeeling, Cooch Behar and for West Bengal. Decline in instability remained statistically insignificant for Midnapore, 24 Parganas, Nadia, Murshidabad, Malda and Purulia.

Table 5.11: Districtwise Measures of Instability Coefficients of Productivity of Various Crops in West Bengal from 1970-71 to 2008-09

	Foodgrain instability coefficient	Rice instability coefficient	Wheat instability coefficient	Pulses instability coefficient	Other Cereals instability coefficient
Burdwan	-3.9 (-2.1)*	-4.5 (-2.3)*	1.2 (0.1)	25.7 (2.7)*	33.7 (0.6)
Birbhum	-13.9 (-1.8)**	-12.8 (-1.1)	-0.7 (-0.3)	-5.0 (-0.6)	28.4 (1.2)
Bankura	-17.8 (-1.4)	-18.9 (-1.4)	37.2 (1.4)	23.8 (3.3)*	28.2 (0.3)
Midnapore	-5.2 (-0.8)	-6.1 (-0.8)	-2.5 (-0.2)	24.8 (3.3)*	-20.5 (-0.2)
Howrah	-13.1 (-1.6)	-18.5 (-1.8)**	-12.2 (-0.1)	25.6 (0.8)	4.0 (0.1)
Hoogly	-9.0 (-3.5)*	-11.0 (-3.5)*	35.9 (1.8)**	28.8 (2.5)*	30.7 (1.3)
24-Parganas	-11.5 (-2.0)**	-13.6 (-2.2)*	-2.0 (-0.3)	-0.3 (-0.1)	-17.3 (-1.3)
Nadia	-4.9 (-1.7)***	-6.6 (-1.90)**	-2.9 (-0.6)	0.4 (0.1)	-39.3 (-0.6)
Murshidabad	-5.2 (-1.2)	-10.9 (-1.3)	-0.8 (-0.2)	12.1 (1.2)	46.1 (1.3)
West Dinajpur	-4.8 (-1.8)**	-4.2 (-1.6)	-36.5 (-0.9)	-16.28 (-1.0)	29.0 (0.4)
Malda	-1.5 (-1.2)	-2.2 (-1.2)	-14.5 (-2.3)*	15.5 (1.0)	40.3 (0.7)
Jalpaiguri	-8.3 (-1.3)	-8.0 (-1.1)	-16.0 (-1.4)	3.5 (0.4)	13.8 (0.1)
Darjeeling	0.7 (0.0)	-3.1 (-0.5)	2.1 (0.1)	1.1 (0.2)	31.5 (0.3)
Cooch Behar	-3.0 (-1.3)	-5.2 (-1.3)	-5.7 (-0.9)	22.9 (2.7)*	27.7 (1.1)
Purulia	-31.0 (-1.0)	-33.6 (-1.1)	4.2 (0.2)	39.6 (1.0)	-17.4 (0.0)
West Bengal	-5.2 (-1.4)	-6.2 (-1.4)	-2.0 (-0.8)	-12.1 (-1.2)	36.7 (1.6)

* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level.

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Instability in wheat production increased over time for Burdwan, Bankura, Howrah and Hoogly. For Hoogly, the increase in instability in wheat production also became statistically significant. Finally, for pulses production, instability over time has increased (though remained statistically insignificant) for Burdwan, Birbhum, Bankura, Midnapore, 24 Parganas, Murshidabad, Malda and Jalpaiguri. Instability was also increased for Howrah and Hoogly and instability coefficients for these two districts also became statistically significant. Districts of Nadia, West Dinajpur, Darjeeling, Cooch Behar, Purulia as well as the state of West Bengal have shown a decline in instability (though remained statistically insignificant) in pulses production.

5.7 Trends in Production and Productivity of Non-Foodgrains in West Bengal

Mention has been made on the trend in growth in production, productivity and area of foodgrains in West Bengal as well as for the districts of West Bengal from 1970-71 to 2008-09. We have also estimated the growth in select foodgrains for the districts of West Bengal. Most of our trend analysis has not only considered the whole period of our study i.e. 1970-71 to 2008-09 but also for four sub-periods viz. 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-01 to 2008-09. We find it imperative to carry on similar exercise for non-foodgrains also and for which the analysis has been confined to state level. Non-foodgrains crops like potato, jute, sugarcane, Rapeseeds and mustard, linseed, linseed plus other oilseeds among the various non-foodgrains grown in West Bengal. First attempt is made to see the percentage of area utilised to grow various non-foodgrains and how these percentages are changing over time. Then we try to find out cropwise kinked exponential growth in production, area and productivity of various non-foodgrains in West Bengal have been keeping undertaken the total period of study as well as for pre-defined four sub-periods. Measuring the nature of acceleration and deceleration of growth in production and productivity and area for select non-foodgrain items is also attempted along with measurements of a production variability of various non-foodgrains into its various components. To measure the extent of variability of production, area and productivity for various non-foodgrains, coefficient of variations are also taken into consideration.

5.7.1 Changes in Percentage of Area under Various Non-Foodgrains in West Bengal from 1970-71 to 2008-09

It is observed from the Table 5.12, that, area under major non-foodgrains crops as percentage of total cropped area in West Bengal has increased over time. In comparison to 1970-71, the area under major non-foodgrain as percentage of total cropped area in West Bengal almost

became double and reached around 20 percent of total cropped area in West Bengal. It also shows that non-foodgrains are gaining importance among the farmers of West Bengal. Among various non-foodgrains grown in West Bengal major area under cultivation were used for jute, oilseeds, Rapeseeds and mustard and potato. A look at the figures of area utilisation (Table 5.13) during 1970-71, reveals that the highest percentage of area (48.1 percent) was utilised for the cultivation of jute among the various non-foodgrains grown in West Bengal. Around 20 percent of the area under non-foodgrain was allocated for the cultivation of oilseeds and around 13 percent of the area was utilised for the cultivation of Rapeseeds and mustard. Cultivation of potato occupied around 8 percent of area under total foodgrains production in West Bengal. Around 5 percent of the area was utilised for the cultivation of sugarcane.

In course of time, the area allocation under different non-foodgrains underwent a change. As time progressed jute started losing its relevance and especially since 1985-86, the area under jute cultivation was consistently falling. In 2008-09, the area under jute cultivation fell to 31.8 percent of total area under non-foodgrain. Similar trend was also visible for sugarcane. Mere 1 percent area under non-foodgrain was utilised for sugarcane cultivation. Potato proved to be more attractive option for the farmers and in comparison to 1970-71, the area under potato as percentage of total area under non-foodgrain registered three fold increase in 2008-09. Area under Rapeseeds and mustard in spite of experiencing fluctuation in some years increased over time. In comparison to 1970-71, the area under Rapeseeds and mustard as percentage of total area under non-foodgrain almost doubled in 2008-09. Area under total oilseeds also steadily increased over time and in comparison to 1970-71, the area under total oilseeds as percentage of total area under non-foodgrain almost got doubled in 2008-09. Though area under linseed declined steadily but area under other oilseeds increased consistently and pulled up the total area under oilseeds.

It needs to be mentioned that increase in area under cultivation for a particular crop does not necessarily suggest that production and productivity shall increase also. Again, growth in production may simultaneously be increased due to the increase in growth in productivity as well as increase in growth in area. To validate or invalidate this statement we computed exponential growth in production, area and productivity for a select non-foodgrains for the whole period of our study (1970-71 to 2008-09) as well as for four sub-periods, viz. sub-period I (1970-71 to 1979-80), sub-period II (1980-81 to 1989-90), sub-period III (1990-91 to 1999-2000) and sub-period IV (2000-01 to 2008-9) by using kinked exponential model.

Table 5.12: Area under Various Non-foodgrains as percentage of Total Cropped Area in West Bengal from 1970-71 to 2008-09

Year	1970-71	1980-81	1990-91	2000-2001	2008-09
Potato	0.96	1.62	1.42	2.77	3.47
Jute	5.98	8.53	6.59	5.73	7.83
Sugarcane	0.56	0.20	0.38	0.20	0.31
Rapeseeds & Mustard	1.59	1.83	4.94	5.86	5.04
Linseed plus Other Oilseeds	0.88	2.60	1.77	2.19	3.55
Total	9.97	14.78	15.1	16.75	20.2

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 5.13: Cropwise Area as percentage of Total Area under Non-foodgrain in West Bengal

Year	Potato	Jute	Sugarcane	Rapeseeds & Mustard	Lin Seed	Linseeds plus Other Oilseeds	Other Oilseeds	Total Oilseeds	Total Area under Non-Foodgrain
1970-71	7.7	48.1	4.5	12.8	5.2	7.1	1.9	19.9	100.0
1975-76	13.9	41.3	3.6	11.8	8.1	12.8	4.7	24.6	100.0
1980-81	9.5	50.4	1.2	10.8	5.6	15.4	9.8	26.2	100.0
1985-86	9.8	51.9	0.9	16.4	3.5	9.9	6.4	26.3	100.0
1990-91	14.5	37.2	0.9	28.1	0.6	10.0	9.4	38.2	100.0
1995-96	18.1	36.5	1.2	23.2	1.1	12.0	10.9	35.2	100.0
2000-01	18.0	36.8	1.3	26.2	0.7	9.8	9.1	36.0	100.0
2005-06	20.7	32.6	0.9	24.6	0.4	13.0	12.6	37.6	100.0
2008-09	21.1	31.9	1.0	22.5	0.3	15.9	15.7	38.4	100.0

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

5.7.2 Kinked Exponential Growth in Production of Select Non-Foodgrains

It has been observed (Table 5.14) that between 1970-71 and 2008-09, potato grew at an impressive rate of 5.78 percent and this growth rate is also statistically significant at 1% level. Now looking at four sub-periods, growth rate became negative in sub-period II (1980-81 to 1989-90) and registered an overwhelming increase during sub-period III (1990-91 to 1999-2000). In sub-period III a net addition of 7.95 percent was made to the growth rate in production of potato in comparison to sub-period II. Though in sub-period IV, growth rate in production remained impressive but a decline has also been observed.

Table 5.14: Kinked Exponential Growth in Production in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09) of Select Non-Foodgrains

Crop/Year	Total Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend Break- I	Trend Break- II	Trend Break- III	DW	R ²
Potato	5.78 (15.1)*	3.17 (5.7)*	-0.37 (4.4)*	7.58 (9.9)*	5.98 (10.8)*	-3.54	7.95	-1.6	1.7	0.93
Jute	3.17 (15.7)*	4.2 (3.2)*	2.3 (2.0)*	3.1 (6.5)*	2.9 (9.3)*	-1.9	0.8	-0.2	1.8	0.88
Sugarcane	-0.37 (-0.7)	-5.31 (-1.8)***	-4.24 (-1.7)***	-0.18 (-0.1)	0.45 (0.7)	1.07	4.0	0.63	0.9	0.32
Rapeseeds & Mustard	7.58 (12.3)*	6.58 (2.5)*	18.26 (7.8)*	9.78 (10.0)*	7.31 (11.6)*	11.7	-8.5	-2.5	1.2	0.91
Linseeds plus Other Oilseeds	5.98 (16.0)*	11.63 (5.7)*	5.57 (3.1)*	4.58 (6.0)*	4.88 (10.0)*	-6.1	-1.0	0.3	1.9	0.91

T stats are shown in parenthesis

Significant at 1% level, ** Significant at 5% level, * Significant at 10% level*

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Jute, one of the premium cash crops of West Bengal grew at a modest rate above 3 percent per annum between 1970-71 and 2008-09. However, looking at growth figures in various sub-periods, jute production attained highest growth rate in sub-period I and in subsequent sub-periods growth rates remained lower than sub-period I but it showed an increase in sub-period III over sub-period II and again declined in sub-period IV. The growth experience of sugarcane production continued to remain bleak from 1970-71 to 2008-09 and in four sub-periods. The growth rate in sugarcane production has either remained negative and significant or positive but less than unity and statistically insignificant. Conversely, Rapeseeds and mustard showed spectacular growth in production. From 1970-71 to 2008-09, the growth rate in production for Rapeseeds and mustard remained as high as 7.58 percent and a huge increase has been observed in sub-period II, where a net addition of 11.7 percent in growth rate in production took place. In two subsequent sub-periods, though growth rates have substantially declined but still it remained very high. In comparison to other non-foodgrains, highest rate of growth in production was achieved by Rapeseeds and mustard. Linseed and other oilseeds also grew at an impressive rate from 1970-71 to 2008-09 and highest growth rate in production was achieved during sub-period I and thereafter growth rates declined substantially in subsequent sub-periods.

5.7.3 Kinked Exponential Growth in Productivity of Select Non-Foodgrains

Growth in productivity is one of the major contributing factors for the growth in production. In case of potato growth rate in productivity from 1970-71 to 2008-09 was not much very impressive at 1.1 percent per annum though significant at 1 percent level. In sub-period I, highest growth in productivity was achieved by potato and there after the growth rate started declining. In sub-period II, and III growth rates though positive but was significant at 5 percent level and in sub-period IV growth rate in productivity became insignificant. The growth rate in productivity for jute for the total period of our study (1970-71 to 2008-09) was found to be 2 percent per annum, and highest growth rate was achieved during sub-period I (3.7 percent), however for rest of the subsequent sub-periods (II, III and IV) growth rates were either negative and insignificant or positive and insignificant. For sugarcane, growth scenario of productivity was also not that encouraging. For the whole period of our study sugarcane grew at an exponential rate of 1.1 percent.

Among four sub-periods, growth rate was found to be insignificant in sub-period I, in sub-period II growth rate increased to 2 percent and in sub-period III and IV growth rates were reduced to 1.4 percent and 1.5 percent. Rapeseeds and mustard achieved productivity growth rate of 2.6 percent per annum for the period between 1970-71 and 2008-09. Impressive growth rates in productivity were achieved during sub-period I and II, however, the growth rates declined in sub-period III & IV. Linseeds and other oilseeds grew at 3 percent per annum from 1970-71 to 2008-09. Growth rate in productivity for linseeds and other oilseeds remained insignificant during sub-period I, however, a turn around was observed in sub-period II, when a net addition of 5.45 percent was achieved. It has also been observed that growth rates remained satisfactory during sub-period III and IV but it declined by more than 1 percent in sub-period III and IV (Table 5.15).

Table 5.15: Kinked Exponential Growth in Productivity of West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09) of Select Non-Foodgrains

Crop/Year	Total Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend Break- I	Trend Break- II	Trend Break- III	DW	R ²
Potato	1.1 (3.5)*	3.6 (2.3)*	2.6 (1.8)**	1.7 (2.8)**	0.4 (1.1)	-1.08	-0.89	-1.25	1.8	0.5
Jute	2.0 (19.3)*	0.6 (1.0)	3.2 (5.8)*	2.5 (11.0)*	2.2 (14.9)*	2.6	-0.7	-0.3	1.9	0.9
Sugarcane	1.3 (8.1)*	0.1 (0.1)	2.0 (2.3)*	1.4 (3.7)*	1.5 (6.4)*	1.9	-0.6	0.1	1.6	0.7
Rapeseeds & Mustard	2.6 (10.6)*	4.5 (4.4)*	5.7 (6.2)*	2.8 (7.3)*	2.2 (8.7)*	1.2	-2.9	-0.7	2.0	0.9
Linseeds plus Other Oilseeds	3.0 (12.7)*	0.4 (0.3)	5.9 (4.9)*	4.3 (8.5)*	3.3 (10.2)*	5.5	-1.5	-1.0	1.6	0.9

T stats are shown in parenthesis

* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

5.7.4 Kinked Exponential Growth in Area of Select Non-Foodgrains

From the analysis it is evident above that for most of the non-foodgrains, growth rate in production was not solely influenced by growth rate in productivity and therefore growth rate in area must have contributed positively to the growth in production of various non-foodgrains. If we look at the figures of growth rate in area under various non-foodgrains (Table 5.16) we observe that for the whole period of our study as well as in the four sub-periods, the growth in area remained much higher than growth rate in productivity and therefore, the growth in area had stronger influence to enhance growth in production of potato in West Bengal. For jute growth in area was highest during sub-period I and for sub-period II and III growth rates of area either remained very low and insignificant or negative. In sub-period IV, growth rate in area though remained at less than 1 percent but was found to be statistically significant. The growth in sugarcane had remained negative for the whole periods as well as for the four sub-periods. Rapeseeds and mustard however, showed impressive growth in area for the whole period and in four sub-periods. Phenomenal growth in area (12.5 percent) was achieved during second sub-period, i.e. between 1980-81 and 1989-90. In sub-period III and IV, decline in growth in area was observed, in spite of which growth rates remained very impressive (more than 5 percent). Therefore, if the growth in production in sub-period I was driven by growth in productivity then in sub-period II and

onwards, growth in production was driven by both growth in area and growth in productivity. However, growth in area had stronger impact on growth in production in comparison to growth in productivity. In case of linseeds and other oilseeds, growth in production was primarily influenced by growth in area in sub-period I but from sub-period II and onwards growth in area had slowed down, therefore growth in productivity played a dominant role in enhancing the growth in production.

Table 5.16: Kinked Exponential Growth in Area of West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09) of Select Non-Foodgrains

Crop/Year	Total Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub- Period IV (2000-01 to 2008-09)	Trend Break-I	Trend Break-II	Trend Break- III	DW	R ²
Potato	4.7 (27.5)*	6.3 (6.9)*	4.2 (5.2)*	4.7 (13.7)*	4.1 (18.5)*	-2.1	0.5	-0.6	1.5	1.0
Jute	1.1 (5.9)*	3.6 (3.1)*	-0.9 (-0.9)	0.6 (1.3)	0.6 (2.3)*	-4.5	1.5	0.1	1.2	0.6
Sugarcane	-1.6 (-3.5)*	-5.4 (-2.2)*	-6.2 (-2.8)*	-1.5 (-1.6)	-1.1 (-1.7)***	-0.8	4.7	0.5	1.0	0.5
Rapeseeds & Mustard	4.9 (12.0)*	2.0 (1.1)	12.5 (7.5)*	6.9 (9.9)*	5.1 (11.4)*	10.5	-5.6	-1.8	1.1	0.9
Linseeds plus Other Oilseeds	2.9 (7.7)*	11.3 (6.2)*	-0.3 (-0.2)	0.3 (0.4)	1.6 (3.6)*	-11.6	0.6	1.3	1.5	0.8

T stats are shown in parenthesis

* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

5.7.5 Acceleration and Deceleration in Growth in Production, Productivity and Area of Select Non-Foodgrains in West Bengal from 1970-71 to 2008-09

Acceleration and deceleration of growth in production, productivity and area under cultivation of some important non-foodgrains (Table 5.17, 5.18 and 5.19) grown in West Bengal for 1970-71 to 2008-09 have been taken in consideration. As has been already stated above that if the coefficient of time square (t^2) in a log-quadratic model becomes positive then growth over time is increasing or accelerating and if it becomes negative then growth over time is falling. Among four non-foodgrains, growth in production of potato, jute and Rapeseeds and mustard achieved positive and significant values but rate of change in growth rate with respect to change in time became negative during 1970-71 to 2008-09. For sugarcane, growth rate in production though found to be insignificant, the coefficient of time square was positive implying that growth rate over time has accelerated. Similar results were

achieved for growth in productivity as well as growth in area for all non-foodgrains crops while the sugarcane rest of the crops have shown deceleration.

Table 5.17: Acceleration and Deceleration in Production of select Non-Foodgrains in West Bengal from 1970-71 to 2008-09

Crop	Exp. Growth	Acceleration or Deceleration (Coefficient of t ²)	DW	R ²
Potato	5.78 (15.1)*	-0.00174 (23.3)*	0.8	0.86
Jute	3.17 (15.7)*	-0.00023 (-1.2)	1.8	0.86
Sugarcane	-0.37 (-0.7)	0.001809 (4.2)*	0.5	0.01
Rapeseeds & Mustard	7.58 (12.4)*	-0.00241 (-5.5)*	0.4	0.81

T stats are shown in parenthesis

*Significant at 1% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 5.18: Acceleration and Deceleration in Productivity of select Non-Foodgrains in West Bengal from 1970-71 to 2008-09

Crop	Exp. Growth	Acceleration or Deceleration (Coefficient of t ²)	DW	R ²
Potato	1.1 (3.5)*	-0.001285 (-5.9)*	1.8	0.5
Jute	2.0 (19.3)*	-0.000062 (-0.6)	1.9	0.9
Sugarcane	1.3 (8.1)*	0.00028 (1.9)**	1.6	0.7
Rapeseeds & Mustard	2.6 (10.6)*	-0.001068 (-6.5)*	2.0	0.9

T stats are shown in parenthesis

*Significant at 1% level, ** Significant at 5% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 5.19: Acceleration and Deceleration in Area under Cultivation of select Non-Foodgrains in West Bengal from 1970-71 to 2008-09

Crop	Exp. Growth	Acceleration or Deceleration (Coefficient of t ²)	DW	R ²
Potato	4.7 (27.5)*	-0.00045 (-3.0)*	1.4	1.0
Jute	1.1 (5.9)*	-0.00017 (-0.9)	1.1	0.5
Sugarcane	-1.6 (-3.5)*	0.001528 (3.9)*	0.80	0.4
Rapeseeds & Mustard	4.9 (12.0)*	-0.00134 (-4.1)*	0.50	0.9

T stats are shown in parenthesis

*Significant at 1% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

5.7.6 Instability in Production and Productivity of Select Non-Foodgrains in West Bengal from 1970-71 to 2008-09

Finally, the question whether instability in production and productivity of some major non-foodgrains in West Bengal has been increasing or decreasing over time (from 1970-71 to 2008-09) needs to be explained. It has been unfurled that instability coefficients of production for potato, sugarcane and linseeds and other oilseeds are positive and instability coefficient for potato is statistically significant at 1 percent level and for linseeds and other oilseeds at 10 percent level. Therefore, instability in production for these crops has increased over time, while for jute, Rapeseeds and mustard it has declined since the instability coefficients for these crops assumed a negative value (though statistically insignificant). We achieved similar results for instability in productivity for the aforementioned non-foodgrains (Table 5.20).

Table 5.20: Extent of Instability in Production and Productivity of Select Non-foodgrains in West Bengal from 1970-71 to 2008-09

Crop	Instability coefficient for Production	Instability coefficient for Productivity
Potato	41.5 (2.25)*	54.40 (2.39)*
Jute	-15.7 (-1.53)	-4.16 (-2.04)*
Sugarcane	17.4 (0.63)	9.59 (2.89)*
Rapeseeds & Mustard	-20.3 (-0.95)	-4.59 (-0.88)
Linseeds and Other Oilseeds	10.9 (0.48)	22.86 (1.72)***

T stats are shown in parenthesis

* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

5.8 Conclusion

The empirical exercise undertaken in this chapter adequately reveals that rice is the catalyst that augments or diminishes the growth in production of foodgrain in West Bengal. During the 1970s, growth in production, productivity and area under cultivation of aman and boro grew at abysmally low rates, while aus registered negative growth in production, area under cultivation and productivity. As cumulative impact, the growth rate for rice remained negligible during the 1970s resulting in a low rate of growth in foodgrain production causing stagnation in West Bengal agriculture. During 1980s, a trend break was observed in foodgrain production in West Bengal alleviating long spell of agricultural stagnation. This turn around was caused by the spectacular rise in growth in production of aman aus and boro. Importantly, in the post-1980s, growth in production of aman and aus were primarily driven

by the growth in productivity while growth in production of boro was achieved through massive growth in area. Notwithstanding the fact that boro is high productivity crop and its absolute productivity is much higher than aman and aus, the growth in productivity remained negative during the decade of 1980s. During the decade of 1990s and in the post 1990s aman experienced decline in growth in production and productivity, for aus a decline in growth in production and productivity and area was observed, and in case of boro, though a high very high growth rate in production was maintained but a sharp decline in growth in area has also been observed. Moreover, growth in productivity for boro remained at low level. As a result the spurt in growth in production and productivity of rice and foodgrain was observed during 1980s could not be sustained in the decade of 1990s and in subsequent years.

As the decline in growth became discernible, the pace of change in growth rate would provide us to judge the long term impact on agrarian scenario in West Bengal and her districts. It has been seen that districts of Birbhum, Midnapore, Hoogly, Murshidabad, West Dinajpur, Jalpaiguri, Cooch Behar and Purulia have experienced acceleration of growth in foodgrain, for the districts of Burdwan, Bankura, Howrah, 24 Parganas, Nadia, Malda and Darjeeling growth rates over times experienced deceleration

Inspite, the growth in production is showing acceleration for the districts of Birbhum, Hoogly, West Dinajpur, Jalpaiguri, Cooch Behar and Purulia, the worrying point is that major rice producing districts Burdwan, Bankura and Midnapore, Murshidabad and 24 Parganas are facing deceleration in growth in foodgrain production. The state of West Bengal also showed acceleration in growth in production between 1970-71 and 2008-09. It needs to argue that though the growth rates are falling over time but that does not necessarily mean that there is retardation or deceleration of growth in the strict sense in order to have such results coefficients of time (t) as well as time square (t^2) both have to be negative, which is not the case for foodgrain and rice in particular.

The impact of rainfall on growth in production has significance only for the districts of Darjeeling and 24 parganas and Midnapore and the rest of the districts as well as the state as whole seem to be insulated from the vagaries of rain fall. Coming to the issues of long term stability or instability in foodgrain and rice production in the state and districts, it may be observed that instability of foodgrain and rice production from 1970-71 to 2008-09 has declined for Burdwan, Birbhum, Bankura, Midnapore, Hoogly, 24 Parganas, Nadia, West Dinajpur, Darjeeling, Cooch Behar, Purulia, Howrah, Jalpaiguri and for the whole state as well. Only in the district of Malda, instability has increased over time.

Shifting our focus from foodgrain to non-foodgrain, it is observed that the area under major non-foodgrains in West Bengal almost became double and reached closer to 20 percent of total cropped area in West Bengal in last thirty eight years. It also shows that non-foodgrains are gaining more importance among the farmers of West Bengal.

Among various non-foodgrains grown in West Bengal major area under cultivation were used for jute, oilseeds, Rapeseeds and mustard and potato. As time progresses, jute started losing its relevance and especially since 1985-86, the area under jute cultivation was consistently falling. Similar trend has also been observed for sugarcane. Potato proved to be more attractive option for the farmers in West Bengal and area under cultivation almost got trebled since 1970-71 to 2008-09. Area under Rapeseeds and mustard in spite of experiencing fluctuation in some years increased over times. Though area under linseed was declined steadily, the area under other oilseeds has consistently increased and pulled up the total area under oilseeds. Potato also registered an impressive growth in production, however growth became pronounced during the decade of 1990s. The growth in production of potato primarily pulled up by the growth in area under potato for the reason that the growth in productivity for potato remained low. Jute, one of major cash crops of West Bengal grew at modest rate above 3 percent per annum from 1970-71 to 2008-09, but it remained highest in the decade of 1970s and has primarily driven by growth in productivity, however, it became susceptible to fluctuation and failed to attain the growth rate in 1970s in the subsequent years. The growth in sugarcane production continued to remain bleak in West Bengal and it never peaked up. Conversely, Rapeseeds and mustard showed spectacular growth in production and a massive increase was achieved during the decade of 80s and growth in productivity as well as area together played a dominant role in this regard. Linseed and other oilseeds also grew at an impressive rate from 1970-71 to 2008-09 and highest growth rate in production was experienced during the decade of 70s, but it started declining thereafter. Especially after 1980s growth in productivity became quite strong and influence of area got dissipated for linseed and other oilseeds. However, the empirical results find that during the whole period of study i.e. 1970-71 to 2008-09, potato, jute, mustard and Rapeseeds experienced deceleration of growth in production, area and yield while sugarcane experienced acceleration. On the issue of stability vis-à-vis instability of production it was observed that production instability has been increasing over time for potato, sugarcane and linseeds and other oilseeds while for jute and Rapeseeds and mustard registered decline.

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¹ In a study mentioned earlier, Saha and Swaminathan (1994) have shown that there was no statistically significant effect of rainfall on agricultural production in West Bengal during 1980s, despite the fact that there was good rainfall in most of the years over the period {(Dutta Roy (1994))}. The rainfall index for four different seasons (i.e. southwest monsoon, post-monsoon, winter and pre-monsoon) of a year was first used by Cumming and Ray (1969) to construct an all India rainfall index based on cropping pattern and estimates of area and production in different divisions and states of India. Later the estimation procedure of rainfall index was refined and extended by Ray (1976, 1983). The variability in the productions of crops may change significantly across the districts depending on the nature of rainfall (Saha and Swaminathan, *op.cit.*). But the variability's of productivity and production of crops in different districts of West Bengal can be better understood if emphasis has been given to decadal growth rates of the districts of the major crops.

² A number of attempts have been made to examine the extent of instability in crop production. Measurement of instability has primarily been evolved as a related issue to the growth measurement exercise in agriculture. Many notable scholars who emphasised on this particular issue are Reddy (1978), Srinivasan (1979), Vaidyanathan (1980), Sen (1967), Das (1978), Rath (1980), Alagh and Sharma (1980), Rao *et al.*, (1980), Bandhopadhyay (1981), Mehra (1981), Hazell (1982), Ray (1983), Dhawan (1983), Mahendradev (1987), Boyce (1987), Hanumantha Rao *et al.*, (1988), Saha and Swaminathan (1994), Chattopadhyay (2001) etc.

While measuring instability in agricultural production, broadly two techniques are mostly used: summary measure and trend measure. The summary measure of instability was used by Barkar *et al.*, (1981), Mehra (1981), Hazell (1982), Ray (1983), Dhawan (1983), Mahendradev (1987), Hanumantha Rao *et al.*, (1988), etc. But in general these summary measures has been criticized on the following grounds: i) These measures could not fully encompass the necessary information on the change of instability over time ii) Again measures based on year to year fluctuations are generally get influenced by the short time variations than the long term variations and the conclusion on instability can easily be manipulated simply by adding or removing one or two years having strong outliers in a period.

Many scholars prefer to use the trend measures of instability instead of summary measures. We get two broad categories of trend measures. The first one is to estimate separate trends (linear or exponential) for 'peak' and 'trough' years and to see whether these two trends are converging, meaning thereby increasing instability over time. For selecting peaks and troughs there are mainly three criterion) the usual local maxima and minima definitions, used by Sen (1967), Das (1978), etc. This criterion has also been criticised because a small output differences can cause certain years to be included or excluded. To overcome these difficulties, in the recent studies [Boyce (1987), Mahendradev (1987), Saha and Swaminathan (1994), etc.,] another trend measure of instability has been used by fitting the time trend (linear or exponential) on the statistic of instability and observing the sign of slope parameter with statistical significance. In comparison to Mahendradev statistic, Boyce statistic is more reliable as, being the detrend statistic; it captures all sorts of variations (namely seasonal, cyclical and irregular variations) in the agricultural production.

Some studies considered the nature of association between growth and instability, along with their measurements, either from the simple visual inspection of the movements of the estimated results on growth rates and summary measures/nature (convergence or divergence) of instability over different sub-periods [Sen (1967), Mehra (1981), Hazell (1982), Ray (1983) etc.,] or by regressing instability levels and trends against growth rates cross-sectionally over different crops and regions. However, the regression method appears to be better than other one since it is amenable to statistical analysis and inferences.

Chapter -VI

Crop Diversification in the Districts of West Bengal: Empirical Evidences and Disaggregated Analysis

6.1 Introduction

Diversity is a phenomenon induced by the appropriate stimuli such as physical infrastructure, human capital, and institutional factors, etc., for the nutrient-rich foods and crops. The term 'diversification' has been derived from the word 'diverge' meaning 'to move or extend' to the direction different from a common point (Jha, Kumar and Mohanty, 2000). Agricultural diversification can well be explained in terms of the shift from the regional dominance of one crop towards the production of a large number of crops to meet the increasing demand of those crops. Diversification can also be conceived as the economic development of non agricultural activities (Start, 2001). The process of diversification can be typified as horizontal and vertical diversification. Horizontal diversification is that form wherein farmers diversify their agricultural activities either to stabilize or increase their income or both. It can either take the form of shift from subsistence farming to commercial farming or the shift from low value food crops to high value crops. Vertical Diversification refers to the farmers' access to non-farm income, i.e., the income from non agricultural sources (Haque, 1996).

Diversification, as a first step in the process, would encourage farmers to go into production of high value crops other than traditional ones. In a competitive economy and a favourable economic environment, farmers may be able to determine the crops that can be efficiently produced, allow them to gain profit and achieve a competitive advantage. The growth of agricultural output depends largely on the growth in productivity and the growth in area. In common parlance, productivity is defined as the ratio of production to area; the productivity factor thus incorporates both pure yield effect and the effects of changes in cropping pattern such as a shift from low-yield to high yield crop. The area effect includes changes in net sown area and cropping intensity (ratio of gross cropped area and net sown area).

Agricultural diversification in Asia and the Pacific has basically occurred in two important ways:

- i) As a response to the changing demand structure for agricultural products;
- ii) As a result of policies designed to achieve certain specific objectives.

Thus, agricultural diversification has been perceived as a strategy that augments growth, stabilizes farm income especially of the small and marginal farmers, generates full employment and attains the goal of food security. There is substantial evidence on crop area shifts from coarse cereals and pulses to rice, wheat, sugarcane and oilseeds during the seventies and eighties and in the subsequent period from crop sector to high value fruits vegetables crops, forestry, livestock and fishery activities (Sawant and Achuthan, 1995; Chand, 1996; Vyas, 1996; Pandey and Sharma, 1996; Saleth, 1999; Joshi, Gulati, Birthal and Tiwari, 2004). While area changes within the cropping sector are stated to have induced by favourable price structure, adoption of high yielding varieties, changes in technology, a move towards horticultural crops and allied activities received impetus by liberal external trade policies under the structural adjustment programme.

Cropping pattern connotes spatio-temporal sequence of crops or proportion of area under different crops at a point of time. Crop Diversification or a change in cropping pattern signifies a change in the proportion of area under different crops. To realise sustained growth in agricultural output four important inter-related factors may be considered: institutional changes in the agrarian sector, rise in cropping intensity of land, switching over from low priced crops with low productivity to more productive and remunerative crops and technological improvements. Among institutional factors equitable distribution of lands and pro-peasant tenurial arrangements, access to credit and other inputs may enhance agricultural production and productivity. However, to achieve sustained agricultural growth along with institutional changes, techniques of cultivation need to be improved. In a situation of constraints in cultivable land, increase in cropping intensity may enhance the agricultural production. The existing discourse suggests that cropping pattern gets influenced by various agro-climatic, technical and institutional factors (Vaidyanathan, 1992). Various price and non-price factors are identified in various studies which influence cropping pattern. Narain (1965), Boyce (1987), Chand (1995), Narayanmoorthy (1997), Sing *et al.*, (1997), Bhalla and Singh (1997), Ashok and Bulsubramania (2006) are few among many who examined the role of infrastructural factors like irrigation, road, market, institutions, technology etc., to bring in changes in the cropping pattern in different parts of India. Narain (1965), Sarkar (1988), Nayyar and Sen (1994), Vyas (1996) observed that changes in the relative prices do have considerable impact on cropping pattern. Chand and Chauhan (2002) considered land holdings of small and marginal farmers which did have considerable impact on crop diversification in India.

Lathar *et al.*, (1996) by conducting a study on Sonpet district of Haryana for the year 1993-94 observed the possibility of raising the income of marginal and small farmers through crop diversification. The study revealed that the adoption of new technology has a positive impact on both income and employment. However, input supply system, marketing system and research and extension programmes need to be upgraded to reap the benefit of advanced production technique. Sharma *et al.*, (1996) studied the growth in production of different crops in Rajasthan from 1960-61 to 1993-94. The study shows that oilseeds production has increased and increased in both area and productivity. There is also an increase in gross cropped area (GCA) for wheat but a decline in GCA has been observed for bajra, jowar and barley. Cropping pattern becomes more favourable for remunerative crops. Shyani and Panda (1998) in their study on Gujarat viewed that the farmers are gradually moving from subsistence crops to the commercial crops. Higher growth rate in acreage was observed for tur, castor Rapeseeds and mustard, sugarcane, maize and wheat and negative growth rate in acreage was observed for millet, jowar and cotton in different agro climatic zones of Gujrat. Ajjan and Selvaraj (1996) while analysing the impact of crop diversification among small tea growers in the Nilgiri district of Tamil Nadu argued that the area under potato registered a negative growth and area under tea experienced a positive growth. According to them, the return from tea stood at higher level in comparison to potato.

Increase in agricultural production through expansion of land area put to agriculture use is almost impossible in most of the states and West Bengal is no exception because of population growth, imbalanced land-man ratio and increasing demand for land for non-agricultural uses. Therefore, increase in agricultural output through more productive use of existing cultivable land seems to be more viable option (Ghosh 2011, Ghosh & Kuri 2005), Pingali *et al.*, (1997) and Joshi *et al.*, (2007) argued crop diversification helps the small and marginal farmers to improve their economic condition. In a situation of continuous shrinkage in land holding size and reduction in profitability, large farmers are in position to continue with rice since they can bear the rising cost of cultivation with input packages but small holders are unable to depend solely on rice and go for crop diversification as they can use family labour to their vantage point. However, flexibility of crop diversification for small and marginal farmers gets hindered by lack of irrigation facilities, market access and other infrastructural support etc.

It may be argued that the small and marginal famers (major constituent of faming community in West Bengal) should not only try to produce maximum output of a particular crop but also

go for crop diversification on a given plot of land because cultivation of cereals fulfils the consumption requirement but switching over to high value crops may provide stable employment and income to a large segment of the rural households who experience problem of seasonal unemployment and low income opportunities outside agriculture (De and Chattopadhyay, 2010). Since agriculture in West Bengal is largely dominated by the small and marginal farmers, crop diversification may prove to be a viable option and therefore it deserves special attention and empirical verification.

An attempt has been made here to understand the movement and spread of crop diversification in the districts of West Bengal using time series disaggregated data available in successive volumes of West Bengal Economic Review, published by Bureau of Applied Economics and Statistics, Government of West Bengal and District Statistical Handbook for the period 1970-71 to 2008-09 covering pre-reform, reform and post reform period respectively. Attempt has been made to provide a picture of nature and extent of crop diversification in West Bengal, and to examine the link between several typologies of diversification and agricultural growth over the past few decades and to analyse the relative importance of diversification process in affecting the growth of agricultural output and to test whether crop diversification has been growth inducive or depressive. The status and prospects of crop diversification is achieved by analysing the trend in cropping pattern as well as changes in land use pattern, cropping intensity, area share of major crops under cultivation, shift in crop area and by pattern of growth of agricultural productivity has also been attempted. For estimation of crop diversification, a good number of methods exists denoting specialization or diversification over a particular time period. Each method has its limitation or comparative advantage over the others in terms of empirical parameters. For the present purpose, Simpson Diversity Index (SI) along with Herfindahl Index (HI) has been used in this chapter to explore the nature and extent of crop diversification. Herfindahl index is the index of crop concentration and higher value of it indicates crop specialisation. Therefore, to obtain the index of diversification, it is subtracted from one, which is simplified form of Simpson index of diversification.

6.2 The Dynamics of Change in Cropping Pattern in West Bengal

The nature and direction of cropping pattern changes have been assessed here for nine major crops namely rice, wheat, pulses, other cereals, potato, jute, sugarcane, Rapeseeds and mustard, linseeds and other oilseeds under foodgrain and non-foodgrain items. These crops occupy more than eighty percent of the total area in almost all major districts of West Bengal.

The exercise is carried out in relative terms based on ten year averages of gross cropped area and total cropped area in all the districts of West Bengal from 1970-71 to 2008-09. Changes in crop area are evident during the seventies and early eighties representing post Green Revolution situation when area under wheat and rice expanded phenomenally in absolute and relative terms. The period from mid-eighties is characterized by policy changes on oilseed crops under technology mission programme and hence expansion of area under several oilseeds was undertaken. Finally, the period starting from the early nineties holds importance in terms of implementation of major trade liberalization policies.

The change in the typologies of diversification across districts of West Bengal gets reflected at the economy level through changes in the composition of crop contribution to gross cropped area. Despite existence of diverse agro-climatic scenario, foodgrains dominate the crop sector, amongst which rice and wheat are the prominent crops (Table 6.1). Over a period of time, the area under these crops has been consistent especially for rice and wheat, and at present, these crops cover more than one-third of the gross cropped area (GCA) in West Bengal. However, there has been a declining trend in the share of area under other foodgrains. This is primarily due to reduction in area under other cereals and pulses; although, one can observe different patterns across districts of West Bengal.

Table 6.1: Area under Different Crops (in 000 ha) in West Bengal (1970-71 to 2008-09)

Crop/Year	1970-71	1980-81	1990-91	2000-2001	2008-09
Aus	799.2	615.1	610.3	394	292.4
Aman	3969.9	4214.6	4306.5	3639.5	4086.6
Boro	186.5	346.5	896.1	1401.8	1556.7
Wheat	360.2	283	269.1	426	307
Pulses	669.5	524.3	314	274.5	184
Other Cereals	138.2	115.3	99.8	57.1	110
Potato	65.1	115.6	108.4	206.2	284
Jute	407.1	610.4	504.3	426.5	641.6
Sugarcane	38.3	14.3	29.3	15.1	25.8
Rapeseeds & Mustard	108.2	131.1	378.1	436	412.5
Linseed+Other Oilseeds	59.9	186.3	135.1	162.6	291.2
Total Cropped Area	6802.1	7156.5	7651	7439.3	8191.8
Gross Cropped Area	8785.2	9088.4	8662.3	9116.6	9801.5

Source: *Various issues of West Bengal Economic Review, Government of West Bengal.*

6.2.1 Changes in Cropping Pattern

There has been a significant change in the cropping pattern as well as in the relative area share of various crops in the gross value of crop area in the past few decades. During the 39 years from 1970-71 to 2008-09, the process of cropping pattern changes was slow and

halting. Rice and wheat, which accounted for more than 75 per cent of the total cropped area in 1970-71, still claimed 75 per cent of area during 2008-09. Again, the share of food-grains in the total cropped area also came down only marginally during this period. In West Bengal, whereas the area under high yielding jute and potatoes as percentage to total cropped area increased during 1970-71 to 2008-09, area under coarse cereals and pulses recorded a sharp decline (Table 6.2 and 6.3).

Table 6.2: Cropping Pattern Changes (Cropwise Area as Percentage of Total Cropped Area) in West Bengal (1970-71 to 2008-09)

Crop/Year	1970-71	1980-81	1990-91	2000-2001	2008-09
Aus	11.75	8.59	7.98	5.30	3.57
Aman	58.36	58.89	56.29	48.92	49.89
Boro	2.74	4.84	11.71	18.84	19.00
Wheat	5.30	3.95	3.52	5.73	3.75
Pulses	9.84	7.33	4.10	3.69	2.25
Other Cereals	2.03	1.61	1.30	0.77	1.34
Potato	0.96	1.62	1.42	2.77	3.47
Jute	5.98	8.53	6.59	5.73	7.83
Sugarcane	0.56	0.20	0.38	0.20	0.31
Rapeseeds & Mustard	1.59	1.83	4.94	5.86	5.04
Linseed+Other Oilseeds	0.88	2.60	1.77	2.19	3.55
Total Cropped Area	100.00	100.00	100.00	100.00	100.00

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

Table 6.3 presents relative areas (as percentage of gross cropped area) of crops in West Bengal from 1970-71 to 2008-09. It shows that the area share of principal crops has changed in response to both shift in area under competing crops or alternating crops as well as to fresh areas brought under cultivation. In both the cases, significant changes are observed in the nature and direction of crop pattern shifts. For rice as a whole, except boro rice, the relative share of area under gross cropped area reduced significantly for aus and aman rice. The introduction of boro rice (high yielding rice variety), and expansion of area under it was largely influenced by spread of minor irrigation and the greater availability of rural credit. This played a major role in increasing rice production and productivity in West Bengal. There was significant shift of cultivated area away from aus towards boro, although aman remains the most important rice crop, accounting for more than 60 per cent of rice production.

Compared to rice, wheat and pulses witnessed a fall in area. The area under wheat as percentage of gross cropped area reduced from 4.10 percent in the early seventies to 3.13 percent in 2008-09 and for pulses, it declined from 7.62 to 1.88 percent during the same period (Table 6.3). The most striking pattern in these results is that non food-grain items such as potatoes, jute and oilseeds have emerged as the most important source of growth in crop

sector despite their limited share in gross cropped area. The growing importance of non food-grain items is a result of increasing demand for these commodities in the domestic markets and their growing exports, supported by the development of roads, markets and processing to link their production with consumption (Joshi *et al.*, 2004). Though the contribution of non food items like jute, Rapeseeds and mustard and potatoes increased marginally during the 1970-71 to 2008-09, that of sugarcane and other cereals decreased.

Table 6.3: Cropping Pattern Changes (Cropwise Area as percentage of Gross Cropped Area) in West Bengal (1970-71 to 2008-09)

Crop/Year	1970-71	1980-81	1990-91	2000-2001	2008-09
Aus	9.10	6.77	7.05	4.32	2.98
Aman	45.19	46.37	49.72	39.92	41.69
Boro	2.12	3.81	10.34	15.38	15.88
Wheat	4.10	3.11	3.11	4.67	3.13
Pulses	7.62	5.77	3.62	3.01	1.88
Other Cereals	1.57	1.27	1.15	0.63	1.12
Potato	0.74	1.27	1.25	2.26	2.90
Jute	4.63	6.72	5.82	4.68	6.55
Sugarcane	0.44	0.16	0.34	0.17	0.26
Rapeseeds & Mustard	1.23	1.44	4.36	4.78	4.21
Linseed+Other Oilseeds	0.68	2.05	1.56	1.78	2.97
Total Cropped Area	9.10	6.77	7.05	4.32	2.98

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

Another important trend is the rising contribution of oilseeds and growing share of wheat during the decade of the nineties. The large contribution of Rapeseeds and mustard in crop income growth during the 1990s was due to the 'Technology Mission on Oilseeds', a programme launched in 1986 to stimulate production, reduce imports of oilseeds and achieve self-sufficiency in edible oils. To achieve these objectives the programme emphasised on improving oilseeds production technology, expanding the cultivated area under oilseeds and providing price support to the cultivators. The area planted under oilseeds (mainly Rapeseeds- mustard), had increased from 1.44 to 4.36 percent during 1980-81 to 1990-91.

6.2.2 Cropping Intensity

Cropping intensity is conventionally defined as the ratio (expressed as a percentage) of gross cropped area (GCA) to net sown area (NSA).¹ It measures the extent of land utilization by taking into account the area used for cultivation for more than once. The change in cropping intensity reflects the sensitivity of agricultural activities to socio-economic, agro-biological condition and climatic aberration from time to time. The level of cropping intensity is determined by several factors. The most important factor is the availability of water from

natural rainfall and man made irrigation system. However, the scope for year round cropping activities in most districts of West Bengal is often constrained by the seasonal distribution of rainfall. So long as this natural constraint is arrested, by means of irrigation facilities, the level of multiple cropping improves. However, it is futile to expect one to one correspondence between irrigation and cropping intensity. There are other crucial factors that could also significantly determine the level of cropping intensities such as farm size or operational holding, availability of surplus labour, machinery goods like tractors etc.

Table 6.4: Districtwise Cropping Intensity (1970-71 to 2008-09)

Dist/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	162	166	171	178	189	191	165	164	175
Birbhum	144	157	143	143	152	156	136	147	159
Bankura	139	148	149	154	151	150	145	135	198
Midnapore	150	165	167	165	161	166	164	149	213
Howrah	203	184	204	234	212	206	190	175	168
Hoogly	163	180	185	198	206	209	198	214	227
24 Parganas	291	308	311	332	348	357	340	131	136
Nadia	230	236	242	251	243	249	242	204	200
Murshidabad	183	190	195	196	206	210	192	208	205
West Dinajpur	161	159	165	164	335	342	340	157	303
Malda	192	163	152	153	153	156	206	168	170
Jalpaiguri	136	144	146	150	153	153	167	131	130
Darjeeling	125	119	113	123	126	117	136	79	86
Cooch Behar	184	191	201	202	201	203	192	180	192
Purulia	106	109	104	109	102	110	104	98	105
West Bengal	159	164	165	169	171	174	168	184	185

Source: Calculated from the data collected from various issues of West Bengal Economic Review and District Statistical Handbook, Government of West Bengal.

Cropping intensity is used to be high when farmers on an average grow two seasonal crops a year, undertake multiple cropping or grow several crops in a year. It is low when farmers on an average grow less than two seasonal crops a year and also when they devote areas to annual crops (Table 6.4). The cropping intensity (GCA/NSA) is highest in West Dinajpur (303) followed by 24parganas (292), Nadia (230) and Howrah (203) in 1970-71. This result is opposite from the popular impression that irrigation is the only attribute that is capable of cultivating more than one crop a year. If we take a look at the area irrigated by government canals in these districts, they are at a distance far away from taking the advantages of development of irrigational facilities. On the contrary, the districts like Burdwan, Birbhum, Bankura and Midnapore were well ahead in those days in terms of irrigational facilities but still stood unfavourably against those of Malda, Cooch Behar where percentage of government canals are insignificant. Thus, according to V. K. R. V. Rao, it is not only the irrigated area that remain responsible for multiple cropping, in fact, in India, a large area

under double cropping is not irrigated but only rainfed (Rao, 1974). In Midnapore, West Dinajpur, Hoogly districts, cropping intensity has increased over a period of time (1970-71 to 2008-09) confirming an increasing trend in widespread multiple cropping whereas in Howrah, 24 Parganas, Darjeeling districts, the rate of intensity among the crops registered a sharp decline indicating that these areas are concentrating on one or two crops while varying the agricultural crops. In the other districts of West Bengal, the rates of cropping intensity are fluctuating over time. The changes in the crop pattern among the districts over the period can be a useful analytical tool for measuring the change in this regard. Another obvious factor bearing on the extent of multiple cropping is the relative weight of the long duration crops in the cultivators' choice of cropping pattern e.g., crops like sugarcane occupies the ground for most of the year or longer, thus precluding the chance of multiple cropping on that field where it is grown.

6.3 Diversification and Growth in Crop Output in West Bengal: A State Level Analysis

To understand the nature of changes in cropping pattern in West Bengal during the period 1970-71 to 2008-09, the rates of growth in acreage of different crops in time perspective have been considered. The whole period has been divided in four sub periods: 1970-79, 1980-89, 1990-1999 and 2000-2009.

Annual exponential rate of growth of the area under crops was estimated by fitting regressions of type $L_n Y_{it} = \alpha + \beta t$, where Y_{it} is the area under i^{th} crop at time t . The trend equations have been estimated by Ordinary Least Square method. The results are shown in Table 6.5. The cropping pattern in terms of growth in area remained heavily tilted towards rice and more precisely boro rice. As it evident from the following table (Table 6.5), during 1970-79 growth in area under boro was 2.54 per cent but since 1980 the growth in area under boro rice has been very impressive and significant (at 1% level). In fact, growth in area for aus remained negative throughout the period of study (1970-71 to 2008-09) while aman experienced positive growth of acreage from 1970 to 1999 but growth was significant only between 1990 and 1999. From 2000 onwards growth in area became negative for aman. Among non-foodgrains, 1980 and onwards, potato, Rapeseeds and mustard emerged as important cash crops among the farmers of West Bengal. From 1990 and onwards area growth of jute also become positive and between 2000 and 2009 the area growth under jute was also found to be significant. Linseeds and other oilseeds (major crop under other oilseeds is teel) has achieved impressive growth of acreage (1.6 per cent and significant at 1per cent level).

Table 6.5: Exponential Growth in Area of Important Crops in West Bengal

Crops/Year	1970-1979	1980-1989	1990-99	2000-2009
Aus	-2.50 (-2.92)*	-1.69 (-2.22)*	-2.37 (-7.45)*	-3.10 (-15.10)*
Aman	0.21 (0.64)	0.14 (0.49)	0.24 (1.93)**	-0.05 (-0.62)
Boro	2.54 (1.79)***	9.02 (7.17)*	7.87 (14.91)*	5.90 (17.35)*
Rice	-0.2 (-0.5)	0.8 (3.0)*	0.9 (7.8)*	0.5 (7.0)*
Wheat	-1.1 (-0.5)	-2.1 (-1.2)	-0.9 (-1.2)	0.3 (0.6)
Pulses	-2.5 (-3.5)*	-5.5 (-8.5)*	-5.1 (-19.1)*	-3.4 (-19.8)*
Other Cereals	-3.5 (-0.5)	-0.4 (-0.1)	-2.5 (-1.0)	-3.0 (-1.9)***
Foodgrains	-0.5 (-1.5)	0.1 (0.5)	0.4 (3.2)*	0.2 (2.9)*
Potato	6.3 (6.9)*	4.2 (5.2)*	4.7 (13.7)*	4.1 (18.5)*
Jute	3.6 (3.1)*	-0.9 (-0.9)	0.6 (1.3)	0.6 (2.3)*
Sugarcane	-2.71 (-1.09)	1.57 (0.71)	-3.15 (-3.41)*	-2.14 (-3.60)*
Rapeseeds and Mustard	2.0 (1.1)	12.5 (7.5)*	6.9 (9.9)*	5.1 (11.4)*
Linseeds plus Other Oilseeds	11.3 (6.2)*	-0.3 (-0.2)	0.3 (0.4)	1.6 (3.6)*

T stats are shown in parentheses

* Significant at 0.01, **Significant at 0.05, ***Significant at 0.1

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

6.4 Components of Growth of Crop Output in West Bengal: Area Effect and Yield Effect

The aggregate change in the cultivated area of a region can be segregated on the basis of 'substitution' and 'expansion' effects while comparing the area growth rates of individual crops with the corresponding growth rate in gross cropped area. In other words, the aggregate change in the cropping pattern in each region can be due to either substitution of area among crops or by expansion of area under cultivation. For measuring the trend in area expansion and substitution, the method of Venkataramanan and Prahladachar (1980) has been applied. According to this method, an unchanged cropping pattern (no change in crop-mix) can be a situation where the respective areas under crops bear the same proportion to the gross cropped area (GCA) over the years. It implies that the rate of growth in area under individual crops must equal the rate of growth in the gross cropped area over the same time period. Such a change can be expressed in the form of a linear homogenous gross cropped area function, where given proportionate changes in area under individual crops are related to equal proportionate change in gross cropped area. The differences in the rates of growth in the area

of individual crops from the rate of growth of GCA, therefore provide evidence of change in the cropping pattern. The total change in the cropping pattern over time is the sum total of the substitution effect (the relative decline in area under some crops and corresponding equivalent increase in area under other substitutable crops for a given gross cropped area) and the expansion effect (effect of increase in the gross cropped area).

Change in output for a particular crop at a particular time point is resultant effect of change in area as well as change in productivity. Various possibilities may occur in this regard. Output may increase because of rise in productivity and increase in acreage simultaneously. Output may increase due to rise in productivity and that may offset the impact of fall in acreage. On the contrary, output may fall due to fall in both productivity and area under a particular crop, or fall in productivity may negate the impact of rise in area under cultivation of a particular crop and allow the output to fall. Finally, fall in area under cultivation may cancel out the impact of rise in productivity on output and can be a cause of fall in output. To explore the above possibilities, the concepts of area effect, yield effect and cropped area-gross cropped area elasticity shall prove to be useful on analytical ground. At operational and computational level, first the output, area and productivity of thirteen crops (both foodgrains and non-foodgrains) were chosen for the period spanning from 1970-71 to 2008-09. To calculate the exponential growth of output, area and productivity of chosen crops, the regression equation of the type $L_n Y_{it} = \alpha + \beta t$ was fitted. Here Y_{it} stands for output, area and productivity for i^{th} crop at time point t . α is the constant term and β gives us the exponential growth rate in output, area and productivity respectively. The trend equations are obtained by using ordinary least square method for the period 1970-71 to 2008-09 (Table 6.6). After obtaining the respective exponential growth rates of output area and productivity by using absolute change (Table 6.7) in output and productivity between 1970-71 and 2008-09, the area effect and yield effect were calculated. To do so, what percentage change in growth rate in output was caused by the growth rate in area and growth rate in productivity were calculated for the chosen crops (Table 6.8).

Finally, how much change in output was caused by area effect and yield effect were calculated in absolute terms. After obtaining the rate of growth and change in the rates of growth of acreage of different crops, substitution effect and expansion effect can easily be calculated. For a given gross cropped area (GCA), the substitution effect is defined as the relative decline in area under some crops and commensurate rise in the area of the substitutable crops. The expansion of GCA for a particular crop is denoted as expansion effect. To ensure, whether the area under any crop has undergone change because of inter-

crop shift of area or due to substitution effect or due to change in the total area under cultivation or expansion effect, the cropped area-gross cropped area elasticity (E) defined by Venkataramanan and Prahladachar (1980) has been used here.

$$\text{Cropped area-gross cropped elasticity (E)} = \frac{\% \text{ Change in the growth in area under crop}}{\% \text{ Change in GCA}}$$

If the value of E is greater than unity (or $E > 1$) for a particular crop then it suggests that area for that particular crop has increased due to both substitution effect and expansion effect. Alternatively if the value of E is negative (or $E < 0$) for a particular crop, then it can easily be said that that the crop has lost area to crops having elasticity greater than one. But if the value of E is positive but less than unity then it is difficult to ascertain whether the rise in area is due to expansion of area or due to inter-crop shift of area or substitution effect. Only conclusion follows here that the area of the crop has increased at a rate less than that of GCA.

From Table 6.7 and 6.8, it is evident that growth of output in West Bengal is mostly driven by growth of yield. In 1970-71, 6142 thousand tonnes of rice was produced and in 2008-09 the figure stood at 15037 thousand tonnes in West Bengal. Therefore, a rise in 8895 thousand tonnes have taken place in rice production and growth in productivity has added 7452 thousand tonnes and 1407 tonnes have been added due to growth in area and in absolute terms the figure stands at 980 thousand hectares. However, a close look reveals that the rise in area under rice is primarily driven by rise in area under cultivation of boro rice, which alone has registered an increase in area under cultivation by 1370 thousand hectares between 1970-71 and 2008-09 and its cropped area-gross cropped elasticity (E) is greater than unity. This clearly implies that area under boro cultivation has increased due to both substitution effect and expansion effect. It is also noticed that from 1970-71 to 2008-09, the production of aus rice has fallen both in absolute and relative term. In 1970-71, the aus production in the state was 910 thousand tonnes and in 2008-09 it came down to 605 tonnes. And this fall is primarily caused by a fall in the area under aus cultivation which is 506.8 thousand hectares in absolute term.

As a result, for aus rice, cropped area-gross cropped elasticity (E) stands negative or $E < 0$. Therefore, farmers have diverted their land from the cultivation of aus to boro cultivation and may be for other crops. Other than aus, fall in production in absolute terms has also been observed for wheat, pulses and sugarcane. For pulses and sugarcane, area under cultivation has fallen and as a result these two crops achieved negative cropped area-gross cropped elasticity ($E < 0$). This area has certainly been diverted to the cultivation of potato, Rapeseeds

and mustard, linseeds and other oilseeds and jute. These four crops have achieved values of cropped area-gross cropped elasticity which are greater than unity ($E > 1$) i.e., for these crops both area effect and yield effect contributed positively for the rise of their output. These results again reaffirm the fact that farmers of west Bengal have moved from foodgrain production to non-foodgrain production and crop diversification has occurred apparently at moderate scale in West Bengal.

Table 6.6: Cropwise Exponential Growth in Output, Area and Yield in West Bengal (1970-71 to 2008-09)

Crops	Exp. Growth of Output	Exp. Growth of Area	Exp. Growth of Yield
Aman	2.41	0.06	2.38
Aus	-0.14	-2.88	2.77
Boro	6.31	5.84	0.44
Total Rice	3.02	0.48	2.53
Wheat	0.16	-0.07	0.23
Pulses	-2.54	-3.48	0.97
Foodgrain	2.64	0.15	2.48
Potato	5.78	4.70	1.10
Jute	3.17	1.10	2.00
Sugarcane	-0.37	-1.60	1.30
Rapeseeds and Mustard	7.58	4.90	2.60
Linseeds plus Other Oilseeds	5.98	2.90	3.00

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 6.7: Change in Production ('000 Tonnes) and Area ('000 Hectares) of Different Crops in West Bengal (1970-71 to 2008-09)

Crops/Year	Output		Change in Output	Area		Change in Area
	1970-71	2008-09		1970-71	2008-09	
Aman	4696.4	10074.3	5377.9	3969.9	4086.6	116.7
Aus	910.3	605.0	-305.3	799.2	292.4	-506.8
Boro	535.4	4358.0	3822.6	186.5	1556.7	1370.2
Rice	6142.1	15037.3	8895.2	4955.6	5935.7	980.1
Wheat	868.2	764.5	-103.7	360.2	307.0	-53.2
Pulses	377.2	129.7	-247.5	669.5	184.0	-485.5
Foodgrain	7493.3	16296.8	8803.5	6123.5	6536.7	413.2
Potato	929.7	4121.2	3191.5	65.1	386.0	320.9
Jute	2683.6	7872.6	5189.0	407.1	584.2	177.1
Sugarcane	2075.0	1638.3	-436.7	38.3	17.6	-20.7
Rapeseeds & Mustard	35.7	315.3	279.6	108.2	412.5	304.3
Linseeds & Other Oilseeds	23.5	267.3	243.8	59.9	291.2	231.3

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 6.8: The Decomposition of the Total Increase in Output in terms of Area Effect, Yield Effect and the Crop Area-Gross Cropped Area Elasticity of Crops in West Bengal (1970-71 to 2008-09)

Crops	Area Effect (‘000 Tonnes)	Yield Effect (‘000 Tonnes)	Increase In Area (‘000 Hectares)	‘E’
Aman	126.8	5319.8	116.7	0 < E < 1
Aus	-6243.5	6016.3	-506.8	E < 0
Boro	3537.5	269.3	1370.2	E > 1
Total Rice	1407.5	7452.1	980.1	0 < E < 1
Wheat	45.1	-148.9	-53.2	0 < E < 1
Pulses	-338.8	94.6	-485.5	E < 0
Foodgrain	513.1	8277.3	413.2	0 < E < 1
Potato	2595.2	607.4	320.9	E > 1
Jute	1800.6	3273.8	177.1	E > 1
Sugarcane	-1888.4	1534.4	-20.7	E < 0
Rapeseeds And Mustard	180.7	95.9	304.3	E > 1
Linseeds plus Other Oilseeds	118.2	122.3	231.3	E > 1

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

6.5 Magnitude and Extent of Crop Diversification in West Bengal: A Disaggregated District Level Analysis

At a given point of time, the extent of crop diversification can be measured by using several indices namely: 1. Herfindhal Index (HI) 2. Simpson Index (SI) 3. Ogive Index (OI) 4. Entropy Index (EI) 5. Modified Entropy Index (MEI) 6. Composite Entropy Index (CEI) etc. All these indices are computed on the basis of proportion of gross area under different crops cultivated in particular geographical locations. Among these indices HI, EI and MEI are most widely used to measure the extent of crop diversification. In this study Herfindahl Index has been used to measure the extent of crop concentration both at aggregate level i.e., for the state of West of Bengal as well as at disaggregated level or at district level. It is to be mentioned that the Herfindahl index is the index of concentration and higher value of it indicates crop specialisation. Therefore, to obtain the index of diversification, it is subtracted from one, which is simplified form of Simpson index of diversification. Herfindahl index is defined as:

$$HI = \sum_{i=1}^n p_i^2$$

Where:

P_i = Proportion of area under i^{th} crop

$$p_i = \frac{A_i}{\sum_{i=1}^n A_i}$$

$$P_i = \frac{A_i}{\sum_{i=1}^n A_i}$$

Where,

$$A_i = \text{Area under } i^{\text{th}} \text{ crop and}$$

$$\sum A_i = \text{Total cropped area}$$

Therefore, Simpson Index of Diversification or

$$SI = 1 - \sum_{i=1}^n p_i^2$$

The HI index can accommodate a large number of alternative production choices; therefore large number of crops can be incorporated to measure the concentration/diversification. This implies that if the total area is equally shared among the large numbers of alternative crops, it means that the share of each crop would be very small or closer to zero. Therefore, higher the value of HI higher will be specialisation and lower value of HI will signify diversification. In case of perfect specialization the value HI index becomes one and zero signifies perfect diversification.

To understand the spatial pattern of diversification, the computed values of indices were ranked for the districts of West Bengal. To test the consistency of the ranking patterns of the districts based on the values of Herfindahl indices, Spearman's rank correlations of districtwise indices between any two years along with level of significance are also considered.

As the Herfindahl index suggests that if the value exceeds 0.5 then that particular region for which the value is calculated with a given sets of crops, is moving towards specialisation or more than 50 per cent of the total cropped area is used for cultivation of one or two specific crops. Here, to compute the indices for the state of West Bengal as well as for the districts, seven crops - a mix of foodgrains as well as non-foodgrains have been considered. They are rice, wheat, other cereals, pulses, jute, potato, Rapeseeds and mustard respectively. To understand the temporal change, nine points of time have been taken into account and these points of time are 1970-71, 1975-76, 1980-81, 1985-86, 1990-91, 1995-96, 2000-01 and 2008-09, five year interval except for the last period. Indices for the state for all these time periods remain fairly constant and hover around 0.56 in 1970-71 to 0.57 in 2008-09, barring 2000-01 when the Herfindahl index for the state assumed a value of 0.49 (Table 6.9). These results suggest that crop concentration is more pronounced than crop diversification. This is based on the fact that majority of the total cropped area in the State is used for foodgrain production and more precisely rice production.

To have a disaggregated picture of crop concentration or diversification, Herfindahl indices for the districts of West Bengal are also being computed by taking the same set of crops and time periods. Based on the values of Herfindahl indices, four observations can be made. In districts like Burdwan, Midnapore, Purulia, Bankura and 24-Parganas, crop concentration is strongly pronounced. From Table 6.9, it can be observed that the value of Herfindahl index stood at 0.7, 0.8, 0.8, 0.7 and 0.7 respectively for the districts of Burdwan, Midnapore, Purulia, Bankura and 24-Parganas in 190-71 and for that year the same set of districts assumed values 0.7, 0.8, 0.8, 0.8 and 0.6. On the contrary, in Nadia, Murshidabad, Malda and Darjeeling, crop diversification is strongly pronounced and their Herfindahl indices are 0.3, 0.2, 0.3 and 0.4 in 1970-71. In 2008-09, the Herfindahl indices for those districts are 0.3, 0.3, 0.4 and 0.3. Therefore, in these four districts, diversification of crop combinations was maintained. Hoogly and Birbhum have gradually been moving from a situation of diversified crop combinations to specialisation or production of one or two crops. However a reverse trend is observed in Cooch Behar and Jalpaiguri, where crop concentration has gradually been reduced and crop diversification has become more prominent (Table 6.9).

The extent of crop diversification can also be explained with the help of Simpson Index (Table 6.10). Since the Simpson index is calculated by deducting the value of Herfindahl index from unity, therefore, value closer to zero indicates crop concentration and value closer to one indicates crop diversification. For the districts of Burdwan, Midnapore, Purulia, Bankura and 24-Parganas in 190-71, the Simpson indices stood at 0.28, 0.18, 0.23 and 0.14 and in 2008-09 the same set of districts assumed values 0.23, 0.16, 0.15 and 0.28 and these values reaffirm that least diversification has taken place in these districts. Conversely, Simpson indices for Nadia, Murshidabad, Malda and Darjeeling remained higher than 0.5 from 1970-71 to 2008-09 and thus reveals that crop mix in those districts has remained diversified all along. Simpson indices for West Dinajpur either remained higher than 0.5 or closer to 0.5 for the entire study period. Simpson indices for the districts of Hoogly and Birbhum in 1970-71 were calculated as 0.46 and 0.44. In 2008-09, the indices stood at 0.47 and 0.31.

It clearly suggests that crop-mix has hardly changed in Hoogly and crop diversification has slightly increased in Birbhum. Finally, in Cooch Behar and Jalpaiguri, the value of Simpson indices were increased from 0.40, 0.32 in 1970-71 to 0.50 and 0.52 in 2008-09 and these results again corroborating the fact that crop concentration has increased in these two districts. Districtwise ranking in terms of Herfindahl indices and Simpson indices for all chosen years almost remained the same. Districts which were at the top in terms of ranking in

early years have maintained their ranking position even in the later years also. Midnapore, bankura, Purulia, Burdwan, 24 Parganas consistently occupied top positions in terms of crop concentration indices or Herfindahl indices and lower brackets in terms of crop diversification indices or Simpson indices (Table 6.11). The rank correlations of districtwise indices between any two years for all chosen years are found to be significantly positive (in most of the cases at 0.01 level and only for few cases at 0.05 levels). This suggests that the districts where crop concentration or diversification was high at the initial stage, it continued to remain so at the later stage also (Table 6.12 & 6.13)

Table 6.9: Districtwise Herfindahl Indices of Crop Diversification in West Bengal (1970-71 to 2008-09)

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	0.7185	0.7011	0.7423	0.7047	0.7093	0.5381	0.7092	0.7825	0.7676
Birbhum	0.5571	0.5720	0.7105	0.6815	0.6950	0.7504	0.6043	0.7251	0.6856
Bankura	0.8597	0.7568	0.8459	0.8196	0.7984	0.8294	0.8022	0.7426	0.7179
Midnapore	0.8186	0.7694	0.8047	0.8140	0.8418	0.8008	0.8052	0.7921	0.8395
Howrah	0.6826	0.6587	0.6394	0.6666	0.8189	0.8430	0.7400	0.7963	0.8188
Hoogly	0.5324	0.5906	0.5775	0.5285	0.5615	0.5663	0.4459	0.5136	0.5283
24 Parganas	0.7077	0.6895	0.7808	0.5481	0.6005	0.6340	0.5128	0.6904	0.6964
Nadia	0.3138	0.3059	0.2863	0.2732	0.3197	0.3368	0.2625	0.3109	0.3321
Murshidabad	0.2969	0.3297	0.3073	0.2751	0.3374	0.3243	0.2382	0.3474	0.3212
West Dinajpur	0.5650	0.4981	0.5186	0.4603	0.5919	0.5841	0.4053	0.5614	0.4915
Malda	0.3432	0.3580	0.3768	0.3763	0.4109	0.4901	0.3894	0.4377	0.4200
Jalpaiguri	0.6734	0.6252	0.5998	0.5292	0.6422	0.5830	0.5374	0.5418	0.4796
Darjeeling	0.4144	0.3990	0.3828	0.3834	0.3001	0.2933	0.2834	0.3517	0.3488
Cooch Behar	0.5993	0.5841	0.5573	0.5611	0.5978	0.5356	0.4980	0.5178	0.4945
Purulia	0.7615	0.7061	0.8067	0.7715	0.7697	0.7925	0.7693	0.7571	0.8449
West Bengal	0.5647	0.5563	0.5787	0.5287	0.5818	0.5643	0.4980	0.5824	0.5718

Source: Calculation based on data collected from various volumes of District Statistical Handbook, Government of West Bengal

Table 6.10: Simpson Indices of Crop Diversification in the Districts of West Bengal (1970-71 to 2008-09)

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	0.2815	0.2989	0.2577	0.2953	0.2907	0.4619	0.2908	0.2175	0.2324
Birbhum	0.4429	0.4280	0.2895	0.3185	0.3050	0.2496	0.3957	0.2749	0.3144
Bankura	0.1403	0.2432	0.1541	0.1804	0.2016	0.1706	0.1978	0.2574	0.2821
Midnapore	0.1814	0.2306	0.1953	0.1860	0.1582	0.1992	0.1948	0.2079	0.1605
Howrah	0.3174	0.3413	0.3606	0.3334	0.1811	0.1570	0.2600	0.2037	0.1812
Hoogly	0.4676	0.4094	0.4225	0.4715	0.4385	0.4337	0.5541	0.4864	0.4717
24 Parganas	0.2923	0.3105	0.2192	0.4519	0.3995	0.3660	0.4872	0.3096	0.3036
Nadia	0.6862	0.6941	0.7137	0.7268	0.6803	0.6632	0.7375	0.6891	0.6679
Murshidabad	0.7031	0.6703	0.6927	0.7249	0.6626	0.6757	0.7618	0.6526	0.6788
West Dinajpur	0.4350	0.5019	0.4814	0.5397	0.4081	0.4159	0.5947	0.4386	0.5085
Malda	0.6568	0.6420	0.6232	0.6237	0.5891	0.5099	0.6106	0.5623	0.5800
Jalpaiguri	0.3266	0.3748	0.4002	0.4708	0.3578	0.4170	0.4626	0.4582	0.5204
Darjeeling	0.5856	0.6010	0.6172	0.6166	0.6999	0.7067	0.7166	0.6483	0.6512
Cooch Behar	0.4007	0.4159	0.4427	0.4389	0.4022	0.4644	0.5020	0.4822	0.5055
Purulia	0.2385	0.2939	0.1933	0.2285	0.2303	0.2075	0.2307	0.2429	0.1551
West Bengal	0.4353	0.4437	0.4213	0.4713	0.4182	0.4357	0.5020	0.4176	0.4282

Source: Calculation based on data collected from various volumes of District Statistical Handbook, Government of West Bengal

Table 6.11: Districtwise Ranking of Herfindhal Indices (HI) and Simpson Indices (SI) of Crop Concentration/Diversification in West Bengal (1970-71 to 2008-09)

District/Year	1970-71		1975-76		1980-81		1985-86		1990-91		1995-96		2000-01		2005-06		2008-09	
	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI
Burdwan	4	12	4	12	5	11	4	12	5	11	10	6	5	11	3	13	4	12
Birbhum	10	6	10	6	6	10	5	11	6	10	5	11	6	10	6	10	7	9
Bankura	1	15	2	14	1	15	1	15	3	13	2	14	2	14	5	11	5	11
Midnapore	2	14	1	15	3	13	2	14	1	15	3	13	1	15	2	14	2	14
Howrah	6	10	6	10	7	9	6	10	2	14	1	15	4	12	1	15	3	13
Hoogly	11	5	8	8	9	7	10	6	11	5	9	7	10	6	11	5	8	8
24 Parganas	5	11	5	11	4	12	8	8	8	8	6	10	8	8	7	9	6	10
Nadia	14	2	15	1	15	1	15	1	14	2	13	3	14	2	15	1	14	2
Murshidabad	15	1	14	2	14	2	14	2	13	3	14	2	15	1	14	2	15	1
West Dinajpur	9	7	11	5	11	5	11	5	10	6	7	9	11	5	8	8	10	6
Malda	13	3	13	3	13	3	13	3	12	4	12	4	12	4	12	4	12	4
Jalpaiguri	7	9	7	9	8	8	9	7	7	9	8	8	7	9	9	7	11	5
Darjeeling	12	4	12	4	12	4	12	4	15	1	15	1	13	3	13	3	13	3
Cooch Behar	8	7	9	7	10	6	7	9	9	7	11	5	9	7	10	6	9	7
Purulia	3	13	3	13	2	14	3	13	4	12	4	12	3	13	4	12	1	15

Source: Calculation based on data collected from various volumes of District Statistical Handbook, Government of West Bengal

Table 6.12: Rank Correlation Matrix of Districtwise Herfindahl Indices of Crop Diversification in West Bengal

Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
1970-71	1								
1975-76	0.97**	1							
1980-81	0.95**	0.96**	1						
1985-86	0.93**	0.93**	0.95**	1					
1990-91	0.91**	0.90**	0.89**	0.93**	1				
1995-96	0.82**	0.81**	0.85**	0.83**	0.92**	1			
2000-01	0.59*	0.59*	0.59*	0.62**	0.62**	0.54*	1		
2005-06	0.89**	0.88**	0.87**	0.90**	0.96**	0.89**	0.59*	1	
2008-09	0.90**	0.92**	0.92**	0.92**	0.92**	0.86**	0.59*	0.95**	1

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed).

Table 6.13: Rank Correlation Matrix of Districtwise Simpson Indices of Crop Diversification in West Bengal

Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
1970-71	1								
1975-76	0.97**	1							
1980-81	0.94**	0.95**	1						
1985-86	0.92**	0.91**	0.94**	1					
1990-91	0.89**	0.88**	0.87**	0.92**	1				
1995-96	0.79**	0.77**	0.82**	0.79**	0.90**	1			
2000-01	0.93**	0.93**	0.93**	0.96**	0.97**	0.87**	1		
2005-06	0.86**	0.85**	0.85**	0.88**	0.95**	0.86**	0.93**	1	
2008-09	0.88**	0.90**	0.90**	0.90**	0.90**	0.84**	0.93**	0.94**	1

**Correlation is significant at the 0.01 level (2-tailed)

6.6 Temporal and Spatial Shifts in Area Share of Major Crops at District Level in West Bengal

There has been a significant change in the cropping pattern as well as in the relative share of various crops in the total cropped area in the past few decades. In West Bengal as a whole, in most of the southern districts the area share of rice in the Total Cropped Area (TCA) has been the highest amongst other crops from 1970-71 to 2007-08. Except for a few districts, the area covered under rice remained consistent over the different decades. There has been an increasing trend for the area under rice cultivation among the districts like Burdwan, Birbhum, Midnapore, Nadia, Murshidabad, Malda, Purulia and other districts like Howrah, Hoogly, 24 Parganas, West Dinajpur, Jalpaiguri, Darjeeling etc., experienced a declining trend for the area under rice cultivation.

While for wheat, area under cultivation has reduced over the decade (1970-71 to 2008-09) as a whole for West Bengal but under the districts of Northern Bengal cultivated area has increased for wheat. Area under wheat has substantially increased in Jalpaiguri and Malda district from 4 to 8 per cent from 1970-71 to 2008-09. The area shares of wheat showed a marginal increase during this period in other districts of North Bengal like West Dinajpur, Cooch Behar and Darjeeling. Except Malda and Darjeeling, other cereals constitute a very small proportion of total cropped area in all the districts of West Bengal. Proportionate area under other cereals has shown a marginal decrease for all the districts over the period (1970-71 to 2008-09) and it is true for Malda and Darjeeling too. In pre-reform period the area under pulses were occupying a significant proportion of total cropped area in Nadia, Murshidabad and Malda districts but after the adoption of new technology in 1980-81 in West Bengal shifting in area under pulses was reduced by a high percentage. The pace of increase in the share of Rapeseeds and mustard in the TCA has been slow, whereas the proportion of potatoes in the TCA has been increasing rapidly. The area under jute cultivation has increased significantly in Nadia and Murshidabad district and substantial growth in area under potatoes was observed in Bankura, Hoogly, Jalpaiguri and Darjeeling district. The share of oilseeds in total area increased in the districts like Bankura, Nadia, Murshidabad, West Dinajpur and Malda.

If we consider the share of agricultural production in the districts of West Bengal, important changes in the cropping pattern in agriculture would be observed over time. Between 1980-81 and 1990-91, there was an absolute fall in the area cultivated with foodgrains, other cereals. In the period after 1990-91, additionally there was an absolute fall in the area cultivated with pulses. Further, the area cultivated with oilseeds declined sharply after 1990-91. Between 1970-71 and

2008-09, the share in gross cropped area cultivated with food crops, foodgrains and cereals continuously declined, particularly after the mid-seventies (Table 6.14). The share in gross cropped area cultivated with oilseeds rose between 1980-81 and 1995-96, and declined afterwards. The share in gross cropped area cultivated with pulses declined after the late-eighties. On the other hand, beginning from the early seventies, there was a steady increase in the share in gross cropped area cultivated with potatoes.

Table 6.14: Districtwise Share of Area of Seven Major Crops as percentage of Total Cropped Area (1970-71 to 2008-09)

Table 6.14 A: Rice

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	84.4	83.3	85.9	83.6	83.6	68.4	83.7	88.2	87.2
Birbhum	72.1	73.7	83.8	82.0	82.6	86.3	76.8	84.8	82.3
Bankura	92.6	86.6	91.9	90.4	89.2	90.9	89.4	85.6	84.1
Midnapore	90.3	87.4	89.5	90.1	91.7	89.3	89.6	88.7	91.4
Howrah	82.1	80.2	78.6	80.7	90.4	91.7	85.6	89.0	90.3
Hoogly	71.6	75.9	74.6	70.7	72.8	72.4	61.2	68.1	69.2
24 Parganas	83.6	82.4	88.1	72.1	76.3	78.5	69.4	82.6	82.9
Nadia	45.5	46.3	42.2	36.4	49.9	52.1	40.7	48.8	50.6
Murshidabad	45.8	50.3	48.7	43.4	53.0	50.3	35.2	54.1	50.4
West Dinajpur	74.0	69.0	70.2	65.1	76.0	75.4	59.6	73.3	68.4
Malda	52.0	54.6	57.6	57.8	61.3	68.3	59.1	64.1	62.3
Jalpaiguri	80.9	78.4	75.7	70.0	79.2	75.2	71.7	72.1	67.4
Darjeeling	50.0	49.2	45.0	49.3	38.1	31.3	29.7	46.4	44.3
Cooch Behar	75.6	75.3	71.8	72.1	75.7	70.4	67.5	69.7	67.3
Purulia	86.7	83.5	89.5	87.5	87.3	88.8	87.3	86.7	91.7

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal

Table 6.14 B: Wheat

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	4.7	6.0	1.6	1.5	0.4	0.5	0.9	0.2	0.3
Birbhum	17.2	13.8	4.8	4.3	3.1	4.2	6.5	4.3	7.3
Bankura	2.1	8.1	2.5	2.9	1.6	1.4	2.0	0.1	0.9
Midnapore	1.0	2.9	0.9	1.0	0.5	1.0	1.1	1.4	0.2
Howrah	5.1	4.1	0.7	0.7	0.1	0.6	0.8	0.3	0.1
Hoogly	7.7	8.0	1.9	1.6	0.2	0.3	0.5	0.5	0.4
24 Parganas	2.1	3.1	1.2	0.8	1.0	0.8	1.7	2.5	1.1
Nadia	9.6	10.7	8.9	11.1	7.3	8.1	10.7	8.5	6.6
Murshidabad	15.9	16.7	14.0	14.9	13.8	16.8	21.3	7.4	12.8
West Dinajpur	3.2	9.3	5.7	5.9	4.5	5.5	5.8	0.9	5.8
Malda	4.9	8.8	7.0	7.6	8.7	11.3	13.2	7.5	12.5
Jalpaiguri	0.3	6.0	2.5	2.7	3.0	6.1	7.3	1.2	4.5
Darjeeling	0.6	2.8	1.6	1.6	2.6	2.1	2.9	2.8	2.7
Cooch Behar	2.1	5.3	3.3	3.6	3.4	4.2	5.8	2.3	2.2
Purulia	0.3	4.6	0.6	0.7	0.4	1.4	1.0	4.3	0.3

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

Table 6.14 C: Other Cereals

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Birbhum	0.5	0.3	0.4	0.2	0.2	0.1	0.1	0.1	0.1
Bankura	0.6	0.6	0.7	0.6	0.7	0.2	0.3	0.3	0.1
Midnapore	0.3	0.3	0.2	0.1	0.1	0.2	0.1	0.1	0.1
Howrah	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Hoogly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 Parganas	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nadia	1.0	3.2	0.5	0.2	0.9	0.2	0.1	0.3	0.6
Murshidabad	3.0	2.3	2.4	1.1	0.7	0.3	0.3	1.0	0.8
West Dinajpur	2.1	1.6	1.1	1.2	0.1	0.2	0.2	1.8	4.2
Malda	10.6	7.8	7.3	5.1	3.1	3.1	1.7	3.7	3.0
Jalpaiguri	1.3	2.3	1.5	3.6	1.4	1.0	0.7	3.6	3.4
Darjeeling	40.2	39.1	41.9	36.7	31.1	24.7	21.5	35.4	37.5
Cooch Behar	0.5	1.5	0.5	0.6	0.8	0.2	0.2	0.9	2.0
Purulia	3.3	3.3	3.5	5.3	5.2	4.4	5.0	3.9	2.6

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

Table 6.14 D: Pulses

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	5.2	5.3	2.7	2.0	0.4	0.2	0.8	0.2	0.4
Birbhum	8.6	10.1	6.8	5.0	1.9	2.7	4.9	4.3	3.4
Bankura	3.2	2.7	1.9	1.5	0.6	0.6	0.3	0.1	0.1
Midnapore	6.0	6.7	5.5	4.1	2.0	1.4	1.7	1.4	1.1
Howrah	6.8	11.2	13.6	11.7	3.1	0.5	0.3	0.3	0.8
Hoogly	5.3	3.7	2.5	1.9	0.2	0.2	0.5	0.5	0.1
24 Parganas	7.9	8.4	6.9	5.0	3.0	1.4	2.1	2.5	2.6
Nadia	28.1	25.2	20.5	14.0	12.9	7.9	10.1	8.5	6.6
Murshidabad	22.2	20.5	17.5	15.2	7.9	6.2	9.3	7.4	4.7
West Dinajpur	6.7	8.1	6.2	4.5	3.6	3.0	1.6	0.9	0.8
Malda	23.5	20.8	15.9	12.6	13.7	7.2	9.6	7.5	5.8
Jalpaiguri	1.2	2.9	2.3	2.0	1.4	0.7	1.8	1.2	1.2
Darjeeling	1.3	1.6	1.5	1.2	0.7	1.5	1.7	2.8	1.6
Cooch Behar	2.7	4.6	2.1	2.0	2.3	2.2	2.4	2.3	1.5
Purulia	8.9	7.6	6.1	6.2	6.4	4.7	6.2	4.3	4.9

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

Table 6. 14 E: Jute

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	2.3	1.4	2.7	3.1	2.0	1.1	1.5	1.7	1.4
Birbhum	0.1	0.1	0.1	0.2	0.0	0.1	0.0	0.1	0.0
Bankura	0.2	0.2	0.5	0.3	0.1	0.1	0.1	0.1	0.0
Midnapore	1.2	1.1	2.1	1.9	0.9	0.8	0.6	0.5	0.4
Howrah	3.9	1.8	5.4	3.9	2.4	2.5	5.1	4.4	2.8
Hoogly	9.1	5.0	10.4	11.5	8.3	5.5	9.2	6.9	6.5
24 Parganas	4.5	4.7	1.6	14.9	10.1	10.9	13.9	6.3	6.7
Nadia	13.6	12.5	23.8	32.5	20.4	19.8	23.2	21.2	23.3
Murshidabad	10.8	7.4	13.4	19.7	15.8	18.5	22.2	17.6	19.3
West Dinajpur	9.8	7.4	13.1	16.4	7.3	7.2	16.5	12.2	9.8
Malda	5.7	4.2	8.9	12.7	6.4	5.9	6.4	7.0	6.3
Jalpaiguri	13.2	7.5	15.9	19.3	11.7	11.2	12.2	11.6	11.8
Darjeeling	3.9	2.2	4.9	6.0	23.7	36.4	37.9	3.3	3.6
Cooch Behar	16.3	10.4	19.9	19.7	15.3	19.1	19.4	16.4	19.1
Purulia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

Table 6.14 F: Potato

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	2.6	3.5	3.8	4.2	5.7	26.1	6.0	6.0	7.3
Birbhum	1.1	1.6	1.6	1.5	1.8	2.1	3.1	3.2	3.9
Bankura	0.7	1.1	1.6	1.8	4.0	4.3	4.9	6.2	7.4
Midnapore	1.0	1.4	1.5	2.1	3.0	4.6	4.9	6.2	5.5
Howrah	2.0	2.4	1.7	2.4	2.4	3.7	6.9	5.2	5.2
Hoogly	5.4	6.8	9.7	11.8	15.4	19.7	24.8	21.2	21.1
24 Parganas	0.3	0.6	0.7	1.6	1.1	1.2	2.7	1.0	1.1
Nadia	0.0	0.5	0.4	0.4	0.3	0.5	0.6	1.0	0.9
Murshidabad	0.4	0.9	1.1	1.0	0.9	1.0	1.4	1.4	1.5
West Dinajpur	0.5	1.2	0.8	1.0	0.7	1.0	2.8	1.7	1.9
Malda	0.2	0.4	0.3	0.4	0.3	0.5	0.6	0.7	1.0
Jalpaiguri	0.4	1.0	0.3	0.7	1.2	3.3	3.9	7.4	8.6
Darjeeling	3.0	4.2	4.8	4.5	2.9	3.9	6.2	8.9	10.0
Cooch Behar	0.5	1.0	0.3	0.8	1.3	2.0	2.8	6.0	6.0
Purulia	0.1	0.5	0.1	0.1	0.4	0.5	0.3	0.4	0.2

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

Table 6.14 G: Rapeseeds and Mustard

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	0.6	0.5	3.2	5.5	7.8	3.7	7.1	3.7	3.3
Birbhum	0.4	0.4	2.5	6.7	10.3	4.5	8.6	3.4	3.0
Bankura	0.5	0.7	1.0	2.5	4.0	2.5	3.1	7.6	7.4
Midnapore	0.4	0.3	0.3	0.8	1.8	2.8	2.0	1.6	1.2
Howrah	0.2	0.2	0.1	0.6	1.7	1.0	1.3	0.8	0.8
Hoogly	0.9	0.7	0.9	2.5	3.1	2.0	3.9	2.8	2.7
24 Parganas	1.5	0.7	1.5	5.6	8.5	7.2	10.2	5.0	5.4
Nadia	2.2	1.7	3.6	5.4	8.3	11.4	14.5	11.6	11.6
Murshidabad	2.0	1.9	2.8	4.8	7.8	6.9	10.2	11.2	10.5
West Dinajpur	3.7	3.4	2.9	5.9	7.9	7.5	13.6	9.2	9.1
Malda	3.1	3.3	2.8	3.8	6.4	3.8	9.3	9.6	9.2
Jalpaiguri	2.8	1.9	1.8	1.9	2.1	2.5	2.3	2.9	3.1
Darjeeling	1.0	0.8	0.4	0.7	0.9	0.2	0.1	0.3	0.3
Cooch Behar	2.3	1.9	2.1	1.2	1.2	1.8	1.9	2.5	1.9
Purulia	0.6	0.5	0.2	0.2	0.3	0.2	0.2	0.4	0.3

Source: Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.

Considering significant cropping pattern changes that have taken place in each of the agriculturally dominant districts, it is important to explore whether such changes are accompanied by locational shifts in area share of major crops and crop groups. The analysis of area share of each district in a particular crop reflects spatial pattern in area shifts or concentration of a crop in a particular region. For instance, area under cereals is relatively more in the districts of Burdwan, Birbhum, Bankura, than the districts like Nadia, Murshidabad, Malda in Bengal. Similarly, area under oilseeds is concentrated largely in the Nadia, Murshidabad and Malda District. A detailed analysis of area share of districts in major crops (Table 6.14) indicates a negligible change in the relative share of rice, wheat and jute grown in different districts and a substantial shift in area under other cereals, oilseeds and pulses across the districts.

For all these crops taken together, it is clear that almost all the districts have specialized in cultivation of one or the other crop. Over a period of last four decades, the area share of all cereal crops except rice is declining in the southern districts of Burdwan, Birbhum, Midnapore, Howrah, Hoogly, Nadia and Murshidabad and fluctuating in Purulia and three northern districts of Malda, Jalpaiguri, and Darjeeling.

The above analysis clearly suggests that the post reform period is marked by changing preferences of crops from cereals to non cereals. These changes can lead to crop diversification or crop specialization and may increase crop output growth as well as alter the sources of growth. In the following section the extent and nature of crop diversification and specialization has been taken into account at district level to reveal their implications for output and productivity growth.

6.7 Factors Affecting Crop Diversification: Drivers and Constraints

To meet the needs of the burgeoning population of the state and to improve the economic wellbeing of the population engaged in agriculture, the degree of diversification of land use towards various crops occupies a special place in recent times. In the previous sections of this chapter, the trends and pattern of crop diversification have been discussed along with its nature in different district of West Bengal during last four decades. While the developments in the agricultural sector have created diversification opportunities, thereby enhancing the ability of farmers to diversify crops and increase their level of income. These factors acting as an instrument in the diversification process augment farm income by enhancing productivity, occupational mobility and eradicating existing income asymmetries among the farmers. Similarly, lack of adequate infrastructure, credit, access to market and normal rainfall can severely constrain the scope of diversification initiatives of the farmer where consumption of fertilizers, developed irrigation facilities can enhance the chance and scope of diversification in agriculture. An attempt has been made in this section to identify the factors that are responsible for crop diversification under the study region.

Pingali and Rosegrant (1995) have shown that diversification of foodgrain was triggered by rapid technological change in agricultural production, improved rural infrastructure and diversification in food demand. Pope and Prescott (1980) revealed a negative relation between farm size and specialisation. According to them, experience, price risks, wealth and education are few of the constraints towards diversification. This was attributed to the fact that wealthier farmers were less risk-averse. This argument challenged the findings of White and Irwin (1972) who established a positive relationship between farm size and specialisation. Singh (1996) illustrated that the impact of irrigation on crop diversification and according to him, income stability of a farmer is dependent upon cropping conditions and the level of irrigation. He noted that when expansion of irrigation takes place in an assured rainfall region, it leads to more crop specialisation in paddy production. In contrast, when an investment in well irrigation occurs in a dry land region, it enhances opportunities for further

crop diversification. Hence, the role of irrigation on crop specialisation or crop diversification depends on regional factors.

It is to be logically noted that fluctuations in crop diversification fluctuation is higher in drought prone areas and crop diversification is more sensitive to agro-climatic determinants such as soil conditions or rainfall. Gregson (1994) hypothesized that diversification is a function of labour availability, risk due to unstable prices, falling transportation cost and the suitability of soil for the crop. The study found that other than distance from market, the geography of the farm has little effect on crop choice when transportation cost is high. But, when transportation costs fall, the geographical locations of farms become a factor in crop choice. In another study, Gregson (1996) notes that higher specialisation takes place by more use of fertilizer as it allows farmers to get higher and stable income. In other words, more use of fertiliser lead farmers away from diversified farming to a more specialised crop mix. In examining the role of socio-economic factors on the levels of crop diversification, Minot *et al.*, (2006) indicated that increase in diversity is positively related with age and education of farmers and negatively with size of farm and irrigation. In this context, Zimmerer (1991) argues that shortage of labour in the labour intensive crops results in low profit by increasing diversification and hence it restricts diversification towards such crops.

In sum, the studies pertaining to diversity in the cropping pattern focussed on examining the role of both economic and non-economic factors. Therefore, on the basis of the previous studies on diversification and making allowance for data limitations, certain factors responsible for crop diversification has been identified. Thus the study considers both economic and non-economic factors such as rainfall index (agro-climatic variable), proxy variables for technology like, use of fertilizer and irrigation under government canals per GCA, number of primary agricultural credit societies (institutional variable), infrastructural variables like regulated market and road density, the percentage of agricultural labour force (used as a proxy for human capital) and percentage of farms under marginal and small holdings (asset variable). The association of these variables with the Simpson index (measures the extent of crop diversity) has been analysed by studying the correlation between Simpson indices of each district and each of the individual factor of the districts (Table 6.15). The Simpson index measures the extent of diversification and it varies between 0 and 1. If there is specialisation, then the index moves towards zero and if there is tendency of crop diversification then the index moves towards '1'. The positive or negative correlations of select variables with the Simpson index imply the association between the extent of

diversification and the causes of diversification. If the correlation coefficient between the diversification indices and the factors undertaken are negative and significant, it clearly indicates an inverse relationship between the extent of diversification and the parameters and vice versa.

Table 6.15: Correlation between SI Index and other factors responsible for Crop Diversification

Districts	Rainfall Index	Fertilizer	No. of Agricultural Credit Institution	No of Regulated Market	Road Density	Irrigation (Govt Canals)	Percentage of Agricultural Labour-force	Percentage of area under small and marginal firms
Burdwan (SI)	0.07	-0.25	-0.05	0.11	0.10	-0.16	0.28**	-0.14**
Birbhum(SI)	-0.35**	-0.46	0.78**	-0.19	-0.51**	-0.44**	-0.41	-0.54**
Bankura(SI)	0.00	0.73*	-0.44**	0.86*	0.45	0.29	-0.15	0.42
Midnapore(SI)	-0.31**	-0.29	0.40	-0.18	-0.49**	0.13	0.23	-0.22
Howrah(SI)	-0.85*	-0.66	0.49	-0.78	-0.18	-0.51**	0.63**	-0.64*
Hoogly(SI)	0.07	0.52**	-0.59	0.37**	0.44	-0.75	-0.53	0.51
24 Parganas(SI)	0.25	-0.08	-0.38	-0.01	0.00	-0.20	-0.41**	0.25
Nadia(SI)	0.00	-0.42	-0.17	0.05	-0.18	0.00	0.17	-0.04
Murshidabad(SI)	0.17	-0.17	0.28**	0.08	-0.02	0.65*	0.05	0.01
West Dinajpur(SI)	-0.18	0.08	-0.31	0.05	0.04	0.23	-0.21*	0.21
Malda(SI)	-0.82**	-0.54	0.78*	-0.77	-0.58	0.00	0.67**	-0.58**
Jalpaiguri(SI)	0.07	0.76**	-0.75**	0.59*	0.60*	0.66	-0.79	0.84
Darjeeling(SI)	0.69	0.44	-0.04	0.48	-0.72*	0.14	-0.53**	0.77*
Cooch Behar(SI)	0.22**	0.76**	-0.63	0.62*	-0.66**	0.40	-0.81	0.94
Purulia(SI)	-0.45**	-0.06	0.20**	-0.60	-0.48**	-0.59*	-0.13	-0.52**
West Bengal(SI)	0.06	0.04	-0.09	0.01	-0.04	-0.12	-0.06	0.15**

Significant at 1% level, * * Significant at 5% level

Source: Calculated from the data collected from various issues of West Bengal Economic Review, District Statistical Handbook, Agricultural Census, Government of West Bengal.

The correlation table shows that out of the two technological variables, fertilizer use has a positive and significant effect on the degree of diversification for districts like Bankura, Jalpaiguri, Darjeeling and Cooch Behar. Thus for these four districts, the present study does not support the result of Gregson (1996) where he has shown that higher use of fertiliser means higher degree of specialisation. For other districts, the association between extent of diversification and the fertilizer use is negative and insignificant. But it is true that availability and utilization of fertilizer made cultivation more expensive for some fertilizer intensive crops such as boro rice and potato in West Bengal. Both potato and boro rice are highly fertilizer intensive and irrigation intensive without which cultivation is impossible. The correlation coefficient of irrigation is however negative and significant for districts like Birbhum, Howrah and Purulia. This means that crop diversification is taking place in the rain fed area where the farmers are unable to cultivate the staple cereals like rice and wheat that

requires abundance of water throughout the period, and have low resources but abundance of labour force.

The development of infrastructural variables like road and availability of regulated market and institutional variables like credit play an important role in encouraging diversification. Road facilities reduce transport costs of inputs and outputs, thereby increasing the profit margin of the farmers. Roads have been seen as the main determinant factor leading to agricultural diversification, though there are other factors like availability of resources, support facilities, etc. This is reflected in the positive and significant coefficient of road for only Jalpaiguri district. The negative significant coefficients of road density for the districts like Birbhum, Midnapore, Malda, Darjeeling, Cooch Behar and Purulia implying that the lack of infrastructural facilities is restricting agricultural diversification and better road network actually enforces diversification in favour of high yielding variety of crops as it implies lower transportation cost and easy and quick disposal of commodities. Thus for these districts it also induces the post harvest risk of incurring losses in case of perishable commodities.

Access to market induces farmers to shift their cultivation of variety of crops especially those that yield higher income which play an active role only after access facilities to market are in place. Thus market is significantly related to income diversification. The negative coefficient for Howrah, Malda and Purulia implies that lower the number of regulated markets the lesser is the tendency of farmers to diversify and vice versa. Villages with poor access to market face higher transaction cost in buying from or selling to the national economy. It is expected that farms that have poor market access to be more specialized in crop production, have fewer non farm activities and fewer income sources.

Credit can influence diversification indices in a different way. Credit is believed to increase the risk bearing ability of farmers; therefore one can expect a positive effect of institutional credit on agricultural diversification provided increase in diversification fulfils the objective of rational farmers. The variable in this study for institutional credit is the number of primary agricultural societies per unit of gross cropped area in the district. This includes credit from cooperative societies and accounts for a bulk of production loan obtained from institutional sources. The signs and significance for Malda, Murshidabad, Birbhum and Purulia suggests that as intensity of credit from an institutional source increases diversification also increases in the districts. Credit reflects farmers' dependence on market purchased inputs, which in turn highlights the commercialization of agriculture in the region.

The availability of number of agricultural labour force (cultivators+ agricultural labourers) across the districts has significant influence on the diversification towards non-foodgrains. This is expected as non-foodgrains are highly labour intensive in nature compared to foodgrains like rice and wheat. Thus high labour intensity crops demands higher density of workers.

Larger farms with more gross cropped area are more diversified than small farms. This is not so much because of the greater costs of diversification for small farmers but because of more profitable opportunities for diversification as well as the capacity to bear higher costs of specialization by large farmers. As large farms hold more fields they can exploit location-specific production opportunities and they also have greater access to credit to finance more input-intensive cropping activities. At the same time, by diversifying crops and thus influencing the cropping calendar, large farms are able to reduce peak season labour requirements. Thus for most of the districts correlation coefficients of percentage of total small and marginal holding farms are negative with Simpson Index of crop diversification. Bankura, Hoogly, 24 Parganas, Cooch Behar and Jalpaiguri districts have positive association with extent of diversity emphasizing the facts that in these districts even with small size of farm, the farmers are taking risk to diversify their incomes as the sources of non farm income in these districts are almost absent or insignificant. Therefore, they diversify land towards the cultivation of boro paddy instead of jute or other competing crops for their survival though they lack inadequate farm size to benefit from scale economies.

6.8 Conclusion

From the overall analysis it may reasonably concluded that the rate of crop diversification in the districts of West Bengal in terms of area under coverage has not gained the expected momentum because of inadequacy in certain important factors that are essential to boost crop diversification. Moreover, the degree of diversification is not evenly distributed across the districts. While some of the districts are much ahead to adopt the technology of diversification, others are lagging behind. This might be because of the fact that even though the state has achieved its self sufficiency in staple food the emphasis is still focused towards increasing production of rice only. While productivity of crop production is associated with the intensive use of inputs, yield can be increased through better land management and farming practices, and weed and pest controlling. The inappropriate ways to apply tools and modern inputs and lack of knowledge for chemical inputs and how to get a good price always constrain farmers for profitability. It is therefore necessary to provide proper financial assistance and training on the part of the

government to spread knowledge of land management and farm practises. This will not only help the farmers in earning higher income, it will also open up opportunities of marketability and widened the export market resulting thereby creating more income and creating employment.

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Chapter-VII

Driving Factors of Agricultural Productivity in West Bengal: Agriculture, Employment and Economy Interrelationship

7.1 Introduction

A considerable number of scholarly works has extensively highlighted the trends in agricultural production and productivity. For example, West Bengal in general and majority of the districts achieved very high growth rates of production and productivity in agriculture since the 1980s (Sagar, *et al.*, 1989; Harris, 1993; Saha and Swaminathan, 1994; Sen and Sengupta, 1995; Rogaly *et al.*, 1995; Raychaudhuri and Sen, 1996; Gazdar and Sengupta, 1996; Banerjee and Ghatak, 1996; Sanyal, Biswas and Bardhan, 1998; Rawal and Swaminathan, 1998; Chakraborty, 2002, Banerjee *et al.*, 2002, Bardhan and Mookherjee 2004, Raychaudhuri, 2004; Chattopadhyay, 2005) after a long spate of stagnation in agriculture (Shah, 1975; Islam, 1978; RBI, 1984; Planning Commission, 1985; GoI, 1985; Vaidyanathan, 1987; Boyce, 1987). Growth in production and productivity of foodgrain was primarily driven by rice and increase in yield contributed most to the growth in productivity and production.

It is noticed, however, the overwhelming growth in production and productivity in foodgrain achieved by West Bengal and her districts during eighties, was arrested in the nineties and since 2000-01 the decline became sharp. In other words, if positive trend break was observed in the eighties then a negative trend break became a reality since 2000-01 (see chapter-IV). In addition, major rice producing districts Burdwan, Birbhum, Bankura and Midnapore, Murshidabad and 24 Parganas are facing deceleration in growth of foodgrain production. The estimates of growth did not change substantially when adjustments for weather were made. In other words, the growth performance of the last four decades in foodgrain production cannot be explained in terms of unusually good or bad weather conditions. Instability in foodgrain production for majority of the districts as well as for the state has declined between 1970-71 and 2008-09 (see chapter-V).

There has been a wide range of economic and non economic factors that may influence growth in production and productivity of agriculture. To be specific, agro-climatic condition including rainfall, institutional reforms especially, land and tenancy reforms, introduction of local level governance or *panchayati raj*, expansion and diffusion of Green Revolution technology combining high-yielding varieties, irrigation, fertiliser etc., size of holdings,

agrarian structure, land distribution pattern, cropping intensity, farm mechanisation, rural infrastructure, credit and cooperatives, population density, area under non agricultural use and urbanisation, relative prices, wages, sense of security of tenants, smooth communications of bureaucrats and technocrats to farmers etc., have considerable impact on agricultural productivity.

As the knowledge on interaction between economic and non economic factors is limited and therefore, to keep the analysis within manageable proportions, non-economic factors are generally treated as exogenous. Inputs are also classified as essential and non-essential inputs. Land, seed, minimum labour for sowing and harvesting are treated as essential inputs because output becomes zero if any one of the inputs assumes zero value. Fertilisers, pesticides, tractor services are considered as non-essential inputs (Sankar, 1997:2, 4). In addition, to estimate the impact of these factors on productivity create statistical impediments because more often than not, these explanatory variables become collinear with each other. Estimation of the impact of various components of agrarian reforms on productivity also suffers from various computational barriers because a long time series contains a number of effects simultaneously and segregation of them often become difficult. Statistical obstacles more often deter the researchers to undertake studies that may elucidate the impact of various economic, non-economic factors, including institutional reforms of varied nature and policy intervention on agricultural productivity. It needs to be reiterated again, the studies conducted so far to identify the underlying factors for major turn around in growth of agricultural production and productivity in West Bengal either explicitly or implicitly exemplifies the role of institutional reforms or more directly, distribution of ceiling surplus land among the landless and conferring quasi-land rights or limited transfer of property rights to the share croppers or operation *barga* and introduction of local level self governance or *panchayati raj*.

Both theoretically and empirically, it has been well established that institutional reforms coupled with devolution of power at the grass root level have contributed towards the increase in the use of high yielding variety of seeds, access to more institutional credit, increase in investment in private irrigation, right incentive to produce more, improvement in the general functioning of market, especially land and credit market, increase in efficiency in small sized farm, expansion of rural infrastructure, increase in rural wage, decrease in inequality and reduction of poverty. All these contributed towards the rise in agricultural production and productivity in West Bengal (Chadha and Bhaumik, 1992; Lieten, 1992; Bhaumik, 1993; Saha and Swaminathan, *op.cit.*; Sen and Sengupta, 1995; Banerjee and

Ghatak 1996; Sengupta and Gazdar, 1996; Mukherji and Mukhopadhyay, 1996; Rawal Swaminatan, *op.cit.*; Ghosh, 1998; Sanyal, Biswas and Bardhan, 1998; William, 1999; Banerjee *et al.*, 2002, Ghatak and Ghatak, 2002; Chakraborty, 2002; Raychaudhuri, 2004; Bardhan and Mookherjee 2004; Bhattachayya 2005; Bhattacharyya and Bhattacharyya 2007).

Harris (1992, 1993) on the other hand, have preferred to ignore the role of institutional reform for enhancing production and productivity growth in agriculture in West Bengal during eighties, rather he emphasised that growth in production of boro and simultaneous expansion of private shallow tube-wells have propelled the growth of agriculture. Seemingly these opposite view points has been synthesised best by Sengupta and Gazdar (*op.cit.*: 168). While they argue that 'the amount of cropped land distributed under ceiling laws represents around 6.5 per cent of total cropped area in the state, less than a third of which was distributed after 1977. Precise estimates of the total area registered under operation *barga* are not available, but this is unlikely to exceeded 15 per cent of the total cropped area. For land redistribution and operation *barga* to be the driving forces behind accelerated growth, these relatively small areas of land would have had to achieve extraordinarily high rates of productivity growth. This, clearly, has not been the case. Instead, there has been wide adoption of HYVs for aman and an extensive increase in (irrigated) boro cultivation. The dichotomization of the explanations of recent agricultural growth in West Bengal between market versus non-market innovations and reforms versus private incentives is problematic from both conceptual as well as empirical viewpoints'.

Banerjee. *et al.*, (*op.cit.*:275& 276) covered the period between 1979 and 1993 and they chose 1979 because it marked the beginning of operation *barga* programme and measured the magnitude of the effect of operation *barga* on productivity by multiplying the coefficient on the registration rate with change in registration over the period. Their estimation ascertained that operation *barga* raised average productivity of rice in West Bengal by 20 per cent.

Raychoudhri (*op.cit.*: 1 &13) attempted to reconcile the interdependence of various land reform measures, decentralized decision-making and 'autonomous and induced technological changes' by using cross-section time series pooled data regressions over districts of West Bengal. Owing to data limitations, data were pooled over districts for the years 1985 and 1994. To ascertain the impact of *barga* registration on yield rate per acre of aman, percentage of *barga* households as percentage of total number of households were calculated and districts were ranked accordingly. To identify the impact of *barga* or to ascertain the critical level of *barga* registration in a single measure, four cut-offs (at 15 per cent, 20 per cent, 25

per cent and 30 per cent) were used in a manner while using a dummy for particular cut-off percentage, that percentage was assigned value 1 and the rest take on the value 0. It was further assumed in this model that a *barga* registration should reach a particular percentage to ensure the use of complementary inputs and simultaneous effects of these two would allow the production to rise. For this, four interactive variables (interaction between *barga* registration and fertiliser use) in accordance with above mentioned cut-offs of *barga* registration percentages were incorporated in the model. The results so derived showed that operation *barga*, along with irrigation, fertiliser, rural roads and labour use had considerable impact in raising agricultural productivity in West Bengal.

Here the study intends to accomplish two specific objectives: first, to measure the impact of various economic and non-economic factors that influenced the growth in productivity in West Bengal in general and her districts in particular and second is to examine how changes in growth of agricultural productivity has influenced the economy and employment of the state vis-à-vis districts by taking aforementioned statistical impediments into consideration.

7.2 Methodology to Measure the Impact of Various Factors on Foodgrain Productivity

Against this backdrop, initially, the effects of operation *barga*, role of *pachayat*, Green Revolution, labour use per hectare, farm size, institutional credit at rural level, and economic reform on agricultural productivity, have been measured by using standard pooled regression over districts and time. Ordinary least squares (OLS) method was applied to estimate the coefficients. Data on 15 districts and for the time period of 1980-81 to 2008-09 were pooled together for the analysis. As dependent variable, log value of yield rate (kg/ha) of foodgrain (FDGRN-PDVTY) has been considered. Among the independent or explanatory variables, *barga* households as percentage to total number households operating (BARGA %) has been incorporated as proxy for operation *barga*. To measure the impact of the activities of *panchayat* on productivity, rural road constructed by the *Zilla Parishad* in terms of kilometre road per thousand square kilometres area (ZILLA ROAD) has been considered. Logarithmic value of districtwise fertiliser use (LNFERT) has been pooled for the period of 1980-81 to 2008-09 and incorporated as an independent variable to capture the impact of Green Revolution technology on agricultural productivity. If fertiliser is considered as a non-essential input, labour is considered as an essential input for production. Therefore, labour engaged on per-unit of land (AGRI LAB-NCA) has been obtained (total number of agricultural labourers divided by Net Cropped Area or NCA) for districts over time and included as one of the independent variables in the model. Average land holding (AV TL

HLDN) has been calculated by as dividing total landholdings by total number of operational holdings (in hectare) and this has been incorporated to verify the farm size-productivity relationship. A dummy has been used to measure the impact of economic reform (RF D1) so that from 1990-91 to 2008-09, assuming value '1' and for rest of the period '0'. While applying the OLS method, VIF statistic and Durbin-Watson statistic (DW) have been considered to check the problems of multi-collinearity and autocorrelation in the model.

The model to be estimated thus takes the following form:

$$FDGRN-PDVTY = \beta_1 + \beta_2 \text{BARGA \%} + \beta_3 \text{ZILLA ROAD} + \beta_4 \text{LNFERT} + \beta_5 \text{AGRI LAB-NCA} + \beta_6 \text{AV TL HLDN} + \beta_7 \text{RF D1} + \mu \text{ ----- (1)}$$

Where,

FDGRN-PDVTY = Log Value of foodgrain productivity (kg/ha)

BARGA % = *Barga* households as percentage to total number households operating.

ZILLA ROAD = Rural road constructed by the *Zilla Parishad* in terms of kilometre road per - thousand square kilometres area.

LNFERT = Log value of fertiliser use (kg)

AGRI LAB-NCA = Labour engaged on per-unit of Net Cropped Area (NCA).

AV TL HLDN = Ratio of total landholdings and total number operational holdings.

μ = Random Term.

Results of the estimated parameters of Equation 1 are presented in Table 7.1.

Table 7.1: Results of Estimated Parameters of Equation 1
Dependent Variable: Log Value of Foodgrain Productivity

Explanatory Variables	Coefficients	Std. Error	T-statistic	Sig.	VIF
Constant	-565.816	139.41	(-4.06)	0.000	
BARGA %	0.079	1.89	(2.66)*	0.008	1.36
ZILLA ROAD	0.015	0.043	(0.44)	0.657	1.73
LNFERT	0.392	30.349	(9.36)*	0.000	2.71
AGRI LAB-NCA	0.560	44.918	(13.43)*	0.000	2.68
CREDIT SOCIETY	0.005	0.397	(0.11)	0.912	2.57
AVG TL HLDN	0.315	65.077	(7.48)*	0.000	2.74
RF D1	0.175	40.556	(4.88)*	0.000	2.00
R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson		
0.723	0.719	290.20	0.689		

*Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of West Bengal Economic Review and District Statistical Handbook, Government of West Bengal.

7.3 Interpretation of the Regression Results (Equation 1)

The results of estimated parameters of equation 1 are been shown in Table 7.1. The value of adjusted R^2 indicates that 72 per cent of the total variation has been explained by the explanatory variables. The value of Durbin-Watson statistic is greater than 0 but less than 4, therefore, the absence of first-order auto-correlation is pronounced. The Variance Inflation Factor or VIF of all the explanatory variables are found to be much less than 10, hence, presence of multi-collinearity among the explanatory variables is negligible. Among the estimated explanatory parameters, except ZILLA ROAD and CREDIT SOCIETY, the rest of the variables have considerable impact on foodgrain productivity. Coefficients of BARGA %, LN FERT, AGRI LAB-NCA, AV TL HLDN and RF D1 are all positive and prove to be significant factors in influencing the foodgrain productivity at 1 per cent level. *Barga* households as percentage of total number of households operating (BARGA %) or operation *barga* has significant impact on agricultural productivity. In other words, rise in *barga* registration by 1 per cent, would raise the foodgrain productivity by 0.079. This result validates the empirical studies of Banerjee *et.al.*, (*op.cit.*), Raychaudhuri (*op.cit.*). The productivity enhancing capacity of fertiliser (LN FERT) have also been validated with strong positive value of its coefficient. Similarly, 1 per cent rise in agricultural labour per hectare net cropped area should enhance the productivity by 0.560. In this model, the estimated coefficient of average land holding (AV TL HLDN) reveals that 1 per cent increase in land holding size will raise the productivity of foodgrain by 0.315 and thus inverse relationship between farm size and productivity does not hold. The result also reaffirms the logic that the increase in labour (AGRI LAB-NCA) and average total holding (AV TL HLDN) shall increase the agricultural productivity as general input-output relationship, as neo-classical economics presupposes. It has also been observed that economic reform whose effect has been captured by reform dummy (RF D1) has a positive impact on agricultural productivity. It is also attempted to capture the impact of the role of *panchayat* in building roads. Taking kilometre road constructed by *zilla parishad* per thousand square kilometres area, as the proxy variable, it does not show any significant effect on foodgrain productivity and neither was any impact visible so far as the number of credit societies is concerned. It has been observed that since 1980-81 number of primary credit societies per thousand square kilometre area has either declined or remained static for all the districts except Darjeeling (Table 7.2). As a result, this component, in spite of having an important role in agricultural development, has turned out to

be insignificant in affecting agricultural productivity, and it must have wider negative influence in meeting up credit requirement in agriculture.

Table 7.2: Districtwise Number of Primary Credit Society per 000 sq-km Area

District/Year	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	87	77	87	87	84	89	88
Birbhum	79	69	75	78	78	75	74
Bankura	42	42	40	41	35	38	38
Midnapore	143	144	138	140	125	125	121
Howrah	160	157	159	148	148	152	134
Hoogly	301	290	242	238	226	226	222
24 Parganas	71	73	73	73	62	72	69
Nadia	116	119	112	116	107	115	115
Murshidabad	96	134	91	93	88	91	87
West Dinajpur	96	95	100	75	64	60	63
Malda	84	87	82	62	64	59	59
Jalpaiguri	30	30	35	29	27	26	26
Darjeeling	21	20	33	31	32	33	33
Cooch Behar	85	67	73	72	71	70	70
Purulia	34	53	36	39	39	28	27
West Bengal	85	87	83	81	75	76	74

Source: Calculation based on data collected from various volumes of District Statistical Handbook, Bureau of Applied Economics and Statistics Government of West Bengal.

7.4 Methodology to Measure the Simultaneous Impact of Operation Barga and Green Revolution

The methodology used by Roychaudhuri (2004) has been adopted in the present study with certain modifications. His model is based on the hypothesis that when *barga* registration will reach to a particular percentage, then the beneficiaries of operation *barga* would be able to access the complementary inputs (nitrogen, phosphorous and potassium based fertilisers) and simultaneous effects of these two would allow a rise in production. Here an attempt has been made to verify the plausibility of the hypothesis by pooling the data for a much longer period (from 1980-81 to 2008-09) for the districts. Four interactive variables (consisting of fertiliser and *barga* registration) have been generated and while doing so, first the percentage of *barga* registration is calculated (*barga* households as percentage of total number households operating) and four cut-off percentages, viz., at 15, 20, 25 and 30 per cent are identified and corresponding to each cut off percentage an interactive variable (fertiliser use per hectare times the number of *barga* registration) has been generated. They have been denoted as int 15, int 20, int 25 and int 30 respectively (Raychaudhuri, *op.cit.*: 13). Four regression equations have been framed for the four above mentioned interactive variables and in every equation road constructed by the *Zilla Parishad* as proxy for activities of *panchayat*, average land holding (AV TL HLDN), economic reform dummy (RF D1) and log value of fertiliser

(LNFERT) have been retained as explanatory variables. Here to measure the individual impact of Green Revolution on foodgrain productivity LNFERT has been taken as a variable in addition to interactive variables. These equations are as follows:

$$FDGRN-PDVTY = \alpha_1 + \alpha_2 LNFERT + \alpha_3 ZILLA ROAD + \alpha_4 AV TL HLDN + \alpha_5 RF D1 + \alpha_6 int 15 + \mu_2 \text{-----}(2)$$

$$FDGRN-PDVTY = \gamma_1 + \gamma_2 LNFERT + \gamma_3 ZILLA ROAD + \gamma_4 AV TL HLDN + \gamma_5 RF D1 + \gamma_6 int 20 + \mu_2 \text{-----}(3)$$

$$FDGRN-PDVTY = \delta_1 + \delta_2 LNFERT + \delta_3 ZILLA ROAD + \delta_4 AV TL HLDN + \delta_5 RF D1 + \delta_6 int 25 + \mu_3 \text{-----}(4)$$

$$FDGRN-PDVTY = \varepsilon_1 + \varepsilon_2 LNFERT + \varepsilon_3 ZILLA ROAD + \varepsilon_4 AV TL HLDN + \varepsilon_5 RF D1 + \varepsilon_6 int 30 + \mu_4 \text{-----}(5)$$

Results of the estimated parameters of Equation 2, 3, 4 and 5 are presented in Table 7.3, 7.4, 7.5 and 7.6 respectively.

Table 7.3: Results of Estimated Parameters of Equation 2

Explanatory Variables	Coefficients	Std. Error	t-statistic	Sig.	VIF
Constant	-23.976	197.571	-0.121	0.903	
ZILLA ROAD	0.125	0.043	(3.74)*	0.000	1.17
LNFERT	0.606	33.468	(3.13)*	0.000	2.24
AVG TL HLDN	0.129	61.549	(3.24)*	0.001	1.67
RF D1	0.282	43.034	(7.37)*	0.000	1.53
int 15	-0.034	165.312	(1.04)	0.299	1.09
R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson		
0.592	0.587	351.6268	0.455		

*Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of District Statistical Handbook, Bureau of Applied Economics and Statistics Government of West Bengal.

Table 7.4: Results of Estimated Parameters of Equation 3

Explanatory Variables	Coefficients	Std. Error	T-statistic	Sig.	VIF
Constant	-148.129	157.341	(-0.941)	0.347	
ZILLA ROAD	0.123	0.044	(3.61)*	0.000	1.22
LNFERT	0.592	34.457	(12.46)*	0.000	2.36
AVG TL HLDN	0.122	62.292	(3.02)*	0.003	1.70
RF D1	0.284	43.556	(7.34)*	0.000	1.57
int 20	0.004	37.548	(0.12)	0.899	1.19
R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson		
0.591	0.586	352.0631	0.452		

*Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of District Statistical Handbook, Bureau of Applied Economics and Statistics Government of West Bengal.

Table 7.5: Results of Estimated Parameters of Equation 4

Explanatory Variables	Coefficients	Std. Error	T-statistic	Sig.	VIF
Constant	14.046	155.21	0.09	0.928	
ZILLA ROAD	0.115	0.04	(3.55)*	0.000	1.16
LNFERT	0.529	33.14	(11.58)*	0.000	2.30
AVG TL HLDN	0.079	61.17	(1.99)**	0.047	1.73
RF D1	0.314	42.616	(8.30)*	0.000	1.58
Int 25	0.150	36.15	(4.73)*	0.000	1.10
R Square	Adjusted R Square	Std. Error of the Estimate		Durbin-Watson	
0.611	0.607	343.2176		0.475	

*Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of District Statistical Handbook, Bureau of Applied Economics and Statistics Government of West Bengal.

Table 7.6: Results of Estimated Parameters of Equation 5

Explanatory Variables	Coefficients	Std. Error	T-statistic	Sig.	VIF
Constant	76.372	145.806	0.52	0.601	
ZILLA ROAD	0.058	0.041	(1.85)***	0.066	1.23
LNFERT	0.531	30.45	(12.64)*	0.000	2.17
AVG TL HLDN	0.067	57.276	(1.79)***	0.074	1.69
RF D1	0.287	39.798	(8.12)*	0.000	1.53
Int 30	0.257	44.111	(8.56)*	0.000	1.10
R Square	Adjusted R Square	Std. Error of the Estimate		Durbin-Watson	
0.651	0.647	325.367		0.532	

*Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Calculation based on data collected from various volumes of District Statistical Handbook, Bureau of Applied Economics and Statistics Government of West Bengal.

7.5 Interpretation of the Regression Results (Equation 2, 3, 4 and 5)

The log linear regression results of equation 2, 3, 4 and 5, the values of Durbin-Watson statistic are found to be greater than '0' but less than '4', and this reaffirms the absence of first-order autocorrelation. The Variance Inflation Factor or VIF of all the explanatory variables are also found to be much less than '10', hence, presence of multi-collinearity among the explanatory variables is negligible in regression results of estimated parameters of equation 2, 3, 4 and 5. Regression results presented in Table 7.3, 7.4, 7.5 and 7.6 show that the expansion of roads constructed by *Zilla Parishad* (ZILLA ROAD) has had a yield-raising effect with significance level varying from 1 per cent to 10 per cent. The *panchayats* execute many rural development schemes sponsored by the Central government; most of the schemes have been designed to create rural infrastructure, especially roads and in some cases, excavation of tanks and ponds. It is thus evident that this effort of improving the rural infrastructure has a positive impact on productivity. Precisely, rural roads and connectivity to

urban centres reduces transportation cost and transaction cost, and also allows farmers to realise better prices of their farm products.

Logically wide spread application and success of Green Revolution technology depend on use of HYV seeds, irrigation and fertiliser. In all above regression results, role of fertiliser to enhance agricultural productivity has doubly been confirmed. Therefore, implicitly, it can be said that the spread of HYV seeds and irrigation must have taken place. In 2008-09, more than 55 percent area of Gross Cropped Area (GCA) is under HYV rice (West Bengal Economic Review, 2008-09). However, presence of high multicollinearity among fertiliser uses, area under HYV and irrigation act as deterrent to incorporate them together as explanatory variables.

Results shown in Table 7.3, 7.4, 7.5 and 7.6 further reflect that inverse relationship between farm size and productivity does not hold. Here average total holding has been considered and in West Bengal, the difference between average total holding and average marginal holding is quite narrow. The average size of total holding stands at 0.77 ha and average marginal holding at 0.49 ha (Calculated from the data available from Agricultural Census 2005-06). Evidently, the possible inverse relationship between farm size and productivity provided a logical basis and favoured a redistribution of land to the landless, and brought substantial improvement in production and productivity. The present study also corroborates the fact that the then prevailing agricultural practices were mostly dependent on inputs procured out of the resources owned by the households. Free resources from nature also contributed substantially. Land was the only resource that such farmers did not have secured access to. Providing access to land, either through redistribution or through a secured tenancy contract, would have been effective in increasing the productivity of agricultural practices. The situation has, however, changed significantly with the Green Revolution that altogether altered the basis of the input supply system faced by the farmer. The inputs are no longer to be procured from out of family resources or from nature. They are to be purchased from market, be it seeds, fertilisers, water and even labour. The poor tenants, small and marginal farmers face a difficult situation not only in procuring the complementary inputs at affordable prices but also realizing the optimum value for the output produced. Our study also corroborates the observations made by Ghosh (1979) and Lipton (1993). According to Ghosh, with the advancement of technology, inverse relationship disappears. Lipton observed that until Green Revolution, the inverse relationship was valid (at least for rice and wheat in Asia) but after Green Revolution the relationship was reversed. Ashok Rudra (1968) is thus perhaps

right while he observed that, 'there is no scope for propounding a general law regarding farm size and productivity relationship.'

Economic reform which is represented by reform dummy (RF D1) has proved to be highly significant in raising the foodgrain productivity in all successive regression results mentioned above. During the reform era, cost of production has increased firstly, because of the withdrawal of subsidy on fertiliser and price being determined by the market, and secondly, public investment in agriculture has declined. There has been continuous hike in diesel prices which is one of the propelling factors behind the sharp expansion of tube-well irrigation in the state. Even other inputs also got dearer to the farmers. Various studies have shown that economic reform laid emphasis price factors and infrastructure while the institutional aspects of agriculture did not receive adequate attention. (Chadha, 2002; Majumdar, 2002; Bhalla, 2002; Kumar, 2002).

Notwithstanding all the negative aspects, West Bengal continued to achieve high growth in production and productivity of rice and foodgrain compared to agriculturally advanced states like Punjab, Haryana and Western Uttar Pradesh. Couple of factors might be held responsible: firstly, agriculture in West Bengal is dominated by small and marginal farmers, since they do not have other alternatives. Under the circumstances, the farmers are compelled to produce rice on their diminishing land. Secondly, many of the small and marginal farmers apart from cultivating their own land are forced to work as agricultural wage labourers. Thirdly, the rate of growth in productivity and harvest price sometimes offsets the rate of rise in cost of production. Fourth, crop diversification, especially production of potato and rapeseeds and mustard partly compensates for the rise in cost of production. Since, mid-2000, various development programmes like interest subvention on crop loans, the National food Security Mission, National Rural Employment Guarantee Scheme (NREGS), have partly stabilised the economic condition of the small and marginal farmers and agricultural labourers. Having said so, to justify the positive impacts economic reform on foodgrain productivity, a deeper empirical probe is imperative to identify the factors that are still propelling foodgrain productivity growth in West Bengal during the post-economic reform era.

From regression results depicted in Table 7.3, 7.4, 7.5 and 7.6, it is also evident that among the four cut-off percentages used for *barga* registration (15 per cent, 20 per cent, 25 per cent and 30 per cent) to create four interactive variables of *barga* registration and fertiliser used (int 15, int 20, int 25 and int 30), int 25 and int 30 were significant at 1% level and do display

considerable impact in raising foodgrain productivity. However, int 15 and int 20 do not have any statistical significance so far their influences to raise productivity of foodgrain are concerned. Therefore, if *barga* registration percentage, reaches 25 per cent or surpasses this percentage, then fertiliser per hectare will successfully utilized by the *bargadars*. Below this percentage, *bargadars* would fail to access required complementary inputs. The changing pattern of tenancy relations in West Bengal substantiates this fact. The field studies of Chadha and Bhaumik (*op.cit.*: 1092) show that there is no strong evidence that rich and big landowners only lease out the land to unrecorded tenants. A vast number of small and middle category farmers who have been identified as self-cultivators also lease out land to overcome short-term difficulties in carrying out the production process. Similarly, those who have been identified as tenants do not always necessarily belong to the category of pure tenant/landless category.

There is a strong possibility that many small cultivators have also identified themselves as tenants and the impact of 'operation *barga*' has had more far reaching influence in enhancing the agricultural production and productivity in West Bengal. Therefore, in this study, Raychaudhuri's (*op.cit.*) hypothesis the *barga* registration has to reach a particular percentage for the beneficiaries of operation *barga* to access the complementary inputs and the simultaneous effects of these two will allow the production to rise, gets validated.

It has also been observed that the districts which are having higher average productivity, the number of *bargadars* registered as percentage of total number of operating households (BARGA %) remained relatively high (Table 7.7). Districts of Birbhum, Bankura, Burdwan, Hoogly, Malda and Midnapore bear the testimony. Commensurate increase in fertiliser use will further make the case stronger in the sense that operation *barga*, coupled with increased use of fertiliser, will be having a stronger impact in raising foodgrain productivity in the districts as well as for the state. Among the districts of West Bengal, Burdwan, Midnapore, 24 Parganas, Hoogly, Murshidabad, West Dinajpur, Nadia and Birbhum achieved high average productivity of foodgrain and average use of fertiliser (kg/ha) also remained relatively higher (Table 7.7) in comparison to the other districts of West Bengal.

Table 7.7: Districtwise Average Foodgrain Productivity (kg/ha), percentage of *Barga* and Average Fertiliser Use (kg/ha) from 1980-81 to 2008-09

District	Average Foodgrain Productivity (kg/ha)	District	Barga %	District	Average Fertiliser Use (kg/ha)
Burdwan	2549	Birbhum	37.6	Midnapore	111.5
Hoogly	2347	Hoogly	31.4	Burdwan	98.0
Birbhum	2307	Bankura	30.1	24 Parganas	93.0
Bankura	2196	Burdwan	28.4	Hoogly	84.6
Nadia	2079	Cooch Behar	27.1	Murshidabad	59.4
Murshidabad	2048	Midnapore	24.8	West Dinajpur	54.1
Malda	1945	Jalpaiguri	23.3	Nadia	53.2
Midnapore	1944	West Dinajpur	22.0	Birbhum	52.9
Howrah	1885	Malda	21.8	Malda	44.6
24 Parganas	1882	24 Parganas	17.4	Bankura	40.7
West Dinajpur	1757	Howrah	17.3	Howrah	39.1
Darjeeling	1696	Nadia	15.4	Cooch Behar	37.6
Purulia	1620	Darjeeling	14.6	Jalpaiguri	33.9
Cooch Behar	1385	Murshidabad	13.7	Purulia	27.4
Jalpaiguri	1282	Purulia	2.5	Darjeeling	20.8

Source: Calculation based on data collected from various volumes of *West Bengal Economic Review*, Government of West Bengal.

7.6 Role of Irrigation in Augmenting Agricultural Productivity

The present study while explaining the role of various factors in influencing the agricultural productivity, has failed to incorporate irrigation as one of the explanatory variables in the above econometric models. The prime reason is the unavailability of comparable time series data at district level. However, an attempt has been made to fill this gap by using various research documents on irrigation in West Bengal. Till 1970, there was slow progress in irrigation, especially the growth of tube-well irrigation was very slow (Rawal, 2001:4017). During 1982 only 16 per cent of the groundwater potential of the state was used (Boyce, op.cit). Within the period till 1970, three major river valley projects were commissioned; Damodar Valley Corporation (DVC) Project was commissioned in 1933 which became the major source of irrigation for Burdwan, Hoogly, Howrah and Bankura. In 1954, the Mayurakshi Project started operating and it provided irrigation to major parts of Birbhum, and certain parts of Burdwan and Murshidabad. The Kangsabati Project became operational in 1968 and irrigated agricultural land in Bankura, Midnapore and Hoogly. During late - seventies and eighties, 11 medium canal irrigation projects and several minor surface irrigation projects were initiated to cater to the irrigation needs of western part of the state and Purulia was largely benefited by these projects. From the Teesta project (awaiting completion), irrigation of agricultural lands of Jalpaiguri, plains of Darjeeling District, Cooch Behar, West Dinajpur and Malda districts are partly accomplished.

However, major turn around in irrigation system as well as increase in net irrigated area took place between eighties and nineties with the massive growth of tube-well irrigation in West Bengal. According to the study made by Rawal (op.cit:4018), one notices that from 1975-76 to 1992, net irrigated area had increased by 115 per cent and tube-well irrigation had increased by more than 460 per cent and irrigated 636 thousand hectares of land. Density of tube-well per 100 sq kms was found to be high in 24 Parganas, Nadia and Murshidabad. High percentage increase in numbers of tube-wells (both driven by electric and diesel) was observed in Jalpaiguri, Cooch Behar, West Dinajpur, Bankura, and Malda, although the density remained much lower in comparison to the eastern districts of West Bengal (Rawal, op.cit, 4018-4023). It has been observed that there is a close relation between introduction of HYV summer paddy and rapid expansion of tube-well irrigation in West Bengal. As a matter of fact, until late seventies, major proportion of agricultural land in the state was mono-cropped. Paddy cultivation in large scale in many low-lying and flood prone areas commenced after the introduction of HYV summer paddy, especially boro paddy. Boro paddy is a highly water intensive crop. During the early eighties, i.e., early period of the transition to boro cultivation, canal irrigation, irrigation by using deep tube-wells or river-lift irrigation were the major sources of irrigation for boro cultivation. Gradually, diesel powered shallow tube-wells and thereafter, with the fall in water level, submersible pump tube-well systems were extensively used. Investment on shallow tube-wells and submersible pump tube-wells were mostly borne by the users from their personal savings, private borrowings from local money lenders (Moitra, 2005:128-140). This opened up the market for the supply of ground water. Therefore, from the aforementioned empirical results and discussion since the eighties, the wider penetration of seed-fertiliser-water technology got established and it certainly contributed positively to the growth in production and productivity of foodgrain in West Bengal.

7.7 Agricultural Productivity and its Impact on Employment and Economy

A common notion of development establishes the fact that as the economy progresses, the share of agriculture and industries declines and that of services increase. These structural changes generally occur through market adjustment in inter-sectoral resource allocations and as a result, in an early stage of economic growth, demand for industrial goods increases and ultimately it leads to the rise in demand for services with relative saturation in consumption of industrial commodities (Clark, 1940; Kuznets, 1966; Syrquin and Chenery, 1988). However, confusion exists as we turn to East Asian, African and Latin American countries.

Especially the countries that achieved independence after World War II and remained as the colonies of Western powers, had started as laggard countries in the process of industrialisation while they failed to replicate the structural changes that took place in western or early industrialised countries. Under colonialism these economies mostly acted as a provider of raw materials and market for manufactured commodities from the West (Hayami & Godo, 2005). Unlike the early industrialised nations, most of present day's developing countries started the process of industrialisation with a high degree of capital scarcity bypassing the phases of investment of agricultural surplus in the industrial activities. Even though many developing countries like India and China achieved considerable success in industrial expansion but they failed to reduce the dependence of the majority of population on agriculture and allied activities for livelihoods.

A cursory look at the sectoral shares of GDP in few selected countries unfolds the fact that share of agriculture in GDP was 44 per cent, 38 per cent and 3 per cent respectively for India, China and USA in 1965, that witnessed a reduction to 25 per cent, 17 per cent and 1 per cent by the end of 2000. But the percentage of population depending on agriculture stands at around 60 per cent for all developing countries as against 2 per cent for USA. Indian economy during the past few decades has also been undergoing a structural transformation with the decline in the share of agriculture in Gross Domestic Product (GDP) and gradual increase in the share of industries and services. Although share of agriculture has come down to 17 per cent in 2008-09 from 55.1 per cent in 1950-51, the dependence of the rural workforce on agriculture in India has not diminished in proportion to share of agriculture to the GDP. As a consequence the gap between agriculture and non-agriculture is likely to get widened and the disparities between rural and urban areas will be on the rise. India, though identified as a fast growing economy, it is observed that in rural areas nearly 63 per cent of the male workers and 79 per cent of the female workers are still engaged in agriculture (GoI, 2011). Similar situation is discernible for the state of West Bengal too.

For West Bengal, doubts may be raised that rise in the growth of agricultural productivity in the eighties and subsequent fall in the nineties may have some negative impact on agricultural income, employment and economy at large. And, lack of alternative employment and income opportunities outside agricultural may further complicate the situation. To get into the depth of these problems, simultaneous interplay of various sectors of economy, contribution of various sectors to Gross State Domestic Product (GSDP at current prices) and kinked exponential growth of various sectors from 1980-81 to 2009-2010 with three sub-periods,

1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-01 to 2009-10 are being analysed. GSDP series from 1980-81 to 1997-98 at 1980-81 prices, GSDP series 1993-94 to 2004-05 at 1993-94 prices and 2004-05 to 2009-10 at 2004-05 prices, have been converted in 1993-94 prices to obviate the impact of inflation. To understand the structural change of the economy of West Bengal from 1980-81 to 2009-10, changing share of various sectors towards the GSDP at current prices have also been analysed.

7.7.1 Sectoral Growth of GSDP (at 1993-94 Prices) from 1980-81 to 2009-10

Results show that over-all growth scenario of West Bengal is quite impressive (Table 7.8). The GSDP at constant prices (base year 1993-94) is growing at an annual rate of 8 per cent between 1980-81 and 2009-10. A close look at the three sub-periods suggests that between 1980-81 and 1989-90 (sub-period I), the economy of West Bengal experienced most sluggish growth rate (3.4 per cent per annum). However, a major upsurge in growth rates are observed in two subsequent sub-periods, viz. 1990-91 to 1999-2000 (sub-period II) and 2000-01 to 2009-10 (sub-period III). From 1990-91 to 1999-2000, the economy grew at an annual exponential rate of 7.4 per cent and between 2000-01 and 2009-10, the growth rate further increased to 9.6 per cent per annum. The decade of the eighties experienced most slow growth rates in three sub-periods and as a matter of fact, the growth rate in tertiary sector became insignificant and highest growth rate was achieved by the primary sector. To be precise, agriculture propelled the growth of the primary sector vis-à-vis the economy.

During the eighties, West Bengal experienced major turn around in growth of foodgrain and rice production and productivity which propelled the growth of agricultural income or output (at constant price) of West Bengal. In sub-period II and III, the growth rate in agricultural SDP tapered off. In sub-period II, agricultural SDP grew at an annual exponential rate of 4.7 per cent and in sub-period III, it declined further and grew at 3.7 per cent per annum. However, growth performance of secondary sector and tertiary sectors improved significantly during sub-periods II and III. In the secondary sector, manufacturing experienced impressive growth rate of above 5 per cent. An interesting feature of manufacturing is that the exponential growth of contribution of unregistered industries remained higher than that of growth of the registered industries from 1980-81 and 2009-10 and in all the three sub-periods. This implies the strong role of small-scale industries in boosting the economy of West Bengal vis-à-vis less penetration of large-scale manufacturing units.

The small scale industries of West Bengal have strong antecedents of producing cotton cloth, jute products, garments, silk, hosiery items, jewellery, leather products, food products,

wooden items, tobacco products (*bidi* making in rural areas), metal works, spare parts, etc. There is a presence of skilled artisans in large numbers, capable of making diverse handicrafts items. Construction and electricity, gas and water supply also maintained impressive growth. The tertiary sector experienced double digit growth in these two sub-periods especially in transport, storage and communication, real estate, ownership of dwelling and business services, trade, hotels and restaurants, and other services. A major upsurge in growth of public administration was also observed in sub-period III. It needs to be mentioned here that the activities under public administration broadly cover the services of the state government administration. Therefore, growth of public administration reflects the income generated for the government employees. Again, other services cover activities pertaining to educational, medical and veterinary, scientific research, sanitary, recreational, rest of the services, international and extra territorial bodies and lottery services. Therefore, bulk of the income generated under 'other services' are primarily coming from government and quasi-government employment. Shifting the focus to agriculture, it can be reiterated that during the nineties, and subsequent periods, the growth rate agricultural SDP declined despite the substantial improvement in the growth rate in GSDP for the state as whole during these periods. This naturally is expected to have an adverse impact on employment and economic status of agrarian community if economy outside agriculture failed to generate off-farm employment and income.

Taking sectoral share into consideration (Table 7.9), it is observed that from 1980-81 to 1995-1996, the share of agriculture to GSDP experienced a gradual increase and thereafter it started declining in subsequent years. The decline became sharp since 2000-01. However, contribution of the secondary sector to GSDP failed to surpass the share of primary sector from 1980-81 to 2009-2010 and decline in share became faster since 1990-91. Within the secondary sector, the secular fall in share of contribution of both registered and unregistered manufacturing sectors has also been observed. Absence of large-scale manufacturing sector is a reality in West Bengal and small-scale industries act as a backbone of industrial activities in the state. In spite of the fact that contribution of registered and unregistered industries to GSDP (at constant prices) being 4.2 per cent and 5.1 per cent per annum respectively between 1980-81 to 2009-10, it became sluggish during the eighties and picked up during nineties and onwards. Share of registered industries started declining since 2000-01 and from 2005-06 and the share of unregistered industries was also declining sharply. This indicates that the number of units in operation must have declined or closed down during this period.

It is clearly evident from Table 7.10A that since 1990, barring the district of Howrah, number of small-scale units registered with Directorate of Micro and Small-Scale Enterprises of the state have declined for all the other districts. However, registration of small-scale industries does not necessarily imply the setting up of the units (Report on the West Bengal Economy, 2003: 46). On the other hand, concentration of registered factories remained high in the districts of Howrah, Hoogly and 24 Parganas. Moderate concentration was observed in Burdwan, Darjeeling and Jalpaiguri. Though the number of registered factories per thousand sq-km increased for all the districts of West Bengal, it however remained low in the districts of Cooch Behar, Purulia, Murshidabad, Malda, Nadia, West Dinajpur, Bankura and Birbhum between 1980 and 2009.

Therefore, these are the districts that are likely to be affected by the deceleration of growth in agriculture since they have low absorbing capacity of the excess workforce released from agriculture. However, situation would have been different if even unregistered small-scale units expanded in those districts. Share of construction and electricity, gas and water supply had either remained static during the period under study or marginally declined. As analysed in the previous chapters, it was observed that growth in production and productivity of foodgrain production in West Bengal had started declining since 1990-91 and deceleration became faster since 2000-01. Simultaneously, the manufacturing sector though experienced increase in growth rates but contribution to GSDP declined sharply. Hence, scope of workforce to move from agricultural to industry remained a contentious issue. The major contribution to GSDP is thus coming from the tertiary sector. Within tertiary sector, trade, hotels and restaurant, real estate and other services contributed significantly. It has been observed that tertiary sector experienced very healthy growth during nineties and in subsequent periods too. Therefore, the overall picture which comes to light from the foregoing discussion is that agriculture almost generated one-third of the state's income till 2000-01 and from 2000-01, half of the income of the state was being generated from services.

Table 7.8: Kinked Exponential Growth in Various Sectors from 1980-81 to 2009-2010 with three sub-periods, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-01 to 2009-10 (at 1993-94 Price)

Sector	Whole Period (1980-81 to 2009- 2010)	Sub-Period I (1980-81 to 1989-90)	Sub-Period II (1990-91 to 1999- 2000)	Sub-Period III (2000-01 to 2009- 10)
Agriculture	4.2 (22.2)*	6.0 (10.8)*	4.7 (9.5)*	3.5 (17.2)*
Primary Sector	4.2 (26.6)*	5.7 (11.9)*	4.6 (10.9)*	3.7 (20.8)*
Registered	4.2 (37.0)*	2.5 (6.9)*	5.4 (16.9)*	4.7 (34.6)*
Unregistered	5.1 (40.0)	3.3 (8.2)	5.7 (16.2)	5.7 (38.5)
Manufacturing	4.6 (43.3)*	2.8 (9.40)*	5.6 (21.1)*	5.2 (46.5)*
Construction	6.2 (37.1)*	4.9 (7.1)*	7.4 (12.1)*	6.6 (25.9)*
Electricity, Gas and Water Supply	7.3 (52.7)*	9.2 (20.2)*	6.4 (15.8)*	6.7 (39.3)*
Secondary Sector	5.2 (60.1)*	3.6 (16.0)*	6.1 (30.4)*	5.6 (66.5)*
Transport, storage & communication	8.2 (59.1)*	6.3 (14.4)*	8.8 (22.9)*	8.8 (54.8)*
Trade, hotels and restaurant	14.5 (9.3)*	1.2 -0.2	10.4 (2.3)*	19.1 (10.0)*
Real estate, ownership of dwelling and business services	8.3 (17.5)*	1.2 -1.6	8.3 (12.2)*	10.6 (37.2)*
Public administration	4.6 (14.7)*	6.2 (5.0)*	5.1 (4.6)*	4.0 (8.6)*
Other services	6.7 (12.3)*	1.4 (-0.8)	5.7 (3.8)*	8.5 (13.6)*
Tertiary Sector	12.8 (10.8)*	1.5 -0.4	10.2 (3.1)*	16.7 (12.1)*
Gross state domestic Product	8.0 (18.0)*	3.4 (2.5)*	7.4 (6.1)*	9.6 (19.0)*

Source: Calculation based on GSDP data collected from Ministry of Statistics and Programme Implementation, Government of India [www.mospi.nic.in] and Department of Planning, Government of West Bengal [www.wbplan.gov.in]

T-statistics are shown in parentheses.

* Significant at 1% level, ** Significant at 5% level and *** Significant at 10% level

Table 7.9: Share of Various Sectors (in percentage) in GSDP (at current prices) from 1980-81 to 2009-10

Year/sectors	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2009-10
Agriculture	26.0	27.2	26.1	30.1	25.0	19.3	18.9
Forestry & logging	1.1	1.1	1.0	0.9	0.8	1.1	1.1
Fishing	3.0	3.5	3.4	3.7	3.8	3.6	3.5
Mining & quarrying	1.2	1.3	1.2	0.8	1.4	1.3	0.8
Sub Total of Primary	31.2	33.1	31.8	35.5	30.9	25.3	24.3
Manufacturing	21.7	17.9	18.6	15.4	12.7	10.2	9.6
Registered	12.9	9.9	10.6	8.3	4.9	5.1	4.8
Unregistered	8.8	7.9	8.0	7.1	7.7	5.1	4.8
Construction	7.3	7.6	7.0	5.4	5.1	7.5	6.1
Electricity, Gas and Water supply	1.0	1.9	1.6	2.0	1.9	2.0	1.9
Sub Total of Secondary	30.0	27.3	27.2	22.8	19.6	19.8	17.7
Transport, storage & communication	4.8	5.9	7.2	7.3	6.5	8.5	8.9
Trade, hotels and restaurants	11.7	12.4	11.6	13.1	10.8	16.1	15.1
Banking & Insurance	5.0	5.2	5.4	7.4	11.0	6.0	5.7
Real estate and etc.	8.1	6.7	5.1	4.1	7.6	8.0	9.3
Public administration	3.0	3.7	4.8	4.2	5.6	5.5	6.0
Other services	6.1	5.7	6.9	5.6	8.0	10.9	13.2
Sub Total of Tertiary	38.7	39.6	41.0	41.6	49.5	55.0	58.1
Gross State Domestic Product (GSDP)	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Calculation based on GSDP data collected from Ministry of Statistics and Programme Implementation, Government of India [www.mospi.nic.in] and Department of Planning, Government of West Bengal [www.wbplan.gov.in]

Table 7.10: Districtwise Number of Small-Scale Industrial Units Registered with Directorate of Micro and Small Scale Enterprises and Number of Registered Factories in per '000 sq-km area

Dist/ Year	Small Scale Units				Registered Factories			
	1980	1990	2000	2009	1980	1990	2000	2009
Burdwan	236	465	106	162	53	74	108	154
Birbhum	75	96	24	65	18	22	32	37
Bankura	72	149	58	61	6	8	13	22
Midnapore	197	586	169	142	7	11	16	28
Howrah	308	601	139	486	1005	1372	1811	2199
Hoogly	74	184	45	69	103	161	250	327
24 Pargans	142	559	121	276	223	314	419	516
Nadia	76	267	67	78	29	45	53	68
Murshidabad	103	222	135	97	3	4	5	13
West Dinajpur	42	113	49	34	6	7	13	19
Malda	183	216	89	79	2	6	9	18
Jalpaiguri	47	240	46	63	41	55	70	85
Darjeeling	71	151	25	18	51	65	78	93
Cooch Behar	49	81	36	45	4	6	8	13
Purulia	98	138	38	41	8	9	11	15
West Bengal	1570	3750	1033	1537	66	92	124	157

Source: Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal.

7.7.2 Districtwise Change in Employment Scenario in West Bengal

Against the backdrop of the above-explained economic scenario of the state, a critical review of the employment scenario becomes necessary. Data on successive census years have been analysed to understand the changes in work participation rate, changing employment scenario of agrarian sector vis-à-vis industry. Total workers as percentage of population have been used to measure the work participation rate. Total workers consist of both main and marginal workers. From Table 7.11, it is evident that work participation rate has increased in successive census years since 1981 in the state of West Bengal as well as for her districts. However, since data on main workers and marginal workers are not shown in census year of 1981, it is not possible to ascertain that rise in work participation implies an increase in main workers. However, looking at districtwise figures of percentage of cultivators¹ to districtwise total workers, the employment scenario that emerges is not much encouraging. It is observed that in three successive census years, i.e., 1981, 1991 and 2001, cultivators as percentage of total workers had been consistently falling. From Table 7.12, it can be observed that between 1981 and 1991, the fall in percentage of cultivators is relatively much less compared to the percentage fall in cultivators during 1991 to 2001.

During 1981 to 1991, most of the districts in West Bengal experienced a decline of 2 to 3 percentage point, however, the fall in percentage of cultivators stood at 8 per cent in 24 Parganas, 5 per cent in Malda and Cooch Behar, while Jalpaiguri experienced a decline of 4 per cent. For the state as a whole the decline in percentage of cultivators to total workers was 1.2 per cent. However, the period between 1991 and 2001 was marked by more rapid fall in percentage of cultivators to total workers. As a matter of fact, for large number of districts, viz. Midnapore, Murshidabad, Malda, West Dinajpur, Darjeeling, Cooch Behar, Purulia, Birbhum and Burdwan, the fall in percentage of cultivators was hovering around 7 to 12 per cent. Here, decline in percentage of cultivators indicates a couple of possibilities: first, it may lead to an increase in percentage of agricultural labourers and precipitate the marginalisation of the rural workforce; second, expansion of rural non-farm activities and absorption of rural workers there in; third, movement of people from rural areas to secure a place at urban sector and finally, demotion of cultivators to marginal workers².

It has further been noticed that between 1981 and 1991, there was barely any increase in agricultural labourers as percentage to total workers (Table 7.12) across the districts of West Bengal. Districts like Midnapore, Murshidabad experienced a fall in percentage of agricultural labourers to total workers. A nominal increase in percentage of agricultural labourers was observed in West Dinajpur, Malda, Jalpaiguri and Purulia. It is not out of place

to mention here that during the eighties, redistribution of ceiling surplus land among the landless labourers and marginal farmers and registration of sharecroppers and granting them quasi land rights (commonly known as operation *barga*) gathered momentum in West Bengal and most of the districts experienced major resurgence in agricultural productivity. Resultantly, landlessness did not increase much during this period. Percentage of workers engaged in household³ industrial activities either declined or increased marginally for most of the districts in West Bengal (Table 7.12) during this period. Rise in agricultural yield and production indirectly contributed to the expansion of market for mass consumption goods and partial increase in non-agricultural activities (West Bengal Human Development Report, 2004: 37). In Murshidabad and Malda the percentage of total workers engaged in household industries increased more than 8 per cent and 7 per cent respectively.

The agrarian scenario underwent a change between 1991 and 2001 and marginalisation of rural workforce became rampant and prominent. As mentioned earlier, decline in cultivators as percentage of total workers experienced a sharp decline and significant rise was observed in percentage of agricultural labourers as well as marginal workers in West Bengal and in many of its districts (Table 7.12). Major rise in percentage of total workers working as agricultural labourers was observed in Purulia and Midnapore. The percentage rise in agricultural labourers was found to be 15 per cent and 10 per cent respectively for these two districts. 3 to 6 per cent rise in percentage of agricultural labourers was observed for the districts of West Dinajpur, Cooch Behar, Bankura and Birbhum. Employment in household industries, however, showed a moderate increase of 3.1 per cent during 1991 to 2001 for the state as whole and most of the districts also experienced a rise in percentage of workers engaged in household industrial activities. Districts like Howrah, Murshidabad, Purulia, Malda experienced a rise in percentage of household industry workers by 4 to 8 per cent. In districts like Burdwan, Birbhum, Bankura, Nadia, West Dinajpur, 2 to 4 per cent rise in employment in household industry was observed (Table 7.12). This indicated that during 1991 to 2001, employment opportunities in rural non-farm activities had experienced an expansion. This has been corroborated by West Bengal Human Development Report, 2004. Industrial recovery experienced by the state of West Bengal was not due to the improvement in the performances of organised industry. The growth of sectors like jute and leather was neutralised by the relative decline in growth of engineering and that had also adversely affected the investment in railways in the eastern region (*ibid.*: 76).

In addition, there was a significant rise in the percentage of marginal workers to total workers across the districts in West Bengal. Highest rise was observed in the district of Purulia where

percentage of marginal workers in relation to total workers increased by 25.3 per cent in 2001 compared to 1991. Followed by Bankura, in Purulia the rise in percentage of marginal workers stood at 24.6 per cent. Around 15 to 20 per cent rise in percentage of marginal workers was observed in Burdwan, Birbhum, Midnapore, West Dinajpur, Malda, Jalpaiguri and Cooch Behar. 10 to 14 per cent rise in percentage of workers engaged in marginal works was experienced by Howrah, 24 Parganas, Nadia, Murshidabad and Darjeeling.

Table 7.11: Districtwise percentage of Total Workers to District Population (Work Participation Rate)

Districts	Year	1981	1991	2001
Burdwan	Total	30.6	30.7	35.5
	Rural	21.3	21.2	24.5
	Urban	9.3	9.5	11.1
Birbhum	Total	30.5	33.1	37.4
	Rural	28.3	30.7	34.6
	Urban	2.2	2.5	2.8
Bankura	Total	32.9	35.9	44.7
	Rural	30.9	33.5	42.2
	Urban	2.0	2.4	2.5
Midnapore	Total	29.7	35.2	39.0
	Rural	27.5	32.4	35.9
	Urban	2.2	2.8	3.2
Howrah	Total	26.9	29.1	33.7
	Rural	13.5	14.2	16.6
	Urban	13.4	14.9	17.1
Hoogly	Total	29.8	31.1	36.9
	Rural	21.4	22.1	25.7
	Urban	8.4	9.0	11.2
24 Parganas	Total	27.2	28.6	33.0
	Rural	16.6	18.8	20.6
	Urban	10.6	9.7	12.4
Nadia	Total	27.5	29.3	35.1
	Rural	21.7	22.8	27.4
	Urban	5.8	6.5	7.7
Murshidabad	Total	40.9	31.5	34.2
	Rural	37.2	28.1	29.3
	Urban	3.7	3.4	4.9
West Dinajpur	Total	32.1	34.5	39.2
	Rural	29.2	30.9	35.3
	Urban	2.9	3.6	4.0
Malda	Total	30.3	34.7	40.7
	Rural	29.1	32.8	38.4
	Urban	1.2	1.9	2.3
Jalpaiguri	Total	33.6	33.8	38.3
	Rural	29.7	29.0	32.5
	Urban	3.9	4.8	5.8
Darjeeling	Total	36.2	34.2	35.4
	Rural	28.0	25.1	25.1
	Urban	8.2	9.1	10.3
Cooch Behar	Total	29.8	32.1	39.0
	Rural	28.0	29.9	36.0
	Urban	1.8	2.2	3.0
Purulia	Total	38.3	43.2	44.5
	Rural	35.9	40.6	41.6
	Urban	2.3	2.5	2.9
West Bengal	Total	32.5	29.9	39.0
	Rural	25.9	23.9	30.8
	Urban	6.7	6.0	8.3

Source: Calculation based on data collected from Census of India-1981, Series 23, West Bengal, Census of India-1991, Series 26, West Bengal and Census of India-2001, Series 20, West Bengal, Directorate of Census Operation

Table 7.12: Districtwise percentage of Cultivators, Agricultural Labourers, Household Industry and Marginal Workers to Districtwise Total Workers

Districts	Year	Cultivators			Agri-Labourers			Household Industry			Marginal Workers		
		1981	1991	2001	1981	1991	2001	1981	1991	2001	1981	1991	2001
Burdwan	Total	21.4	21.1	14.8	28.2	29.8	29.9	3.0	2.8	4.9	7.9	3.1	22.4
	Rural	20.8	20.2	14.2	27.1	28.0	28.8	2.0	2.3	3.8	2.5	2.6	17.9
	Urban	0.6	0.9	0.5	1.0	1.7	1.1	0.9	0.5	1.2	5.3	0.5	4.5
Birbhum	Total	34.9	31.7	23.1	35.4	34.3	36.9	3.3	3.3	6.5	7.9	8.2	26.3
	Rural	34.6	31.4	23.0	34.7	33.7	36.7	3.0	3.1	6.2	7.7	8.1	25.6
	Urban	0.3	0.4	0.1	0.7	0.6	0.2	0.3	0.2	0.3	0.2	0.1	0.7
Bankura	Total	36.3	37.3	33.8	30.7	30.8	35.3	4.2	3.1	5.8	11.5	8.5	33.8
	Rural	36.1	37.1	33.2	30.4	30.4	35.1	3.4	2.7	5.3	11.3	8.4	33.2
	Urban	0.2	0.2	0.6	0.4	0.4	0.1	0.7	0.5	0.6	0.2	0.1	0.6
Midnapore	Total	39.0	36.4	28.1	27.9	22.0	31.8	4.0	4.2	7.4	9.9	13.5	32.5
	Rural	38.5	35.9	27.8	27.2	21.2	31.3	3.7	4.1	7.2	9.7	13.1	31.5
	Urban	0.5	0.6	0.3	0.7	0.7	0.5	0.2	0.1	0.2	0.2	0.4	1.0
Howrah	Total	10.1	10.5	5.2	14.2	14.5	10.2	5.4	3.6	11.5	2.6	1.9	14.9
	Rural	9.7	9.9	5.0	13.3	12.8	9.7	3.3	1.9	6.9	2.0	1.5	10.3
	Urban	0.4	0.6	0.2	1.0	1.7	0.5	2.2	1.7	4.6	0.6	0.3	4.5
Hoogly	Total	23.1	20.7	14.9	26.8	26.1	24.3	3.4	6.0	5.2	3.8	1.8	17.8
	Rural	22.8	20.4	14.7	26.1	25.3	23.8	2.8	2.5	4.2	3.3	1.6	15.2
	Urban	0.3	0.4	0.2	0.8	0.8	0.5	0.7	3.5	0.9	0.5	0.2	2.6
24 Parganas	Total	20.8	12.5	12.7	21.2	21.5	18.9	2.9	2.9	5.1	3.9	4.5	17.8
	Rural	20.5	12.1	12.5	20.2	20.4	18.5	1.6	2.1	3.9	3.4	4.2	14.4
	Urban	0.4	0.4	0.2	1.0	1.1	0.4	1.2	0.8	1.2	0.5	0.3	3.3
Nadia	Total	30.5	28.8	19.8	27.9	27.0	23.2	5.6	7.2	11.4	2.8	1.8	13.0
	Rural	29.8	27.9	19.5	26.6	25.5	22.7	3.1	4.1	7.6	2.4	1.3	11.0
	Urban	0.7	0.9	0.3	1.3	1.5	0.6	2.5	3.1	3.8	0.4	0.5	2.0
Murshidabad	Total	33.3	30.0	18.7	31.6	27.9	28.0	5.4	13.0	20.4	5.8	4.6	16.6
	Rural	33.0	29.6	18.5	31.0	27.3	27.7	4.7	10.3	14.6	5.5	4.2	14.8
	Urban	0.4	0.4	0.2	0.6	0.6	0.3	0.7	2.7	5.8	0.2	0.4	1.8
West Dinajpur	Total	43.8	40.7	30.1	32.1	33.4	38.3	1.8	1.8	4.1	6.9	5.2	23.3
	Rural	43.2	39.7	30.0	31.6	32.7	38.0	1.5	1.6	3.6	6.6	5.1	22.5
	Urban	0.6	1.0	0.1	0.5	0.7	0.3	0.3	0.2	0.5	0.2	0.1	0.8
Malda	Total	36.0	31.5	20.8	30.9	31.6	30.7	3.8	11.2	15.6	10.0	8.8	27.9
	Rural	35.9	31.4	20.8	30.8	31.5	30.7	3.7	10.2	15.3	9.9	8.8	27.4
	Urban	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0	0.3	0.1	0.0	0.4
Jalpaiguri	Total	31.5	27.4	20.7	15.4	15.8	17.7	1.1	1.1	2.1	5.5	6.7	21.3
	Rural	30.7	26.7	20.5	14.7	15.0	17.4	0.9	0.8	1.6	5.3	6.6	20.2
	Urban	0.8	0.7	0.2	0.6	0.8	0.3	0.3	0.3	0.4	0.2	0.1	1.2
Darjeeling	Total	25.5	24.4	15.5	8.7	11.6	10.2	1.3	0.6	2.8	3.4	1.5	15.9
	Rural	25.4	24.1	15.4	8.5	11.3	10.1	0.7	0.4	2.1	3.1	1.3	14.0
	Urban	0.2	0.3	0.1	0.2	0.4	0.1	0.6	0.3	0.7	0.3	0.2	1.9
Cooch Behar	Total	50.6	45.8	37.4	26.5	24.8	29.5	2.0	2.2	4.1	2.7	4.9	22.0
	Rural	50.4	45.6	37.3	26.3	24.5	29.4	1.8	2.0	3.7	2.7	4.8	21.5
	Urban	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.4	0.0	0.1	0.5
Purulia	Total	41.0	40.5	31.3	20.1	20.9	36.0	2.6	2.3	7.5	18.7	18.1	42.7
	Rural	40.8	40.3	31.2	19.8	20.6	35.9	2.4	2.1	7.3	18.5	17.9	41.9
	Urban	0.2	0.2	0.1	0.3	0.2	0.1	0.2	0.1	0.2	0.2	0.2	0.8
West Bengal	Total	28.7	27.1	20.5	25.4	24.7	26.5	3.4	4.5	7.6	6.7	6.5	22.9
	Rural	28.3	26.6	20.2	24.7	23.8	26.1	2.6	3.4	6.2	5.9	6.2	20.8
	Urban	0.4	0.5	0.3	0.7	0.9	0.4	0.8	1.0	1.4	0.8	0.3	2.1

Source: Calculation based on data collected from Census of India-1981, Series 23, West Bengal, Census of India-1991, Series 26, West Bengal and Census of India-2001, Series 20, West Bengal, Directorate of Census Operation

Increase in incidence of land alienation of *pattadars* and eviction of *bargadars* has also been observed in various districts of West Bengal. A study conducted by the State Institute of Panchayat and Rural Development observed that by 2001, on an average, almost 13 per cent of the *pattadars* had lost their land and around 14 per cent of *bargadars* were evicted from their land (Table 7.13). The extent of dispossession widely varied across the districts. More than 30 per cent of the *bargadars* lost possession of their land in Cooch Behar, North and South Dinajpur, and Jalpaiguri and these are also relatively agriculturally backward districts. The rate of eviction were also found to be high (around 15 to 20 per cent) in Darjeeling, Murshidabad, North 24 Parganas, Howrah and Burdwan. The percentage of dispossession, however, was low (less than 10 per cent) among districts of Malda, Purulia, Nadia and West Midnapore. It has further been observed that *pattadars* who had lost possession of land we also varied across the districts. Land alienation remained high (around or more than 20 per cent) in North Dinajpur, South 24 Parganas and South Dinajpur. Extension of tea estates in North Dinajpur and proliferation of brackish water fish cultivation and appropriation of arable land for such purposes in Sundarban regions of south 24 Parganas were identified as few possible causes, among many, for high incidence of land alienation in those districts (West Bengal Human Development Report, *op. cit.*: 41). A high percentage (14 to 16 per cent) of dispossession could also be found in Jalpaiguri, Birbhum, Murshidabad, North 24 Parganas, Purulia, Bankura and Hoogly. Among the evicted *bargadars* only 24.1 per cent reported that eviction caused the dispossession. Another important feature was highlighted in the report that around 74 per cent of *bargadars* had a feeling of tenurial security and rest were feeling insecure, inspite of the fact that their names had already been registered as share croppers or *bargadars*. However, a high proportion of *bargadars* (closer to 50 per cent) had a perceived sense of insecurity among the districts of Darjeeling, Hoogly, Jalpaiguri and North Dinajpur.

Table 7.13: Dispossession of *Pattadars* and Eviction of *Bargadars* (in percent) from Lands between Inception of land Reforms and the year 2000

DIST/YEAR	Dispossessed <i>Pattadars</i> (in per cent)	Evicted <i>Bargadars</i> (in per cent)
Burdwan	11.93	14.5
Birbhum	16.62	9.83
Bankura	15.45	11.09
West Midnapore	5.62	9.29
Howrah	9.34	15.9
Hoogly	14.63	10.48
North 24 Parganas	16.99	16.65
South 24 Parganas	22.07	10.31
Nadia	11.27	9.74
Murshidabad	15.87	19.06
North Dinajpur	22.35	31.49
South Dinajpur	19.17	30.73
Malda	10.41	5.66
Jalpaiguri	16.72	31.6
Darjeeling	14.71	16.0
Cooch Behar	12.33	30.9
Purulia	16.11	6.7
West Bengal	13.23	14.37

Source: *Chakraborti et al., (2003): 35 and 57*

7.7.3 Changing Land Holding Pattern and Emerging Agrarian Structure in West Bengal

In West Bengal in general, and her districts in particular, majority of the people rely primarily on agriculture, land being the primary income generating asset. Hence, any change in landholding pattern may be viewed as a signal of relative prosperity or destitution among different segments of rural people. Alienation of rural masses from their land force them to 'lose their direct control over land and operation' and finally they 'lose their capacity to fulfil their basic consumption needs on the basis of self provisioning' (Joshi, 1982:771). In addition, with in elastic land area and with an adverse land/man ratio, it becomes imperative to transfer excess agrarian population to non-farm activities. Otherwise, absolute number of persons and households dependent on agriculture is bound to rise. As a consequence, the rise in number of marginal farmers and landless agricultural labourers become inevitable which aggravates rural distress and poverty.

In the foregoing analysis, it has already been observed that land reform and tenancy reform in terms of operation *barga* has contributed positively to the growth of foodgrain production and yield in the state as well as in the districts, during eighties and early-nineties. The positive impact of agricultural growth also helped indirectly towards the growth of unorganised small scale industries. But the scenario had started changing since the late-

nineties. Marginalisation of rural workforce is being increasingly felt. In addition, distribution of ceiling surplus land and granting tenurial security to the sharecroppers indeed helped the landless section of agrarian community. But at the same time, average size of landholdings is small and growing population makes it smaller and there is a possibility that with rising cost of production many of these holdings may prove to be uneconomical for the farmers.

To scrutinize the possible marginalisation of rural workforce, along with changing employment scenario (discussed in preceding section-7.4.2), the change in landholding patterns has been considered at state and at the district level. For this, Agricultural Census data on land holdings of major size-classes for 1970-71 and 2005-06 have been compared (Table 7.14, Table 7.15 and Table 16). It has been observed that in 1970-71, the percentage of household belonging to marginal category was relatively low in Darjeeling, Jalpaiguri, West Dinajpur and Burdwan compared to other districts and state as a whole. Further, the number of households in small, semi-medium and medium categories was relatively high. Conversely, the percentage of marginal holders was quite high in Howrah, Murshidabad, 24 Parganas and Midnapore. In comparison to 1970-71, a massive increase in percentage of households belonging to marginal category was observed for the state as well as for most of the districts. Most noticeable rise was observed in Darjeeling, Jalpaiguri, Malda and Burdwan. Growth of plantation economy in Darjeeling, Jalpaiguri and continuous migration of people from neighbouring countries Nepal, Bhutan, Bangladesh and Assam have partly contributed to the growth of percentage of households in marginal category. However, fall in percentage of households belonging to small, semi-medium and medium category across the districts proves the success of tenancy reform in West Bengal.

The major size-class wise distribution of area (in percentage) and magnitude of change that took place between 1970-71 and 2005-06 reveals that area belonging to marginal category has uniformly increased for all the districts as well as for the state. Area operated under small category declined for Howrah, Hoogly and Midnapore. However, area under semi-medium, medium category uniformly declined across the districts, reaffirming the relative equitable distribution of land through reform measures. Growth of plantation economy has increased the percentage of large land holdings in Darjeeling, Jalpaiguri, Cooch Behar and West Dinajpur. In addition, average land-holding for all districts has declined for both the districts and state.

Therefore, decreasing size of average land holdings coupled with increasing percentage of households in marginal category indicates gradual marginalisation of rural workforce.

Growth of unorganised small manufacturing units has also slowed down from late-nineties. It has been observed that the number of registered factories increased over the years but average daily employment per factory has substantially declined between 1990 and 2009. During the period between eighties and nineties per-factory average daily employment was quite high in Burdwan, Midnapore, Hoogly, 24 Parganas and Howrah while these districts experienced decline in average daily employment (Table 7.17). Large scale manufacturing units are hardly visible in the state. As a consequence, employment opportunities outside agriculture are becoming more and more inadequate. This would increase economic hardship of agrarian community of the state. Sufferings of agriculturally backward districts, therefore, would undoubtedly be on the rise.

Table 7.14: Number of Holdings of Major Size-Classes as percentage of Total Number of Holdings

Year/Dist	1970-71						2005-06					
	Marginal	Small	Semi - Medium	Medium	Large	Total	Marginal	Small	Semi - Medium	Medium	Large	Total
Darjeeling	38.1	27.9	23.3	10.0	0.6	100.0	83.2	12.6	3.7	0.4	0.15	100.0
Jalpaiguri	38.0	33.2	23.5	5.2	0.1	100.0	80.3	16.0	3.3	0.4	0.07	100.0
Cooch Behar	56.5	26.6	13.6	3.3	0.0	100.0	77.6	15.8	6.5	0.1	0.01	100.0
West Dinajpur	43.3	25.9	20.8	9.8	0.2	100.0	75.6	18.1	6.0	0.3	0.02	100.0
Malda	59.3	20.4	14.4	5.9	0.1	100.0	82.5	13.2	4.0	0.3	0.00	100.0
Murshidabad	63.8	20.2	12.2	3.8	0.0	100.0	79.6	15.9	4.2	0.4	0.00	100.0
Nadia	53.8	24.0	16.5	5.6	0.1	100.0	78.7	18.1	3.0	0.2	0.00	100.0
24 Parganas	68.2	18.9	9.9	3.0	0.0	100.0	87.0	10.9	1.9	0.1	0.00	100.0
Howrah	86.9	9.9	2.7	0.5	0.0	100.0	94.0	5.6	0.4	0.0	0.00	100.0
Hoogly	68.6	20.0	9.3	2.2	0.0	100.0	85.7	11.8	2.2	0.3	0.00	100.0
Burdwan	41.5	29.5	21.7	7.3	0.1	100.0	73.0	19.0	6.8	1.1	0.02	100.0
Birbhum	49.6	24.2	18.8	7.1	0.2	100.0	70.7	19.9	8.8	0.6	0.00	100.0
Bankura	50.0	27.3	16.7	5.9	0.1	100.0	66.6	22.0	9.5	1.9	0.00	100.0
Purulia	55.1	25.6	14.0	5.1	0.3	100.0	74.9	19.3	5.3	0.5	0.00	100.0
Midnapore	65.4	21.9	9.9	2.8	0.0	100.0	88.5	9.4	2.0	0.1	0.00	100.0
West Bengal	60.0	22.3	13.2	4.4	0.1	100.0	81.2	14.4	4.0	0.4	0.01	100.0

Source: Calculation based on data collected from Agricultural Census 1970-71 and 2005-06, Government of West Bengal.

*Marginal: less than 1 ha; Small: 1-2 ha; Semi-Medium: 2-4 ha; Medium: 4-10 ha and Large: more than 10 ha

Table 7.15: Area under Operational Holdings of Major Size-Classes as percentage Total Area Operated

Year/Dist	1970-71						2005-06					
	Marginal	Small	Semi-Medium	Medium	Large	Total	Marginal	Small	Semi-Medium	Medium	Large	Total
Darjeeling	6.7	12.9	20.3	18.1	42.0	100.0	25.0	12.8	6.3	1.5	54.5	100.0
Jalpaiguri	9.5	18.8	24.3	10.6	36.8	100.0	35.0	21.1	7.6	1.6	34.7	100.0
Cooch Behar	23.5	31.7	30.6	14.1	0.2	100.0	48.5	29.0	21.0	0.8	0.7	100.0
West												
Dinajpur	12.9	21.8	31.8	32.1	1.5	100.0	45.4	32.6	18.3	1.7	2.0	100.0
Malda	20.0	22.8	30.9	25.2	1.1	100.0	57.4	27.5	13.5	1.6	0.0	100.0
Murshidabad	24.3	26.4	30.4	18.3	0.6	100.0	48.7	33.4	15.6	2.3	0.0	100.0
Nadia	18.3	25.5	33.3	22.1	0.8	100.0	52.1	36.7	9.7	1.4	0.1	100.0
24 Parganas	27.9	27.5	27.7	16.4	0.5	100.0	63.8	27.1	8.1	1.0	0.1	100.0
Howrah	55.3	26.3	13.5	4.8	0.1	100.0	80.5	16.7	2.1	0.5	0.2	100.0
Hoogly	30.4	30.3	26.7	12.2	0.4	100.0	59.6	28.3	9.4	2.5	0.1	100.0
Burdwan	17.2	24.6	34.7	22.5	0.9	100.0	41.6	32.7	19.6	5.8	0.3	100.0
Birbhum	14.9	23.2	33.9	25.8	2.2	100.0	39.7	32.9	24.4	2.9	0.1	100.0
Bankura	17.3	27.4	31.7	22.8	0.9	100.0	33.2	32.3	25.1	9.5	0.0	100.0
Purulia	21.6	26.5	27.6	21.6	2.7	100.0	44.6	35.2	17.2	3.0	0.1	100.0
Midnapore	28.6	30.0	25.9	14.7	0.8	100.0	66.7	23.6	8.6	0.9	0.1	100.0
West Bengal	21.5	25.7	28.9	19.2	4.6	100.0	50.7	28.9	14.0	2.5	4.0	100.0

Source: Calculation based on data collected from Agricultural Census 1970-71 and 2005-06, Government of West Bengal.

Table 7.16: Average Land Holding (in ha) under Various Size-Classes

Dist/Year	Marginal		Small		Semi Medium		Medium		Large		Total	
	1970-71	2005-06	1970-71	2005-06	1970-71	2005-06	1970-71	2005-06	1970-71	2005-06	1970-71	2005-06
Darjeeling	0.54	0.44	1.42	1.49	2.67	2.51	5.52	5.47	204.05	548.03	3.06	1.47
Jalpaiguri	0.60	0.52	1.36	1.59	2.48	2.76	4.87	5.01	736.62	629.99	2.40	1.20
Cooch Behar	0.48	0.53	1.37	1.57	2.59	2.77	4.98	4.85	11.41	51.05	1.15	0.85
West												
Dinajpur	0.49	0.54	1.40	1.62	2.55	2.73	5.44	4.82	11.95	109.99	1.67	0.90
Malda	0.42	0.55	1.38	1.64	2.65	2.67	5.32	4.91	13.96	10.00	1.24	0.79
Murshidabad	0.40	0.45	1.38	1.55	2.64	2.72	5.15	4.88	22.19	10.00	1.06	0.74
Nadia	0.45	0.56	1.40	1.70	2.65	2.73	5.19	5.48	15.36	31.92	1.31	0.84
24 Parganas	0.39	0.45	1.38	1.53	2.67	2.60	5.20	4.97	13.61	12.94	0.95	0.62
Howrah	0.32	0.38	1.34	1.35	2.55	2.37	5.00	5.32	12.22	20.00	0.50	0.45
Hoogly	0.40	0.44	1.37	1.52	2.62	2.73	5.07	4.68	17.45	9.92	0.91	0.63
Burdwan	0.70	0.57	1.40	1.72	2.70	2.91	5.20	5.05	12.85	18.52	1.68	1.00
Birbhum	0.45	0.57	1.43	1.67	2.71	2.82	5.43	4.70	16.30	173.00	1.50	1.01
Bankura	0.48	0.50	1.39	1.47	2.62	2.63	5.36	4.95	12.70	12.00	1.39	1.00
Purulia	0.50	0.49	1.33	1.50	2.54	2.64	5.40	4.91	12.50	13.91	1.28	0.82
Midnapore	0.44	0.48	1.38	1.60	2.63	2.80	5.32	4.77	18.18	51.08	1.00	0.64
West Bengal	0.43	0.49	1.38	1.59	2.63	2.73	5.28	4.94	64.20	339.60	1.20	0.79

Source: Calculation based on data collected from Agricultural Census 1970-71 and 2005-06, Government of West Bengal.

Table 7.17: Per-Factory (Registered) Average Daily Employment

Dist/Year	1980	1990	2000	2009
Burdwan	267	243	111	96
Birbhum	50	42	34	39
Bankura	25	22	26	49
Midnapore	204	156	137	113
Howrah	111	80	67	54
Hoogly	469	290	187	143
24 Pargans	145	96	71	61
Nadia	95	89	80	71
Murshidabad	114	174	166	75
West Dinajpur	53	69	60	59
Malda	37	36	36	39
Jalpaiguri	79	59	61	56
Darjeeling	55	49	49	50
Cooch Behar	56	49	36	61
Purulia	97	81	72	67
West Bengal	147	106	78	67

Source: Calculation based on data collected from various issues of *West Bengal Economic Review*, Government of West Bnegal

7.8 Conclusion

The important findings of this chapter has been delineate below. There has been significant growth in production and productivity in foodgrain in West Bengal and her districts during the eighties. However, such growth slowed down in the nineties and since 2000-01 the decline was sharper. The results obtained from econometric analysis provide a clear indication that the turn around in West Bengal cannot solely be attributed to institutional reforms; rather institutional reform, adoption and spread of Green Revolution technology and functioning of *panchayats*, together brought the positive changes in agricultural production and productivity. It has been shown in the present analysis that unless the number of *bargadars* as percentage of operating household is reaches a critical level of 25 per cent the fruits of Green Revolution would not be fully realised. As a matter of fact, the districts of Birbhum, Bankura, Burdwan, Hoogly, Malda and Midnapore achieved high average productivity. The number of *bargadars* registered as percentage of total number of operating households in those districts also remained relatively high in comparison to other districts of West Bengal. Of the districts of West Bengal, Burdwan, Midnapore, 24 Parganas, Hoogly, Murshidabad, West Dinajpur, Nadia and Birbhum achieved high average productivity of foodgrain and in those districts average use of fertiliser (kg/ha) also remained relatively higher.

This study has further reaffirmed the role of fertiliser in enhancing productivity with the help of regression analysis. This also proves the greater spread of HYV seeds and irrigation.

Expansion of tube-well irrigation in large scale allowed reaping the productivity gain in output of HYV varieties of rice in West Bengal. In addition, the spread of *Zilla Parishad* road and credit society per thousand square kilometres is yet to reach a level at which it may exert strong influence on the agricultural productivity to a large extent.

The study further confirms that inverse relationship between farm size and productivity does not hold good universally. The study further observed that impact of economic reforms which is captured by using a dummy variable depicted positive relationship with agricultural productivity though it was observed since late-nineties, productivity had started declining in most of the districts of West Bengal. On income-employment front, the impressive productivity gain in agriculture also helped to raise the over all agricultural income in the state and it was also responsible most for the sluggish growth in the '80s in comparison to secondary and tertiary sector of the economy. However, growth performance of secondary sector and tertiary sectors markedly improved during 1990 to 2009. Hence, the strong role of small-scale industries propelling the economy gets pronounced alternatively which also implies less penetration of large-scale manufacturing units. During the nineties and in subsequent years, the growth rate in agricultural SDP declined inspite of the fact that The growth rate in GSDP for the state as a whole improved substantially during these periods. However, the fall in contribution of agriculture to GSDP was not compensated by the proportionate increase in the share of the secondary sector.

Absence of large-scale manufacturing sector has elongated industrial backwardness of the state. Looking at the employment scenario for three successive census years, i.e., 1981, 1991 and 2001, it is noticed that cultivators as percentage of total workers is consistently falling and such downward trend became sharp between 1991 and 2001. At the same time, there was an overwhelming rise in the percentage of marginal workers to total workers across the districts of West Bengal. Increasing incidence of land alienation of *pattadars* and eviction of *bargadars* has been noticed in the state and districts. A considerable increase in percentage of households belonging to marginal category was observed for the state as well as for most of the districts. Therefore, decreasing size of average land holdings coupled with increasing percentage of households in marginal category indicates gradual marginalisation of the rural workforce. Resultantly, the huge growth and gain in agricultural production and productivity in West Bengal that ushered in during the eighties could not be sustained. The inadequacies in generating alternative employment avenues had been discernible in the following decades which to a large extent crippled the economic status of the agrarian community of Bengal.

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¹ A person is classified as cultivator if he or she is engaged in cultivation of land owned or held from Government or held from private persons or institutions for payment in money, kind or share. Cultivation includes effective supervision or direction in cultivation. A person who has given out her/his land to another person or persons or institution(s) for cultivation for money, kind or share of crop and who does not even supervise or direct cultivation of land, is not treated as cultivator. Similarly, a person working on another person's land for wages in cash or kind or a combination of both (agricultural labourer) is not treated as cultivator.

Cultivation involves ploughing, sowing, harvesting and production of cereals and millet crops such as wheat, paddy, jowar, bajra, ragi, etc., and other crops such as sugarcane, tobacco, ground-nuts, tapioca, etc., and pulses, raw jute and kindred fibre crop, cotton, cinchona and other medicinal plants, fruit growing, vegetable growing or keeping orchards or groves, etc. Cultivation does not include the following plantation crops - tea, coffee, rubber, coconut and betel-nuts (areca).

² Marginal workers are those workers who had not worked for the major part of the reference period i.e., less than 6 months in a year.

³ Household Industry is defined as an industry conducted by one or more members of the household at home or within the village in rural areas and only within the precincts of the house where the household lives in urban areas. The larger proportion of workers in the household industry consists of members of the household. The industry is not run on the scale of a registered factory which would qualify or has to be registered under the Indian Factories Act. The main criterion of a Household industry even in urban areas is the participation of one or more members of a household. Even if the industry is not actually located at home in rural areas there is a greater possibility of the members of the household participating even if it is located anywhere within the village limits. In the urban areas, where organized industry takes greater prominence, the Household Industry is confined to the precincts of the house where the participants live. In urban areas, even if the members of the household run an industry by themselves but at a place away from the precincts of their home, it is not considered as a Household Industry.

Some of the typical industries that can be conducted on a household industry basis are: Foodstuffs : such as production of flour, milking or dehusking of paddy, grinding of herbs, production of pickles, preservation of meat etc. Beverages: such as manufacture of country liquor, ice cream, soda water etc., Tobacco Products : such as bidi, cigars, Textile cotton, Jute, Wool or Silk, Manufacture of Wood and Wood Products, Paper and Paper Products, Leather and Leather Products, Petroleum and Coal Products : such as making foot wear from torn tyres and other rubber footwear, Chemical and Chemical Products :such as manufacture of toys, paints, colours, matches, fireworks, perfumes, ink etc., Service and Repairing of Transport Equipments : such as cycle, rickshaw, boat or animal driven carts etc.

Chapter-VIII

Summary and Conclusions

This study has focused principally on the trends in agricultural productivity and the impact of such productivity on the economy and employment in West Bengal for a distinctly defined period of time. The exercises undertaken in earlier Chapters of the thesis have validated the hypotheses initially framed in this study, albeit with certain modifications. The study has addressed the colonial tenancy systems as it evolved in different phases and the impact of such systems on the agrarian relations and agricultural productivity in Bengal. Coming to the post-colonial era, an attempt has been made to assess the rate of growth of agricultural production and productivity amidst changes in decadalwise crop-mix especially from 1960-61 to 2007-08 in India in general and the states in particular under the aegis of land reform, the Green Revolution and economic reforms. The study has assessed primarily the impact of such changes on the growth rate in agricultural production, production area, productivity of foodgrains and non-foodgrains in West Bengal and her districts during a defined period viz. 1970-71 to 2008-09. Such assessment analysis has shown that West Bengal and her districts have experienced changes in crop-mix, crop diversification, and significant change in farm size due to land reforms followed by operation *barga*, introduction of Green Revolution technology, liberal economic reforms and such other economic and non-economic inputs. The study has attempted to present here, in the form of findings, the corresponding impact on agricultural employment, and the economy.

To adumbrate, the study has shown how colonial Bengal experienced in feudation and sub-infeudation in the agrarian sector causing hindrances to the ushering in of desired agricultural production and productivity. By bringing reforms in institutional, techno-biological and economic fields the postcolonial Indian state has shown the ability of enhancing both agricultural production and productivity and reducing disparity in regional growth rate in agricultural production and productivity. With respect to agrarian growth, West Bengal has done exceptionally well especially after 1970s. Agrarian growth, both in terms of production and productivity in West Bengal, has been consistent since the late 1970s, after a very long period of stagnation in the preceding period. It has been established in the study that crop diversification has increased over time both in the districts and West Bengal in general. Much of this growth was on account of factor productivity growth. Productivity growth in non-foodgrains has also increased over the period. Multicropping has not only generated higher

agrarian output, beneficial to the consumers as well as to the producers, but also induced higher and more sustained worker participation throughout the year. It has also been established that the growth of foodgrain productivity has helped the growth of income, employment and non-farm sector of the economy over time across the districts of West Bengal. A summary of the findings of the different sections of the study along with observations are presented herein.

At the outset, one of the basic tenets of the present study has been that the possible inverse relationship between farm size and productivity provided a logical basis and favoured a redistribution of lands to landless to bring in improvement in production and productivity in India and her states in the post-independence period. Further, providing access to land for a large number of landless agricultural workers, marginal farmers, and tenants either through redistribution or through a secured tenancy contract has proved to be effective in increasing the agricultural productivity. It has been identified that since 1991 the basis of the input supply system faced by the farmers has changed altogether. Most of the inputs were to be procured from market as market determines the prices. The poor tenants, small and marginal farmers do face difficulties not only in procuring the complementary inputs at affordable prices but also realizing the optimum value for the output produced. In the case of West Bengal, it has been found that studies measuring long term growth pattern of agricultural production and productivity, disaggregated at district level and long term changes in crop-mix have been insufficient and non-comprehensive. Sub-period growth in accordance with major institutional and policy changes has seldom received attention. Most of the trend analysis on agricultural production and productivity in West Bengal did not move beyond state level aggregated data with implicit assumptions that the turn-around has been caused by introduction of land reforms, operation *barga* and introduction of grass root level governance through *panachayati raj*. The present study has shown the simultaneous impact of institutional reforms, Green Revolution technologies and economic reforms on farm production and productivity both at the state and the districts.

Growth estimation along with estimation of sub-period growth rates, nature and direction of long term acceleration or deceleration of growth, extent of stability and instability in growth have been shown in the study. To ascertain the magnitude of the impact of decline in growth rate in foodgrain production and productivity in West Bengal, district-wise acceleration and deceleration of crop wise growth, district-wise status of instability and stability over a long time frame, estimation of sub-period growth in production, area and productivity in tune with

major institutional and policy changes have been attempted. The study also shows the fact that crop diversification does have a significant impact on agricultural production and productivity. The study argues for various economic and non-economic factors that influence growth in production and productivity of agriculture at the level of the districts. Precisely, factors namely, agro-climatic conditions including rainfall, institutional reforms especially operation *barga* and *panchayat*, Green Revolution technology (use of high-yielding varieties, irrigation, fertiliser etc.), size of holdings, land distribution pattern, rural infrastructure, credit and cooperatives, population density, area under non agricultural use, wage and many more are seen to have considerable impact on agricultural productivity. Using econometric models and by standard pooled regression measurement of the impact of various economic, non-economic variables and changes in agricultural policies on foodgrain productivity in post land reform period in West Bengal and impact of changes in productivity on employment and economy has been shown.

From the theoretical analysis, as attempted in the initial Chapters of the study, it can well be observed that India's agricultural development effort has been widely discussed, debated and commonly lamented. The perspective of agricultural economic history suggests that the efforts to raise production and productivity are not a post-independence phenomenon. The Permanent Settlement Regulations of 1793 had left the cultivating *raiya*s entirely at the mercy of landlords. There were sub-infeudation, eviction, and re-settlement with the *raiya*s on payment of fresh premium or rent at enhanced rate. The need for new legislations to improve on the situation was widely felt. This led to the passing of the Rent Act of 1859. The Act sought to provide certain safeguards to some classes of cultivating tenants with regard to tenancy relations; however, the beneficial effect was usurped by the landlords. The inherent defects of the Rent Act gradually surfaced and it was replaced by The Bengal Tenancy Act of 1885. This Act was followed by a host of other Acts legislated in the subsequent period. All these Acts provided, *inter alia*, certain concessions like conferment of occupancy rights and protection against eviction in favour of certain classes of tenants. Despite all these measures, the Indian rural society continued to remain afflicted with low capacity of agricultural production and productivity. Precisely, agriculture-related reform measures in India during the British rule were prompted not by any serious consideration for improving production and productivity.

Considering the situation in colonial Bengal, it has been observed that despite bringing repeated amendments to Bengal Tenancy Act between 1928 -1940 to secure the rights of the

*raiya*s, not much benefit accrued to them. However, the Act resulted in broadening the ambit of the tenancy stratum. The wide range of intermediary hierarchy was engaged in making profits. Unfortunately however, agriculture, which sustained the system, was nobody's concern. The half-hearted administrative efforts were found to be inadequate to relieve the *raiya*s of their distress. The Government of Bengal appointed Flood Commission in 1939 to look into the matters of tenancy reform. The recommendations of the Commission could not be implemented due to partition. Thus, agriculture-related reform measures in colonial Bengal failed to bring about any perceptible change in Bengal's agrarian scenario, characterized by a skewed land holding pattern, exploitative land relations, a persecuted peasantry and languishing production and productivity.

Thus it was pertinent to the broad policy interventions undertaken in post-Independence period in India, the production and productivity of foodgrain and non-foodgrains that could neither move linearly nor uniformly over time. At the policy level till the 1960s, India remained preoccupied in attempting to bring institutional changes in the agrarian sector. It remained as an unfinished task for most of the states in India. During the fifties and sixties, the growth of foodgrain and non-foodgrains remained low and growth was primarily driven by growth in area. However, growth of non-foodgrains remained relatively higher than foodgrains. Sluggish spread of irrigation and increasing thrust on industrial expansion were the major causes of slow growth in agriculture. In the early-sixties, India encountered the problem of food scarcity and the scope to increase production through area expansion also reached the saturation point. This forced the country to introduce Green Revolution technology for wheat and rice. The period between 1967-68 and 1979-80 is identified as the early Green Revolution period. The agricultural growth scenario during this period remained less impressive in comparison to pre-Green Revolution period. Growth in area, production and productivity for rice, pulses, oilseeds and foodgrain remained lower than pre-Green Revolution period. A major turn-around in growth in production and productivity was observed for wheat during this period. This success remained confined to Punjab, Haryana and western Uttar Pradesh. However, stagnation in growth of other crops and slow growth in rest of the states failed to boost the overall growth in production and productivity. Unlike the rest of India, the North-West region consisting of Punjab, Haryana, and Uttar Pradesh was well endowed with irrigation facilities and that helped the Green Revolution technology to spread during the early Green Revolution period of the sixties.

Between the eighties and nineties, the growth in production in both foodgrains and non-foodgrains increased. It was primarily driven by growth of yield. Wider dissemination of Green Revolution technology boosted the growth of yield. Turn-around in growth of rice production in Eastern region, especially in West Bengal and rise in oilseed production in Central India helped the country in achieving the highest ever growth rates of foodgrain and non-foodgrain production. Price support, credit support, input subsidy support and marketing support contributed positively towards achieving higher growth in production and productivity in several foodgrains and non-foodgrains. Increase in crop-diversification and cropping intensity also helped to increase agricultural output. The period between 1990-91 and 1999-2000 or the first ten years of economic reforms shows a sharp decline in the growth in production, yield and area for most of the crops. The states of North-West India are considered to be the foodgrain basket of India and Uttar Pradesh contributes highest amount of foodgrains. However, since, 1991, this region has experienced deceleration in growth of foodgrain productivity. This scenario made the country fragile in managing self-sufficiency in foodgrain production. Sustenance of the success of Green Revolution technology has also seriously been challenged. Growth scenario of foodgrain production and productivity however, improved between 2000-2001 and 2008-09.

The Eastern region which experienced a turn-around in growth in production and productivity of foodgrain and rice in the eighties has substantially propelled the growth in production and productivity of foodgrain at the national level. In particular, rice failed to maintain the same from 2000-01 to 2008-09. However, increase in crop diversification or for that matter, moving towards high-value crop may be an option for farmers in a situation where production and productivity of foodgrains are falling. A change in crop-mix is gradually taking place. Onion occupied considerable area in many states of North-West, Central and Southern region of India. Potato and mustard and rapeseeds in West Bengal, coconut in Tamil Nadu have achieved considerable growth in area under cultivation.

Fall in growth in production and productivity implicitly and explicitly affected agrarian community across the states of India. The increasing threat of loss of food security, rise in incidences of rural poverty and indebtedness, increase in gap of income between the farm and non-farm sector, fall in per-capita agricultural income and rise in agricultural labourers and marginal workers have been identified as the natural outcomes of slump in foodgrain production and productivity both at the national and regional level.

The statistical findings lead us to certain inferences:

(a) Rice is the catalyst to augment or diminish the growth in production of foodgrains in West Bengal. During the 1970s, growth in production, productivity and area under cultivation of aman and boro grew at abysmally low rates, while aus achieved negative growth in production, area under cultivation and productivity. As a cumulative impact, the growth rate for rice remained low during the 1970s resulting in low rate of growth in foodgrain production causing stagnation in agriculture in West Bengal;

(b) From the 1980s, a break in the trend was observed in foodgrain production in West Bengal alleviating the long spell of agricultural stagnation. This turn around was caused by the spectacular rise in growth in production of aman, aus and boro. Importantly, in the post-1980s, growth in production of aman and aus was primarily driven by the growth in productivity while growth in production of boro was achieved through growth of cultivable area. Notwithstanding the fact that boro is a high productivity crop and its absolute productivity is much higher than aman and aus, the growth in productivity remained negative during the decade of 1980s;

(c) During the 1990s and in the post 1990s, aman experienced decline in growth in production and productivity; for aus a decline in growth in production and productivity and area was observed, and in the case of boro, though a very high growth rate in production was maintained, a sharp decline in growth in area was also observed. Moreover, growth in productivity for boro remained low. As a result the spurt in growth in production and productivity of rice and foodgrain observed during 1980s could not be sustained in the decade of 1990s and in subsequent years;

(d) As the decline in growth becomes discernible, the pace of change in growth rate enables us to judge the long term impact on agrarian scenario in West Bengal and her districts. It has been found that districts of Birbhum, Midnapore, Hoogly, Murshidabad, West Dinajpur, Jalpaiguri, Cooch Behar and Purulia have experienced acceleration of growth of foodgrains, while the rest of the districts such as Burdwan, Bankura, Howrah, 24 Parganas, Nadia, Malda and Darjeeling, experienced deceleration in growth rates over time;

(e) Despite the acceleration of growth in production for the districts of Birbhum, Hoogly, West Dinajpur, Jalpaiguri, Cooch Behar and Purulia, the worrying factor has been that the major rice producing districts of Burdwan, Bankura and Midnapore, Murshidabad and 24 Parganas have been faced deceleration in growth of foodgrain production;

(f) West Bengal, in general, has shown acceleration in growth in production from 1970-71 to 2008-09. It thus may be argued that though the growth rates have fallen over time, it does not necessarily mean that there is deceleration of growth in the strictest sense. In order to arrive at such results, coefficients of time (t) as well as time square (t^2) both have to be negative, which is not the case for foodgrain, and rice in particular;

(g) The impact of rainfall on growth in production is significant only for the districts of Darjeeling, 24 Parganas and Midnapore. The rest of the districts as well as the state seem to be insulated from the vagaries of rainfall;

(h) Coming to the issue of long term stability or instability in foodgrain and rice production in the state and the districts, it has been identified that instability of foodgrain and rice production from 1970-71 to 2008-09 has declined for Burdwan, Birbhum, Bankura, Midnapore, Hoogly, 24 Parganas, Nadia, West Dinajpur, Darjeeling, Cooch Behar, Purulia, Howrah, Jalpaiguri and for the whole state as well. Only in the district of Malda, instability has increased over time;

(i) In the matter of non-foodgrains, it has been found that the area under major non-foodgrains in West Bengal has almost doubled and reached close to 20 percent of total cropped area in last thirty eight years. Consequently, non-foodgrains have gained ground among the farmers of West Bengal.

(j) Among the various non-foodgrains grown in West Bengal, majority of the area under cultivation has been used for jute, oilseeds, rapeseeds and mustard and potato. With the passage of time, jute started losing its relevance and especially from 1985-86, the area under jute cultivation has consistently fallen. A similar trend has also been observed for sugarcane. Potato has proved to be more attractive option for the farmers in West Bengal and area under potato cultivation increased considerably in the period 1970-71 to 2008-09. Area under rapeseed and mustard cultivation – despite fluctuations in some years – has registered an increase over time. Though the area under linseed cultivation declined steadily, the area under other oilseeds consistently increased and added to the total area under oilseed cultivation. Potato has also registered an impressive growth in production; however, this growth became more pronounced during the 1990s. The growth in productivity for potato though remained low, the growth in production of potato was primarily driven by the growth in area under potato cultivation in West Bengal;

(k) Jute, one of the major cash crops of West Bengal grew at a modest rate of above 3 percent per annum the period 1970-71 to 2008-09, but it remained the highest in the decade of 1970s and was primarily driven by growth in productivity, however, it became susceptible to fluctuation and failed to attain the growth rate in 1970s in the subsequent years as per the data. It is seen that the growth of sugarcane production continued to remain bleak in West Bengal. Conversely, rapeseed and mustard have shown spectacular growth in production and a massive increase was achieved during the decade of eighties and growth in productivity together with increase in area under cultivation, the latter having played a dominant role in this. Linseed and other oilseeds also grew at an impressive rate during the period 1970-71 to 2008-09 and the highest growth rate in production was experienced during the decade of 1970s, but it started declining thereafter. Especially after 1980s, growth in productivity became so strong that the influence of increase of area under cultivation was dissipated for linseed and other oilseeds. However, the statistical results have established that during the period i.e., 1970-71 to 2008-09, potato, jute, mustard and rapeseed experienced deceleration of growth in production, area and yield while sugarcane experienced acceleration. On the issue of stability vis-à-vis instability of production it has been found that production instability has increased over time for potato, sugarcane and linseeds and other oilseeds while for jute, rapeseeds and mustard, instability has registered a decline.

The aforementioned observations need further elaboration and corroboration with the findings of the study which have been presented herein.

The study identifies that in West Bengal, since the seventies, more than half of the total foodgrain production has come from Burdwan, Midnapore, Birbhum, 24 Parganas and Murshidabad. Except in Nadia, Murshidabad, Malda and Jalpaiguri, foodgrain production is completely dominated by rice and predominance of rice has increased over time. An important aspect that emerges out of this research is that Birbhum, Bankura and West Midnapore, though falling under Red Lateritic sub-region contribute more to rice production of the state in comparison to the more fertile strips of Nadia and Hoogly which fall under new the alluvial zone of lower Gangetic region. In terms of yield of rice, Birbhum, Midnapore and Bankura either maintained higher or same level of yield compared to Hoogly and Nadia. The yield of foodgrain and rice has substantially improved for most of the districts since the eighties, and this upward movement has been maintained till date. In the seventies, Burdwan, Hoogly and Birbhum were the only districts which achieved yield level between 1500-2000 kg/ha, rest of the districts were had productivity of 1000-1500 kg/ha. For Malda and 24

Parganas the yield of foodgrain was even less than 1000kg/ha. However, in 2008-09, Birbhum, Hoogly, Burdwan, Murshidabad, Bankura, Nadia, West Dinajpur and Malda, yield rate of foodgrains crossed 2500kg/ha, which is indeed a success story. Trends in production and productivity of foodgrain and rice calculated during the period 1970-71 to 2008-09 and for four sub-periods did not deviate much in comparison to the studies either in West Bengal in general or at the district level in particular for a shorter time span. For the trend estimation of production and productivity this study has considered a time series from 1970-71 to 2008-09. This has allowed to validate or invalidate the sustainability of high growth achieved during the decade of eighties. During the decade of 1990s, Birbhum, Bankura, Midnapore, Howrah, Nadia, Darjeeling, Purulia and the state as a whole experienced a break in trend, but unlike the eighties, the values of break in trend turned out to be negative. Burdwan, Hoogly, Murshidabad, West Dinajpur made marginal progress and were successful in holding the gain. In respect of productivity, all the districts and the state as a whole experienced a negative break in trend in the nineties except Murshidabad, Malda and Darjeeling. Growth scenario became gloomier between 2000-01 and 2008-09. All the districts and the state experienced further fall in growth rate in foodgrain production and productivity except Jalpaiguri and Cooch Behar. Districtwise growth scenario of production and productivity of rice replicated the growth trajectory experienced by the districts for foodgrain during the nineties and the period between 2000-01 and 2008-09. Among the major gainers in growth rates of foodgrain and rice production and productivity, Howrah, Purulia and Nadia turned out to be major losers in the post-nineties. It may thus well be observed that the trends in production and productivity in West Bengal and in the districts indicate that a downward trend from 1990-91 and this downward movement became sharp from 2000-01. The impressive gain achieved in the eighties thus could not be sustained.

Moreover, agriculturally progressive districts started losing their stronghold and as a result this affected the overall agrarian condition of the state. The positive aspect that emerged from trend analysis is that though agriculturally progressive districts like Burdwan, Birbhum, Hoogly, Midnapore, Murshidabad, Malda or major part the of Gangetic plains were facing retardation in growth rates, this did not off-set the gain achieved by these districts in the eighties. In addition, districts which lagged behind like Cooch Behar, Jalpaiguri, are rather experiencing marginal improvements. Murshidabad and Malda have also performed marginally better. This has allowed West Bengal to remain better off in terms of growth in production and productivity in comparison to agriculturally progressive states like Punjab,

Haryana, Uttar Pradesh or the southern states like Andhra Pradesh, and other states of Eastern region which have been facing serious deceleration in growth since the nineties.

The research findings demonstrate that the changes in foodgrain production and productivity of the state and districts in various time periods are closely linked with the changes in production and productivity of rice. During the period of agricultural stagnation which continued till 1980s, very low or negative growth rate in production, area and productivity of aman, aus and boro caused low growth of foodgrain production in the state and created the 'impasse' in agriculture. The turn-around in agriculture in the eighties was driven by growth in production and productivity of aman and growth in production of area under boro. Finally, in the nineties and in the post-nineties, the fall in growth in production and productivity in aman, fall in growth in production, productivity and area under aus and fall in growth in area under boro collectively pull down the growth rate in production and productivity. A high growth rate that was achieved earlier was partially neutralised during the nineties and in post-nineties.

Analysis of long term acceleration and deceleration has enabled us to make more definite comments on the direction of growth. This study empirically verifies that while the state of West Bengal is still experiencing long term acceleration in foodgrain production, major rice producing districts like Burdwan, Birbhum, Midnapore and 24 Parganas are experiencing deceleration. Since expansion of area in the lower Gangetic region is not virtually possible; therefore, yield expansion is the only alternative to augment production. Failure to do so would make the state vulnerable not only in foodgrain production, but also the economic status of half of the population would be adversely affected. Another important aspect that has been explored in this study is that the agrarian sector can add long term benefits if instability of production and productivity decrease over time. Frequent fluctuations in growth productivity and production add to instability. This implicitly indicates inconsistency of the impact factors that affect production and productivity. Most of the districts in West Bengal achieved a decline in instability over time in foodgrain and rice. However, statistical significance was achieved only for West Dinajpur in rice. This research also found that rainfall has impact on foodgrain production in the districts of Darjeeling, 24 Parganas and Midnapore. It implies that spread of irrigation over time has substantially stabilised the fluctuation in foodgrain production in most of the districts as well as for the state.

Among many non foodgrains grown in West Bengal, the dominance of jute has been eroded over the years. The partition of Bengal had a strong negative impact on jute. Jute that had

global demand was primarily grown in East Bengal or present day Bangladesh and shipped to Calcutta where the jute industries were located. The Partition of Bengal was partly responsible for the decline of the jute industry in West Bengal. The jute providing area situated in the alluvial tract of the upper active delta created by the river Ganges and Brahmaputra now form a part of present day Bangladesh. Therefore, West Bengal has been denied the most fertile jute producing zone. In subsequent years, replacement of jute-based products by synthetic fibre further reduced the demand for jute. Less remunerative price for jute in comparison to other crops have discouraged farmers from cultivating jute in West Bengal. Impressive expansion of area under potato, mustard and rapeseed, linseed and other oilseeds was observed in West Bengal and in terms of area allocation; a shift from foodgrains to non-foodgrains has taken place. This shows that the farmers of West Bengal – though primarily cultivating rice – are gradually moving towards crop diversification to create a buffer against crop failure.

The study reveals that a sizeable area has been allocated to cultivation of non-foodgrains replacing area under cultivation of foodgrains. This validates that there has been a change in crop-mix in West Bengal over time. It has been further revealed that during the 39 years of the span of study, changes in cropping pattern remained rather slow and varied across the districts. In a broader frame, area under rice and wheat as percentage of gross cropped area (GCA) almost remained static, however, area under other cereals and pulses declined and area under jute and potato increased. A change has been observed in case of shifts in area under competing crops and alternating crops. For certain crops additional area has also been brought under cultivation. A considerable area has been diverted from the cultivation of aus and aman to boro. From the late eighties, the expansion of minor irrigation and credit aided the high yielding boro to expand its area under cultivation. Since the eighties, potato, and from the nineties, wheat, rapeseed and mustard, linseed and other oilseeds have absorbed considerable area under cultivation. In the post nineties, area under jute has also increased.

In the larger contour, it has been observed that fall in area under aus and aman in foodgrain was compensated by the increase of area under, boro, wheat, potato, rapeseed and mustard and jute. Crop diversification varied considerably across districts over time. In the districts of Burdwan, Midnapore, Purulia, Bankura and 24 Parganas crop concentration assumed more importance than crop diversification, i.e., these districts are moving more and more towards producing one or two crops. Crop diversification however increased in Nadia, Murshidabad, Malda, Darjeeling, Cooch Behar and Jalpaiguri over the period. Birbhum and Hoogly are

gradually moving from producing diverse crops to producing one or two crops. Crop-wise segregation suggests that rice is the most sought after crop in districts like Burdwan, Birbhum, Midnapore, Howrah, 24 Parganas and Purulia. The most diversified crop basket has been found in the districts of Nadia, Malda, Murshidabad, West Dinajpur, Darjeeling, Cooch Behar and Jalpaiguri. Along with rice, farmers in these districts have engaged considerable area under cultivation of wheat, other cereals, jute, rapeseed and mustard. A significant area in Hoogly has come under potato cultivation; it has increased in rice dominated districts of Burdwan, Bankura, Midnapore, Howrah and in districts of Northern Bengal, especially in Darjeeling, Jalpaiguri and Cooch Behar.

Another important finding which has emerged from this study is that districts that are more and more agro-economically backward have adopted crop-diversification to a great extent because the small and marginal farmers of economically backward districts like, West Dinajpur, Malda, Murshidabad, Jalpaiguri, Cooch Behar, and Darjeeling prefer to grow cereals to meet their consumption requirements. The backward districts have experienced diversification of crops or shift from low value crop to high value crop which has helped the districts to avoid the problem of seasonal unemployment and limited income opportunities outside agriculture. The study also revealed that the districtwise or district-based groupwise variations in crop diversification do not necessarily depend on the preference of the farmers, rather, the agroclimatic differentials between the districts induce the farmers to produce diversified crops. However, districts with high irrigation support facility are mostly moving towards producing fertilizer intensive high yielding varieties of rice and potato. It has also been observed that improvement of infrastructure, marketing facilities, institutional credit and strong labour force contributes positively towards prudent diversification of crops, and have the potential to raise the income of the farmers. Crop diversification can be considered as a more viable option when growth of foodgrains is slowly decreasing.

The study has established that the rate of crop diversification in the districts of West Bengal in terms of area under coverage has not gained expected momentum due to inadequacy in certain important economic and non-economic factors essentially related to crop diversification. It has been found that the degree of diversification is not evenly distributed over the districts. While certain districts have been swift in adopting the technology of diversification, others are lagging behind. This may be because of the fact that even though the state has achieved self-sufficiency in production of staple food, i.e., rice, the emphasis is still on increasing the production of rice. While crop productivity is associated with the

intensive use of inputs, yield can be increased through better land management and farming practices, and weed and pest controlling. Inappropriate ways of applying tools and modern inputs, lack of knowledge regarding chemical inputs and how to obtain a good price, also constrain farmers from earning profit. It is therefore necessary to provide financial assistance and training by the government, to spread knowledge of land management and best farm practices. This will not only help the farmers to earn higher income, it will also open up opportunities of marketability and widen the export market creating more income and employment.

It has been observed, the overwhelming growth in production and productivity in foodgrain achieved by West Bengal during the eighties, witnessed a slow-down in the nineties and since 2000-01 the decline became more pronounced. From the econometric analysis, it has been observed that the effects of operation *barga*, use of chemical fertiliser, labour use in agriculture in per-hectare net cropped area, presence of grass root level governance or *panchayati raj*, average land holding size and economic reforms, have considerable influence on the varying degree of foodgrain productivity in West Bengal. The results obtained from econometric analysis provide a clear indication that the turn-around in West Bengal can not be attributed to institutional reforms alone, rather, institutional reform, adoption and spread of Green Revolution technology and functioning of *panchayats* together brought about positive changes in agricultural production and productivity. The role of institutional reforms cannot be alone credited for this; rather, unless the number of *bargadars* as a percentage of operating household reached the critical level of 25 percent the fruits of Green Revolution would not have been fully be realised. As a matter of fact, in the districts of Birbhum, Bankura, Burdwan, Hoogly, Malda and Midnapore which achieved high average productivity, the number of *bargadar* registered as percentage of total number of operating households in those districts also remained relatively high in comparison to other districts in West Bengal. Among the districts of West Bengal, Burdwan, Midnapore, 24 Parganas, Hoogly, Murshidabad, West Dinajpur, Nadia and Birbhum achieved high average productivity of foodgrain and in these districts the average use of fertilizer (kg/ha) also remained relatively higher. The study has identified that while the small farmers engaged in cultivation of their small holdings may sometimes be included as registered *barga*. This random mix at different periods may be held responsible for forming higher percentage of registered *bargadars*.

The role of fertilizers in enhancing productivity has been reaffirmed in the regression results which go to implicitly prove the greater spread of HYV seeds and irrigation. Area under

HYV aman and boro as percentage of gross cropped area (GCA) registered more than three-fold increase from 1980-81 to 2008-09. The cumulative impact has also brought more than three fold increase in area under HYV rice during the same period. Expansion of tube-well irrigation in large scale allowed gain in productivity and output of HYV varieties of rice in West Bengal.

The study further confirmed that the inverse relationship between farm size and productivity does not hold good universally. After the introduction of Green Revolution, inputs like seeds, fertilizers, water and even labour were no longer procured from family resources or from nature, rather, they were purchased from the market. As a consequence, the poor tenants, small and marginal farmers were increasingly facing a difficulties not only in procuring the complementary inputs at affordable prices but also in realizing optimum value for the output produced. This possibly allowed the efficiency gain that was achieved through redistribution of land, to be gradually eroded. The study further observed that the impact of economic reform – which is captured by using a dummy variable – achieved positive relationship with agricultural productivity, though it was found that since late-nineties productivity has started declining in most of the districts of West Bengal. In addition, the spread of transport infrastructure in the form of expanding *zilla parishad* roads and credit society per thousand square kilometres were yet to reach a level at which it may strongly influence the agricultural productivity to large extent. On the income-employment front, the huge productivity gain in agriculture also helped in raising the over-all agricultural income in the state and it also contributed the most - in comparison to the secondary and tertiary sectors of the economy - to sluggish growth rate in the eighties. However, growth performance of secondary sector and tertiary sectors has remarkably improved during the period 1990 to 2009.

Manufacturing, being the backbone of the secondary sector, experienced an impressive growth rate and within the secondary sector, growth of unregistered industries remained higher than the growth of the registered industries during the period 1980-81 to 2009-10. Hence, the strong role of small-scale industries in propelling the economy gets pronounced alternatively. This also implies less penetration of large-scale manufacturing units. During the nineties and in subsequent periods, the growth rate in agricultural SDP declined, despite the fact that growth rate in GSDP for the state as a whole improving substantially during these periods. It has been found that rise in agricultural production and productivity during the eighties allowed a gradual increase in agricultural GSDP till the late-nineties. Thereafter, it started declining and such decline became sharper since 2000-01. However, the fall in

contribution of agriculture to GSDP was not compensated by the proportionate increase in the share of secondary sector. Since 1980-81, a secular fall in share of contribution to GSDP of both registered and unregistered manufacturing sectors became a matter of concern. Absence of large-scale manufacturing sector has also precipitated industrial backwardness in the state.

Looking at the employment scenario for three successive census years, i.e., 1981, 1991 and 2001, the cultivators as percentage of total workers has been consistently falling, and the fall became even more pronounced between 1991 and 2001. In the districts, viz., Midnapore, Murshidabad, Malda, West Dinajpur, Darjeeling, Cooch Behar, Purulia, Birbhum and Burdwan, the fall in percentage of cultivators to total workers was either close to 10 per cent or more than 10 per cent. At the same time, large increase took place in the percentage of marginal workers to total workers across the districts in West Bengal. A substantial rise in percentage of marginal workers has been observed in the districts of Purulia, Bankura, Burdwan, Birbhum, Midnapore, West Dinajpur, Malda, Jalpaiguri and Cooch Behar. Increase of incidence of land alienation of *pattadars* and increasing eviction of *bagadars* have been found in the state. A considerable increase in percentage of households belonging to marginal category has been observed for the state as well as for most of the districts in West Bengal. The decreasing size of average land holdings coupled with increasing percentage of household in marginal category resulted in the gradual marginalisation of the rural workforce. Consequently, the huge growth and gain in agricultural production and productivity in West Bengal that was ushered in during the eighties could not become sustainable. The inadequacies in providing alternative employment avenues had been discernible in the following decades, which to a large extent crippled the economic status of the agrarian community of Bengal. Another auxiliary negative trend noticed during the late nineties has been the rapid slow-down in industrial activities, especially small and cottage industries, causing tremendous economic stress in the overall economy of Bengal.

It has been observed that enhancement in agricultural growth is essential for achieving the objective of inclusive growth. Unfortunately, the multi-dimensional problems encountered by the farmers have put impediments in achieving such an objective. It has been revealed that non-application or low application of technology is one of the principal reasons for the low or differential rate of growth of agricultural crops. Thus, availability of and access to technology along with viability issues need to be addressed. Sometimes, price-related reasons have a direct bearing on production or productivity of agricultural crops. Stagnation in productivity of certain crops in certain districts has been due to economic or different agro-climatic

reasons and certainly not due to technological failure. The increased dependence on groundwater irrigation increases the cost of cultivation. It also depletes the ground-water level and increases the rate of well failures.

It has been recognized that fixed capital formation is essential for sustaining growth of agriculture as it reduces the transaction cost for farmers besides reducing the operational cost of cultivation. Unfortunately, fixed capital formation by the government in agriculture has declined. The findings suggest that both the government and the policy makers should make concerted efforts to step up public investment in agriculture. Another issue related to production and productivity has been agricultural credit. It has been found that institutional credit is essential for agricultural development, particularly for farmers belonging to the marginal and small categories, since there has always been a lack of simultaneity between the realisation of income and expenditure in agriculture. A well organized public institutional credit system may save the farmers from the clutches of money lenders. It is suggested that easily accessible, cheap and development oriented credit and meaningful crop insurance system can well achieve sustainability in agricultural productivity.

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