# 1

## INTRODUCTION

During the last couple of decades the global agriculture has undergone dramatic transformation. This transformation in the agricultural scenario even from a subsistence peasant farming to its modern and technically advanced counterpart in many areas is largely due to a pressing need of food grains specifically to eradicate the problem of hunger, under nutrition and malnutrition. The tremendous pressure exerted by population growth on arable land and the growing demand for food and agricultural raw materials are some of the pressing problems of the present day world. While doing extensive farming, man has already pushed the frontier of arable land to the limit and hence agricultural production can only be raised by intensification, multiplication and diversification of crops by adopting new agricultural technology and practices. In recent years, production of cereals has gone up in the developing countries nontheless, the numerous qualitative targets are miles ahead to be achieved.

One of the most spectacular aspects of technological revolution in agriculture is the introduction of High Yielding Varieties of crops which have since the outset conspicuously transformed the agrarian phenomena in most of the developing countries of south and south-east Asia. In so far as the introduction of HYV seeds during early sixtees

go, the post introduction phase highlights a discouraging productivity pattern of the new crops specifically rice in terms of both absolute and relative figures. A fundamental question arises as to what precisely has been the role of the new seeds in minimising the long standing social problems ? The answer is obviously disheartening, for, the introduction of HYV programme with an advent of a technological breakthrough has failed to a large extent to bring down the hunger, malnutrition under nutrition and social inequality to minimum in the country. The percapita output has not appreciably increased. It has simply helped to maintain the existing levels of production per capita alongside the nutrition level in many states and union territories confronting an acute problem of population growth. The new varieties have thus resulted in a change in cropping structure, their rotation, methods and agricultural operations. Consequent upon, the advanced technology has quickened the formation of a commercial agriculture. The subsistence peasant farming is therefore in the process of being destroyed with the advent of this new techlology.[1] This, as an attribute can be singled out so as to identify its wide spread effect such as growth of wage labour, formation of a stratum of agricultural labourers, rise of large farmers in terms of social importance and emergence of a new

---

1. K.Griffin(1973) The Political Economy of Agrarian Change. Macmillan, Oxford, pp.46-82, 171-194.

class of rural elites. In turn it has brought about a polarisation of social classes creating greater disparities in the income of the rural people which have in the long run led to many social tensions.

The social class structure, relation, alignment and status have drastically changed with a corresponding change in the income distribution. These features in rural India are largely due to the introduction of HYV crops which have substituted the human labour with a high level of farm mechanisation. It has however, ultimately generated a vast potential of human labour surplus in agricultural sector thereby substantially widening the gulf of economic inequality, regional disparity and increasing the problem of unemployment.

There has been an interaction between the modern agriculture and industry, the former depending on the latter for a variety of chemical and mechanical inputs. The subsidies issued by most governments in case of essential inputs indicate the capital intensive nature of agriculture. This is on the other hand, an impetus to innovation diffusion in agricultural sector. Inefficient too, this kind of agriculture will not provide adequate requirements for a sound living thereby opening an outlet of labour flow from rural to urban areas showing a rise in unproductive employment as a negative symbol of social and economic development.

The above discussion mostly reflects the social and economic repurcussions of the introduction of High Yielding varieties of food crops in India.

Without going into the details of merits and shortcomings of the HYV it would be worthwhile to study and analyse the diffusion pattern of the new varieties of rice in a micro region of the Lower Brahmaputra valley which has tremendous renewable resource base and enormous agricultural potential.

The study is aimed to enquire into the diffusion, distributional and dispositional patterns of High Yielding Varieties of rice. Barring the basic objective as regards an assessment of the existing picture of the extent and levels of diffusion of the HYV rice in the area under study, several consequent issues and their solutions have simultaniously been explored. The issues thus raised incorporate as to how, why and to what extent the diffusion has been reflected in the several holding strata of the rural peasantry. What have been the absolute and relative gain in terms of output ? Whether the crop is neutral to scale or dependent on a varietyof socio-economic and physical input factors ?

Before drawing up the details, it will be worthwhile to discuss about the conceptual frame work of a diffusion of innovation of any natural or social phenomenon,

upon which the study is based.

The relative existence of phenomena over space has always formed an exciting study for both the social and natural scientists. For an analyst(s) however, it is the spatial/behavioural aspects of such phenomena that stands as the primary concern. This relationship between man on the one hand and space and time on the other, if studied in the spatio-temporal dimension (particularly with reference to HYV of rice) brings out the dynamics of the spatial pattern of diffusion.

There is a growing literature concerning the effectiveness and implementation of High Yielding Varieties programmes. These have been carried out by various organisations, but what seems to be lacking is, how far such programmes have really succeeded . and whether they have encouraging results particularly the support of the peasantry ? These are in addition to the socio-cultural variables that really influence the psychological and effectiveness of such programmes in the rural landscape.

There are a variety of phenomena whose scientific study of diffusion is yet to be attempted. The diffusion of new technological innovation study in agricultural sector draws special attention to raise and improve the standard of living in a society which is predominantly agricultural in character. Agriculture being the backbone of a country's

economy is also as the basic sector, an indicator of the overall socio-economic development. The modernisation of an agrarian society i.e. the technological change from the contemporary to modern can be brought about only when the orthodox ideas, conservatism and superstitions, of the rural lot are absolutely wiped out by means of adequate scientific education and training. The advanced technology employed in agricultural sector can also help to accelerate the production and productivity of field crops to a considerable extent.

The main objective of the present study is to find out the pattern and extent to which the adoption of High Yielding Varieties of rice has been diffused among the farmers of the Lower Brahmaputra Valley. Secondly, it seeks an answer as to the distribution of output of the HYV revolution in the country side vis-a-vis the distribution of factor markets. Thirdly an attempt has been made to distinguish, identify and trace out the factors which infact constrain and encourage their way of acceptance. Viewed objectively, the problem is an enquiry as to why some cultivators introduce latest agricultural innovations such as the application of chemical fertilizers or advanced machineries, HYV of crops and so on while others living in the same community do not. The answer is as simple as, the farmers may be knowledgeable,

socially powerful and having interaction[2] with the technologically and educationally advanced communities of the society. The immediate neighbours may be lacking these qualities and hence fail to accept the modern agricultural practices. Thirdly the study examines the choice of the farmer as an individual among more than one option open to him as regards the introudction of modern innovation in his farm[3] under the presumption that the infrastructural facilties (credit, extension services, communication and transport and market) are available, the non-availability of which might restrain the adoption.

Despite a variety of reasons often some casual inferences are also made as to the exposure of the farmer to radio and other communication media. This will of course lead us to the limitation of data and adequate informations. Other media such as extension services from the personnels of the Department of Agriculture are also to be examined and analysed so as to draw inferences in view of their importance and effectiveness in helping the spread of diffusion of a new innovation i.e. the High Yielding cultivation of rice.

Fourthly the carriers and the barriers in the process of diffusion of HYV rice will be identified. With a view

---

2. Fligel, Sen et.al (1968), Agricultural Innovations among Indian Farmers, NICD, Hyderabad pp.1-10.

3. Ibid., pp.1-10

to analysing the diffusion pattern of HYV rice adoption in the various strata of the cultivating households according to their socio-economic standing, the farmer's social setting has been given due importance. For a better understanding, the social characteristics, such as age, formal education, literacy, nonfarm employment of the farmer, family size, agrarian relation (land tenancy such as lease in and lease out of land etc.) religious beliefs, position in the social ladder (such as caste) have been analysed and given deep insight as regards their role in pulling and pushing a new agricultural innovation i.e. High Yielding Varieties of rice.

In addition to the above features in the farmers social setting, the most vital spectrum of the problem is the farm structure in terms of holdings. This aspect gives rise to some fundamental questions. Is it the farm size (net) which stands as the limiting factor in adopting a new technique of cultivation specifically the HYV of crops? Is the adoption of HYV rice labour intensive ? Is the HYV cultivation scale neutral ? The main aim of raising these questions is therefore to enquire into the nature or characteristics of the farm setting in general and the various strata of holding in particular.

Fragmentation of the cultivated land is also taken into account to determine its influence on the farmers

decision in adopting HYV crops. Meaning thereby, quite often the large holdings are so much broken up and fragmented due to the corresponding split up of extended and large families that it poses a psychological problem for the cultivator as to whether he should adopt the same or not.[4] Because there is a fear that small and fragmented fields will stand uneconomic specially in the investment of costly inputs.

Other than these existing situations arround the farmer himself and his farm, the organisational facilities such as credit through cooperatives and banks etc. extension services, the essential inputs (water, fertilizer, machineries) are also to be discussed. These of course have direct impact upon the farming society to have free choice of crops for better production. However, this will enable a researcher to know that within an existing environmental setting what circumstances can encourage the new agricultural innovations especially the adoption of HYV rice as well as modern methods and practices in a particular agrarian society.

In fact, the size of the farm holding plays vital role as the core issue in the spread of HYV rice and when the latter gets magnified numerous social and agro-economic

---

4. See Fligel, Sen et.all. Op.cit. P. 34

problems crop up. The analysis will, therefore be followed by the biasness of the spread of HYV rice cultivation towards a particular direction/holding size.

While analysing the socio-economic obstacles in the diffusion of HYV rice, one gets tempted to know as to what agro-climatic environment a region under study comes within. What is the average impact of the environment on the productivity of HYV rice which is an indirect impetus to the farming inhabitants. Hence the purpose of the study is also to assess and evaluate and to measure the impact of the physical surrounding in terms of the principal parameters. This specific attempt has great socio-economic relevance not only because rice is the leading crop of the area under study but also because the HYVs are not very successful over the greater parts of the country probably due to the uncontrolled supply of water to the crop.

Study Area

The present study is confined to the districts of Goalpara, Kamrup and Nowgong of the Lower Brahmaputra Valley. As a climatic region Brahmaputra Valley is unique in itself. It records over 400 cm. of rain fall annually. The soil is highly fertile being formed by the fluvial deposits of Brahmaputra and its tributaries. The agroclimatic conditions have made the valley an area of monoculture of rice in which

more than 70 percent of the gross cropped area is devoted to this crop.

Lower Brahmaputra Valley has been selected as an area of study primarily because of its distinct socio-economic and cultural character ( as compared to the rest of the Valley). Reasons are many, but suffice it to say that the influx of immigrants has contributed significantly to the complexity of agricultural land scape. The study contends that the elements of the distribution of phenomena are known and concern itself with the problem connected with the process of diffusion of HYV rice.

The problem of the diffusion of HYV rice and its distribution pattern in social and economic context in the region can also be considered as a spatial phenomenon[5] whose diffusion process will highlight the various physiographic, socio-economic and cultural barriers. Since this sort of study will involve data and information in a time series and there are numerous limitations in procuring them, the study about the spatial diffusion of a new crop in a region is a cumbersome task. The economic pattern of diffusion and distribution of the cultivation of High Yielding Varieties as reflected in the rural farms of

---

5. From the point of view of the typologies of spatial diffusion, two important aspects arise. Firstly, anything that moves over space is carried by some agent or the other secondly, the rate of movement varies because

this area has been the focus of the study because of its physiographic and socio-economic personality.

Hypotheses

In the present work the following points and hypotheses will be tested:

1. What is the extent of distributional pattern and disposition of the High Yielding Varieties in the Lower Brahmaputra Valley.
2. Whether the physical attributes of the region are conducive for the diffusion and spread of the HYV of rice in the area of study.
3. Whether the socio-cultural, economic and institutional attributes are creating barriers in the diffusion of HYV of rice in the region.
4. The major carriers and barriers of the HYV of rice will be identified.
5. It will be tested if the farm size and their fragmentation are the limiting factors in the spread of HYV of rice or whether the HYVs are neutral to the scale and labour intensive.
6. Whether the Lower Brahmaputra Valley has adquate organisational facilities for the adoption of HYV of rice.

---

of extranious factor acting on the direction of the way of diffusion. The most exciting part of the problem of diffusion is the study of both 'carriers' and 'barriers'. For detailed discussion on spatial diffusion see Adams, Abler and Gould, 1971, The Spatial Organisation, Newjersey, pp. 389-450.

7. Whether the small farmers and landless labour have been deprived of the benefits of new seeds of rice because of the growing inequality in the distributional pattern of land and output.

8. Whether the farmers of the Lower Brahmaputra Valley are movingfrom the subsistence towards the market oriented economy.

Plan and Design of the Study.

Data Base

The entire study is based on both the primary and the secondary data and information. The first few chapters are primarily based on the secondary sources. The reports and Field data on the yield estimation survey of High Yielding Varieties of rice conducted by the Directorate of Agriculture, Government of Assam have been procured. Other relevant data on agro-climatic parameters were obtained from the different government sources which include the records of the India meteorological Department, Soil Testing Laboratory of the Government of Assam. In addition to these, the author conducted field survey in the area under review to obtain first hand information and data about soil conditions, agricultural practices, levels and dynamics of production and the performance of HYV of rice. A field to field survey in the sample villages of Goalpara and Kamrup districts was conducted in the form of structured questionnaires. The schedules were designed at the village and household

levels. The basic information were collected and plotted on the village maps.

The field and on-the-spot collection of data by a direct interview with the farmers of the Lower Brahmaputra Valley(such as the districts of Goalpara and Kamrup) have been executed in the following fashion.

Questionnaire Construction

A set of questions basically to know the attitude of the farmers towards the practice of cultivation of High Yielding Varieties of rice alongwith several other circumstances of the farmers socio-economic setting were framed. The sub-sections of the questions were split up into the following areas of investigation.

(i) Social setting

The social setting of the farmers to adopt a new innovation relies on a variety of conditions as to how educated a farmer is, what position he occupies in the social ladder concerning the caste, religion etc., how extended and large a family he lives in, and how financially strong/stable he is, as reflected in his daily or monthly consumption or income. These aspects have been enquired and investigated through simple and comprehensible questions.

(ii) Holding Size

The land holding size of the farmers in terms of area operated, area owned, fragmentation of fields, pattern of land utilization-season wise and crop wise, cropping pattern concerning the number of crops raised in various seasons, formation of the fields, levels of productivity of the field crops with special reference to High Yielding and local traditional paddy have been probed into through a set of questions framed for the purpose.

(iii) Consumption Levels of Inputs

The information concerning the advanced economic inputs such as fertilizer, pesticide, irrigation, tractor, diesel pump, weeder, sprayer, and the level of their use have been tapped from individual farmers through direct interview. The response of each of the farmers has been filled up against the respective question asked. A specific column has been devoted to record the expenses incurred in terms of money for the cultivation of different crops in general and the cultivation of High Yielding and traditional varieties of paddy in particular for the final assessment of these two crops.

(iv) Miscellanious

A few questions in the schedule have been designed to collect information about the benefits of the cultivation

of High Yielding crops specifically paddy, for noting down the dissatisfication caused due to any attribute, and about physical conditions of the agricultural land .

Criteria of Sample Study

Generally for a standard study dealing with socio-economic aspect about 10 to 15 percent of the universe is taken as the sample. But looking at the time, finance and several socio-cultural constraints only eight sample villages were selected. Even in the case of these eight villages the author confronted many problems in the procurement of village maps - showing the field boundries and in filling up the questionnaires, mainly because of the political instability and the problem of foreigners. All the village maps except a few therefore, could not be procured because of such situation in Assam.

In fact the socio-political instability and foreigners issue, were the serious impediments for a smooth field work. All the time the villagers remained curious to know whether the incoming stranger is a government agent, politician, missionary worker, a social reformer or simply a research worker. During the period 1980-81 when the field work was conducted there was a strong 'local vs. outsider' and 'Bengali vs. Assamese' feeling and therefore a very few villages cuold be covered up by the author.

It has, however, been attempted to meet as many farmers as possible in each of the selected villages to know the prevailing socio-economic condition of the people and their attitude towards the HYV of crops and paddy in particular.

About 80 (eighty) questionnaires were completed from the selected villages representing the innovators, non-adopters and immitators, marginal, small, medium and large farmers. It is hoped that a generalisation on the basis of the sample taken can give a satisfactory and sufficiently reliable picture of the diffusion of HYV rice in the area of study. The sample farmers adopting HYV rice in their farms have therefore been taken into consideration.

Plan of Work and Methodology

The study planned and designed within an environmental-cum-socio-economic frame work begins with an assessment of the physiographic background of the region. The agricultural operations being implicit phenomena within the agro-climatic set up of the Brahmaputra Valley, various climatic indices have been prepared for a better understanding of the area in terms of environmental conditions.

In third chapter an attempt has been made to delimit the areal concentration of rice in the Brahmaputra Valley to determine the relative position of the

Lower Brahmaputra Valley. For the determination of the areal dominance of rice in the different component areal units of Brahmaputra Valley the"location quotient method" has been applied. This study is a part of the work done by the author in his unpublished M.Phil. dessertation.

Chapter four is primarily an attempt to find out as to how effective the environmental determinants (such as temperature, rainfall, humidity, nutrient index, soil texture index and pH index) are in explaining the productivity variation of High Yielding varieties in space. For this purpose, the multiple and stepwise regression analysis have been adopted as the tool to measure the composite effect of these variables on the yield per hectare. The inter-relationships of the variables have been tested through bivariate correlation coefficients. The analysis of residuals have been suggestive of the predominance of favourable and adverse environmental factors of lower and higher yield per unit area respectively. The stepwise regression model has helped in discovering the contribution of every individual variable in explaining the productivity variation. It also explains as to how the parameters get changed when the new variables are added in rotation. The changes in the value of $R^2$(i.e. the coefficient of determination) show the percent variation in each step. It also suggests whether a new variable is worth considering or not thereby helping to keep a watch over the

the changes in the values of regression coefficients and their standard errors. The variables selected are:

(i) Soil nutrient index
(ii) Soil texture index
(iii) pH index
(iv) Rainfall in mm.
(v ) Temperature in oC
(vi) Percentage of relative humidity
(vii) Yield of HYVs of rice per hectare

After having established a cause and effect relationship between the environmental parameters and per hectare yield, a map of yield per hectare super-imposed by temperature rain fall and humidity has been presented to show how the yield varies with the corresponding variation of the climatic elements.

The fifth chapter studies and analyses the inter and intra-farm and intra-holding characteristics of the sample farm households. The discussion has been highlighted and made conceivable by the presentation of frequency Tables. Various measures of central tendency and dispersion have been adopted as the media of explanation. It has also been explored that how the High Yielding culture of rice is reflected in different strata of rural households. The inter-relationships of the landuse characteristics have been measured using pearson's correlation coefficients with the test of significance.

In the light of the above discussion, concentrating on the problems and prospects of landuse in the study area, the social setting of the farm households has been assessed and evaluated in the sixth chapter. The bivariate relationships have been found out between the yield and the social variables and among the social variables as well. The variables include family size, religion, age of the cultivator, formal education, number of working members and number of fragmented fields.

The seventh chapter embodies the socio-economic and cultural factors involved in the process of diffusion of new exotic varieties seeds and the pattern of inequality in the distribution of land, output of HYV rice, the profitability in the adoption of HYV rice in relation to indigenous varieties has also been emphasised as far as the various categories of farmers(i.e. small, medium and large farmers) are concerned. The first part of the chapter focusses attention on the identification of the principal component factors which posses a substantial decriptive power from the above two sets of variables taken into account. Factor analysis has therefore been adopted as the tool of analysis. This technique helps in describing economically the sets of variables and also helps in locating the hidden dimensions (components) which account for the statistical relationship between them.

The relative significance of the variables has been determined from the factor loadings which are infact the correlation coefficient of the principal components (such as first, second and third etc.) with each of the variables of any particular set. The factor loadings above 0.5 have been considered as significant. The percentage variation a particular component explains has been calculated by dividing each eigen value above unit by the number of variables and multiplying by 100. The total percentage variation is determined by taking each such eigen value (generally more than unity) into consideration.

The second part of the chapter encompasses an analytical presentation of the inequality in the distribution pattern of net cultivated land, area under HYV rice and output of HYV rice among the various strata of sample farm households. The analysis has been supported through a discussion on Lorenz-Curve which shows the extent of its deviation from the line of equal distribution or the egalitarian line. The concentration indices have been worked out using the formula for Gini's coefficient to show as to how unequal and biased the distribution is. The study of inequality is followed by a subsequent discussion which primarily concentrates on the extent of cultivation and the distributional pattern of area and output among the various strata of farm households. It highlights the extent of cultivation of HYV rice in terms

of percentage share of the same to the total operational holding and the level of output per unit area achieved by the different categories of farmers such as marginal,small, low medium, medium, moderately large and large.

The third part is an attempt to analyse the profitability of HYV rice with the help of some quantitative measures so as to assess the problems and the prospects of the cultivation of HYV rice in the area of study. The measures of profitability in the study incorporate the yield in kg.per hectare, Gross return in kg. per hectares net return in Rupees per hectare, net return per unit of output and incremental net return (as percentage of incremental cost). Prior to working out the measures of profitability, an attempt has been made in the third section of the chapter to examine the pattern of distribution of the material inputs in terms of the level of consumption among the sample households. The discussion also highlights whether there has been a technological change in the rural sector or the contemporary traditional technology is still in operation taking the case of the use of input levels for either the varieties of rice-HYV and traditional in money terms.

Inferences and conclusions have been drawn in the concluding chapter to assess the cause of non-adoption of HYV rice in the area under study. Some important suggestions

have been made as to why a conducive atmosphere cannot be created for a better yield of HYV rice per unit area, so that a large section of farmers will be attracted thereby accelerating the process for a speedy diffusion of the High Yielding varieties of rice in the Lower Brahmaputra Valley. It has also been suggested that the diffusion of these new varieties will boost the total volume of production to a new high and will bring about a positive change in the agricultural landscape of the region on the one hand and in the agricultural income on the other on which the level of standard of living of the rural population almost exclusively depends.