CHAPTER 1

INTRODUCTION

I. STATEMENT OF THE PROBLEM

Agricultural sector occupies a key position in the Indian economy. It provides employment to about more than 50 per cent of the working population in India. This sector including allied activities accounted for 13.9 per cent of GDP at 2004-05 prices in 2011-12 as compared to 14.5 per cent of GDP in 2010-11. Agriculture alone contributing 12.3 per cent of GDP and fishery and forestry contributing only 0.5 per cent and 1.1 per cent in GDP respectively.Agriculture is the main source of income for the people of West Bengal. About 70 per cent of the total population depends on farming for their livelihood(Govt. of West Bengal, 2009). The state has 3 per cent cultivable lands which account for 8 per cent of the total food grains produced in the nation. The major crops grown in the state include Rice, Wheat, Jute, Tea, Potato, Sugarcane, Pulses, and Oilseeds etc. The cropping intensity has been significantly increased from 131 per cent to 162 percent in the last two decades. The state is the highest producer of Rice in the nation; also there is a remarkable progress in the production of Jute and Oilseeds. About 60 per cent of the raw Jute is produced in the state. The state also produces about 28 per cent of the total Potatoes grown in the country. Tea is produced in the northern region of the state and is of great commercial value. The region is well known for Darjeeling Tea and Tobacco, Sugarcane are also grown in significant quantity. There are small farmers in the state who depend fully on the agricultural activities for earning of living. Steps are taken by the government to increase rate of productivity by the utilization of high yielding varieties of seeds, application of fertilizer and also by following the modern scientific equipments and techniques. The department of Agriculture of West Bengal looks after formulating policy decisions on agricultural production.In spite of this higher production of agricultural crops West Bengal is dependent on the central government for meeting its different crop demand. The food production remained slow and the impact of green revolution was partially successful in the state. The impact of green revolution was found in some states only such as Punjab, Haryana, Uttar Pradesh and

Andhra Pradesh etc. But in West Bengal green revolution did not play major role to extend benefit of farm sector for some reasons. These are:

a) Scattered land holding
b) Lack of agricultural credit
c) Unskilled labour force
d) Law of inheritance
e) Unavailability of government subsidy etc.

It is imperative that the problems of the farmers are addressed here with a sense of urgency. As against the commercialized nature of agricultural operation in the developed counters, farming in India still remains a source of livelihood for most of farmers. Although India is experiencing rapid economic growth, agriculture sector remains neglected part of Indian economy. As a result its contribution in GDP coming down gradually. But there is plenty of room for improvement in this sector. Indeed, there are numerous Indian agricultural problems that pose a current threat to the food supply of the country. These problems are: (i) Overpopulation-The population of India is growing at a rate of 1.3% per year and total population reached at 121 crore according to census, 2011. This overpopulation not only deals with greater need of food, it also means that agricultural holdings have to compete for space against developments. According to the World Bank, the population density of India is already 411.89 persons/square kilometer. (ii) Small Land Holdings-The average size of a land holding in India is less than 2 hectare which is very small. Land fragmentation has resulted from the practice of dividing land amongst heirs, land ceiling acts, and in some instances, family disputes. Many small land holdings have excessive manpower and low productivity. They also make it difficult for farmers to adopt new technology and perpetuate impracticality for farm inputs and outputs. (iii) Poor Irrigation Systems-Irrigation problems are a major obstacle to farming in India. Most facilities are inadequate; it was revealed in 2003/2004 that only 52.6% of the land was irrigated. Many farmers are dependent on rainfall; however the monsoon is unpredictable, and can result in heavy flooding. Other areas of the country face extreme water shortages and drought.(iv)Soils are Depleted of Nutrients-Agriculture has been going on in India for over ten thousand years, meaning thatthe vast majority of farmland is either already infertile or on its way to becoming infertile. Deforestation has also hampered soil fertility. Lack of awareness as to how to

maintain soil fertility perpetuates this problem. (v) Inadequate Food Storage-One truly astounding fact is that one-third of all produce from Indian crops actually ends up going rotten. This is the result of hot and humid weather, inefficient supply chains, and inadequate storage facilities. (vi) Backward Farming Implements and Practices-Most farmers face extreme difficulty in making a living. The majority of them is poor and cannot afford to purchase modern technology to increase yield and farm productivity. In addition, there is a lack of awareness as to proper practices for farm productivity

Moreover productivity is low because of the fact that traditional agricultural practices still prevail in large parts of the country. Use of new agricultural technology has remained confined to few pockets of affluent farmers in selected states. The average size of farms has become smaller over the years and the trend is continued. One important reason for this trend is the first growing population which has adversely affected the per capita availability of land after independence. Statistical evidence suggests that farm productivity in India is low as compared to other countries of the world. The low productivity of the agricultural sector is attributable to a host of technological and institutional factors. We can mention some of the important factors as follows:-

A. **Technological Factors:** Lack of irrigational facilities, limited use of fertilizers, limited use of high yielding varieties of seeds, inadequate plant protection scheme, lack of farm mechanization, flood and soil erosion etc.

B. **Institutional Factors:** Feudal land relation, small sized holdings, rural indebtedness, marketing difficulties etc.

Major sources of farm power include both animate (humans and draught animals) as well as inanimate sources such as diesel engines, tractors and electric motors. India's well-orchestrated Green Revolution began in the mid 60's. It is worth noting that through the adoption of higher and balanced doses of the biological, chemical and mechanical inputs, high yielding seed varieties, fertilizers, pesticides water and improved power sources and equipment production level started growing rapidly. The Government provided the minimum support price, easy access to procurement markets, rural roads and other infrastructures which helped to trigger the green revolution in selected areas of the country. Resultantly gross food production increased from 50.8 M tons in1950-51 to 230 M tons in 2008-09. But the impact of Green Revolution and government intervention does not

concentrate equally in all states in the country. Use ofthese improved ingredients and farm machineries did not incorporate successfully in all states. On the other hand, where use of high yielding seeds, fertilizers, pesticide was accepted by all, use of farm mechanization was at the center of controversy due to its impact on employment of human labour in a labour abundant economy. It has been argued by some economists that use of farm implements reduce the opportunity of farm employment because machineries replace the human labour. In addition to that infrastructure is also needed for agricultural diversification like rural roads, drying yards, storage structures, transportation facilities etc. Water though essential for human, animal and plant life, is becoming a scarce commodity. Thus proper harvesting and efficient utilization of water is of great significance. Shortage of water will cause fall in crop yields and food security. So non- renewable factors of farm productions should be implemented by scientific and mechanical ways.

Over the years promotion of agricultural mechanization has been directed towards the promotion of eco-friendly and agricultural implements and machines with the aims of optimal utilization of the available sources of human, animal and mechanical/ electrical power, removing the drudgery associated with various agricultural operations. Farmers also have been provided financial assistance by the government for owning a wide range of agricultural equipments viz. tractors, power tillers, bullock/ tractor drawn equipments, threshers, irrigation equipment, hand tools etc. Further new equipment's such as precision planter, zero- till drill, seed cum fertilizer drill, raised bed planter, improved weeders, plant protection equipment's , harvesting and threshing machine, drip, micro sprinkler irrigation equipment have been made available to the farmers. As a result of the joint efforts by the government and the private sector, the level of mechanization has been increasing steadily over the years. (Kulkarni S.D, CIAE)

II. RESEARCH HYPOTHESES

We would like to test the following hypotheses in the proposed study:

1. Level of landholding affects agricultural mechanization.

2. There is relationship between access of credit and agricultural mechanization.

3. Agricultural mechanization is affected by level of education of farmers.

III. OBJECTIVES OF THE STUDY

The case for mechanization of agriculture is based primarily on advantage of production made possible by machinery. Man by himself can produce only small level of crops but with the help of machinery he can produce much more. A farmer with a pair of bullocks can plough one acre land in 10 days where a tractor can do it in one day and far deeper too. Secondly farm machinery has relieved man from heavy work. For instance land reclamation, digging and carrying of soil etc. are all heavy jobs. Farm machinery helps to perform these tasks easily. It has led to large scale production. The main objectives of the present study are:

a) To measure the extent of agricultural mechanization in West Bengal and its variation across different conditions like location, farm size, educational status and crop wise.
b) To assess the impact of mechanization of agriculture on farms income, productivity and employment.
c) To examine the state of market for services of agricultural machineries such as tractor, power tiller and pump sets etc.
d) To identify the factors facilitating and restricting spread of agricultural mechanization in the state with an aim to prescribe policy measures.

IV. SIGNIFICANCE OF THE STUDY

The main purpose of this study is to find out the impact of agricultural mechanization on production, crop diversificationand employment in farm sector and on farm size. It should also be examined as to extent farm mechanization and its gainful result is dependent on availability of credit provided by the different banks. We tried to give the clear picture of farm employment along with farm mechanization which is a controversial issue coming from beginning of planning period in India and have tried to find out the increasing women participation in farm activities. One more important objective of our study which shall examine in this study is the impact of education on farm sector along with farm mechanization in India.

V. RESEARCH METHODOLOGY

The study is based on existing literature, secondary data and field survey. For collecting secondary data and literature resources at the Library of the University of North Bengal, Raja Rammohunpur; the National Library, Kolkata; Library of the Center for Studies in Social Sciences, Kolkata; Library of the Indian Statistical Institute, Kolkata etc. have been used.

The following major steps have been followed as parts of research methodology of this study.

V.1. Area of the Study

The area of the study is agricultural mechanization in West Bengal. We have selected two districts namely Bardhaman and Dakshin dinajpur to show the comparison in the extent of agricultural mechanization.

V.2. Universe of the Study

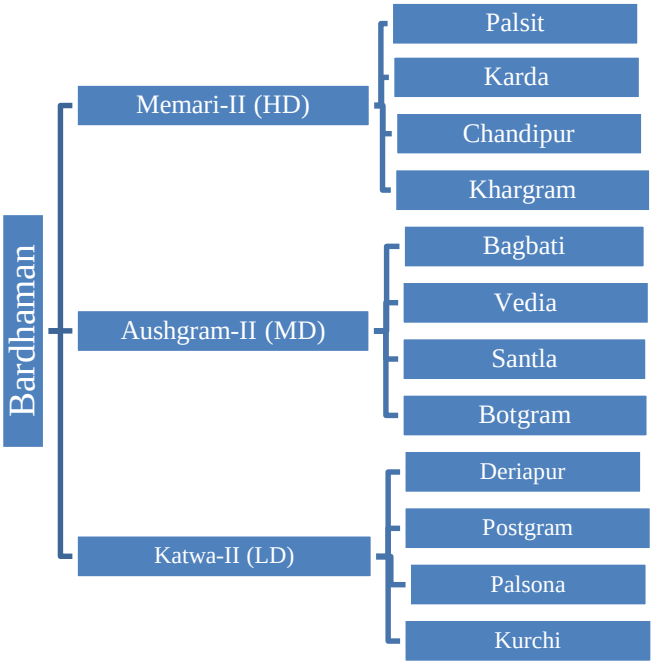
The universe of the study is the state of West Bengal in India.

V.3. Tools and Technique of Data Collection

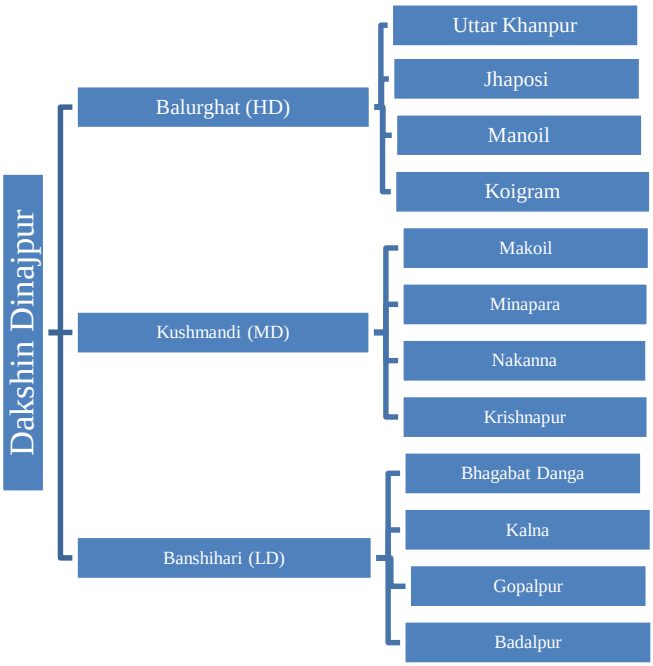
Data have been collected with the help of structured questionnaire by personal interview with relevant respondents. We have selected two districts - Bardhaman and Dakshin

Dinajpur where first one is agriculturally more developed and the second one is less developed. Based on the data of Government of West Bengal viz. Annual Action Plan, State Agricultural Plan, Statistical Abstract, Economic Review, Statistical Abstract etc. We can see that Bardhaman district is more agriculturally developed than Dinajpur district. To prove this we have collected data from both the districts. Here we have selected three blocks from each district from where data have been collected randomly. Selected three blocks of each district are from highest developed, lowest developed and one from moderately developed block. For selecting three blocks we have used Nath's formula. According to this formula performance of farm sector has been judged by examining productivity of seven common crops produced in both the districts. On the basis of level of productivity three blocks namely Memari II (highest developed), Katwa II (lowest developed) and Aushgram II (moderately developed) has been selected from Bardhaman district. Again we have surveyed four villages form each block and in total 120 households has been selected by us. On the other hand, on the basis of same technique Balurghat (highest developed), Banshihari (lowest developed) and Kushmandi (moderately developed) has been selected from Dakshin Dinajpur district. Here also we have surveyed total 120 households from 12 villages, four from each block. So we have selected 40 households from each block randomly and total 120 households have been collected from each district and in total 240 households have been surveyed from two districts of West Bengal. The details of selected villages are given bellow-

Total Household in Bardhaman District



Total Household in Dakshin Dinajpur District



We have also taken help of secondary data to supplement the primary data for our study. The sources of secondary data are the Census Reports of 1991, 2001 and 2011 for the districts and the records of Gram Panchayats in the case of selected villages. Moreover, relevant data have been collected from Statistical Abstracts and Economic Reviews published by the Bureau of Applied Economics and Statistics, Government of West Bengal and Economic Survey published every year by the Government of India. Similarly various reports, books, journals, bulletins, unpublished M. Phil and Ph.D. theses and research works of different scholars etc. have been consulted to collect relevant secondary data and information.

V.4. Data Processing

Initially we have analyzed the collected data by using simple statistical tools like ratios, percentages, averages etc. We have also used Tables and diagrams to visualized the findings clearly. Analysis of Variance (ANOVA) has been used to test the hypothesis in our study. Similarly, correlation coefficient has been used by us to know the relationship between variables.

Analysis of Variance (ANOVA) is a technique of testing hypothesis about the significant difference in several population means. In this technique Null Hypothesis (Ho) assumes that all population means are equal whereas Alternative Hypothesis (H1) assumes that all population means are not equal. In one -way analysis of variance testing of hypothesis is carried out by partitioning the total variation of the data in two parts. The first part is the variance between the samples and the second is the variance within the samples. The first one can be attributed to treatment effects and second one can be attributed to experimental errors. As part of this process the total sum of squares can be divided into two additive and independent parts as SST (total sum of square) = SSC (sum of square between columns) +SSE (sum of squares within samples).

V.5. Steps in Calculating SST

We know there are two steps in calculating SST in one-way analysis of variance in terms of calculating sum of squares between columns and sum of squares within samples. Let us say that the observations obtained for k independent samples are based on one-criterion classification and can be arranged as shown below.

Where $T = \sum_{j=1}^{k} T_j$

$$\overline{x_i} = \frac{1}{n}\sum_{i=1}^{n} x_{i1} \; and \; \bar{\bar{x}} = \frac{1}{nk}\sum_{j=1}^{k} \overline{x_j} = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{k} x_{ij}$$

Step 1: Calculate variance between samples

This is usually referred to as sum of squares between the samples and denoted by SSC. The variance between columns measures the difference between the sample mean of each group and the grand mean. Grand mean is the overall mean and can be obtained by adding all the individual observations of the columns and then dividing this total by the number of observations. We can show it as follows

(a) In the first step, we need to calculate the mean of each sample. For example $\overline{x_1}, \overline{x_2}$, … … $\overline{x_k}$ for number of observations.

(b) Next the grand mean is calculated. The grand mean is calculated as

$$\bar{\bar{x}} = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{k} x_{ij}$$

(c) In third step, the difference between the mean of each sample and grand mean is calculated ie. we calculate $\overline{x_1} - \bar{\bar{x}}$, $\overline{x_2} - \bar{\bar{x}}$, …. . $\overline{x_k} - \bar{x}$.

(d) In forth step, we multiply each of these by the number of observations in the corresponding sample, square each of these observations and add them. This will give the sum of squares between samples.

(e) In the last step the total obtained in step 4 is divided by the degrees of freedom. This degrees of freedom is the one less than the total number of samples. If there are k samples the degrees of freedom will be v= k-1. When the sum of squares obtained in step 4 is divided by the number of degrees of freedom, the result is called Mean Square (MSC).

$$\text{SSC (sum of squares between the samples)} = \sum_{j=1}^{k} n_j \left(\overline{x_j} - \bar{\bar{x}}\right)^2 \text{where k is the number of groups}$$

being compared , n_j the number of observation in group j, $\bar{x}_j$ the sample mean of group j, and $\bar{\bar{x}}$ the grand mean and $MSC = \frac{SSC}{K-1}$

whereSSC is the sum of squares between columns and k-1 the degrees of freedom.

Step 2: Calculate variance within the samples

This is usually referred to as the sum of squares within samples. The variance within samples measures the difference within the samples due to chance. This is denoted by SSE. The procedure of calculating the variance within the samples is as bellow:

(a) In first step, we have to calculate the mean of each sample as$\overline{x_1}, \overline{x_2}$, … … $\overline{x_k}$.

(b) In second step, we have to calculate the deviation of each observation in k samples from the mean values of the respective samples.

(c) As a third step, square al the deviations obtained in step 2 and calculate the total of all these squared deviations.

(d) In the last step, we have to divide the total squared deviations obtained in step 3 by the degrees of freedom and obtained the mean square. If there are n observations and k samples then the degrees of freedom will be v = n-k

$$SSE(\text{sum of squares within samples}) = \sum_{i=1}^{n}\sum_{j=1}^{k}(x_{ij} - \bar{x}_j)^2$$

where $x_{ij}$is the ith observation in group j, $\bar{x}_j$is the sample mean of group j, k the number of groups

being compared and n is the total number of observation in all the groups and

$$\text{MSE} = \frac{\text{SSE}}{\text{n} - \text{k}}$$

Step 3: calculate total sum of square

The total variation is equal to the sum of the squared difference between each observation and the grand mean. This is often referred to as SST. We can calculate it as bellow:

SST = SSC + SSE

Or

$$\sum_{i=1}^{n}\sum_{j=1}^{k}(x_{ij} - \bar{\bar{x}})^2 = \sum_{j=1}^{k} n_j\,(\bar{x_j} - \bar{\bar{x}})^2 + \sum_{i=1}^{n}\sum_{j=1}^{k}(x_{ij} - \bar{x_j})^2$$

$$\text{SST(total sum of squares)} = \sum_{i=1}^{n}\sum_{j=1}^{k}(x_{ij} - \bar{\bar{x}})^2$$

where x_{ij} is the ith observation in group j, $\bar{\bar{x}}$ the group mean, k is the number of groups being compared, and n is the total nomber of observation in all the groups and $\text{MST} = \frac{\text{SST}}{\text{n} - 1}$

where SST is the total sum of squares and n-1 the degrees of freedom.

V.6. Applying F- test

As we know ANOVA can be computed with three sum of squares namely. SSC, SSE and SST. Here *F* is the ratio of two variations. In case of ANOVA*F* value is obtained by dividing the treatment variance (MSC) by the error variance (MSE). So in case of ANOVA, *F* value is calculated as below:

$$F = \frac{MSC}{MSE}$$

The F test follows F distribution with k-1 degrees of freedom corresponding to MSC in the numerator and n-k degrees of freedom corresponding to MSE in the denominator. The null hypothesis is rejected if the calculated value of F is greater than the upper-tail critical value

$F_u$withk-1 degrees of freedom in the numerator and n-k degrees of freedom in the denominator. For a given level of significance α, the rules for acceptance and rejection of null hypothesis are shown below:

$$\text{Reject } H_0 \text{ , if calculated } F > F_u \text{(upper tail vale of F), otherwise do not reject } H_0$$

(Business statistics , Naval Bajpai, 2014)

VI. RESEARCH QUESTIONS

We shall make an attempt to find out answers to the following research questions in our study:

1. What factors influence the agricultural mechanization?
2. What types of machineries are used in agricultural sector in West Bengal?
3. Is agricultural mechanization is dependent on availability of institutional sources or non-institutional sources of credit?
4. Do the farmers get training to adopt agricultural mechanization?
5. What types of assistance are provided to the farmers by the extension agencies in the study area?
6. Are the farmers getting sufficient institutional credit for buying agricultural machinery?

7. Is agricultural mechanization reducing the employment opportunity in the farm sector?
8. Is agricultural mechanization increasing the level of productivity and production?
9. What are the benefits of agricultural mechanization?
10. What are the drawbacks of agricultural mechanization?
11. Does mechanization reduces cost of cultivation?
12. What is the preference of farmers between purchases of agricultural machinery and hiring in agricultural machinery?
13. Does agricultural mechanization influence the cropping pattern and crop diversification in the study area?

VII. IMPORTANCE OF THE STUDY

In India total geographical area is 328.7 million hectare which is only 2.5 per cent of world area and net sown area is 140.3 million hectare. In this available land 16.7 per cent global population is dependent for supply of food. On the other hand, contribution of GDP from this sector is going down gradually having only 14 per cent in current year which was above 50 per cent in the beginning of planning period. But till now more than 50 per cent people depend on this sector for their livelihood. Peoples are migrating from farm sector to non-farm sector because per capita land holding is decreasing rapidly. Two options are open for the existing farmers to continue farming activity, first one is expansion of landholding and another is expansion of farm productivity. It is impossible to expand landholding where population is continuously rising. So the second option which talks about farm productivity can solve the problem of food crisis. To get higher productivity farmers have to use better seeds, fertilizers, pesticides, proper irrigation etc. But all this improved factors will give successful result if their proper utilization takes place. Traditional system of farming is not compatible with modern farming system. That is why efficient farm machineries are required to utilize these factors to get higher productivity. On the other hand, recently in farming activities scarcity of farm labour is a tremendous problem. Labourers prefer to do non-farm jobs neglecting the farm activities. So farm machineries fulfill the gap of labour shortage in farm sector. But mechanization of agriculture did not spread out equally for all crops and in all states. Few states like Punjab, Uttar Pradesh, Rajasthan, and Madhya Pradesh have used machineries successfully on farm sector for rice, wheat, potato and

cotton only. But in some states like Assam, Bihar, West Bengal, Odisha, Nagaland etc farm machineries are used marginally. In addition to that dissimilarity of farm mechanization exists in different parts of states in India. In this study we have an attempt to find out the reasons of variations of farm mechanization in the state of West Bengal.

VIII. LIMITATIONS OF THE STUDY

Every investigation and study has some certain limitations. Similarly the present study has faced number of problems. This study could be more meaningful and representative if there were availability of desired secondary data to know some trends of agricultural performance throughout the State. We have surveyed total 240 households from two districts in West Bengal and tried to test the hypothesis which have considered in the study. However this result would be more consistent and demonstrative if we could expand our household numbers. But for an individual researcher with constraints of resources and time it is not possible to make census survey. Nevertheless in this study we have tried to overcome these limitations by our sincere effort in data collection.