INTRODUCTION

(I) OBJECTIVES OF THE STUDY

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 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 a 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, nonetheless, the numerous qualitative targets are miles to be covered.

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 the south and south-east Asia. With the introduction of HYV seeds during early sixties, the post-
introduction phase highlights an encouraging productivity pattern of the new crops, specifically, rice, in terms, both absolute and relative figures. However, 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 a minimum in the country. The per capita output has not appreciably been increased. It has simply helped maintaining the existing levels of per capita production 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 quickned the formation of a commercial agriculture. The subsistence peasant farming is therefore, in the process of being destroyed with the advent of this new technology (Griffin, 1983)\textsuperscript{36}.

This, an attribute can be singled out as to identify its widespread 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 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 been 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 labours with a high level of farm mechanisation. It has however, ultimately generated a vast potential of human labour, surplus in agricultural sector thereby, regional disparity and increasing the problem of unemployment.

The above discussion mostly reflects the social and economic repercussions on 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 distribution pattern of the new varieties of rice in a micro region (Malda District) of the North Bengal plain which has a tremendous renewable resource base and enormous agricultural potential.

The study is aimed at enquiring into the diffusion, the trend of distribution and depositional patterns of High-Yielding varieties of rice over space. 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 resultant issues and their solutions have simultaneously been explored. The issue thus raised incorporates as to how, why and to what extent the diffusion has been reflected in the several holding strate 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 variety of socio-economic and physical input factors?

Before drawing up the details, it will be worthwhile to discuss about the conceptual work of a diffusion of innovation of any natural or social phenomena, 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 however it is the spatial/behavioural aspects of such phenomena that stands as the primary concern. This relationship between man in the one hand and space and time on the other, if studied in the spatio-temporal dimensions (particularly with reference to HYV of rice) bring 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 lacking is, how far such programmes have really succeeded? and whether they have encouraging results particularly the support of 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 distribution 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 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 trend and extent to which the adoption of High Yielding varieties of rice has been diffused among the farmers of the Malda District. Secondly, it seeks an answer as to the
distribution of output of the HYV revolution in the countryside vis-a-vis the distribution of factor markets. Thirdly, an attempt has been made to distinguish identity and trace out the factors which in fact 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, 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 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. Fourthly, the study examines the choice of the farmer as an individual among more than one option open to him as regards the introduction of modern innovation in his farm under the presumption that the infra-structural facilities (credit, extension services, communication, transport and market) are available, the non-availability of which might restrain the adoption.

Fifthly, the carriers and the barriers in the process of diffusion of HYV rice will be identified with a view to analysing the diffusion pattern of HYV rice adoption in the various strata of the cultivating households according
to their socio-economic standing and farmers 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, religious beliefs, 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. Sixthly, an attempt has also been made to identify the intra village disparities in the diffusion of HYV among the sample villages.

In addition to the above features in farmers social setting, the most initial 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. (Patnaik, 1984) 69

Because there is a fear that small and fragmented fields will stand uneconomic specifically in the investment of costly inputs.

Other than these existing situations around the farmer himself and his farm the organisational facilities such as credit through co-operatives and banks etc. extension services, the essential inputs (water, fertilizer, mechineries) 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 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
adoption 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 uncontrolled supply of water to the crop.

(II) LITERATURE SURVEY

Studies on spatial distribution and temporal change have asked for major emphasis in the field of Geography. However, diffusion of High-yielding varieties of rice and its changing scenario have been attracted by few geographers of national and international levels. But both economic and agricultural scientists have paid a fairly large measure of attention on High yielding varieties and its related problems from topical to regional and from micro to macro levels.

The study of diffusion processes, especially the formation of simulation models, which aims at recreating patterns of diffusion and distribution, has engaged the
attention of many geographers in recent years. This field of study has its origin in the work of the Swedish geographer, T. Hagerstrand, who during the 1950s, developed a technique for simulating the patterns of diffusion of a variety of innovations. Sauver's Agricultural origins and dispersals was a speculative work on the origin of agriculture and its distribution (Sauver, 1952). Then more detailed studies on agricultural diffusion have been studied by Jones (1963), Brown (1965), and Harvey (1966), Metcalf (1969). Special studies on innovation adoption have been made in the underdeveloped world, notably by Schultz (1965).

In India some of very important research work on diffusion of agriculture have been done by Delhi School of Economics, Geographers, namely, Misra (1968). Ramchandran and Roy (1982) distinguish different kinds of agricultural innovation and their adoption by the Indian farmers. Ommen (1986) discussed the influence of Technology on diffusion pattern in Indian Agricultural situation. Raja Gopalan & Singh (1987) discussed on adoption of agricultural innovation in a systematic manner.

High yielding varieties of rice and its related problems have been the main subject in the south-southeast Asia and East Asian countries by geographers, Economists and by the Agricultural scientists. Moreover Japan, Korea and Phillipines have done a significant and meaningful work on this subject.
A number of agricultural scientists and geographers in Japan have undertaken different aspects of High yielding varieties of rice since 1953. Takahashi (1953)\textsuperscript{92} have made an elementary attempt to workout a direct relationship between nutrition requirements and HYV rice of southern Japan. Shiroshita (1958)\textsuperscript{85} draws attention on the geographical conditions required for HYV rice fields in Japan. Murata (1966)\textsuperscript{66} in another attempt, has pointed out that environment specially solar radiation has a tremendous impact on HYV's performance. Tsunoda (1968)\textsuperscript{95} contributed two papers on regional studies on morphological adaptability of short duration of rice varieties. Moomaw Baldago and Lucas (1967)\textsuperscript{64} presented a paper to analyse the effects of ripening period environment on yields of temperate rice in Japan. Fukai (1971)\textsuperscript{34} has highlighted the environmental influence on the potential dissemination of HYV rice of Chao phyrra river basin. The most comprehensive work on the effect of soil to the HYV rice crop has been done in Hokkaido island by Sataki (1976)\textsuperscript{80} where pedology is the main limiting factor in rice production. Rice culture and use of improved seeds and fertilizers was the main study of Matsuo (1980)\textsuperscript{59}.

An intensive work on HYV of rice was conducted by Koreans after 1970. Chang and vergara (1972)\textsuperscript{21} have tried to find out the adoptability problems of HYV seeds in Korean condition and suggested some genetic changes required by geophysical conditions. Choi (1978)\textsuperscript{22} in his work discussed in
the recent advancement in rice breeding in Korea. Chung (1979)\textsuperscript{23} draws attention how low temperature often causes low rice yields in Korea, he also identified few factors cause cold injury to rice, among them, cold irrigation water caused major damage on many rice varieties. Yoshida & paro (1981)\textsuperscript{98} have analysed the influences of different climatic elements on productivity of HYV rice and specially on low land varieties.

The utilisation of High-yielding varieties of rice can be traced first in Koang Tung and Kiangsi areas of China in 1964. Since then Academy of agricultural science has done substantial work on HYV rice. Chang (1972)\textsuperscript{20} has highlighted the cultivation of dissemination and diversification of different HYV varieties. Chang (1978)\textsuperscript{19} has also presented an important study on the morphological changes in paddy field with the different rice varieties. Lin and Yuan (1980)\textsuperscript{57} have attempted to summerise the hybrid rice breeding in china since its inception. Rice yields are influenced by many interrelated and often diverse environmental and biological factors with the result that it is difficult to seperate their effects, was the main conclusion by Zaman (1980)\textsuperscript{99}.

Probably no country has taken up more enthusiastically the rice research than Phillipines. The major reason may be the location of International Rice Research Institute (IRRI) in Manila and various geographical conditions for rice research and cultivation. A large volume of work on
HYV rice have been done in Phillipines covering almost all the aspects. De Datte and Feur (1975)\textsuperscript{28} examined the soil condition of upland rice and its yield rate in Northern Phillipines. Herdt & Wickham (1975)\textsuperscript{39} studied the reasons and exploring the gap between potential and actual rice yield in the phillipines. Huke (1976)\textsuperscript{44} analysed the geoclimatic elements of rice and its relation. Various systems of classification of paddy soils and its specific use in Phillipines have been analysed by Raymund (1978)\textsuperscript{73}. Vegara and Vispears (1979)\textsuperscript{96} incorporated 'Harvest index criteria for selecting rice plants for different regions of Phillipines'. De Datta and Garciai (1979) have given a detailed account on biological constraints to farmers' rice yield in philipines.

A large number of papers and literature have been contributed by the United States agricultural scientists and geographers. Varietal development of rice and grain yield are the main two subjects they handled. Beachheli, H.M., and P.R. Jennings (1965)\textsuperscript{9} have studied the need for modification of plant type for better mineral nutrition utilisation. Bollich and Scott (1975)\textsuperscript{13} have studied rice breeding development in Texas. Johnston, Jodon, Bollich and Rutger (1972)\textsuperscript{49} in their studies discussed short duration varieties and nitrogen responsive rice varieties in the united states specially in Southern region. Johnston, Wells, Hunter and Hebry (1976)\textsuperscript{41} have analysed performance of rice varieties in Arkansas.
between 1971 to 1975. Huey in (1976) and in (1977)\textsuperscript{40} has studied a detailed survey on water management for rice production and factors responsible for spatial distribution of production in California region.

Research on High yielding varieties of rice is equally in progress in some of South-east Asian, South American and North American countries. Among them Peru, Mexico, U.S.A., Taiwan, Thailand and Burma are doing in real sense.

Uptil now the foregoing survey of literature indicates that there have been no planned attempts by the Indian geographers to study the problems of High yielding varieties of rice. However, Indian agricultural scientists, economists and geographers recently have been attracted to study the problems of rice cultivation with a view to finding out ways and means for a better return.

Das (1970)\textsuperscript{25} has marked the agro climatic factors that influence the production of rice particularly in West Bengal. A most informative study on the origin and dispersal of rice has been made by Singh (1971)\textsuperscript{86}, who analised the historical, archeological and botanical evidences argues that rice has its origin in India. It has spread out from India in pre-historic and early historic times and made the global dispersal within the tropical and sub-tropical regions with the passage of time. Since information on the cultivation and
improvement of rice in the saline soils of India is quite scattered. Bhattacharya (1971)\textsuperscript{10} has tried to put them together. Patnaik (1971)\textsuperscript{68} has studied the results of the application of fertilizers in sub-merged rice soils evaluated the nutritional requirements of rice at different growth stages and shown the ways and means of improving soil conditions and the application of fertilizers build on a rational base for getting higher yield of rice. Govindsswamy (1971)\textsuperscript{35} has described how rice production can be increased with the use of better seeds and the application of improved technology, while Mahapatra and Padalia (1971)\textsuperscript{58} have suggested improved agronomic practices for this purpose. Swaminathan (1986)\textsuperscript{90} have studied new farm technology to get maximum benefit in rice production. Dwivedi (1972)\textsuperscript{32} and Shenoi (1975)\textsuperscript{84} have studied the new strategy of agricultural development including rice. Rao and Biswas have found a remarkable progress in rainfed lowland rice condition in West Bengal. Mukherjee discussed the problems of deepwater rice cultivation in West Bengal and possibilities for evolving better varieties. Chatterjee and Maiti (1981) have studied in their book general principles and practices of rice growing. An extensive work with the problems of rice crop in the areas where the crop is grown and its related constraints is the main focus of De Dutta's book (1984)\textsuperscript{27} and ultimately a large number of progress reports by Indian Rice Research Institution. Indian Council of Agricultural Research, Ministry
of Agriculture (New Delhi). Directorates of Agriculture of different states and different rice research stations have enriched the literature of HYV rice research.

(III) HYPOTHESIS

In the present work the following hypothesis will be tested:

1. What is the extent of distributional pattern and disposition of the High Yielding varieties of rice in the Malda District.

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 barrier 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 HYV are neutral to the scale and labour intensive.
6. Whether this district has adequate organisational facilities of the adoption of HYV of rice.

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

8. Whether the farmers of the Malda District are moving from subsistence economy to the market oriented economy.

9. Whether urban influence have any impact on spatial distribution of HYV rice.

10. And finally suggestion to be made so, that the farmer are encouraged for the adoption of HYV rice and to help to improve the economy of the district.

(IV) STUDY AREA

The present study which is confined to the district of Malda in general and some selected villages in particular has been selected as an area of study primarily because being historically the centre of Socio-economic transitions and administration in the entire North Bengal, the data base for this district happens to be well developed, exhaustive and cover a wide range of interlinked subjects mainly on the agricultural issues. Apart from it Malda is agriculturally
developed district in North Bengal and represents the general prevailing conditions of the Bengal plan. And lastly the influence of immigrants has contributed significantly to the complexity of agricultural landscape. The study contends that the elements of the distribution phenomena are known and concern itself with the problem connected with the processes of diffusion of HYV rice.

Malda, the southern most district of the North Bengal is included into the Jalpaiguri division. The district is situated between the latitude $25^\circ 33'08''N$ and $24^\circ 40'20''N$ in the northern hemisphere, entirely to the north of the Tropic of cancer. The eastern most extremity of the district is marked by $88^\circ 28'10''E$ longitude and its western most extremity by $87^\circ 45'50''E$ of longitude. It is bounded on the north by the North Dinajpur district of West Bengal and the district of Purnea in Bihar, in the East it is vastly bounded by the district of South Dinajpur of West Bengal and the district of Rajshahi in Bangladesh, in the south by the district of Murshidabad (West Bengal) in the west by the district of Murshidabad and the district of Santal Pargana of Bihar.

The area of the district according to the surveyor General of India in 3713 Sq.Km. and the population size according to 1991 census is 2479106 with a density of 668/sq.km. (1991).
Malda district has witnessed a sizeable increase in population of 69 percent during 1961 to 1991. For administrative purpose, the district has 2 (two) sub-divisions and 15 (fifteen) blocks. There are 3701 villages and 147 Gram Panchayets, Malda town (Class-I) is the district headquarter. Scheduled Tribes (142579) and Scheduled Castes (333855) comprises 7.0 percent and 16.4 respectively of the total population of the district. The population of Malda is overwhelming rural. About 94 percent of which live in rural areas in comparison to 79 percent in West Bengal as a whole. Thus the burden of demographic pressure on the rural economy of Malda District is much heavier and the pace of urbanization is very slow. (Key statistics, 1990-91).

(V) VILLAGE INTRODUCTION

A brief geographical account of the selected villages under study is as follows:

The basis of selection of the villages is discussed under the sub heading of data base and methodology in the same chapter (Chapter-I).

**Jadupur**: Jadupur represents the urbanised village of malda district. Jodupur comes under English Bazar block approximately at 24°50' north latitude and 88°15' east longitude and characterised by the plain surface land. The
MALDA
SAMPLE VILLAGE LOCATION

FIG-2
nearest urban centre from this village happens to be the
district town Malda and is connected with all, weather
graveled road with the National Highway (NH) 34. Jodupur has a
total population of 1197 and covers an area of 561 hectares of
land distributed among 208 households.

The most important physiographic feature of this
village is that it is located on an extensive tract of Ganga,
hence, the surface is characterised by unvarying monotony of
levelled tract, with total absence of natural undulations. The
surface is well-drained and it has a gentle slope towards the
south. The structure of soil also presents a monotonic
character which is primarily clay loam. The texture of the
soil is generally medium except that of the northern corner of
the village where it is slightly heavier in nature. Though
rainfall is the principal factor in determining the cropping
pattern and extent of cropped area cultivation in this village
nevertheless, irrigation cover a substantial part in the
village. The village is mainly dominated by the Muslim
population.

Chaksundar : The second village of this cluster is
Chaksundar which comes under Gazole block. It is situated
approximately at 25° north latitude and 88°-10' east
longitude. It is characterised by a plain surface land. The
nearest urban centre from this village is gazole town,
approximately 2 km away. It is situated along Gazole-
Balurghat state highway and connected with a metalled road.

Chaksundar is characterised by a relatively upland plain stretching from state highway in the west upto village metalled road having a general slope from North to South. The surface elevation of the village is about 150 feet above the sea level and is well drained except some water logged patches in the southernmost corner, where the village boundary slopes into a marshy tract. The texture of the soil is generally loam and standy loam and fertile in nature. But due to frequent changes in the gap between the surface and the water table, the colour and the texture of the soils present distinctly contrasting views. Though climatically the village does not differ greatly from the rest of the northern part of the district, but on an average it receives a little higher amount of rainfall, which is slightly more than 1500 mm per annum.

Chaksundar has a total area of 347 hectares with 183 households, accounting for its total population of 806. The village has both Hindu and Muslim families.

Rishipur : The Rishipur village (Habibpur Block) situated at 24°30' north latitude and 88°45' east longitude, is the first village of the cluster-II representing a predominantly immigrant Hindu population. It is situated along Aiho-Bamongola metalled road. The nearest urban centre from this village is the English Bazar (town), located
approximately 13 km. away.

The surface feature of this village is uniform alluvial plain as has a general slope towards south-east from the north-eastern side. The composition of soil is characterised by the old alluvium structure, the texture of soil which is mainly loamy and sandy-loamy with negligible acidic differences. The climatic condition of Rishipur is more or less similar to that of the rest of the region.

The village covers a total area of 649 hectares of land with a total population of 1476. The Bengali-Hindus constitute the majority of the population. These people have mostly emigrated from Bangladesh around 1971-72 and immediately there had been and appreciable and noticeable shift in the agricultural land use pattern. The village also have a few santhal households.

Gouripur: Gouripur of Ratua-II block is the second village in this cluster situated at about 20 km. away from its nearest urban centre Malda town and is connected with all seasons Ratua - Manikchak road. The geographical situation of this village is 23°45' North latitude and 87°45' east longitude.

The village presents no characteristically distinct pattern from the physiographical point of view as it has apparently perfect levelled surface which is significantly
monotonic. One inch topographical sheet shows that the average elevation of the village is approximately 120 feet with a minor variations around one or two feet only. The village has a general slope from north-east to south-west.

The soil is pre-dominantly loamy except to that of a small area in the central portion where it is sandy loam with moderate percentage of sand in the composition. The climatic condition of the village presents a similar pattern as to the overall condition of the entire district. Hindu population dominates the demographic setup of the village.

(VI) PLACE OF AGRICULTURE IN THE ECONOMY OF MALDA

Malda is primarily an agricultural economy. It provides employment to 81.3 percent of the total working population and 73.4 percent of the total population of the district. Though agriculture is the main, rather only occupation of the people of the district, it has not been exploited to the optimum level. Commercial cropping or introduction of mechanised agriculture which can earn good money is not extensive.

Agricultural productivity in this district is pretty low as compared to the other parts of West Bengal, and to the national level. The main causes of low productivity is the uneconomic size of holdings, traditional cropping patterns,
low use of modern agro inputs, lack of proper irrigation facilities, absence of institutional finance and over and above national calamities such as droughts and floods.

The total area of the districts is 3,69,048 hectares, out of which 2369 hectares (0.66%) is under forest and 54260 hectares (15.23%) under non-agricultural uses, 4200 hectares (1.18%) are uncultivable land, 1100 hectares are grazing field, 7704 hectares (2.16%) are used for miscellaneous tree growing and 2305 hectares (0.065%) are cultivable wasteland. Net sown area of the district is 2,80,850 hectares (78.89%). Whereas total cropped area of the district is 4,44,252 hectares of which 1,63,402 hectares are under double cropping (Statistical Handbook, West Bengal - 1990)\textsuperscript{89}.

As mentioned, the size of land holding in the district is very small. For example 53.0 percent of the total holdings are below 1.0 hectares. Another 28.0 percent are between 1.0 - 2.0 hectares. About 15.0 percent of the holdings vary between 2.0 - 3.0 hectares. There are about 4 percent of the farmer whose holding size is above 4 hectares. (Annual plan on Agriculture, 1982-83)\textsuperscript{3}.

Foodgrains are the major crops in the district. This included paddy and wheat. Apart from foodgrains, sugarcane pulses, Tobacco, Oilseeds, mulberry and potatoes are grown in
some parts of the district. Paddy, the principal crop in the district occupied 60,010 hectares under AUS, 1,14,232 hectares under AMON and 28,000 hectares under BORO paddy. Wheat occupied 33,688 hectares area in 1993-94.

During the Rabi season like Masur, Kesari and Peas occupied 71,300 hectares in the year of 1993-94 while oil seeds were cultivated in 18,000 hectares. The next important cash crop cultivated in the district is Jute which was grown 27,700 hectares of land.

(VII) DATA BASE AND METHODOLOGY

The entire study is based on both the primary and 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 West Bengal, have been procured. Other relevant data on agro climatic parameters were obtained from the different Government sources which include the records of the Indian Meteorological Department, soil testing laboratory of the Government of West Bengal, District Statistical Office Principal Agricultural Office's Office. In the present work, Community Development Block have been taken as the unit of study. Community Development Block was first introduced as an administrative unit in 1952. The area fixed for a Community
Development Block is to 100 villages with an area of about 10 thousands acres of cultivable land having a population between 60,000 - 1,00,000. These criteria are fixed up by planning commission (Parikkar, 1974).

In addition to these a field survey was conducted in the area under review to obtain first hand informations and data about soil conditions, agricultural practices, levels and dynamic of production and the performance of HYV of rice. A field to field survey in the sample villages of Malda district was conducted in the form of structured questionairs. The schedules were designed at the village and household levels. The basic informations were collected and plotted on the village maps. The ideal method of quantitative study is by systematic field work. In fact, systematic field work is an important component in agricultural geography. For a small area, the entire area coverage is possible, but for a large area like a district, the sample areas have to be positioned systematically for maintaining accuracy in mapping, discussion and analysis. Generally for a standard study dealing with socio-economic aspects about 10 percent of the universe is taken as a sample. But owing to the financial and time constraints and the prevailing social tension, only four sample villages were taken to depict the diffusion and distribution picture of High yielding varieties of rice. Even in the case of 4 villages, it has been found that the
procurement of village maps, showing the field boundaries and in filling up the questionnaires are not easy tasks, mainly because of problem of infiltration and recent implements of land ceiling acts. In fact in the border villages of Malda district the socio political instability and Bangladesh migration issues were the serious impediments for a smooth fieldwork. All the time the villagers remained curious to know whether, the incoming stranger is a government agent, politician, as a social reformer or a simply research worker. During the period 1992-93 when the fieldwork was conducted a strong tension prevailed in this part due to Babri Masjid issue and Bharatiya Janata Party's (BJP) anti foreigners movement.

In the selection of the villages, population structure, demographic composition, urban influence and accessibility factors were taken into consideration. For this purpose all the villages in the Malda District have been categorised into two broad strata, these are:

(i) firstly, all the villages situated within the range of 5 KM distance from the respective town and headquarter, have been assumed to come into closer contact with an intense spell of the urban influence as reflected through the increased modernization of agriculture, relatively easier physical accessibility to the communicational facilities and the number of people working as salaryed
employed and or in difficult commercial opportunities in the nearly urban centres;

(ii) In the second category, those villages have been clustered together, which have evidenced a wide scale of migration and relatively located in the remote parts of the district. In those villages immigrated/immigrated population is a dominant social factor.

Having clustered the villages in these two categories, the principal factor components determining the individual categories have been statistically tested to obtain ranks through kendalls rank indices method. Once the villages have been ordered highest ranking villages each of the two clusters have been combined together to form the basic sampling frame.

Two of the selected villages namely Jodupur (English Bazar block), Chaksundar (Gazole Block) are situated in the vicinity of urban places, the study of which reflects the urban influence on diffusion scene. The other two villages i.e. namely Rishipur (Habibpur block) and Gouripur (Ratua II Block) are located in such areas of the district where urban influence are not strong enough on the farmers and it is expected that there is no such impact in the agricultural scene. Moreover, Rishipur (Habibpur Block) is also evidenced a wide scale migration from Bangladesh. An attempt was made to
meet almost all the farmers in each of the selected villages to know the prevailing socio-economic condition of the people, their response and attitude towards the HYV crops and rice in particular. About 400 questionnaires were completed covering all the section of the farmers representing adopters, non adopters, marginal, small, medium and large farmers. Then in the second order 40 households or sample farmers (10 each from 4 villages) those who have been adopting HYV rice in their farm significantly taken into consideration for detailed study on the trends of spatial variation of HYV rice cultivation within their socio economic and cultural milieu.

The field and on the spot collection of data by a direct interview with the farmers of Malda District, 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 along with 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.

(a) 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 religion, 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 question.

(b) **Holding Size**:

The land holding size of the farmers, in terms of area operated, area owned, fragmentation of fields, pattern of land utilisation seasonwise and cropwise, 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 question framed for the purpose.

(c) **Consumption levels of inputs**:

The information concerning the advance economic inputs such as fertilizer, pesticide, irrigation, tractor, diesel pump, weeder sprayer and the level of their use have been tapped from individual farms through direct interview. The response of each farmers have been filled in against the respective question asked. A specific column has been devoted to record 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.
(d) **Miscellaneous** :

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 dis-satisfaction caused due to any attribute and about physical conditions of the agricultural law.

**(VIII) LIMITATIONS**

The district of Malda is bordering district (with Bangladesh) has unique constraints, in the collection of data (both primary and secondary level). In addition, being a Muslim majority area, had lot of tensions because of Babri Masjid issue during the time of field work (1992-93) and other related socio-economic problems. Furthermore, the researcher, had to face difficulties in procuring data from the different Government departments/offices owing to lack of co-ordination between the departments. In such a situation, researcher tried her level best to cover up the district in general and the sample studies in particular after careful consideration.

**(IX) PLAN OF WORK**

The study planned and designed an environmental cum-socio-economic frame work begins with an assessment of the physiographic background of the region. The agricultural operation being implicit phenomena within the agro climatic set up of Malda district, various climatic indices have been
prepared for a better understanding of the area in terms of environmental conditions. These aspects have been dealt with in Chapter-II whereas, Chapter-I deals with general introduction hypothesis etc.

In the third chapter an attempt has been made to delimit the areal concentration of rice in the Malda district to determine the relative position of the area under study. For the determination of the areal dominance of rice in the different component areal units of the district, hence, for the purpose, the location Quotient method has been applied. Location quotient or the index of concentration of crops has been worked out in the way as given below:

\[
I = \frac{\text{Area of crop 'x' in a component areal unit}}{\text{Area of all crops in the component areal unit}} \times \frac{\text{Area of crop 'x' in the entire region}}{\text{Area of all crops in the entire region}}
\]

If the index value is greater than unity, the component areal unit accounts for a share greater than it would have had, if the distribution were uniform in the entire region of the particular crop under study, Hussain (1981).

This chapter also includes a discussion on how HYV rice introduced in the district, area occupied by HYV rice and its spatial distribution.
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 $p^H$ index) are in explaining the productivity variation of High yielding varities in space. For this purpose, the multiple and stepwise regression analysis have been adopted as the tool to measure the composite effect of these variable on the yield per hectare. The inter-relationship of the variable have been tested through bivariate correlation coefficient. 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 parameter get changed when the new variable are added in rotation. It also suggest whether a new variable is worth considering or not thereby helping to keep a watch over the changes in the value of regression co-efficient and their standard errors.

After having established a cause and effect relationship between the environmental parameter and per hectare yield, a map of yield per hectare superimposed by temperature and rainfall and humidity has been presented 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-relationship of land use characteristics have been measured using Pearson's correlation co-efficients with the test of significance.

In the light of the above discussion, concentrating on the problem and prospects of land use in the study area, the social setting of the farm households has been assessed and evaluated in the sixth chapter. The bivariate relationship have been found out between the yield and the social variable as well. The variables include family size, religion, age of the cultivation, formal education, number of working members and number of fragmented fields. And ultimately the chapter ends with an analysis the differences of High yielding varieties performance within the two clustered of socio-economic set up.

Inferences and conclusions have been drawn in the concluding chapter to assess the cause of less adoption of HYV rice in the area under study. Some important suggestion have been made as to why a conducive atmosphere can not be created
for a better of HYV rice per unit area, so that a large section of farmers will be attracted thereby accelerating the process for a speedy distribution of the High yielding varieties of rice in the Malda District. 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.