DIFFUSION AND DISTRIBUTIONAL PATTERNS OF HIGH YIELDING VARIETIES OF RICE IN THE LOWER BRAHMAPUTRA VALLEY

By

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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

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1. K.Griffin(1973) <u>The Political Economy of Agrarian Change</u>. 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 edication 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 comrse 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 to

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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 cultivation 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 intvestment of costly inputs.

Other than these existing situations arround the farmer himself and his farm,the organisational faciltties 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

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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

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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 of

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 factorss in the spread of HYV of rice or whether the HYV 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.

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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 moving from the subsistence towards the market oriented economy.

Pland 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 informations 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 informations 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) Miseellanious

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.

CONCLUSION

The present work is an attempt to study the diffusion pattern and performance of the High Yielding Varieties of rice in the various size of land holdings in the Lower Brahmaputra Valley. The objective of the study has been to ascertain the influence of the physico-socio-economic factors on the spread of High Yielding Varieties of rice. The input cost, return and profitability have been investigated with the set goal of determining the measure of inequality and the carriers and barriers of the exotic varieties of rice in the area under study.

The agricultural Mosaic of the region reveals that rice is the dominant crop occupying at least 60 per cent of the gross cropped area in each of the component areal units, excepting Golaghat sub-division in which only 52 per cent of the total cropped area is under rice cultivation. In some of the sub-divisions, rice is sown over 80 per cent of the total cropped area, nevertheless, there are significant variations in the concentration and the distributional pattern of rice in the lower part of the Brahmaputra Valley. Cultivation of two to three crops of rice in a year is a common practice, but it dominates the agricultural land scape mainly in the Kharif season. A large number of areal units are, however, poorly irrigated and, it has been determined that higher concentration of rice areas possess a low irrigation potential. High Yielding Varieties of rice seen to be grown mainly in the areas of high concentration of rice.

So far as the correlation coefficients between the agro-climatic variables in the region are concerned, it has been ascertained that significant positive correlation exists between soil nutrient index and rainfall at 2 per cent level of significance. Nutrient index and temperature are also found to be highly and positively correlated at 1 per cent level of significance. Soil texture and temperature are positively related and the relation is significant at 10 per cent level. The most significant and high positive correlation exists between rainfall and temperature, rainfall and humidity and temperature and humidity, the significance levels being 1, 5 and 2 per cant respectively. It has also been ascertained that, though the negative correlation exists between soil texture and p^H values and soil texture and humidity but the relationship comes out to be insignificant at all the levels.

The correlation coefficient between every individual independent variable and the dependent variable (i.e. the productivity of HYV of rice) reveals that the relationship between the per hectare yield of HYV of rice and the physical indicators in the Lower Brahmaputra valley is negative in every case. Moreover, insignificant positive correlations exist between yield and soil nutrients, yield and soil pH (tending to no correlation) and yield and relative humidity. All the above paived variables have correlation coefficients which are insigificant at all the levels.

Significant negative correlation however does exist between rainfall and yield of HYV of rice at 5 per cent levels of significance. In a similar manner temperature and per hectare yield are also highly and negatively correlated at 1 per cent level. Taking all the variables together into consideration the multiple correlation coefficient comes out to be positive but insignificant at all the levels.

Out of the analysis concerning the sub-division wise per hectate yield of traditional and HYV of rice and the agro-climatic determinants an interesting picture emerged out. In the case of traditional varieties, there seems to be no correlation between the soil nutrient index and the per hectare yield. Conversely, there is high negative correlation between per hectare yield and soil texture and significant at 1 per cent level. Soil pH and yield of local varieties of rice show a positive correlation, but the relationship is insignificant at all the levels.

With the help of multiple regression analysis, the per hectare yield of every community development block has been predicted. The estimated yields per hectare in many cases show an increasing trend rather than a real decrease. The residual analysis throws light on the fact that in the area under study, the negative residuals are more dominant than positive because of the unfavourable soil and climatic conditions for the growth of HYV of rice.

The stepwise regression analysis enables to express the change in the explanatory power of the independent variables in explaining that of the dependent with the help of the every additional variable in the model. It has been concluded that as the variables are added one by one in the model the explanatory power of the variables starts increasing. The increase is however observed to be very low. All the six variables together explain only 12 per cent variation in the yield.

In order to examine the spread out level of diffusion of the HYV of rice in the different parts of the study area and the various size of holdings some typical villages and sample households were selected. The sample study reveals that 50 per cent of the farmers are yet to adopt the cultivation of HYVs. The rest have adopted the same, but it is vivid from their farm size and the area under HYV of rice that they are still at the experimental level. The area devoted to HYV of rice varies between as low as 0.068 hectare to as high as 2.025 hectares for two different villages situated at the extreme tips of the Lower Brahmaputra valley (Fig. 21.13). An overwhelming majority of the sample farm households constituting 90 per cent have put less than one hectare of cultivated land under HYV of rice irrespective of their net area under cultivation.

An analysis of the frequency distribution of net area under cultivation or the holding size which is under plough only reveals that 42.5 per cent of the households possess small holding - varying between less than one to

2.25 hectares. The medium holding farmers consist of 45 per cent of the sample, the holding size varying between 2.25 to 4.75 hectares. The rest 12.5 per cent with a holding size between 4.75 to 6 hectares may be called as the large farmers.

On the basis of the size of holding the farmers in the sample villages have been classified as marginal, small medium and large whose net area under cultivation varies between less than 1.00 hectare, 1 to 2.25 hectares, 2.25 to 4.75 hectares and 4.75 hectares and above respectively. In accordance with the above classifications, the percentage share of the aforesaid categories of farmers are 7.5, 35.0, 45.0 and 12.5 per cent respectively. The small and medium farmers are, however, dominant among the sample households. The large farmers are very few in number. Inference can be made from the above analysis that, in the Lower Brahmaputra Valley, the operated net holding appears to have been concentrated in marginal, medium and small categories of farmers accounting for 87.5 per cent of the sample. The same view concerning the dominance of small and medium farmers in Assam is also expressed by the ICAR report on the HYV programme in India (1979-80) with reference to Assam. In the subsequent discussion on the pattern of inequality of land, it has been found that the relative concentration of land is high among the large farmers.

The gross cropped area as an indicator of higher cropping intensity has a range of variation between 1.283 to 9.315 hectares for the villages located in the western part of the area under study. (Fig. 21,22) The intensive nature of cultivation of land is well manifested as the size category of the gross cropped area increases with the decrease in the frequency of households. The frequency distribution of the gross cropped area shows that a sizeable number of households (i.e. 85 per cent) have little or moderate intensity of land use while high intensive of agriculture is found in only 15 per cent of the sample households. The gross cropped area of these 15 per cent farmers varies between 7.0 to 8.5 hectares and above. The final analysis reveals that the arable land is very less intensively cultivated in the Lower Brahmaputra valley.

The area sown more than once ranges between as low as 0.067 hectares to as high as 4.185 hectares for the villages Jhagarapara and Ketekibari of Goalpara and Kamrup districts respectively. (Fig. 21 and 13). A substantial share of the households i.e. 35 per cent of the sample comes within the low size group of area sown more than once varying between 0.75 to 1.50 hectares. The distribution being of bimodal and skew, the second highest share of households accounting for 25 per cent comes within the size group of moderate degree in area put to double cropping. High degree of double cropping is noticed only in 5 per cent of the sample, the area varying between 3.00 to 3.75 hectares and above. As a whole, it appears that 50 per cent of the sample households practise double cropping in a low degree (i.e. less than 0.75 to 1.50 hectares). The next 45 per cent do have moderate degree of double cropping. What is evident is that a large number of farmers i.e. 95 per cent of the sample households devote very little area to double and multiple cropping. The agricultural land use hence in the study area is not very intensively cultivated.

The lowest and highest index of cropping intensity varies between 104.72 to 275.0 in Ketekibari an eastern village and Kheraj Deobhangi a western village respectively. From among the entire sample, 32.50, 57.50 and 10.00 per cent households have low, medium and high degree of efficiency in crop raising. Only one household has, however, very high degree of cropping intensity the index being 275. The first 62.5 per cent of the households coming within the categories of very low, low, medium, degree of efficiency in terms of land use indicate that though the High Yielding Varieites of rice have been adopted by them but the extent of landuse for three crops seems to be very low the index of cropping intensity being less than 200. Even, the household haveing highest degree of cropping intensity the intensity index being 275, is however, noticed to have devoted only 0.135 hectare of land to HYV of rice. This analysis high lights that the farmers of the Lower Brahmaputra valley are not very efficient in land utilization, inspite of the conducive agro-climatic setting and the introduction of the short duration High Yielding varieties of rice. The diffusion of HYV rice crops is, therefore yet to gather momentum in this area and largely depends on the farmers enthusiasm to go in for the adoption of these crops which can quicken the crop cycle in an agricultural year.

With reference to the question posed as to whether the farmers devoting more or little area to this HYV of rice have proportionately adequate or scanty operational holding, gross cropped area, and double cropped area, whether the inter-relationships between the different aspects of landuse are significant or not, the following results have been ascertained. The study of inter correlations between the landuse variables indicates that excepting a few, most of the pairs of variables are positively correlated. The paired variables having positive and significant relations between each other comprise of area under traditional varieties of rice and net ctopped area (r = 0.855, significant at all the levels), area under traditional varieties and gross cropped area (r = 0.912, significant at all the levels), area under traditional varieties of rice and double cropped area (r = 0.625 significant at all the levels), net cropped area and gross cropped area (r = 0.916, significant at all the levels), net cropped area and double cropped area (r = 0.385, significant at all the levels except at one percent), gross cropped area and double cropped area (r = 0.722, significant at all the levels, and finally the double cropped area and the indices of cropping intensity (r = 0.490, significant at all the levels, except at one per cent).

The high and significant positive correlation between the area under traditional rice and net cropped area is indicative at a vigorous increase in the area under local varieties with the increase in the net cropped area. It implies that the farmers are so much inclined towards these traditional crops, most probably, because of their high reliability and environmental adaptibility that a substantial or even the entire net holding is brought under cultivation during the respective seasons of Ahu and Sali round the year. The widespread diffusion of the new exotic varieties of rice can thus, be expected only when the farmers go in the reverse way.

The high positive and significant relationship between the net area sown and the gross cropped area suggests that the gross cropped area, to a large extent depends on the total operational holding (i.e. the net area sown) which by double and multiple cropping helps to increase the gross cropped area. Hence, as the net area sown increases, there is a corresponding increase in the gross cropped area. It further suggests that a substantial net area sown facilitates the farmers to achieve through cropping multiplication, an appreciable gross acreage. In order to achieve this goal, the short duration High Yielding varieties of rice crops should be extensively grown, so that there will be a faster multiplication of the crop cycle in terms of number of times.

From among the paired variables being negatively correlated, one pair shows negative and significant relationship between themselves. The variables are, net cropped area and the indices of cropping intensity. It is obvious that the net area is not efficiently brought under cultivation thereby decreasing the cropping intensity. It therefore results in a conseuqnet decrease in double cropping multiplicity and gross acreage.

An insignificant positive relationship between the area under HYV of rice and the net area sown indicates that farm size is never a factor for the cultivation of HYV of rice. Farmers psychology and attitude, on the contrary, play an important role in the adoption of new innovations in agriculture. On the other hand, the area devoted to the local varieties of rice is highly, positively and significantly related with the farm size (i.e. the net operational holding or net area sown). This is because, higher reliability is attached to the local varieties than that of its High Yielding counterparts. Hence, HYV rice culture is never farm size biassed. It, by and large, depends on the farmer's progressive attitude, skill and self-interest which can be given further impetus through adequate scientific education, training and pursuation.

The productivity of HYV of rice is found to be having positive and significant relationship with the area under HYV of rice ($r = 0.446$, significant at all the levels), with the gross cropped area ($r = 0.342$, significant at 5 and 10 per cent levels), with the net cropped area ($r = 0.357$, significant at 5 and 10 per cent levels) and with the productivity of local rice ($r = 0.823$, significant at all the levels. With the indices of cropping intensity, the relationship is however, negative but insignificant.

Substantiating the above analysis one can say that larger areas under HYV of rice become economic for the application of modern farm inputs which, obviously, will raise the productivity. Meaning thereby, larger is the area under HYV of rice higher is the productivity level. Since the relationship between the area under HYV of rice and the net cropped area tends to be positive, farmers having bigger farm size seem to have been tempted to devote relatively more area under the former. It is distinct therefore that, bigger the farm size, higher the productivity as evident from their being positively correlated.

As far as the socio-economic profile of the farmers selected for study is concerned, most of the farmers possess low and medium educational status, the percentages being 40.00 and 32.50 per cent respectively while 15 per cent of the farmers are illiterate. The rest 12.50 per cent farmers have attained higher educational status i.e. college and university education. The young farmers below 30 years of age are only about 7.00 per cent and therefore the adventurous nature is missing in the sample households and villages.

Family-size as a social indicator behind the adoption of modern innovations varies between 2 to 23 in case of the sample households. Small families are more numerous than the larger ones. The percentage shares in different size categories such as verylow, low, medium, high medium, high and very high are 5, 27.5, 50, 12.5, 2.5 and 2.5 respectively. This analysis makes the study distinct that the households having medium family size (i.e. between 8 to 16 members) dominate which account for 62.50 per cent in the entire sample followed by the small families (the members varying between less than 4 to 8) constituting of as much as 32.50 per cent of the sample. Large families are only 5.00 per cent of the sample. The medium and large families are mostly Muslims who belong to the western villages of the area of study.

Religious beliefs and religion in particular as socio-cultural factors often determine the social and economic behaviour of the farming community to accept new ideas. As per the direct interview with the farmers of different religious, the Hindus are observed to be more inclined towards the religious beliefs in agriculture than that of the Muslims. The sample households constitute mainly of Hindus and Muslims accounting for 45.00 and 55.00 per cent respectively.

As much as 80 per cent households in the sample do have adult working members who work in the field for about 8 hours in general and their number varies between 1 to 6. Rest of the households do not have working members and hence rely on the hired labour for all kinds of agricultural operations. From among the households having working members, 59.38 per cent have less than 3 adult working members and do come in the low category in terms of family labour. The medium category of households in family labour constitutes of 31.25 per cent and do have adult working members. varying between 3 to 5. The rest 9.38 per cent of the households have more than 5 members who devote full time in agriculture.

As much as 30.00 per cent farm households do not have permanent farm labour. The rest have permanent farm workers between 1 to 4 in number. Maximum households (i.e. 53.57 per cent) have permanent labour between 2 to 3 followed by next 39.29 per cent having less than 2 farm labours. A substantial share of the households (i.e. 46.43 per cent) pay salary to their permanent labour between Rs.600/- to Rs.700/- per annum. Next to this group i.e. 17.85 per cent households pay more than Rs.700/- as salary to their permanent farm workers. The salaries are, however, excluding the fooding and clothing which are provided by the farm households.

A majority of the households (i.e. 65 per cent) are noticed to have possessed draught animals on whom the field operations largely depend, less than 3. The next higher group of farmers having draught animals between 3 to 5 and constitute of 22.5 per cent of the sample. Only 10 per cent of the households have between 5 to 7 draught animals while only one household possesses more than 7 draught animals.

Fragmentation of agricultural land as a social problem is no way a less in the Lower Brahmaputra valley. As much as 55 per cent of the sample households have fragmented fields varying between 4 to 8. Low and high fragmentation of cultivable land is observed in 22.5 per cent of the households each, the number of fragments varying between less than 2 to 4 and 8 to 10 and above respectively.

Other than cultivation, as much as 57.50 per cent sample farm households have members at least one or more being engaged in off farm occupations which include teaching, government services business and construction works. As far as indebtedness of the farmers and the sources of finance of the farm households are concerned, it is found that 17.5 per cent of the farmers are resorted to indebtedness either to money lenders or other financial agencies. The rest of the farmers are still not financially sound. Of the entire sample, 22.5 per cent households both own and have used the different advanced agricultural implements. As much as 35 per cent of the farmers have only used these implements. The rest 42.5 per cene neither own nor do they use these implements such as diesel pump, sprayer, weeder, thrasher and duster etc.. The most advanced in regard to these implements is the village Ketekibari (Fig.20) of Kamrup district being provided with lift irrigation facilities.

The agricultural production in the farm households is mostly consumed and sold in small quantity to clear up debts, land revenue, and to fulfil other needs. About 60 per cent households are not left with any surplus, rather they depend on the market at the time of deficit.

The inter-relationships between the socio-cultural variables reveal interesting findings. The number of fragmented fields increases with the increase in the size of holdings. Educational levels of the farmers increase with the decrease in age, signifying the fact that, the young farmers are more educated than the older ones. Education also increases with the decrease in family size. It indicates that farmers coming from smaller families are more educated than that of their bigger counter parts. As the educational level of the farmers increases, there is a corresponding decrease in the number of working adult members in the family. Educated families hence, have less number of working members who work in the field. The agricultural fields of the educated families are less fragmented the relationship between the former and the latter being insignificant. This tendency is, on the other hand, a healthy sign in the country side of the Lower Brahmaputra valley. Education seems to have spread more among the Hindus than the Muslims, though the relationship of education with religion is insignificant statistically at all the levels. This tendency might lead to serious consequences in the agricultural development in the area. Since Muslims appear to be good cultivators in terms of productivity as compared to Hindus, the agriculture will be more traditional if education does not spread among the Muslims. The productivity increases with a corresponding increase in the number of working members in the family, the relationship being significant at 5 and 10 per cent levels. On the contrary, a negative and insignificant correlation exists between family size and religion highlighting the fact that Muslims have bigger family size than the Hindus (according to the weightage given to different religious). In accordance with the above situation, one can arrive at the conclusion that Muslim cultivators are making headway in terms of productivity which can be possibly attributed to larger family size. It may be because larger family size serves the purpose of intensive utilization family labour. Since family size and number of working members are positively and significantly correlated, it can be rightly said that Muslim families have adequate number of working members because of larger families, thereby increasing the productivity level.

Factor analysis of the land use variables highlights the fact that traditional technology still prevails in the area. Local varieties of rice occupy a pivotal position in the land use system. While the area devoted to HYV of rice forms a separate factor being negatively loaded on the same, the local varieties of rice go along with the other land use variables, such as gross cropped area, double cropping and net cropped area and make a cluster projecting linear relation with each other. The efficiency of land use can straight way be attributed to the extensive cultivation of local varieties rice. The analysis shows a poor performance of landuse for the new exotic varieties of rice which reflects a negative attitude of the farmers towards these crops.

Factor analysis of socio-cultural variables throws light on the social background of the farmers. While, on the one hand, factor I depicts the farming households as highly tradition bound and orthodox in terms of larger families, high fragmentation of agricultural land, and low educational status; on the other, factor II represents the biassness of farm holding towards the Hindus.

The measures of inequality in the distribution of HYV of rice reveal that more than 50 per cent of the output appears to have been concentrated within 50 per cent of the net area under cultivation, belonging to as much as 70 per cent households from bottom. The inequality in the distribution pattern of output appears to be relatively less than that of the area under HYV of rice for which the output curve runs almost parallel to the egalitarian line beyond 62.87 per cent of the net area (Fig. 24). At 6 and 18 per cent levels land and output seem to have been equally distributed between which share of output is less than than of the land. As much as 65.09 per cent of the total area under HYV of rice is found concentrated within 49.68 per cent of the net area owned by 70 per cent of the households from the bottom. The Gini's coefficients show that the distribution of output of HYV of rice is less unequal than that of the area under HYV of rice with respect to the net area, the coefficients being 0.034 and 0.172 respectively.

The share of the farm attributes as against the households show that land is most unequally distributed followed by the output of HYV of rice and the area under HYV of rice. Much of the land and output concentration (i.e. 50.32 and 45.33 per cent each) is spectacularly and relatively high within the top 30 per cent i.e. the big farmers. The shares of the same for the bottom 30 per cent farmers are as low as 14.21 and 12.24 per cent each. The share of the land devoted to HYV of rice for the farmers in the top and bottom strata of 30 per cent each include 34.91 and 20.01 per cent respectively. The middle

40 per cent farmers posses a substantially high share of area under HYVs (i.e. 45.08 per cent) and do have encouraging shares of output and cultivated land. Land and output with an equal share each are available to 15 and 34 per cent households as evident from the inter-section of both these curves at these points. The Gini's coefficents for land, output and area under HYV of rice indicating relatively high and low concentration in sequence incorporate 0.287, 0.254 and 0.118 respectively.

The study of inequality indicates that a relatively greater concantration of output and land is visible among the large farmers than that of the area under HYVs. This tendency might lead to a situation of monopoly agriculture in the diffusion process. What emerges from the analysis is that the area under study is dominated by small and medium farmers with highly unequal distribution of land, output and area under HYV of rice. If this process continues then it may result into serious social disparity and tensions. Hence it is high time to bring equality in the society with equal access to social opportunities. To achieve this goal, the redistribution of land among the small and medium farmers needs urgent attention. By virtue of it, a uniform spread of the new technology, specifically HYV of rice can take place irrespective of holdings such as small, medium and large which will have a real reflection of farmer's interest and enthusiasm in the adoption of new innovations in agriculture.

It has also been found that the marginal farmers having net operational holding less than one hectare of cultivated land are relatively more inclined towards the HYV of rice culture than that of the other categories of farmers, their share being more than 50 per cent to the net holding followed by small (22.49 per cent), moderately large (18.27 per cent) low medium (17.62 per cent), medium (11.59 per cent) and the large farmers (2.01 per cent).

Such an extensive and widespread cultivation of High Yielding rice among the marginal farmers may be attributed to the reason that the exotic new varieties of crops give relatively better production than that of the local varieties. This has been illustrated in Chapter-IV. The coverage of HYV of rice in case of the small farmers is also appreciable and encouraging. It is clear that the small and marginal educated farmers do take risk to go in for the High Yielding Culture as far as the water availability is concerned. Lower Brahmaputra valley being less vulnerable to draught conditions owing to its location in the high rainfall zone of the country stands favourable for the cultivation of rice. Though the area does lack adequate irrigation potential for controlled water system specifically for the new varieties of rice. Nevertheless, water does not pose much problem for the farmers because of assured rainfall during June to October. On the other hand, the rainfall variability in the whole of Brahmaputra valley is less than 20 per cent. Apart from the above reasons, there are still many other factors which remain unexplored as to why the small and marginal farmers have much propensity towards HYV culture.

The case is just reverse with the large farmers in the study area who appear to be indifferent towards High Yielding Culture as evident from their area coverage. It may be because, these farmers try to avert risk due to crop failure and may be because the infrastructural facilities are inadequate and the High Yielding culture is capital intensive and labour substituting for which farm mechanisation is imperative. But what apparently is visualised in the area that other than the lack of farm mechanisation in terms of advanced machineries and technical skill, specifically in case of the big farmers, human labour may be a serious impediment in the process of adoption of HYV rice which does not suffice to their need because of bigger farm size even though, there is a relative increase in working members with that of the holding size. Since small farmers largely depend on family labour as has been observed in other areas of the country, this may also be a reason as to why small and medium farmers in the present case are more interested and able in adopting HYV of rice apart from the reasons cited above. In the absence of mechanisation in agriculture in the study area, it will not perhaps be exaggerated if said that the High Yielding cultivation in the study area is more characterised by its labour intensive nature than that of its labour substitutive through mechanisation by capital investment. This is because, productivity of HYV of rice as an indicator of enthusiastic agriculture increases with the increase in the number of working members in the family which has been pointed out in the preceding discussions. The medium farmers also seem to be progressive in regard to the coverage of land under HYV of rice and output level also as compared to their bigger counterpart.

The output per unit area (i.e. hectare) reveals that the marginal farmers come in the lowest rung of the ladder (i.e. 1890.94 kg/ha), the reason of which may be attributed to poor capital investment which is on the other hand, not available easily to these farmers. The moderately large farmers are the most progressive in terms of output (i.e. 6385.27 kg/ha). Though the reasons are obvious, but it needs further investigation. The large farmers appear to be lagging behind in this regard the productivity in their case being 2488.9 kg per hectare. The small farmers deserve mention because they rank second to the moderately large group in terms of output i.e. 3076.09 kg per hectare. Encouraging output in case of the moderately large and small farmers may by and large be due to family labour and the farmers progressive attitude towards modern agriculture. It further implies that the farm-size of moderately large group of farmers stands viable and economic for the adoption of HYV of rice unlike the small farmers whose agriculture may be because of efficient utilization of family labour. The average output for all the categories of farmers comes out to be 3534.09 kg per hectare of cultivated land.

It can be concluded in the light of the above discussion that if the farmers are split into just three strata as small medium and large, then the small farmers have considerably made headway in terms of coverage of area under HYV of rice, lagging behind in output level, where as the picture seems to be reverse in the case of the large farmers. The medium farmers appear to have shown an encouraging performance in terms of coverage of area under HYV of rice and output per unit area. The small farmers are, still ahead in terms of output as compared to their medium counterpart.

The picture that emerges from the above discussion is that the size of HYV practice does not have significant positive relation with the size of holding in the sense that the size of HYV plots remains constant irrespective of holding size i.e. small, medium and large. This may be largely due to lack of mechanisation and concentration of use of labour, particularly the family labour. The HYV package practice is thus scale neutral and perhaps more favourable to smaller holdings.

The diffusion of HYV culture is therefore, appreciable among the small and medium holding farmers whose social and economic standing needs a thorough investigation within a more rational, pragmatic and comprehensible framework. The large farmers are, however, still to be attracted towards this modern farm innovation. The reasons are though numerous, nevertheless, it can be said that the area suffers from the inadequacy or paucity of infrastructural facilities for farm mechanisation as well as the human labour. Moreover, scientific training and education is felt imperative as prerequisite to motivate the big farmers for the adoption of new innovations such as HYV of rice.

In order to have a pragmatic approach to the cost benefit analysis of the adoption of HYV of rice human and animal labour have been given due importance in terms of real cost incurred on the same. The total cost owing to these two inputs include the yearly salary paid to the permanent labour and that of the investment on drought animals as parts of total cost. These inclusions have led to minimum exaggeration in working out cost figures. The total cost for the farm households per hectare individually shows that as much as 62.5 per cent of the farmers have more or less benefitted from the HYV of rice cultivation, the total cost being less than the gross return per hectare. Mention may be made of the sample farmers of Ketekibari who have all, except one benefitted from the High Yielding rice cultivation. This may be largely because of efficient resource utilization that is accessible to the farmers within their reach. The average cost and return (gross) per hectare have been calculated as Rs.2380.71 and Rs.3297.95 respectively for the entire sample.

The measures of profitability of HYV of rice vis-a-vis the local varieties such as gross return in rupees per hectare, net return in rupees per hectare, net return per unit of output and incremental net return as percentage to incremental cost have highlighted the following results.

The yield and gross return as excess for HYV of rice as compared to local rice are 69.73 and 70.02 per cent respectively. The new varieties incur a higher cost for producing just one unit of output than the local rice. The excess cost for HYV of rice over that of the local varieties is 25.62 per cent. The incremental net return of HYV of rice as percentage to incremental cost over the local varieties of rice is 79.77 per cent. It implies that one unit of extra cost will bring 1.79 i.e. 1.80 units of an additional net return of High Yielding rice. This ratio appears to be highly encouraging and suggests that the adoption of HY.V of rice has got better prospect over a longer time period.

Having examined as to how much the farmer gets after the deduction of all the costs for every quintal or kilogram of crops, it is found that the net return per unit of output (i.e. per quintal or kilogram) are Rs.35.15 and Rs.0.35 per quintal and kilogram of HYV of rice. In case of local varieties, the same are substantially low i.e. Rs.2.9

and Rs.0.029 respectively per quintal and kilogram of crops. It is vivid that the HYV of rice is much more remunerative than that of the local varieties in terms of net return in the study area.

Although there are speculations on the diffusion, spread and performance of HYV of rice in the Lower Brahmaputra Valley the study reveals that the region is lagging behind in the productivity of rice. On the basis of the multivariate analysis made in the present venture the author ascertained that the region has the ecological set up conducive for the cultivation of HYV of rice and their diffusion has therefore a great scope. In order to obtain the desired results more research, however, is to be done both in the agro-climatic set up and cultural milieu of the region on the one hand and the physiology of the new varieties of rice on the other.

The following suggestions in the opinion of the author will go a long way in popularising the HYV and in raising their productivity in the highly fertile and extensively cultivated tract of the Lower Brahmaputra valley.

The High Yielding variety rice crops are highly sensitive to the weather elements specially at the flowering and grain formation periods. The absence of an adequate meteorological information keeps the former in guessing the weather conditions. Installation of more Meteorological and rainfall recording stations is therefore, a pre-requisite for the success of HYV of rice : Such climatic data will help in making timely and more realistic weather forecast enabling the farmers to adjust and regularise their agricultural operations accordingly. A similar point is observed about the properties of soils. The soil regional laboratories have got enough data but the information needs to be plotted on large scale maps and explained to the respective farmers so that they may apply the deficient components of soil nutrients in the right proportions.

The soil analysis shows that the humus contents in the soil of Nowgong and Kamrup are deficient. With the help of more fertilizers and manures, the fertility and productivity of these districts can appreciably increase the productivity of rice in the region.

From the study made, the author arrived at the result that it is not the total amount of rainfall but its timely distribution over the different phases of crop growth which determines the total output. The chemical fertilizers which are costly inputs cannot be used with confidence by the farmers specially in the Ahu rice crop during the winter season when the weather is clear, cool and rainless. The winter rice crops in the region could be ideally grown if provisions for controlled irrigation through canals, tanks, wells and tube wells could be made.

Apart from financial aspects, the extension machinery should be most extensive and efficient. The optimum use of inputs can be made only if proper supervision to the cultivators is available, which depends on the type of extension machinery evolved and the personnel employed. There should be a perfect coordination between farmers, extension agent farm supervisors technologists, researchers, planners and administrators. Any slackness in the coordination specially the research and diffusion of innovations may further retard the progress towards the adoption of HYVs in the region.

The process of diffusion of HYV of rice can be quickened by a vigorous and wide spread campaign through the nook and corners of the country-side about the benefits of the advanced agriculture.

Since the landuse pattern in the country-side of the Lower Brahmaputra Valley has been explored to be the most inefficient in terms of cropping intensity, the author is of the opinion that the cropping multiplicity be accelerated by introducing the exotic short duration crops. This will generate a vast surplus of production and the surplus work force can get employment during the off season.

Based on a hypothetical view right from the inception of this study as to whether the modern enterprises in agriculture are confronted with socio-cultural and economic resistance of the farming community at the initial level the following suggestions for the farmers of the Lower Brahmaputra valley area might probably generate positive repurcussions if acted upon with an objective view of policy implementation. It has been concluded that a large section of the sample farmers have achieved at least formal education or more in the area under study. So an effective implementation of High Yielding Varieties programme is supposed to envisage the linkage of production inputs with technical know-how and skill of the farmers through a planned and organised training programme supported by Farm Radio Broadcast and functional literacy as has been included in the set objective of farmers training and education in India by the farm information unit, Directorate of Extension, Ministry of Agriculture and Irrigation, New Delhi.

The family size of the farm households being of largely low and medium suggests that a greater proportion of human labour for all kinds of agricultural operations may be hired because of small families which probably may not be catering to the need of adequate labour. This needs further investigation. This is supplemented by a subsequent finding that from among a large number of households having adult working members for agricultural operations, maximum families lack an adequate number of the same, thereby relying on permanent hired labour or seasonal or either. A curiosity or inquisitiveness arises as to despite an extensive traditional technology prevailed which in general human labour intensive the area in deficient of labour. The question arises where the hired labour is to be procured from? Is it that the area experiences a floating seasonal labours hail from outside of its jurisdiction? The author is of opinion that if the outside influx of labour perpetuates in the area more than desired and the floating labour tries to settle down in search of employment, then it might accentuate further social tensions in the long run which is already spearheading with speed and vigour.

There are obvious reasons as regards the non-availability of hired labour within the region. It is because, every farmer has more or less some land at his disposal. Moreover the landless labourers in the area under study may be proportionately very few. On the other hand, the inequality in the distribution of cultivated land among the farmers is not very alarming as compared to other areas of the country. This kind of situation in the area has, probably, resulted into a considerable shortage of human labour specifically during the cropping seasons. The author, therefore, has a strong conviction in this regard and is tempted to suggest that the introduction and breakthrough of new tools and implements be used in the area which can solve the problem of inadequacy of labour.

It may be proposed here in the case of the religious dichotomy linked with production relations in the area that Muslims being the progressive cultivators in the area should be paid extra-attention by protecting their interests in terms of socio-economic accessibilities to the factor markets for the introduction of new innovations in agriculture without social deprivation and discrimination.

Some of the very acute problems in the agrarian scene of the Lower Brahmaputra Valley area include land fragmentation, less employment opportunities, during the off farm seasons, poor organisation of social institutions such as credit facilities, low level of application of advanced mechâneries and less generation of sûrplus in production absence of larger commercial centres and low level of communication facilities which have almost retarded the diffusion of new innovations in agrâculture specifically the High Yielding Varieties programme. The role of community Development Blocks has, however, been commendable as regards the extension services in bringing the illiterate farmers home to the inherent benefit of the agrâcultural innovations. After having examined, the situation is not very satisfactory in the agrâcultural scene. The author extends suggestion that a transformation from the traditional to its modern counterpart can only be brought about in the agrâculture of the rural areas of the Lower Brahmaputra valley through an organised and systematic execution of agricultural policy, so that the trial on the diffusion of any updated innovations in the area will be a greater success. And this needs a perfect coordination between the cultivators, administrators researchers, other committed agencies and the communication media. How this co-ordination could be achieved, needs more research and investigation.