CHAPTER - IX

FACTORS BEHIND AREA MOVEMENT OF TOBACCO

Tobacco is an important age-old cash crop next to jute in Coochbehar and Jalpaiguri districts of West Bengal. In Coochbehar and Jalpaiguri tobacco singularly accounts for about 60 per cent and 35 per cent of area under rabi crops of the respective districts. The economic condition of the farm people of these two districts, therefore, largely hinges upon the prospect of this crop. The prospect of the crop can be assessed to greater extent by examining its past and present. As a part of historial analysis of this crop, analysis of temporal behaviour of area under this crop is attempted in this chapter.

Time series data on area of tobacco as presented in Table 9.1 and 9.2 reveals its inter-year fluctuation. The results of test of randomness of the area series[1] shows no trend of tobacco area in Coochbehar district. But in case of Jalpaiguri the area series is observed to have a significant positive trend (Table 9.3).

Now the question as to which factors have brought about such area movement of tobacco. At this juncture, let us first examine the possibility of area substitution between tobacco and its principal competing crops during the period under consideration. The values of correlation coefficients between tobacco area and area under each of its competing crops in Coochbehar district are noted negative but very low and hence not statistically significant. But in Jalpaiguri district in contrast to Coochbehar, positive high correlation coefficients between tobacco area and area under each of its competing crops are found statistically significant (Table 9.4). Considering negative coefficient as an indication of substitution, one may conclude that the posibility of area substitution between tobacco and its competing crops during the period is very feeble and not inferable in Coochbehar district. While

---

1. Rank correlation test has been adopted here following the method suggested by Kendall Steeart and Ord. see M. Kendall, A. Steeart and J.K. Ord. : Advanced Theory of Statistics, Vol. 3, Charles Griffin and Company Ltd., London and High WyCombe, Fourth edition, p. 440-441.

Table 9.1 : Movement of area under Tobacco and its Competing Crops in selected districts of West Bengal

(In thousandd hectare)

Year	COOCHBEHAR				JALGAIGURI			
	Tobacco	Wheat	Potato	Mustard	Tobacco	Wheat	Potato	Mustard
1965-66	12.10	1.72	1.50	6.80	2.40	0.88	1.60	5.10
1966-67	12.10	1.80	1.50	7.80	2.20	0.84	1.60	6.10
1967-68	8.00	2.52	1.40	14.70	1.80	1.68	1.60	10.90
1968-69	9.70	4.44	1.70	11.30	2.20	0.92	1.10	7.90
1069-70	10.00	4.92	1.50	7.00	2.00	0.64	1.30	5.60
1970-71	7.10	7.00	1.70	8.10	1.30	0.88	1.20	8.90
1971-72	8.90	7.24	1.30	7.30	1.30	1.08	1.20	7.00
1972-73	9.60	5.70	1.60	9.00	1.60	1.50	1.00	7.70
1973-74	10.50	6.80	1.60	9.70	1.60	3.40	1.30	8.90
1974-75	8.60	9.90	1.20	8.00	1.40	7.00	1.20	6.70
1975-76	8.10	21.40	4.20	7.70	1.60	23.50	3.80	7.50
1976-77	10.50	39.30	4.80	4.60	2.20	32.00	3.90	4.60
1977-78	10.80	41.60	4.80	5.30	2.50	30.30	4.30	5.00
1978-79	8.70	48.70	5.50	9.70	2.60	34.80	5.40	8.60
1979-80	8.00	53.60	1.80	9.10	2.60	34.80	1.50	7.30
1980-81	14.20	12.60	1.20	7.80	2.60	8.80	1.20	6.20
1981-82	9.40	8.00	1.80	6.90	3.10	8.00	1.50	7.10
1982-83	11.70	13.10	2.01	7.20	2.90	8.90	1.70	10.90
1983-84	10.95	15.30	2.78	7.60	2.90	10.20	1.60	8.35
1984-85	10.00	15.50	3.07	5.56	3.84	10.20	2.50	9.27
1985-86	9.80	14.00	3.10	4.50	3.00	9.80	10.00	9.40
1986-87	9.80	33.50	9.50	7.50	3.13	25.50	10.80	10.14
1987-88	9.80	34.80	4.10	6.50	3.05	21.20	12.20	10.50
1988-89	9.50	21.70	3.90	7.70	3.57	21.20	13.70	12.73
1989-90	9.00	30.00	7.00	7.00	2.70	23.70	14.40	13.13
1990-91	8.80	35.00	8.50	7.00	2.80	22.30	15.30	14.42

Source : Statistical Abstract, Bureau of Applied Economics and Statistics, Government of West Bengal

Table 9.2 : Change of area under tobacco and its competing crops over the preceding year in the selected districts of West Bengal

(In thousand hectares)

District/Crop	COOCHBEHAR				JALPAIGURI			
Year	Tobacco	Wheat	Potato	Mustard	Tobacco	Wheat	Potato	Mustard
1965-66	(+) 0.80	(+) 0.40	(-) 0.80	(+) 0.20	(-) 0.10	(+) 0.20	(-) 0.10	(-) 0.50
1966-67	0.00	(+) 0.08	0.00	(+) 1.00	(-) 0.20	(-) 0.04	0.00	(+) 1.00
1967-68	(-) 4.10	(+) 0.72	(-) 0.10	(+) 6.90	(-) 0.40	(+) 0.84	0.00	(+) 4.80
1968-69	(+) 1.70	(+) 1.92	(+) 0.30	(-) 3.40	(+) 0.40	(-) 0.92	(-) 0.50	(-) 3.00
1969-70	(+) 0.30	(+) 0.48	(-) 0.20	(-) 4.30	(-) 0.20	(-) 0.28	(+) 0.20	(-) 2.30
1970-71	(-) 2.90	+) 2.08	(+) 0.20	(+) 1.10	(-) 0.70	(+) 0.24	(-) 0.10	(+) 2.30
1971-72	(+) 1.80	(+) 0.24	(-) 0.40	(-) 0.80	0.00	(+) 0.20	0.00	(-) 1.90
1972-73	(+) 0.70	(-) 1.54	(+) 0.30	(+) 1.70	(+) 0.30	(+) 0.42	(-) 0.20	(+) 0.70
1973-74	(+) 0.90	(+) 1.10	0.00	(+) 0.70	0.00	(+) 1.90	(+) 0.30	(+) 1.20
1974-75	(-) 1.90	(+) 3.10	(-) 0.40	(-) 1.70	(-) 0.20	(+) 3.60	(-) 0.10	(-) 2.20
1975-76	(-) 0.50	(+)11.50	(+) 3.00	(-) 0.30	(+) 0.20	(+)16.50	(+) 2.60	(+) 0.80
1976-77	(+) 2.40	(+)17.90	(+) 0.60	(-) 3.10	(+) 0.60	(+) 8.50	(+) 0.10	(-) 2.90
1977-78	(+) 0.30	(+) 2.30	0.00	(+) 0.70	(+) 0.30	(-) 1.70	(+) 0.40	(+) 0.40
1978-79	(-) 2.10	(+) 7.10	(+) 0.70	(+) 4.40	(+) 0.10	(+) 4.50	(+) 1.10	(+) 3.60
1979-80	(-) 0.70	(+) 4.90	(-) 3.70	(-) 0.60	0.00	0.00	(-) 3.90	(-) 1.30
1980-81	(+) 6.20	(-)41.00	(-) 0.60	(-) 1.30	0.00	(-)26.00	(-) 0.30	(-) 1.10
1981-82	(-) 4.80	(-) 4.60	(+) 0.60	(-) 0.90	(+) 0.50	(-) 0.80	(+) 0.30	(+) 0.90
1982-83	(+) 2.30	(+) 5.10	(+) 0.21	(+) 0.30	(-) 0.20	(+) 0.90	(+) 0.20	(+) 3.80
1983-84	(-) 0.75	(+) 2.20	(+) 0.77	(+) 0.40	0.00	(+) 1.30	(-) 0.10	(-) 2.55
1984-85	(-) 0.95	(+) 0.20	(+) 0.29	(-) 2.04	(+) 0.94	0.00	(+) 0.90	(+) 0.92
1985-86	(-) 0.20	(-) 1.50	(+) 0.03	(+) 1.06	(-) 0.84	(-) 0.40	(+) 7.50	(+) 0.13
1986-87	0.00	(+)19.50	(+) 6.40	(+) 3.00	(+) 0.13	(+)15.70	(+) 0.80	(+) 0.74
1987-88	0.00	(+) 1.30	(-) 5.40	(-) 1.00	(-) 0.12	(-) 4.20	(+) 1.40	(+) 0.36
1988-89	(-) 0.30	(-)13.10	(-) 0.20	(+) 1.20	(+) 0.52	0.00	(+) 1.50	(+) 2.23
1989-90	(-) 0.50	(+) 8.30	(+) 3.16	(-) 0.70	(-) 0.87	(+) 2.50	(+) 0.70	(+) 0.40
1990-91	(-) 0.20	(+) 5.00	(+) 1.50	0.00	(+) 0.10	(-) 1.40	(+) 0.90	(+) 1.29

Table 9.3 : Rank correlation coefficient between time and area under tobacco and each of its competing crops for selected districts of West Bengal

District	Value of r and t	CROP			
		Tobacco	Wheat	Potato	Mustard
Coochbehar	r	(-)0.021	0.725	0.698	(-)0.403
	t	0.103	5.159**	4.775**	2.156*
Jalpaiguri	r	0.896	0.685	0.732	0.603
	t	6.675**	4.605**	5.264**	3.704**

* Stands for statistically significant at 5% probability level

** Stands for statistically significant at 1% probability level

Table 9.4 : Correlation coefficients between area under tobacco and area under each of its competing crops in selected districts of West Bengal

District	Correlation coefficients between area under		
	Tobacco and Wheat	Tobacco and Potato	Tobacco and Mustard
Coochbehar	(-)0.218	(-)0.180	(-)0.296
	(1.48)	(0.89)	(1.52)
Jalpaiguri	0.419*	0.512**	0.387*
	(2.26)	(2.92)	(2.06)

Note : 1. Figures in the parentheses indicate the value of t.

2. *Stands for statistically significant at 5% probability level.

3. **Stands for statistically significant at 1% probability level.

in Jalpaiguri, keeing in view the significant positive area trend of tobacco and its competing crops (Table 9.3), it can safely be affirmed that both tobacco area and area of its competing crops have moved favourably in the same direction. And therefore, the possibility of area substitution between tobacco and its competing crops is refuted for Jalpaiguri district. Thus in both the districts the question of area substitution between tobacco and its principal competing crops is unfounded.

What have the factors been operative to such observed area movement and how can one deal with this problem ? Let us first review the past works on the allied problems in this respect.

9.1 A Brief Review of the Past Works : Choosing Analytical Tool and Variables

A few of the relevant parts of the available literatures are cited here with an objective of gethering ideas as to how the allied problems were dealt with in the past so that the analytical framework of the present problem, considering the field reality, can be formulated as much as possible accurately.

Extensive studies were carried out on acreage response of commercial and cereal crops using price expectation models. But analogous studies on tobacco are still scanty. Singh and Rao[2], however, attempted to examine the role of price and non-price factors in explaining the supply behaviour of verginia tobacco. The Nerlovian adjustment lag model was used by them. Price-factors like relative Verginia prices, price-risk, and cost of production, and non-price factors like yield, rainfall, incidence of pest and diseases, and time trend were incorporated into the model. Variance of prices over three preceding years was introduced in the model as price-risk. Pal and Mazumder[3] tried to find out the factors (price and non-price) that

---

2. R.D. Singh and P.R. Rao : "Determinants of Supply Behaviour : The case of verginia Tobacco in India", Artha Vijnan, September 1974, p. 279-297.

3. A. Pal and N.R. Mazumder : "Impact of Prices on Area Fluctuation of Tobacco in West Bengal", Agricultural Situation in India, June 1985, p. 167-170.

would have been responsible for area fluctuation of tobacco in West Bengal. The relative tobacco prices, price risk measured by standard deviation of tobacco prices over three preceding years, relative gross revenues, and area lag were taken into consideration in explaining area movement of tobacco. A considerable difference was observed among different price expectation models in question of choosing representative observed prices to be used for expected ones. In Nerlove's[4] own work on estimating acreage response for agricultural commodities in USA he used average prices realised by the farmers during the year as the representative observed prices. Jakhade and Mazumdar[5] argued that the most important price influencing farmer's decision might be the prices prevailing before the sowing season and accordingly that should be considered as appropriate observed prices. Rajkrishna using Nerlovian model, on the other hand considered post harvest price as appropriate observed price. Jai Krishna and Rao[6] in their work pointed out the average of prices prevailing in post harvest and pre-harvest seasons as the relevant price for farmer's decision making framework. Tobacco in the districts under study is harvested within February. Thereafter, at least 15 days are required for sun curing to make the crop ready for sale. It is also recorded that the bulk of tobacco leaf (about 60 per cent) is marketed within the month of April in view of predominence of small and marginal holding in tobacco production nexus. Considering the field reality, average price for the month of April may be considered as pertinent price to influence the farmer's acreage allocation. Thus, it is the post harvest price rather than pre-harvest or pre-sowing price that has some relevance to allocative decision in regard to tobacco cultivation in the selected districts.

---

4. Marc Nerlove : Dynamics of supply : Estimation of Farmer's Response to Prices, Johns Hopkens University Press, USA, 1958.

5. V.M. Jakhade and N.A. Mazumdar : "Response of Agricultural Producers to prices - The Case Study of Jute and Rice in India", Indian JOurnal of Agricultural Economics, Vol. 19, No. 3 and 4, 1964.

6. Jai Krishna and M.S. Rao : "Dynamics of Acreage Allocation for Wheat in Uttar Pradesh - A Study in Supply Response". Indian Journal of Agricultural Economics, Vol. 22, No. 1, 1967.

Farmer's rational conduct following the risk aversion hypothesis implies that given the subjective price and yield probability distributions, the farmers would seek to maximize expected return. A major econometric work in dynamic supply response analysis by incorporating risk aversion factor was done by Berhman[7], and Maji, et al.[8]. They suggested to account for the ratio of standard deviation of prices of the crop concerned to the standard deviation of prices of the alternative crops as a proxy variance in the subjective probability distribution of price. And the standard deviation of yields over three preceding production periods as proxy for the variance in the subjective probability distribution of yield they suggested to consider. In a few studies[9],[10], however, the standard deviation over three preceding years has been used as risk factor both for price and yield. This latter concept of price and yield risk has been introduced in the present analysis. Reported incidence of pests and diseases, high rainfall in growing period, etc. and thereby reducing yield are assumed to have been captured by yield.

Tobacco is sown in the area from middle of October to first week of November. Since the crop is very sensitive to water logging, high rainfall at sowing time is assumed to affect its area sown. In view of this inter alia high correlation between yield and rainfall in October, rainfall recorded for October has also been chosen as an explanatory

---

7. J.R. Behrman : Supply Response in Underdeveloped Agriculture-Contribution to Economic Analysis, North Holland Publishing Company, Amsterdam, 1968.

8. C.C. Maji, D. Jha and L.S. Venkataramanam : "Dynamic Supply and Demand Models for Better Estimations and Projections : An Econometric Study for Major Food grains in Punjab Region", Indian Journal of Agricultural EConomics, Vol. 26, No. 1, 1971.

9. Jagdish Lal : "Response of Sugarcane Producers to Price and Non-price Factors", Agricultural Situation in India, Vol. XLI, No. 10, 1987.

10. A. Pal and N.R. Mazumdar : "Impact of Price on Area Fluctuation of Tobacco in West Bengal". Agricultural Situation in India, June, 1985.

variable for the study. To capture the farmers' propensity to devote a minimum area under the crop the factor time trend seems to be plausible to consider for this purpose.

In view of consistency and efficiency of OLS estimates of a model involving lagged dependent variable as suggested by Jonston[11] for a large sample, the Nerlovian adjustment lag model applying OLS estimation method has been chosen for the present analysis as analytical tool. Singh, et al.,[12] however, observed difficult to establish any superiority of an adjustment model over a traditional or static one. Farmer's opinion in regard to his response to price factors taking into account, one year time lag adjustment model has been adopted for this analysis. Dharm Narain[13] also observed it realistic to allow one year lag in correlating prices with area. Because of additional advantage of getting direct estimates of elasticity co-efficients the variables in logarithmic terms have been used in the model.

The following functional form has been taken for the study.

$$Y_t^* = a p_{t-1}^b \, ut \quad \ldots\ldots\ldots\ldots (1)$$

Where,

Y_t^* = Long run acreage;
P_{t-1} = lagged price;
a = intercept; and
b = elasticity co-efficients

Another Nerlovian relationship between short run and long run elasticities is pertulated as

---

11. J. Jonston : Econometric Methods (2nd ed.), Mc Graw-Hill, 1972, p. 305-307.

12. R.D. Singh, D. Singh and P.R. Rao : "Estimation of Agricultural Acreage Response Relationship - Some Methodological Issues", Indian Journal of Agricultural Economics, Vol. 29, No. 1, 1974.

13. Dharm Narain : The Impact of Price Movements on Area Under Selected Crops in India : 1900-39, Cambridge University Press, 1965, p. 9.

$$\left(\frac{Y_t^*}{Y_t}\right) = \left(\frac{Y_t^*}{Y_{t-1}}\right)^{\lambda}, \quad 0 < \lambda < 1 \quad \ldots\ldots\ldots (2)$$

Solving equation (2) for Y_t^* and substituting it in equation (1) one may get

$$\left(\frac{Y_t}{Y_{t-1}}\right)^{\frac{1}{1-\lambda}} = a p_{t-1}^{b} \; u_t \quad \ldots\ldots\ldots (3)$$

Solving for Y_t and taking log in both sides one may get

$$\text{Log } Y_t = (1-\lambda) \log a + b(1-\lambda) \log P_{t-1} + \log Y_{t-1} + (1-\lambda) \log u_t$$

$$= A + B \log P_{t-1} + \log Y_{t-1} + V_t$$

Where,

A	=	Constant term;
B	=	short run elasticity co-efficient;
λ	=	Coefficient of adjustment; and
V_t	=	error term.

Using the above conceptual framework of analysis the response relation of the present models is given below :

$$\text{Log } Y_t = \alpha + \beta_1 \log {}_{t-1} + \beta_2 \log P_{t-1}^{T/P} + \beta_3 \log P_{t-1}^{T/N}$$

$$+ \beta_4 \log P_{t-1}^{T/M} + \beta_5 \log R_{t-1}^{T/P} + \beta_6 \log R_{t-1}^{T/N}$$

$$+ \beta_7 \log R_{t-1}^{T/N} + \beta_8 \log Y_t + \beta_9 \log T_t$$

$$+ \beta_{10} \log S_t + \beta_{11} \log Pr_t + V_t$$

Where,

Y_t = Area under tobacco in year t (Y);

Y_{t-1} = Area under tobacco in year $_{t-1}$(X_1);

T/P

P_{t-1} = relative price of tobacco with respect to price of potato in year (t-1) (x_2);

T/W

P_{t-1} = relative price of tobacco with respect to price of wheat in year (t-1) (x_3);

T/M

P_{t-1} = relative price of tobacco with respect to price of mustard in year t-1 (x_4);

T/P

R_{t-1} = relative gross revenue of tobacco with respect to gross revenue of potato in year t-1 (x_5);

T/W

R_{t-1} = relative gross revenue of tobacco with respect to gross revenue of wheat in year t-1 (x_6);

T/M

R_{t-1} = relative gross revenue of tobacco with respect to gross revenue of mustard in year t-1 (x_7);

Y_t = Yield risk in year t (x_8);

T_t = Time-trend in year t (x_9);

S_t = Rainfall in sowing month in year t (x_{10});

Pr_t = Price risk in year t (x_{11});

V_t = error terms;

α = Constant term;

β_1 = Co-efficient of adjustment; and

β_i = Short run elasticity coefficients.

(i = 2, 3, ... , 10)

Test for Detecting Multicollinearity

The correlation matrix is given below in order to understand the degree of relationship between each pairs of explanatory variables. High value of inter-correlation is an apparent indication of multi-collinearity but it is debatable as to what degree of inter-correlation is tolerable. The correlation matrix presented by Table 9.5 and 9.6 shows high inter-correlation for some of the pairs. But it is difficult to say which variables are collinear and create instability and impreciseness to the estimates. The seriousness of the effects of multicollinearity seems to depend on the degree of inter-correlation (x_{ij}) as well as on the over all correlation coefficient ($R_{y.x1,x2 \ldots xp}$). Among the available tests for detecting multicollinearity the method based on Frisch's Confluence Analysis (or 'Bunch-Map Analysis)[14], has been adopted in this study. He suggested to classify a new variable as 'useful', 'superfluous', and 'detrimental' depending upon the following conditions.

(1) If the new variable improves R^2 without rendering the individual regression coefficients unacceptable on a priory considerations, the variable is considered useful and is retained as an explanatory variable;

(2) If the new variable does not improve R^2 and does not affect to any considerable extent the values of the individual co-eccicients, it is considered as superfluous and is rejected.

---

14. A. Koutsoyiannis : Theory of Econometrics, Second ed., The Macmillan Press Ltd., 1979, p. 238-242.

Table 9.5 : Correlation Matrix : Coochbehar District

	Y	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}
Y	1.0000	0.0272	-0.0163	0.1538	0.0483	0.0388	0.1975	-0.0653	0.1541	0.5842	-0.2263	-0.2080
x_1	0.0272	1.0000	-0.0719	-0.2602	-0.3250	-0.1356	-0.0038	-0.1846	-0.2840	0.5369	0.0755	-0.4664
x_2	-0.0163	-0.0719	1.0000	0.4834	0.7159	0.7756	0.5502	-0.0612	0.5526	-0.1645	0.1798	-0.1556
x_3	0.1538	-0.2602	0.4834	1.0000	0.6874	0.4891	0.6746	-0.0109	0.6764	-0.0611	-0.0764	0.1233
x_4	0.0483	-0.3250	0.7159	0.6874	1.0000	0.7030	0.5015	0.1852	0.8163	-0.1954	0.0398	-0.1659
x_5	0.0388	-0.1356	0.7756	0.4891	0.7030	1.0000	0.6218	0.1115	0.5647	-0.2183	-0.1445	-0.1418
x_6	0.1975	-0.0038	0.5502	0.6746	0.5015	0.6218	1.0000	-0.0366	0.4187	0.1095	0.0085	-0.2464
x_7	-0.0653	-0.1846	-0.0612	-0.0109	0.1852	0.1115	-0.0366	1.0000	0.0716	-0.1921	-0.1320	-0.1268
x_8	0.1541	-0.2840	0.5526	0.6764	0.8163	0.5647	0.4187	0.0716	1.0000	0.0429	-0.0119	-0.1016
x_9	0.5842	0.5369	-0.1645	-0.0611	-0.1954	-0.2184	0.1095	-0.1921	0.0429	1.0000	-0.1581	-0.5228
x_{10}	-0.2263	0.0755	0.1798	-0.0764	0.0398	-0.1445	0.0085	-0.1320	-0.0119	-0.1581	1.0000	0.1253
x_{11}	-0.2080	-0.4664	-0.1556	0.1233	-0.1659	-0.1418	-0.2464	-0.1268	-0.1016	-0.5228	0.1253	1.0000

Table 9.6 : Correlation Matrix : Jalpaiguri District

	Y	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}
Y	1.0000	0.8415	-0.3548	-0.3646	-0.5957	-0.3794	-0.1624	0.3402	-0.5512	0.9208	0.0875	-0.1871
x_1	0.8415	1.0000	-0.3557	-0.4198	-0.6193	-0.4104	-0.1026	0.2292	-0.6789	0.8798	-0.0208	-0.0819
x_2	-0.3548	-0.3557	1.0000	0.8619	0.8413	0.9326	0.7041	-0.1253	0.6665	-0.4117	-0.1344	0.1102
x_3	-0.3646	-0.4198	0.8619	1.0000	0.8991	0.7899	0.7801	-0.1553	0.7926	-0.4244	-0.1898	0.2471
x_4	-0.5957	-0.6193	0.8413	0.8991	1.0000	0.7747	0.7443	-0.2580	0.8666	-0.6332	-0.1574	0.0791
x_5	-0.3794	-0.4104	0.9326	0.7899	0.7747	1.0000	0.6126	-0.1573	0.6715	-0.4361	-0.0425	0.1505
x_6	-0.1624	-0.1026	0.7041	0.7801	0.7443	0.6126	1.0000	-0.4299	0.6393	-0.1970	-0.1334	0.2258
x_7	0.3402	0.2292	-0.1253	-0.1553	-0.2580	-0.1573	-0.4299	1.0000	-0.2189	0.3326	0.3428	-0.0554
x_8	-0.5512	-0.6789	0.6665	0.7926	0.8660	0.6715	0.6393	-0.2189	1.0000	-0.5804	0.0648	0.2383
x_9	0.9208	0.8798	-0.4117	-0.4244	-0.6332	-0.4361	-0.1970	0.3326	-0.5804	1.0000	0.1275	-0.1931
x_{10}	0.0875	-0.0208	-0.1344	-0.1898	-0.1574	-0.0425	-0.1334	0.3428	0.0648	0.1275	1.0000	0.0728
x_{11}	-0.1871	-0.0819	0.1102	0.2471	0.0791	0.1505	0.2258	-0.0554	0.2383	-0.1931	0.0728	1.0000

(3) If the new variable affects considerably the signs or the values of the coefficients, it is considered as detrimental.

Above three criteria keeping in view, the step-up regression analysis programme was run (PC-AT 386 SX; Microstat) and the results are summerised in Table 9.7 and 9.8. In case of Coochbehar district (Table 9.7) proceeding from step 6 to step 7 it is observed that standard errors of each of the six regression coefficients will be increasing considerably, the values of coefficients excepting of x_9 decreasing and that of R^2 will not be improving so much. Therefore, the variables entered at step 6 (i.e., x_1, x_3, x_5, x_6, x_7 and x_9) should be taken into consideration in regression analysis for Coochbehar district. Analogously, the variables entered at step 10 (i.e., x_1, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10} and x_{11}) should be incorporated into the model for Jalpaiguri district (Table 9.8).

Test for Autocorrelation

In view of inapprotriateness of Durbin-Watson d- statistic for a lag model involving lagged dependent variable in least square regression, the Durbin[15] h-statistic has been worked out in order to test the presence or absence of first order serial correlation in the series. The d-statistic has been calculated to work out h-statistic by using the following relation -

$$h = \left(1 - \tfrac{1}{2} d\right) \sqrt{\frac{N}{1 - N\,\widehat{V}\,(\widehat{\beta}_1)}}$$

Where, d = value of Durbin-Watson statistic;

N = sample size; and

$\widehat{V}\,(\widehat{\beta}_1)$ = estimate of variance of β_1.

---

15. J. Durbin : "Testing for Serial Correlation in Least Square Regressions When Some of the Regressors are Lagged Dependent Variables". Econometrica, Vol. 38, 1970, p. 410-421.

Table 9.7 : Results of Step-up Regression : Coochbehar District

	$\hat{\alpha}$ Constant	$\hat{\beta}_1$ (x_1)	$\hat{\beta}_2$ (x_2)	$\hat{\beta}_3$ (x_3)	$\hat{\beta}_4$ (x_4)	$\hat{\beta}_5$ (x_5)	$\hat{\beta}_6$ (x_6)	$\hat{\beta}_7$ (x_7)	$\hat{\beta}_8$ (x_8)	$\hat{\beta}_9$ (x_9)	$\hat{\beta}_{10}$ (x_{10})	$\hat{\beta}_{11}$ (x_{11})	R^2
$Y=f(x_9)$	0.0200									0.9746 (0.2764)			0.3413
$Y=f(x_9,x_1)$	0.0577	-0.3988 (0.1806)								1.3350 (0.3039)			0.4566
$Y=f(x_9,x_1,x_5)$	-0.0070	-0.3946 (0.1801)				0.0491 (0.0462)				1.3919 (0.3078)			0.4831
$Y=f(x_9,x_1,x_5,x_7)$	-0.0083	-0.4640 (0.2017)				0.0785 (0.0596)		-0.0471 (0.0595)		1.5031 (0.3407)			0.4981
$Y=f(x_9,x_1,x_5,x_7,x_3)$	-0.0513	-0.4546 (0.2052)		0.0721 (0.1162)		0.0723 (0.0612)		-0.0686 (0.0696)		1.5063 (0.3458)			0.5076
$Y=f(x_9,x_1,x_5,x_7,x_3,x_6)$	-0.1186	-0.4576 (0.2093)		0.1206 (0.1542)		0.0955 (0.0783)	-0.0430 (0.0874)	-0.0828 (0.0766)		1.5760 (0.3800)			0.5138
$Y=f(x_9,x_1,x_5,x_7,x_3,x_6,x_{11}$	-0.1681	-0.4449 (0.2229)		0.1050 (0.1745)		0.0967 (0.0805)	-0.0365 (0.0947)	-0.0781 (0.0817)		1.6012 (0.4074)		0.0082 (0.0384)	0.5150
$Y=f(x_9,x_1,x_5,x_7,x_3,x_6,x_{11},x_4)$	-0.2346	-0.4326 (0.2329)		0.0806 (0.1986)	0.0488 (0.1725)	0.0876 (0.0887)	-0.0310 (0.0991)	-0.0928 (0.0988)		1.6516 (0.4544)		0.0152 (0.0465)	0.5173
$Y=f(x_9,x_1,x_5,x_7,x_3,x_6,x_{11},x_4,x_2)$	-0.2210	-0.4180 (0.2466)	-0.0362 (0.1446)	0.0736 (0.2062)	0.0654 (0.1894)	0.069 (0.0986)	-0.0267 (0.1034)	-0.0931 (0.1016)		1.6470 (0.4679)		0.0168 (0.0483)	0.5192
$Y=f(x_9,x_1,x_5,x_7,x_3,x_6,x_{11},x_4,x_2,x_{10})$	-0.2221	-0.4269 (0.2737)	-0.0417 (0.1616)	0.0834 (0.2397)	0.0608 (0.2023)	0.1040 (0.1294)	-0.0315 (0.1199)	-0.951 (0.1073)		1.6587 (0.5009)	0.0025 (0.0284)	0.0151 (0.0535)	0.5194
$Y=f(x_9,x_1,x_5,x_7,x_3,x_6,x_{11},x_4,x_2,x_{10},x_8)$	-0.2310	-0.4254 (0.2843)	-0.0388 (0.1743)	0.0835 (0.2481)	0.0589 (0.2118)	0.1031 (0.1348)	-0.0311 (0.1243)	-0.0947 (0.1112)	0.0023 (0.0379)	1.6636 (0.5250)	0.0025 (0.0294)	0.0157 (0.0565)	0.5196

Table 9.8 : Results of Step-up Regression : Jalpaiguri District

	$\hat{\alpha}$ Constant	$\hat{\beta}_1$ (x_1)	$\hat{\beta}_2$ (x_2)	$\hat{\beta}_3$ (x_3)	$\hat{\beta}_4$ (x_4)	$\hat{\beta}_5$ (x_5)	$\hat{\beta}_6$ (x_6)	$\hat{\beta}_7$ (x_7)	$\hat{\beta}_8$ (x_8)	$\hat{\beta}_9$ (x_9)	$\hat{\beta}_{10}$ (x_{10})	$\hat{\beta}_{11}$ (x_{11})	R^2
$Y=f(x_9)$	0.0082									0.9902 (0.0856)			0.8479
$Y=f(x_9,x_1)$	0.0048	0.1397 (0.1697)								0.8589 (0.1813)			0.8523
$Y=f(x_9,x_1,x_8)$	0.0141	0.1535 (0.1740)							0.0202 (0.0360)	0.8283 (0.1919)			0.8544
$Y=f(x_9,x_1,x_8,x_3)$	-0.0132	0.1626 (0.1783)		0.0324 (0.0712)					0.0208 ((0.0367)	0.8385 (0.1967)			0.8558
$Y=f(x_9,x_1,x_8,x_3,x_4)$	-0.0286	0.1298 (0.1817)		0.1762 (0.1640)	-0.1387 (0.1424)				0.0157 (0.0371)	0.7920 (0.2026)			0.8623
$Y=f(x_9,x_1,x_8,x_3,x_4,x_{11})$	0.0513	0.1569 (0.1834)		0.2834 (0.1940)	-0.2242 (0.1647)				0.0145 (0.0371)	0.7063 (0.2188)		-0.0470 (0.0456)	0.8696
$Y=f(x_9,x_1,x_8,x_3,x_4,x_{11},x_6)$	0.1748	0.0381 (0.2121)		0.2749 (0.1932)	-0.3817 (0.2178)		0.1520 (0.1385)		0.0509 (0.0496)	0.6386 (0.2262)		-0.0709 (0.0503)	0.8778
$Y=f(x_9,x_1,x_8,x_3,x_4,x_{11},x_6,x_7$	0.1721	0.1076 (0.2804)		0.2838 (0.1991)	-0.4135 (0.2374)		0.1373 (0.1468)	0.0347 (0.0885)	0.0485 (0.0512)	0.5906 (0.2621)		-0.0788 (0.0554)	0.8789
$Y=f(x_9,x_1,x_8,x_3,x_4,x_{11},x_6,x_7,x_{10}$	0.2076	0.0771 (0.2977)		0.2574 (0.2148)	-0.4301 (0.2471)		0.1592 (0.1604)	0.0428 (0.0931)	0.0599 (0.0598)	0.6022 (0.2704)	-0.0099 (0.0249)	-0.0783 (0.0568)	0.8801
$Y=f(x_9,x_1,x_8,x_3,x_4,x_{11},x_6,x_7,x_{10},x_5)$	0.2389	0.0590 (0.3105)		0.2278 (0.2363)	-0.4468 (0.2584)	0.0265 (0.0748)	0.1695 (0.1675)	0.0438 (0.0958)	0.0635 (0.0624)	0.6115 (0.2794)	-0.0125 (0.0267)	-0.0781 (0.0584)	0.8811
$Y=f(x_9,x_1,x_8,x_3,x_4,x_{11},x_6,x_7,x_{10},x_5,x_2)$	0.2510	0.0612 (0.3225)	-0.0165 (0.2118)	0.2309 0.2479)	-0.4414 (0.2761)	0.0357 (0.1416)	0.1715 (0.1751)	0.0418 (0.1024)	0.0647 (0.0664)	0.6101 (0.2897)	-0.0126 (0.0277)	-0.0785 (0.0606)	0.8811

The value of 'd' is found 2.2559 for Coochbehar and 2.5112 for Jalpaiguri district. The respective value of 'h' is worked out as (-)0.6232 and (-)0.8395 which are shown statistically not significant. Hence, the possibility of existence of serial corelation in the series is ruled out.

Analysis of Regression Results

Being a cash crop it is quite likely to respond area under tobacco to change in price factors like relative prices and relative profitabilities. Due to non-availability of time-series data on cost of cultivation of tobacco and its competing crops relative gross revenue have been taken as an alternative measure of relative profitability of tobacco. Neither relative prices nor relative profitability/ies have any impact on observed area movement of tobacco in the selected districts as revealed by regression results depicted by Table 9.9. It does not mean, however, that the relative price and relative profitability have any role neither in acreage allocation decision of tobacco. Continuous favourable movement of price cost ratio of tobacco as discussed in Chapter V might have historically placed the crop to a higher rung of profitability ladder which the temporal changes in prices and gross revenue (product of yield and price) of the competing crops could not alter over time under consideration. Significant positive time trend of area elicited from regression results in both the districts substantiates the above presumption. Thus, one may conclude that the significant time trend does not indicate the farmer's so called traditionality rather it is the farmer's traditional rationality in allocating land means to competing ends. The coefficient of adjustment (Coefficient of lagged dependent variable) in Coochbehar unlike in Jalpaiguri district is noted to be negative and statistically significant. Higher acreage sown in one year followed by lower acreage in the next year has been established in Coochbehar district by the above revelation. It resembles to an acreage control measure against price instability in free market system in view of limited demand. The limited demand condition of tobacco, at least qualitatively, has been highlighted in

Table 9.9 : Results of Regression Analysis

District	Constant term $\hat{\alpha}$	Coefficient of adjustment $\hat{\beta}_1$	Short run price elasticity of tobacco with respect to price of: Potato $\hat{\beta}_2$	Wheat $\hat{\beta}_3$	Mustard $\hat{\beta}_4$	Short run gross revenue elasticity of tobacco with respect to gross revenue of: Potato $\hat{\beta}_5$	Wheat $\hat{\beta}_6$	Mustard $\hat{\beta}_7$	Elasticity coefficient of yield risk $\hat{\beta}_8$	Elasticity coefficient of time trend $\hat{\beta}_9$	Elasticity coefficient of sowing time rainfall $\hat{\beta}_{10}$	Elasticity coefficient of price risk $\hat{\beta}_{11}$	R^2
Coochbehar	-0.1186	-0.4576* (0.2093) (SS)		0.1206 (0.1542) (NS)		0.0955 (0.0783) (NS)	-0.0430 (0.0874) (NS)	-0.0828 (0.0766) (NS)		1.5760** (0.3800) (SS)			0.5138
Jalpaiguri	0.2389	0.0590 (0.3105) (NS)		0.2278 (0.2363) (NS)	-0.4468 (0.2584) (NS)	0.0265 (0.0748) (NS)	0.1695 (0.1675) (NS)	0.0438 (0.0958) (NS)	0.0635 (0.0624) (NS)	0.6115* (0.2794) (SS)	-0.0125 (0.0267) (NS)	-0.0781 (0.0584) (NS)	0.8811

* Statistically significant at 5% level
** Statistically significant at 1% level
NS : Not statistically significant
SS : Statistically significant
Figure in the parenthesis indicates the respective standard error

Chapter X. Here also prudent behaviour of tobacco farmers in Cooch-behar district is reflected.

Risk factors like yield risk and price risk are also found to have no bearing upon acreage. Yield risk arising out of pest and disease infestations is reported by the sample farmers. They have also reported to have their awareness and knowledge to a greater extent for controlling pests and diseases because of gethering experience by them from years together growing the crop. Inter-year price variability has led to inter-year variability of favourable terms of trade of tobacco growers which has already discussed in Chapter V. Implication is that neither yield nor price risk nor a combination of both has become so powerful as to outweigh the safety margin out of tobacco cultivation. The sowing time rainfall also shows no impact on area movement of tobacco.