CHAPTER - I

INTRODUCTION

1.0 Introduction

Dinhata in the district of Koch Behar (spelling as per Govt. of W.B., 2004), West Bengal, India is predominantly an agricultural subdivision and agricultural farms are the principal occupation there due to absence of notable industry. Most of the people of this subdivision are engaged in agricultural pursuits earning livelihood for their families. Tobacco is an important cash crop in this subdivision occupying about 7.2 thousand hectares of area (14.25 % of the total arable land in the subdivision) and producing around 9.38 thousand tonnes of leaf annually (Sub-divisional agricultural office, Dinhata, 2011). Dinhata occupies unique place in non-FCV (non-Flue-Cured Virginia) tobacco cultivation producing with the capability of good quality and strong flavour. Among non-FCV tobacco, cigar wrapper, cigar filler (cigar tobacco), Jati (chewing tobacco) and Motihari (hookah and chewing tobacco) are well grown in this subdivision during the Rabi season on Alluvial sandy loam to silty loam soils under irrigated conditions. Out of these four types, the first three types fall in Nicotiana tabacum while the fourth one belongs to Nicotiana rustica (Deo Singh, 2003). Motihari and Jati are the main types grown in this subdivision. But the area under Cigar wrapper and cigar filler are meagre due to very low market demand. Jati tobacco was mostly grown in the banks of river Singimari.Chama and Podali types are extensively grown in the western (Adabari) and eastern site (Natabari) of the river and is famous for its high quality. This tobacco is used for both hookah and chewing purposes. Motihari tobacco was cultivated in most of the mozas in Sitai, Dinhata-I and Dinhata-II blocks, is famous for its quality and strong flavour and this tobacco is used for hookah as well as chewing purpose. C.T.R.I. Research Station, Dinhata was established in the year 1952 under aegis of the Indian Central Tobacco Committee (ICTC), Ministry of Agriculture, and Govt. of India and in 1965-66 its function was taken over by the Indian Council of Agricultural Research (ICAR) for exploring possibility of growing cigar wrapper, cigar filler, jati and motihari

tobaccos for enhancing yield and quality of these indigenous tobacco types. Hence, it can be said that farmers started cultivating the tobacco in this region with Government support since post-independence period.

1.1 Statement of the Problem

In the present time tobacco consumption have assumed proportions of an epidemic. Tobacco cultivation accordingly has got importants to netigate the use of tobacco. Tobacco addiction has become a communicated disease. Tobacco plant is therefore rightly called as a killer plant (Panchamukhi, 2000). In such a situation, for controlling tobacco consumption any country has to necessarily rely upon controlling the supply of tobacco itself rather than the demand. Because it is believed that, *'supply creates its own demand'* (Panchamukhi, 2000). An extended version of this adage may be stated as, *'control of supply would control its own demand'.* So, if the production of tobacco leaves is restricted the supply of leaf as raw materials for manufracturing tobacco products will be limited. If such strategy taken in any country, farmers of the tobacco crop will opposed for distress. To overcome this situation, the present researcher feels it justified to think of alternative crops of tobacco cultivation for the control of tobacco supply as well as optimal utilization of agricultural lands for maintain the socio-economic setup of the study area.

The World Health Organization Framework Convention on Tobacco Control (WHO-FCTC) was developed in response to the globalization of the tobacco consumption epidemic. It requires signatories to this framework to provide adequate legislation to reduce production of tobacco since in doing so, it is hoped that there will be reduction of tobacco, so will there be reduction in use of tobacco. India being a signatory to the FCTC treaty, it is imperative that by 2020 AD, the area under tobacco cultivation ought to be reduced to 50% (Schwartz, 2011). Farmers, who depend on tobacco production for their livelihood, will therefore be left with no option but to seek other alternative crops to produce.

It should be mentioned further that cultivation of tobacco also invites some health hazard at the time cultivation and processing until some protective measures are adopted. In study area, there is generally lack of protective devices like gum boots, nose masks, overall coats, and gloves etc. required during the production and preliminary processing of tobacco leaves. During the harvesting and curing period, there also occurs a serious

shortage of storage facilities. Most farmers use their own houses to store the leaves, an act which is hazardous to their health. Children and women are more vulnerable than men to tobacco-related health risks since they spend a lot of time in tobacco farming. The tobacco cultivation is also meagre due to the increase in the costs of different inputs of cultivation, socio-economic constrains, orthodox method of farming, stagnancy of productivity, fluctuation of market price which causing reduction of the margin of profit year after year and also due to the growing awareness of health risk associated with tobacco consumption. In such a situation the chewing tobacco crops are not supported by Tobacco board/MSP in India. Moreover recently State Govt. of Assam completely ban chewing tobacco in Assam, where export huge amount of tobacco from the study area. Such anti-tobacco legislation establishes the principle of support to tobacco farmers wanting to shift out of tobacco cultivation in the study area. How to do so remains a key challenge.

Though in developed countries tobacco related activities like cultivation, production and consumption of tobacco products, etc seem to be under control. According to WHO-FCTC, (2003) world tobacco production is shifting towards developing countries, but profitability is beginning to decrease due to cost-benefit imbalance, thus affecting farmers' incomes. In this context, the current trends in the global food market represent an opportunity for economically sustainable alternatives to tobacco growing, particularly as the tobacco crop has a negative impact on food security. The WHO- FCTC has added a new dimension to the complex nature of the crop. The treaty envisages non-price, price and tax measures to reduce the supply and demand for tobacco in the world. The non-price measures include, protection from exposure to environmental tobacco smoke (ETS); regulation of the contents of tobacco products; regulation of product disclosures; packaging & labeling; education, communication, training & public awareness; advertising, promotion & sponsorship and demand reduction measures concerning tobacco dependence & cessation. The Article 17 of FCTC stipulates "Parties shall, in co-operation with each other and with competent international and inter-governmental organizations, promote, as appropriate, economically viable alternatives for tobacco workers, growers and, as the case may be, individual sellers" (WHO, 2003).

As per the obligations under WHO-FCTC and as an established strategy to reduce the supply of tobacco, extensive research to find the alternate crops for tobacco is needed.

There have been a few peripheral studies on this subject in the country (discussed in literacy review section). However evidence base is required to take up alternate crops on a larger scale so that the profit and gain to tobacco farmers is not compromised. Hence the present researcher tries to find out the environmental and economically sustainable alternative crops of tobacco in different physico-cultural environment of Dinhata subdivision.

1.2 The Area of Study

The entire study area falls in Dinhata subdivision of Koch Behar district, is situated between 25^0 57’ 24’’ to 26^0 14’ 06’’ north latitudes and 89^0 15’ 17’’ to 89^0 37’36’’ east longitudes. The sub-division is situated in the south-eastern part of Koch Behar district. In shape it forms an irregular trapezoid having an area of 764.84 sq km., which accounts for about 14.85 % of the total geographical area of Koch Behar district and is bounded by Sitalkuchi block in the west. On the north partially by Tuanganj block-I and partially by Cooch Behar block-I and south and east is entirely bounded by Bangladesh. The subdivision is divided into three administrative blocks namely Dinhata-I, Dinhata-II and Sitai. There are 33 Gram Panchayet and 307 Mouzas (names given in Appendix-B) in this subdivision.

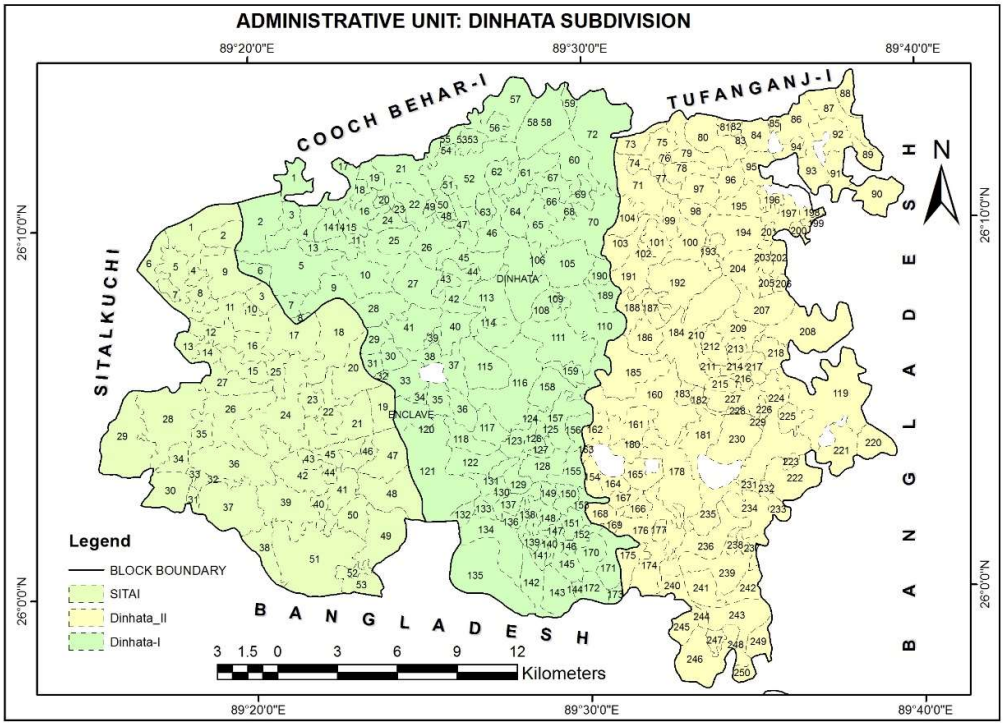

Figure: 1:1 Mouza map of the study area

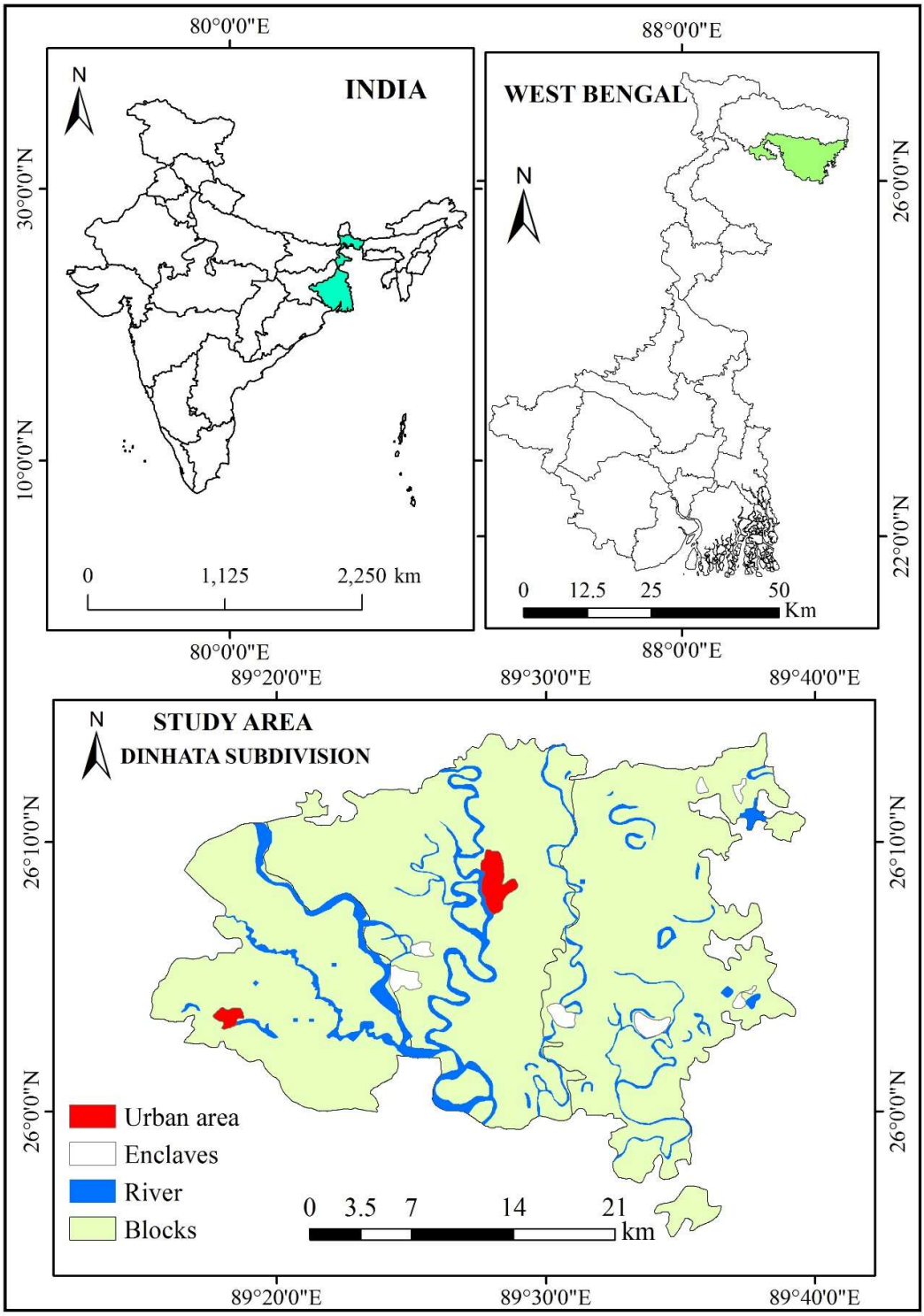

Figure: 1:2 Location Map of the study area

1.3 Review of literatures

The present researcher has consulted some books, articles and thesis regarding the different aspects related to the present study. During the library work the researcher found that till date few rich and applicable works have been done in the field of alternative crops of tobacco for replacement.

John C. Keyser (2002) in his discussion paper *"The costs and profitability of tobacco compared to other crops in Zimbabwe"* compares the financial costs and returns to tobacco growing with twelve alternative crops, looking at profitability, costs, labour intensity, financial support, technical infrastructure, land-suitability, marketing difficulties world demand and production risks in Zimbabwe. The study finds that tobacco is a highly profitable cash crop for both large and small farmers. However, even for farmers in suitable agro-ecological areas, tobacco is expensive to grow, with high up-front costs and high labour requirements. Many commercial farmers have diversified sources of income, and most smallholder tobacco farmer grow only small amounts of tobacco, and grow other food and cash crops like maize, soybeans, cotton, groundnuts and wheat as part of a crop rotation system, to help provide a steady cash flow and as an essential part of their household food security strategy.

Kaur, S. (2002) in his article *"Tobacco cultivation in India: Time to search for alternatives"* examined that tobacco can be replaced with a crop which is at least equally profitable, having export potential, and is user friendly. Plantago is a suitable alternative as it requires mild temperatures and can be encouraged by the Government and suggests that just as other cropping patterns have been changed for various reasons, so tobacco cultivation could be reduced in favour of more beneficial alternatives.

Naher and Efroymson, (2007) another research carried out in Bangladesh observed the situation of tobacco growing and vegetable areas. Research for this case study involved travel to key tobacco growing regions of Bangladesh as well as collection of information in Dhaka from various sources. During the fieldwork, researchers observed the situation of tobacco growing and vegetable growing areas, and spoke to current and former tobacco farmers about their economic situation and their reasons for growing tobacco or switching from tobacco to other crops. It emerged that the principal reason behind farmers choosing to grow tobacco is that it is considered to be more profitable than other crops due to its guaranteed market and that the farmer receives his entire money for his produce at once. The study also observed that the key benefits of tobacco growing,

meanwhile, accrue mainly to registered farmers only, while unregistered farmers often receive a lower price for their tobacco leaf, depending on registered farmers to buy whatever quantity they may need.

WHO (2004), a paper on **Tobacco and Poverty**, explains the trouble of tobacco farmers and the problems related to tobacco farming around the world. According to the WHO, for decades the tobacco industry has encouraged countries and families to cultivate tobacco, claiming that it will bring them prosperity. For many farmers, the reality has been quite different. Among poor families who depend on tobacco, children work on tobacco farms or factories from a childhood or early age, missing out on vital educational opportunities that could help life them out of poverty. The use of child worker in the tobacco fields is common practice in many tobacco-producing countries. Tobacco producing contributes to poverty not only through the money wasted on its marketing but also through lost educational opportunities. While some large scale tobacco farmers have undoubtedly become wealthy, many are barely making a living producing a crop that is labour and input intensive, bringing with it a host of health and environmental dangers from pesticide use to nicotine poisoning. Moreover, while tobacco farming is not unique in its use of child labour, the particular hazards posed by tobacco cultivation places these children at increased risk of disease and illness. All over the world, and especially in developing and poor countries, the expansion of tobacco farming, encouraged and in some cases financed by major cigarette companies, has created a situation where more and more farmers are competing to produce and sell tobacco to companies at increasingly lower prices.

Naher, F. and Chowdhury, A.N.R. (2002) in his article "*To produce or not to produce: Tackling the tobacco dilemma in Bangladesh"* the authors found that growing vegetables and sunflowers can yield more money than tobacco at a lesser cost to the environment, and also benefit the health of the farmer.

Omari, M.P. (2009): in his Thesis *"A cost-benefit analysis of substituting bamboo for tobacco: a case study of South Nyanza, Kenya",* he applied the framework of cost benefit analysis by using primary data to analyze the cost and benefits of both tobacco and bamboo. Results showed that bamboo farming is financially and economically beneficial to tobacco farmers since the incremental benefits are positive. This is shown by the results which indicate that whilst the financial net present value for tobacco farmers is

KShs 155,445 that of bamboo farmers is KShs 663,272. A sensitivity analysis showed no change in the sign of the net incremental benefit. He concluded that bamboo farming therefore, if well managed can meet the objective of the Framework Convention on Tobacco Control and also the government as it seeks to find an alternative to tobacco growing. The study therefore recommends that Bamboo be introduced as an alternative tobacco growing areas in Kenya.

Panchamukhi, P. R. (2000) in his research work *"Agricultural Diversification as a Tool of Tobacco Control"* is to examine determinants of decision to grow or shift from tobacco by multivariate statistical analysis. He believes that supply side measures can be only long term measures to eradicate the tobacco epidemic. He says that an integrated approach of tobacco control, incorporating region specific elements seems to have a bigger mileage in achieving the objective of controlling the tobacco epidemic. He concludes that mixed cropping may be a better alternative for agricultural diversification away from tobacco in Karnataka. *Tobacco-plus garlic* recorded maximum total yield followed by *tobacco and rajmash*. *Maize-plus-potato*, *garlic and potato* are also attractive tobacco free mixed cropping alternatives. He also conclude that if tobacco needs to be cultivated in view of the environmental and soil conditions of the region then, alternative uses of tobacco need to be focused upon.

Sharma, S. (1993) in his research *"Economics of tobacco cultivation in West Bengal with special reference to its constraints and prospects"* has made an attempt to examine the marketing structure and market performance of leaf tobacco and cost of production and profitability of tobacco and its competing crops in West Bengal.

Suvarna K. V. and Naveen Thomas (2002) in their article *"Tobacco farming in India: An unreliable option to growers and workers, expensive proposition to farmers and a death warrant to forests"* said that tobacco growing can provide the funds for basic existence, it keeps the poor entrenched in a cycle of poverty, as can be seen in the cases of those whose children are illiterate labourers like themselves. While the owners benefit from a continuing pool of desperate people with no better source of livelihood, tobacco cultivation is obviously not benefiting the economic development of the country. The intensive, difficult, and health-harming nature of the work means that people are happy to make a move from tobacco growing to something more remunerative.

UBINIG (2008) in a project work *"From Tobacco to Food Production: Assessing Constraints and Transition Strategies in Bangladesh"* discussed the constraints farmers face or practical ways to make the transition to alternative cropping systems of tobacco in Bangladesh. The findings point to the need for public investment in the rehabilitation of soils degraded by years of tobacco production, urgent action to halt the expansion of tobacco into new and fragile environments, the critical role of farmer-based seed systems in facilitating a transition out of tobacco cultivation, and the need for public investment in marketing infrastructure for food and other economic products.

Umana M., Paula, M. (2011) in their Master's Thesis *"Potential for Alternative Agricultural Enterprises to Replace Tobacco: Burley Producers Perceptions*" they uses a rank-ordered logit model (ROLM) to explore factors affecting farmers' perceptions about the potential for grain crops, cotton, peanuts, hay, fruits and vegetables, cow/calf, dairy, beef cattle and, other crops/livestock to replace tobacco production. They suggest that hay is one of the on-farm enterprises perceived as having the highest potential to replace tobacco among burley tobacco farmers. Age, education, farm size and farm cash receipts were found to affect farmers' perceptions about the potential for different alternative enterprises to replace tobacco.

W. Verheya (1992) in his article *"Soil Survey interpretation, Land evaluation and land resource management"* explains the link between soil data collection and land resource management, including policy formation.

However, the reviews of literature indicate that, most of the research work had been done on flue cured tobacco, covering a vast area of an agro-climatic zone and no systematic work had been done by any scholar so far on 'Strategies for replacement of tobacco cultivation in Dinhata subdivision of Koch Behar district'. Hence the present research work was undertaken to evolve beneficial alternate crops of tobacco that may help improve the economic and health conditions of farming community of Dinhata subdivision and the outcome of the study will also be utilize to develop Government strategies.

1.4 Objectives of the study

There is remarkable variation in the meteorological parameters, soil characteristics, cultural practice and economic environment to the growth of rabi crop in different

physico-cultural environment of this subdivision. The minute analysis of the growth variation of tobacco and its alternative crops requires details investigation of soil characteristic, climatic influence, and socio-economic factor which the investigator keenly interested for.

Thus, the present study has the following objectives –

1. To study physical and cultural background of the study area.
2. To investigate the present status of tobacco cultivation of the study area.
3. To assess whether Govt. strategies in tobacco control are likely to affect the cultivation of tobacco of the study area.
4. To make land evaluation for best alternative crops of tobacco of the study area.
5. Identify significant constraints faced by tobacco farmers trying to shift out of tobacco production.
6. To study a comprehensive overview of the economic aspects of tobacco farming and to assess economically viable alternative crops to tobacco cultivation of the study area.
7. To suggest recommendations for policy makers aimed at assisting tobacco farmers' shift from tobacco cultivation to alternative crops.

1.5 Hypotheses

The present studies tries to assert the truth or falsity of the following research hypotheses:

I. Profitability of tobacco cultivation emerges from the fact that most farmers economize on the cost of labour required for producing this highly labour intensive crop by using farmer's household labour especially of women and children.

II. Net returns from tobacco are less than from many other crops, and the economic condition of farmers would benefit from a switch from tobacco to other crops.

III. As proposed by World Health Organization Framework Convention on Tobacco Control for 50% reduction of the area under tobacco cultivation by 2020 AD, there is possibility for farmers to switch over from tobacco towards alternative crops for exploring viable and profitable substitutes to tobacco.

IV. If irrigation and credit facilities are provided farmers would divert their landholdings away from tobacco to more profitable crops.

1.6 Methodology

Keeping in mind the above mention objectives and hypotheses the methodology adopted by the present researcher is a rationalistic one based on quantitative method depending upon both primary and secondary data.

Primary Data

The primary data and information is to be collected from Soil Survey, household survey and from unpublished official record.

Coverage and design of the sample Survey

Relevant primary data was collected from the sample farmer in Dinhata sub-division through survey method with the use of schedule and questionnaire (Appendix-I). A simple random sampling design without replacement was adopted for household survey. For this purpose four mouzas were chosen from each block on the basis of simple random sampling without replacement. The name of the selected mouza are Bara Natabari (J.L. No- 2), Alokjhari (J.L. No-28), Bhalka (J.L. No- 46) and Dakshin Kharija Gitaldaha (J.L. No-139) at Dinhata-I block; Bhulki (J.L. No- 71), Karala (J.L. No-174) Bara Shakdal (J.L. No- 184) and Sahebganj (J.L. No-208), at Dinhata-II block; Bara Adabari (J.L. No-11), Pirpal Sitai (J.L. No-32), and Bharali (J.L. No-36) Chamta (J.L. No.-51) at Sitai block. After the selection of mouzas the tobacco and non-tobacco grower in each mouzas were identified. After selection of mouzas tobacco grower and non-tobacco grower identified and considering the time and resource constraints, twenty samples in each mouzas are proportionately selected among different strata including KPS, ADO, farmer, agriculture labourer were selected randomly for details investigation on the basis of simple random sampling without replacement. Following this method 240 farmers selected, out of which 120 famers are observed to cultivate tobacco crop.

Secondary data

The meteorological data for 40 years (1972-2011) were collected from Meteorological Station, Central Tobacco Research Institute, regional research station, Dinhata, Koch Behar, which is located at 26º20’ N latitude, 89 º 27’ E longitude and 41 metre above mean sea level. Soil resources information for this region was collected from national Bureau of Soil Survey and Land Use Planning, Regional Centre, Kolkata (2008).

During Farma Management Survey 2012

Plate 1.1 Field Survey, 2012 at Chamta Mouza, Sitai block

The data on production of different crops were taken from the published reports (Annual report of Bureau of Applied Economics and Statistics, Cooch Behar; Department of Agriculture, Kolkata and Evaluation Wing, Kolkata, sub-divisional agricultural office, Dinhata). The information regarding physical environment, drainage system were collected from the latest survey of India Topographical Sheets and Satellite imageries.

Statistical Tool

The primary data which has been collected during the field survey and house hold survey was verified with the information available from secondary sources. The data and information were summarized followed by the suitable statistical methods.

Various statistical tools, namely statistical tables, standard deviation, co-efficient of variation, co-efficient of co-relation and co-efficient of determination were also worked out. The yearly rainfall is also classified as drought, normal, and excessive rainfall years when particular year receives rainfall less than $y - s$, $y + s$, and between $y - s$, and $y + s$, respective, where y is mean of yearly rainfall and s represents the standard deviation of yearly rainfall (Singh*, et al.*, 2007). The probability analysis was carried out using Waybill's method (Chow, 1964), which is $P = [\frac{m}{n+1}] \times 100$ where , P is the plotting position percent chance; m is the rank number when the data are arranged in descending order and n is total number of years. Recurrence intervals (T) were calculated using the relationship $T = P^{-1}$.

Compound growth rate

Here use exponential curve for computing compound annual growth rate of tobacco production, area and yield rate (Gupta, 2008)

$$\hat{g} = (\hat{b} - 1)100$$

By taking logarithm equation become linear function,

$$\log Y = \log a + (\log b)x$$

Where, Y= log y; A= log a; B= log b

Now, the method of least square can be applied to yield the normal equations given the estimates of A and B.

Then, a=Antilog A; b= Antilog B

Land suitability evaluation

Land suitability evaluation and climate suitability have been prepared followed by FAO methods available in the existing literature (FAO, 1976, 1985; Verheya, W. 1992; Prakash T.N., 2003; Kuria, D. et. al., 2011; Al-Mashreki, M.H. et.al., 2015; Mustafa, A.A. et. al., 2011; Naidu, L.G.K. et.al., 2006) after necessary modifications.

Parametric method for climate suitability evaluation

In the parametric method a numeral rating is attributed to each characteristics (Sys et al., 1991b). The process of evaluation is based on the FAO qualitative land evaluation system (FAO 1976, 1984, 1985), which compares climatic conditions including insolation, temperature, rainfall and relative air humidity with each specific crop requirements developed by Sys et al. (1991a, b, 1993). The climatic indices are calculated from the individual rating. If the observed value is *x* and it falls into the interval [*a, b*] it needs to get a score y that falls into the interval [*c, d*]. The formula (Baghehzadeh and Gholizadeh, 2016) to calculate y is:

$$y = a + \frac{(b - a)(x - c)}{(d - c)}$$

Then, climate index has been calculated based on khiddir's square root method. The formula to calculate CI is:

Square root method (Khiddir, 1986)

$$\mathbf{CI = Rmin} \times \sqrt{\frac{\mathbf{A}}{\mathbf{100}} \times \frac{\mathbf{B}}{\mathbf{100}} \times \ldots}$$

Where, CI= Climate Index

Rmin= minimum rating.

A, B … = other rating besides the minimum rating,

The climatic rating to be used in the total evaluation has to be calculated by (Sys et al., 1991b)

- If index between 25 and 92.5: climatic rating =16.67 + 0.9 index
- If index less than 25: Climatic rating = 1.6 × index

The average day (td) and night (tn) temperature are calculated by following formula (Gommes, 1983; Sys et al., 1991a)

$$td = \frac{(tmax + tmin)}{2} + \frac{(tmax - tmin)}{4\pi} \frac{(46 - N)}{N}$$

$$tn = \frac{(tmax + tmin)}{2} - \frac{(tmax - tmin)}{4\pi} \frac{(46 - N)}{(24 - N)}$$

Where,

td= average daytime temperature °C

tn= average night time temperature °C

tmax= daily maximum temperature °C

tmin= daily minimum temperature °C

π = 3.1416

It is noted that, in the study area, rabi crops are grown under irrigation supply, hence rainfall parameter has not to be considered for climate index.

Modelling of analytical hierarchy process for land suitability evaluation

The analytical hierarchy process is firstly introduced by Saaty in 1980. It is a multi-objective, multi-criteria decision making approach, which enables the user to arrive at a scale of preference drown from a set of alternatives (Saaty, 1980). This method is very important for suitability analysis, regional planning, decision making. In the construction of a pair wise comparison matrix, each factor is rated against every other factor by assigning a relative dominant value between 1 and 9 to the intersecting cell.

For the AHP model, the final result includes the weights of the derived factors, class weights and a calculated consistency ratio (CR). In the AHP method, an index of consistence, known as the consistency ratio (CR), is used to indicate the probability that the matrix judgments were randomly generated (Saaty, 1980).

$$CR = CI/RI$$

Where RI is the average of the resulting consistency index depending on the order of the matrix given by Saaty in 1980 and CI is the consistency index and can be expressed as:

$$CI = (\lambda max - n)/(n - 1)$$

Where λmax is the largest or principle eigenvalue of the matrix and can be easily computed from the matrix and 'n' is the order of the matrix. The consistency ratio is a ratio between the matrix consistency index and random index, and in general ranges from 0 to 1. A CR of 0.1 or less is a reasonable level of consistency (Malczewski, 1999). A

CR above 0.1 requires revision of the judgment in the matrix due to an inconsistent treatment for particular factor ratings.

In this study, the consistency ratio is less than 0.06; the ratio indicates a logical level of consistency in the pair-wise comparison that is good enough for recognize factor weights. For all cases of the gained class weights, the CRs are less than 0.1, the ratio indicates a reasonable level of consistency in the pair-wise comparison that is good enough to recognize the class weights. Regard alternative crop suitability mapping (ACSM) by AHP, is used based on following equation:

$$\sum_{i=1}^{n}(Ri \times Wi)$$

Where Ri is the rating classes each layer and Wi is the weights for each of the crops conditioning factors. For the estimation of alternative crops suitability value (ACSV) the each crops conditioning factors values is summed by weighted linear sum model on a GIS environment (Lee and Talib, 2005). Finally ACSV is classified into four classes (S1, S2, S3 and N) based on natural break to determine the class interval in the ACSM.

Concept of Cost Benefit Analysis used in the study

Concept of cost is necessary to be developed first for calculation of production cost of a crop. The profitability of farming could be affected by many factors, that directly affect farm profit are total revenue and total cost. The total revenue is dependent upon yield level and production price. Yield level is influenced by technology adoption i.e., the use of tobacco variety, fertilizers, pesticides etc. and agro-ecological condition i.e., soil and climatic condition. Technology adoption is affected by agro-ecology, input prices such as seeds, fertilizers, pesticides, labour etc. and capital availability from bank and money lender. Input price, to some extent is determined by Government policies e.g. fertilizer subsidy. The following values for revenue, costs and returns were estimated.

Revenue: Revenue which is measured by the Total Revenue (TR) is the total value of output produced. TR will be computed by multiplying average yield by average price at farm level. TR includes output produced during the year, which may be sold, used for household consumption, used on the farm for seed, used for payments in kind; or kept in

the store for future sale (ending stock). Non market transactions are valued at their opportunity cost (average market price).

Costs: Costs are measured by;

i) **Operating costs (Cost A):** These refer to the sum of input costs, traction contract costs and hired labour costs. Input costs consists of value of expenses incurred on seeds, fertilizers, insecticides, fungicides and herbicides while traction costs consists of opportunity costs for using tractors or oxen for primary land tillage. Non-purchased seeds are valued at their opportunity costs i.e. market price.

ii) **Opportunity cost of operating capital (Cost B):** This is estimated at 12% of cash/operating cost.

iii) **Opportunity cost of family labour (Cost C):** This is the value of family labour used, which was valued at local wage rate (this study has used the average of the cost paid for hired labour by operation).

iv) **Total Enterprise Costs (Cost D):** This refers to values of all inputs used in production. It was the sum of operating costs, opportunity cost of equity capital, and opportunity cost of family labour. Total costs are generally divided into total variable costs and total fixed costs.

Farmer Profit: Following analytical tool used for gross and net profitability of tobacco compare to alternative crops.

Comparison of farm profitability aims to understand whether or not tobacco farm is more profitable than alternative crops. To assess the costs and returns of the target commodities is used for each data set as an analytical tool. Using a simple formula $\pi = TR - TOC$, where π= Gross profit, TR= total revenue and TOC= total operating cost. Farmer net profitability can be easily estimated using the following simple algebraic equation (Hadi, P.U. et al., 2008):

$$\pi = \mathcal{Q}_Y \mathcal{P}_Y - \sum_{i=1}^{n} (\mathcal{Q}_i \mathcal{P}_i) - \sum_{j=1}^{k} (c_j)$$

π = Net Profit (Rs/ Hactare)

$\mathcal{Q}_Y$=Yield (kg/ Hactare)

$\mathcal{P}_Y$ =Output price

$\mathcal{Q}_i$= Variable input quantity (unit/hactare)

$\mathcal{P}_i$= Variable input price (unit/hactare)

c_j = Fixed cost (Rs/ Hactare)

i= Variable input (tillage, seed, fertilizer, pesticides, labour, other materials)

j= Fixed input (family labour, depreciation, interest etc.)

Rates of returns: Rates of returns were measured by;

i) **Return to operating cost:** This is computed by deducting total operating cost (Cost A) from TR, then divided by Cost A.

ii) **Return to total cost:** This is the difference between TR and TEC (Cost D), which includes the opportunity cost of family labour and equity capital as part of cost and then divided by Cost D.

Labour: In addition to the estimated number of days of family and hired labour required for each cultivation, the following measure is also provided.

i) **Gross profit per day family labour, land, management:** This is measured by dividing gross profit by family labour days. It measures the reward to the family for farmers' labour, management and land.

ii) **Gross profit per day family labour, land, management:** This is computed by dividing gross profit by total family and hired labour days. It measures the reward to the family for farmers' management and land.

Unit measurement:

1 Bigha convert to 1/8.24 hectare as standardized an SI accepted metric system unit.

Procedure for imputation of values of farm inventory and inputs

Seeds: Purchase seeds are valued at actual price paid plus transportation costs, and farm produced seeds were evaluated at prevailing market rates at the time of sowing.

Farmyard Manure: It was valued at the actual purchase price and self-produced FYM was valued at market prices.

Fertilizers: Cost incurred in the purchase of fertilizers actual prices plus transport and other incidental charges.

Plant Protection Chemicals: The actual purchase price of plant protection chemicals, purchased by the respondents.

Irrigation charges: This include repair charges, working expenses such as oil, lubricants etc. and hire charges paid for using water from other sources. Irrigation charges paid to the concerned Government department for each crop are also include.

Human Labour: Hired human labour was accounted for at the actual wages paid by the farmers. Family human labour was imputed at the prevailing wage rates in the study area. Woman labour is taken as equivalent to 0.75 of male labour. One child labour is taken as equivalent to half of one adult male labour. One man day means eight hours work of one adult man.

Bullock labour: Hired bullock labour cost was calculated at the prevailing market rate for the services of a pair of bullocks in the study area. Owned bullock labour was evaluated at the same rate with hired bullock labour. One bullock labour day means 8 hours of services rendered by one pair of bullocks.

Tractor power has also been converted into bullock pair day on the basis of average time required by tractor power in performing a given job done by a pair of bullock.

Marketing Costs: These were the costs incurred by the farmers in cleaning, grading, packing, transporting and selling their products.

Miscellaneous Costs: These were the other incidental costs incurred in the operation of enterprises. These included cost on perishable implements like ropes, baskets, repairs and maintenance of implements used, etc.

Interest on Working Capital

Interest on working capital is changed at the time rate of 12% per annum for a period of three months for individual crop. The following were the item including under working capital such as (i) hired human labour, (ii) hired bullock labour, (iii) machine labour (both owned and hired), (iv) seeds (owned and purchased), (v) manures, fertilizer and plant protection chemicals, (vi) insecticides, pesticides and (viii) irrigation charges.

Fixed Costs

Depreciation: The depreciation rates, life span and junk value for various agricultural implements and machinery were decided in consultation with the respondents. Consequently, the depreciation was calculated using the straight line method as shown below.

$$\text{Depreciation} := \frac{Purchase\ value - Junk\ value}{Life\ Span}$$

Electricity Costs: These were levied on horsepower basis and were included under fixed costs.

In this study, other fixed costs such as land revenue, land rent, interest on fixed capital were excluded. The study will focus on evaluating the farm's profitability on a short term basis because in the short run, a firm's output level is determined by variable factor inputs Since in the short term fixed costs are ignored, net returns is defined as gross income per unit of activity.

Cartographic Presentation: The calculated data were plotted by suitable cartographic methods such as histograms, line graphs, bar graphs, pie charts etc.

Maps were prepared under GIS platform. Arc GIS 10.3 software were used to accomplish the spatial database creation. Finally Microsoft office was used for the documentation and calculations pertaining to the study.

Library Work

To compile of the bibliography as well as the reference works, the Library of North Bengal University; the Library of Central Tobacco Research Institute, Dinhata; Uttarbanga Krishi Vishwavidyalaya, Pundibary; The National Library, Siliguri; North Bengal Library, Cooch Behar have been consulted thoroughly.

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