ROLE OF GROWTH CENTRES IN AGRICULTURAL DEVELOPMENT IN GOLAGHAT DISTRICT (ASSAM)

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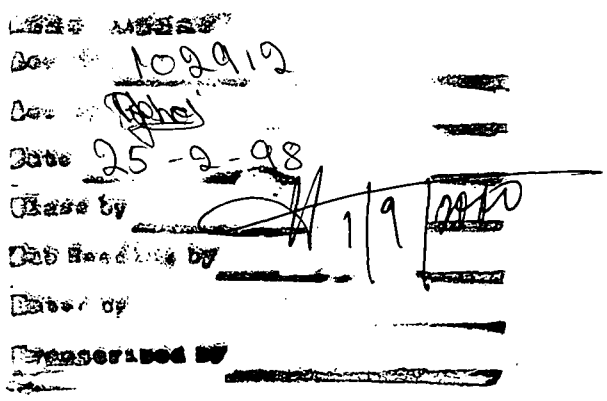

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This is to certify that the dissertation entitled : Role Of Growth Centres in Agricultural Development in Golaghat District (Assam), submitted by Sri Pravat Kumar Phukan for the Degree of Master of Philosophy to the Department of Geography, North-Eastern Hill University, Shillong is a bonafide study of the author to the best of my knowledge and belief. This study may now be placed before the Examiners for due evaluation.

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C H A P T E R - I

CONCEPTUAL FRAME

The idea of growth pole/centre, associated with Perroux (1955) and Boudeville (1966) suggests a dynamic and integrated set of secondary activities like industries organised around a propulsive leading sector. It is a rapidly growing centre which subsequently generates growth through multiplier effects and spillover (Richardson, 1978) in the rest of the economy.

The precise meaning of the term has been made difficult to pin down, however, it is frequently used in a far looser fashion to denote any (planned) spatial clustering of economic activity (Johnston, 1983). The idea has already infected almost all social science disciplines, like, geography, economics, sociology and urban planning (Misra, 1983). Although the idea is widely accepted to use in planning for its simplicity, its suggestion of dynamic ability to locate problem of growth and planning with those of intra and interregional growth, there are certain difficulties associated with both, the idea and in practice (Misra, 1983). Thus it lacks clarity of ideas and structural strength in the model and is yet to acquire the status of theory.

The basic weakness of the conception are ;

a. functional rigidities,

b. conflict between trickle-down and polarization processes,

and c. relevance to varying development situations.

As the hypothesis has root in western economic thought with a pre-conceived role of accelerating development through industrialization in few favourable sites with strong socio-cultural base, it needs no explanation about the amount of social cost and the creation of more problems than solved. Instead, in Indian conditions these have to function as service stations providing services like medical, educational and daily needs; also as innovative and growth promoting centres; as employment centres for surplus workers; and most importantly have to function as the development generation centres for the lower order units in the hierarchy.

GROWTH CENTRES AS A TOOL FOR AGRICULTURAL DEVELOPMENT :

In a country like India, growth centres have to function as social interaction points and as information diffusing centres with extension services, educational services, which can ultimately create economic opportunity and

social togetherness for overall development. In present context, since growth centres of an area are being considered for accelerating agricultural production processes, the functional gathering related to agricultural activities and the ranges of their spread are the main aspects to study. Thus, growth centre concept is helpful in understanding the strategy of agricultural development. In fact, the concept is restricted to functional - organisational space centred on the propulsive forces of agricultural development. According to Harmansen (1972), it provides the inter-related structural features of activity agglomerations through the appropriate direction of economic development through the creation and control of geographical forces of the area. Thus, growth centres strategy of agricultural growth and development may, in present context, be interpreted by considering few but important pre-requisites of this concept as : political stability, provision of agricultural infrastructure, stimulation of demand of agricultural innovations in the area, promotion of appropriate agricultural technology, and provision of agricultural resources leakages from the area, which are helpful for the growth of these centres (Singh, 1979).

Further, the trickle-down processes of growth centre

concept work via hierarchic orders. It might halt, when a particular level is missing. So, the diffusion processes of agricultural innovations are to be operated through these hierarchic orderings of the growth centres for balanced development of the area/region. Functional linkages and ranges of the available agricultural infrastructure are closely associated with the ordering of these centres. Thus, a growth centre, after all, is a planned insertion into the constantly changing landscape demanding scope for extension or reorganisation of the production.

GROWTH CENTRES' ARRANGEMENT AS AN OPTIMISATION TOWARDS BALANCE AGRICULTURAL DEVELOPMENT :

The search for suitability of growth foci in Indian condition finds a four-tier arrangement (Misra, 1983).

1. Service Centres,
2. Growth points,
3. Growth Centres, and
4. Growth poles.

Service centres should perform in local level serving a population of 5 to 10 thousand persons in a number of villages or a big village. The facilities include grocery shops, mini repair facility, restaurant, primary

or middle school, a branch post office, etc. Developmental information may spread via interaction as well as by village level government workers to the present way of life.

Growth points at the next level are to serve 10 to 20 service centres of 50 to 100 thousand persons. These are similar to market towns with tertiary functions predominating. About 2000 market towns in India have the potential of making into growth points. But India needs 10,000 such points for today and tomorrow, with innovative and propulsive thrust aided by well interconnected state High ways and Railways (Misra, 1983). There should be agro-based and mineral based industrial plan to play the role of solving agricultural unemployment problem in the country. The services include a police station, bank, daily market place, godown, a college, fertilizer store, pesticide shop, machine tool dealer and repairing shop, and, of course, a planning cell with expertise and extension officer.

Growth centres at the third high level in the hierarchy of growth foci should serve 50 - 500 thousand population spread over a large region. These should have atleast ten growth points, specialised in secondary activities followed by primary or tertiary functions depending on the economy of the region. These centres are consumers of what growth

points produce out of secondary activities and the produce of primary activities in the service centres and the villages. These centres will absorb by making room for the surplus labour which growth points cannot absorb and at the same time resist the surplus force entering into the already crowded growth poles like big cities. This is the act of 'Countermagnets' making the growth centres as satellite centres around metropolis.

Growth centres will also have large collection of storage and processing facilities for agricultural products. Banking facilities, technical institutions, production facilities for minor agricultural implements and will lead to total urban centres.

Growth pole will be at the height of the hierarchy having population of 5 to 25 lakh dimension. These now exist as big cities. Planning for systematic growth, identifying problems and rectification are essential in these poles. Tertiary functions dominate over secondary and primary functions.

In agricultural context, the idea of growth centres may be well utilised in searching for means to overall development of their own and the area they serve. These centres

have two important processes by which the functions and facilities diffuse to the areas of lower order in the hierarchy through growth points/service centres and individual villages endowed to be benefitted and developed. These are;

1. Spread effect (Myrdal, 1967)
or
Trickle-Down effect (Hirschmann, 1958)

and 2. Backwash effect (Myrdal, 1967)
or
Polarization process (Hirschmann, 1958)

Spread effect refers to the development mainly as a result of the development of the transport network by which interdependence of the services between village level to the growth centre level is well established. This may be achieved through the road transport and railway network which lead to symbiotic self-sustained growth.

The backwash effect or polarization is the process that reserve the growth to selected centres with similar potentiality which ultimately help long term development of the region as a whole.

The ways these processes work are mostly determined by the availability of functions, secondary and tertiary.

Growth centres have a big role to play in supplying

most of the inputs including agricultural information literature, fertilizer, pesticides, high yielding variety seeds, and implements including capital sanctions. Over all, these help in total utilization of agricultural resources along with complete participation of the human resources either in the farms or in agro-based industries locating on the centres.

Thirdly, the functions of the growth centres lie, in fact that the diffusion processes take place because the centres are points of social intercourse and centres of innovations, mechanical or educational. These processes of diffusion in agricultural perspective are of much importance to develop and change the agricultural landscape just to cope with the increasing demand of the products.

Availability of agricultural functions and facilities in the lowest order will determine the nature of facilities that are to be provided in turn by the growth centres. This refers to the stage of the economic advancement of the both orders of growth centres and feeder areas.

GROWTH CENTRE ORDERING AS AN AID TO PROPER AGRICULTURAL RESOURCE LINKAGES :

The linkage of the area served with the growth centres is a determinant of the concreteness of the growth

centres. The higher the linkages, the higher will be the growth for both units. The connectivity of road of the centres also determine the possibility of providing more and more facilities and in turn, more and more raw products will pour the growth centres at minimum cost and time from the surrounding areas. The process will ultimately feed the higher order centres like 'growth poles' earning and adding the total transaction by the growth centres. This will result in the total utilisation of resources, man, land and technology.

In this connection, crowded growth poles will be relieved from the overpopulation which can no more afford employment. Counter-magnetism is thus induced by the growth centres.

GROWTH CENTRES' CONTRIBUTION TO AGRICULTURAL DEVELOPMENT :

Growth centres play pivotal roles by which the entire agricultural scenario is changed. The roles are centripetal and centrifugal in nature which induce development in the centres itself and in the surrounding areas. Agricultural development refers, here, to progressive changes exclusively in the structure and patterns of agricultural productivity and its associated functions like change in occupational structure of the labour force,

improvement in agricultural labour skill and other functions like banking, transport facilities and agro-based industries and marketing of food and fibre (Halcrow, 1981). Agricultural production processes are associated with the established relationship between output and input. In optimising the agricultural production processes, growth centres extend facilities and functions playing the important role because they are the pivotal centres of the interacting phenomena of agricultural development. Diagram shows that the centres growing in the rural areas, whether they are larger villages or small towns, accelerate the processes of its own growth and of the development of the surrounding areas are dependent on availability of resources in the area, natural as well as human (Figure 1.1). For example, if the surplus production(food production and /or agro-based raw material) is available in the area, the functional structure of growth centres of the area would develop accordingly. Further, it is also fact that if abundant labour in the rural areas (labour surplus) is available, then, it migrates to these growth centres and, consequently, stabilises the wage-rates on these centres. Therefore, they are acting as 'shock-absorber' and 'agro-processing/food collecting' centres of the area.

These centres are contributing to the agricultural growth and development in the areas of agricultural

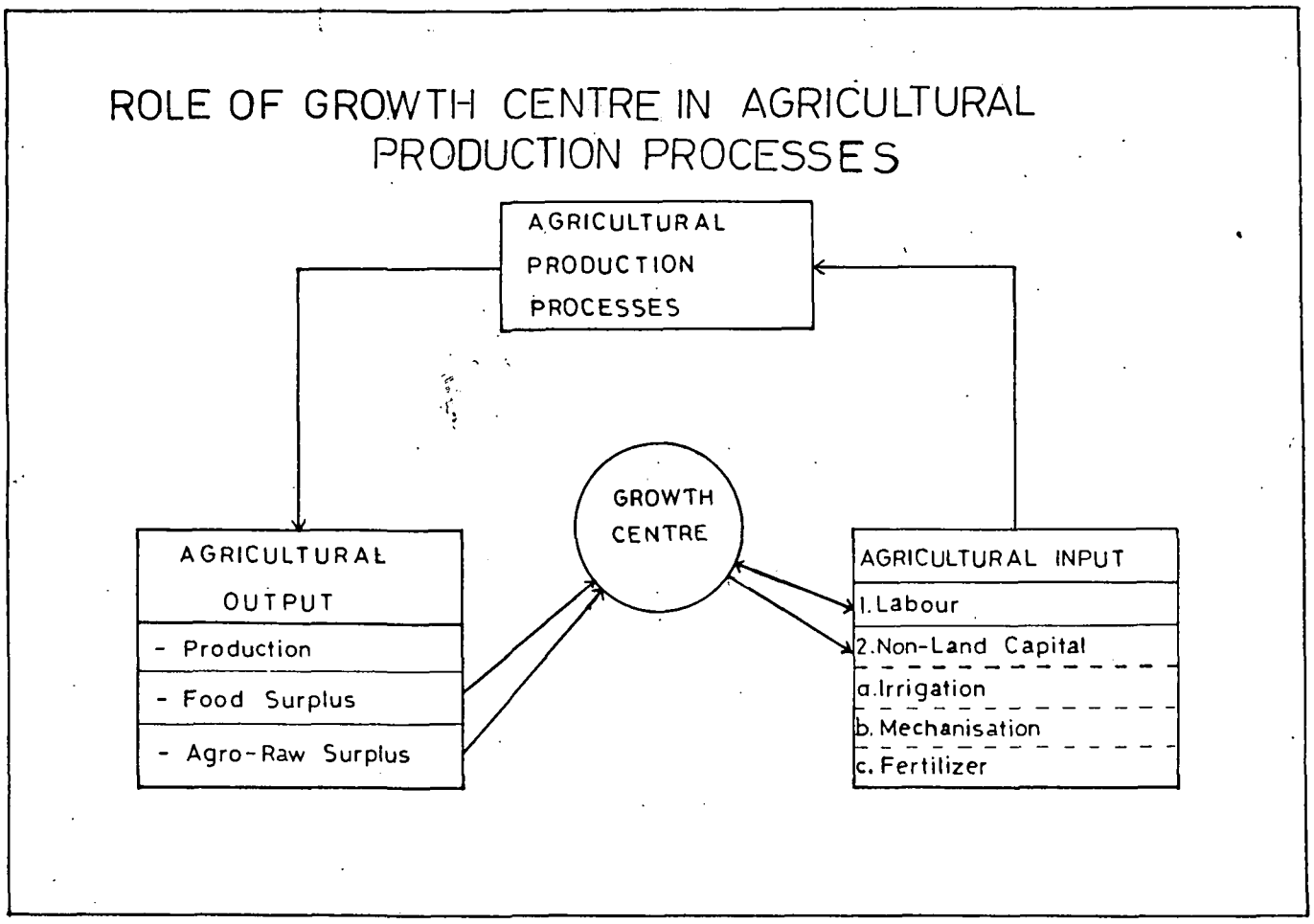
ROLE OF GROWTH CENTRE IN AGRICULTURAL PRODUCTION PROCESSES
AGRICULTURAL PRODUCTION PROCESSES
GROWTH CENTRE
AGRICULTURAL OUTPUT
- Production
- Food Surplus
- Agro-Raw Surplus
AGRICULTURAL INPUT
1. Labour
2. Non-Land Capital
a. Irrigation
b. Mechanisation
c. Fertilizer

Fig. 1.1

domination in the following four ways.

First, the expansion of domestic agriculture not only for sustainable increase in the supply of food, but transfromation of the existing subsistence type of commercial agriculture, wherefrom surplus is expected for the change in totality and changes in the functional structure of the growth centres. This surplus, in turn, is used as raw materials in other industries. Because of the result of agro-industrial development of these centres, this is called the 'production-processing contribution' of the growth centres.

Secondly, the agricultural surplus will create markets where products are to be assembled for sale and consumption in the centres and also for sale of the processed products in and outside the growth centres. Further, development in the area/region as a whole would be dependent on these centres where market facilities would be intensified. It is called 'market contribution' of growth centres to the agricultural development.

Thirdly, growth centres help diffusing the agricultural input factors like mechanical as well as bio-chemical. The agricultural land use processes, namely expansion and intensification, may include newly reclaimed area

as a result of introduction of technological inputs, transformation of unfertile land into productive one by use of proper technological inputs. These centres would help to diffuse these agricultural innovations. Therefore, it is called the 'acceleration of diffusion processes' and 'factor contribution' to the agricultural development.

The function of growth centres are to generate employment for the surplus labour force, a phenomenon of green revolution and mechanisation, to generate processing and consumption of surplus food from the bordering units. The rural to urban migration is also due to the higher wages at these centres and to the low productivity of land in the surrounding areas. Thus growth centres act as 'shock absorber' of the surpluses (whether labour or agricultural production).

STAGES OF GROWTH AND DEVELOPMENT OF GROWTH CENTRES :

As a result, the study of the organisation of the growth centres is a major tool for agricultural development. While, the arrangement of those growth centres would give the tendency of whole spatial system to optimise the balanced agricultural development of the area, their ordering is useful as an aid to balance the agricultural resource linkages of the area. In this connection, the areal personality of the agricultural resource is also important to study.

Analogically, growth centre suits Davisian concept of landform which is a function of structure, process and stage. Similarly, growth centre is a function of push, pull and push back factors in its development. Distinctiveness of growth centres, and functional and qualitative change in the surrounding areas are the result of continuous and even cyclical forces like diffusion of innovation and services and other agricultural production forces. Similarly, distinct land forms are common at different stages in the cycle.

As the different stages of agricultural growth proceed, its certain characteristic features are inevitable. Characteristic features are conspicuous at different stages of development such as, mandi, periodic market, warehouses, agro-based industries, developed transport links, communication set-up, and agro-technical institutions, and so on, in both the growth centres and surrounding areas. On the basis of pull and push forces of growth centres, their growth proceeds following its three stages which lead directly to the development of the entire area. They are initial stage, mature stage, and final stage of growth.

In the initial stage, diffusion of agricultural innovations, new technology take place to the surrounding areas. This push force accelerates the stagnant agricultural activities for a better production. Agricultural labour

force in part, may be pulled as normally to the centres for better prospects. The push forces start showing more yield resulting in surplus production.

In mature stage of development of growth centre, simultaneous pull factors come into force in due course of time. This can be observed by the structure of food collecting functions, mandi and other periodic market functions.

The final stage (old), the functional structure of the growth centres is completely changed to non-agricultural activities. Large markets for interchange of food and finished products are common. The complete change in the set up is achieved where both push and pull forces make growth centres to be identified as big towns and cities.

Thus in studying the role of growth centres in agricultural development these stages of growth of the centres must be taken into consideration.

STATEMENT OF THE PROBLEM

The economy of Golaghat district (Assam) is basically dominated by agricultural activities. The rapid growth indicates the development of new emerging centres in the area through which various processes of agricultural development are taking place. Therefore, the growth of growth centres is positively related to the rate of increase in the agricultural

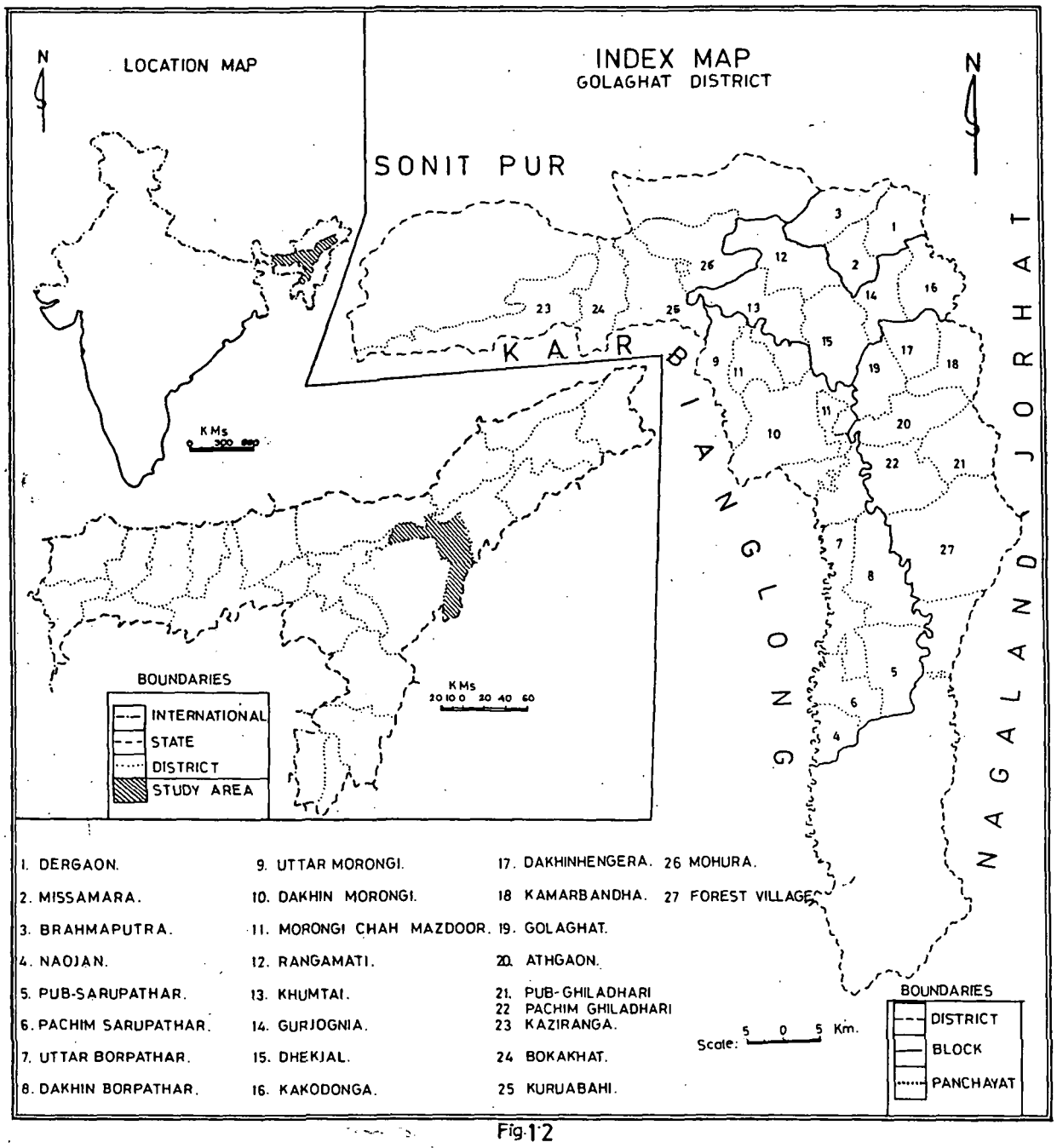
LOCATION MAP
N
INDEX MAP
GOLAGHAT DISTRICT
N
SONIT PUR
K A R B I A N G L O N G
NAGALAND
JORHAT
KMs
300 0 300
KMs
20 10 0 20 40 60
BOUNDARIES
INTERNATIONAL
STATE
DISTRICT
STUDY AREA
1. DERGAON.
2. MISSAMARA.
3. BRAHMAPUTRA.
4. NAOJAN.
5. PUB-SARUPATHAR.
6. PACHIM SARUPATHAR.
7. UTTAR BORPATHAR.
8. DAKHIN BORPATHAR.
9. UTTAR MORONGI.
10. DAKHIN MORONGI.
11. MORONGI CHAH MAZDOOR.
12. RANGAMATI.
13. KHUMTAI.
14. GURJOGNIA.
15. DHEKJAL.
16. KAKODONGA.
17. DAKHINHENGERA.
18 KAMARBANDHA.
19. GOLAGHAT.
20. ATHGAON.
21. PUB-GHILADHARI
22 PACHIM GHILADHARI
23 KAZIRANGA.
24 BOKAKHAT.
25 KURUABAHI.
26 MOHURA.
27 FOREST VILLAGE
Scale: 5 0 5 Km.
BOUNDARIES
DISTRICT
BLOCK
PANCHAYAT

Fig.1·2

activities. During pre-green revolution period, the growth of these centres was based on other factors than agricultural activities. But during post-green revolution period (after 1970s) these centres are playing significant roles by accelerating various processes related to agricultural development, like diffusion of agricultural innovations, agricultural extension service and mobilising the surplus of agricultural products and agricultural labour. They are also helpful for employment generation and are the centres for functional interaction. If the growth centres are considered as spatial equilibrium of agricultural development pattern of an area, there should be positive relationship between the structural growth of these points/centres and agricultural development.

These relationships can be studied by taking into account, (a) the areal patterns of agriculture development and their changing tendencies over time, and (b) the changing nature of activities specially related to agriculture and factors of change over time. It is also pertinent to explain how these growth centres are radiating the effects of development towards their surrounding areas and are helpful for agricultural development in the area. The nature and spatial interaction patterns of growth centres, the distributional pattern of agricultural development of the area, the

relationships among the components of agri-development and the functional linkages tied up with the growth centres specially relating to agriculture, are some of the aspects that need scientific explanation.

For systematic conceptual study of the problem, part of the Upper Brahmaputra valley comprising Golaghat district of Assam has been taken into consideration partly because of its richness in agricultural resources and their improper utilisation. However, the agricultural productivity in the area has been recorded very low (Rs. 854 per hectare) with its negligible decrease during 1970-1 to 1990 - 1 (0.90 p.c.).

Golaghat district covers an area of 3541.0 sq.km. with a total population of 5,36,608 persons in 1971 and 3502 sq.km. with a total population of 8,01,740 persons in 1991, according to provisional census. Agriculture is the dominating occupation in which 65.4 per cent of working force is engaged. Very low level of cropping intensity (107 per cent which is lower than that the state level of 123.5 per cent), low percentage of irrigated area to the total NSA (7.0 per cent), low agricultural yield her hectare, low percentage use of chemical fertilizers (7.5 per cent) are some of the aspects inspite of its rich growth potential on account of favourable physiographic as well as human resource

conditions. With agricultural conditions prevailing as such, there is ample need of operating various developmental processes through emerging growth centres.

OBJECTIVES

The present study has been oriented on the basis of the problems, facts and figures cited above to the following main objectives :

1. To analyse the distributional pattern of agricultural productivity and its changing patterns.
2. To evaluate the contribution of growth centres in the agricultural production processes.
3. To establish the relationship between the agro-based functional structure of growth centres and change in the level of agricultural productivity.

RESEARCH QUESTIONS

The main objectives of the present study reflect the structural relationships between the changing nature of growth centres and levels of agricultural development. Three major research questions demand proper explanation.

i) How the agricultural innovations and the effects of green revolution technology are being diffused

to the surrounding areas through growth centres?

ii) How the growth centres are influencing the leakages of agricultural resources for sustainable growth and well-balanced development ?

iii) To what extent the spatial linkages of the area which are controlled by the growth centres, are influencing the level of agricultural development ?

These questions are directly related to the structural change of the growth centres and the areal variation of agricultural development over a period of time.

DATA BASE AND METHODOLOGY

Data regarding the treatment of the first question is concerned are collected from secondary as well as primary sources. Publications of Directorate of Economics and Statistics, Government of Assam, Agro-Industries Department, Fertilizer Corporation, Seed Corporation, and the office reports collected from Land Mortgaged Banks, Commercial Banks, Co-Operative Banks, Community Development Blocks, Panchayat Offices, non-government fertilizer-pesticide shops and machine tool dealers, are some of the sources of secondary data. The primary source includes the data relating to agricultural information, exhibition and training of the innovations through panchayats or any other individual or organisation.

Regarding the second question, data from secondary sources collected from recent publications of hand books published by the economic and statistical department, have been processed and analysed. Moreover, panchayatwise agricultural resource data have been collected from different panchayats and community Block Development offices alongwith revenue collectidn offices. As regards to the collection of primary data for showing strength and control of the growth centres, the number of functions/facilities related to agriculture available in the growth centres have been collected. Data of beneficiaries availing functions/facilities, number of people from panchayats benefitted, such as from banks and fertilizer-pesticide shops, etc., have been collected by questionaires method.

Despite the inevitable constraints of data, the structural characteristics of agricultural development have been analysed by calculating agricultural production and productivity indices, agricultural inputs, and infrastructural variables for two points of time, i.e. 1969 - 72 and 1989 - 92.

PRODUCTIVITY - PRODUCTION GROWTH : METHODOLOGY

Agricultural productivity may be defined as the ratio of out put to input in relation to land, labour and capital and overall resources employed in agriculture.

Agricultural productivity can be increased with lesser amount of capital investment in the initial stages with the existing but dynamic work force, but with proper use of technology in an effort to increase the yield of important crops leading to more production. Increased agricultural productivity is the pivot on which development revolves. As the horizontal expansion in agriculture is limited vertical expansion of it might be an appropriate tool to combat with the 'menacing calamity like starvation' (Myrdal 1967) of the increasing population and to feed many agro-based industries. It is also tool for removing rural poverty in India (Ahluwalia, 1978). Therefore, it is important in this sense to look into the dimensions of agricultural productivity like its functions, patterns, constraints in details so that development processes can be reoriented in potential areas.

For the purpose of finding agricultural growth and productivity, Bhatian concept of conversion of area and yield of the various crops would have been the best (Bhatia, 1967). But it is applicable only for one point of time. The temporal variations can not be analysed by this method because of its shortcomings (Dayal, 1984). Therefore, the agricultural output of each areal unit has been calculated by converting crop-production into its money term with the help of multiplying the total production of each crop by its harvest price.

The mathematical expression of productivity calculation is given as :

$$Y = \frac{\sum_{i=1}^{n} (A_i \; Y_i \; P_i)}{A_n}, \quad \ldots\ldots (1.1)$$

$$\text{and} \quad O = \sum_{i=1}^{n} A_i \; Y_i \; P_i \quad \ldots\ldots (1.2)$$

Where Y = the agricultural productivity per areal unit of panchayat.

Ai = the area of the i th crop.

Yi = the yield of the i th crop.

Pi = the harvest price of the i th crop, and

An = gross cropped area of panchayats.

O = agricultural output in money term.

Here, the panchayatwise data in relation to area and yield of various crops are required. Yield of different crops is calculated from the available production data of crops while the prices of crops is available at district agricultural marketing offices, agro-based household and non-household industrial establishments. Primary investigation is also conducted in this respect in different panchayat areas of the district. 1970 - 71 harvest prices have been considered as constant in finding the out-put for both the points of time, so that comparison becomes meaningful, and influence of price change controlled.

Agricultural area, land use and cropping pattern data have been collected from different circle offices of the district. General informations of agriculture, such as population, occupational structure, technological input have been collected from the district offices of agriculture, Department of Economics and Statistics, Agro-industries Development Corporation, Block Development Offices. Apart from it, statistical handbook of Assam for different years of the specified period, census handbooks including 1991 provisional handbook Journals of Assam Agricultural University, Jorhat, Agricultural Atlas of Assam by the same university, Status Report of the Titabor, Rice Research Station; Geological Survey of India Regional Office, Shillong for geological map and other relevant informations, have been some of the sources of informations and maps.

The cropping intensity is calculated by using the following simple formula.

$$I_r = \frac{G\,C\,A\,r}{N\,S\,A\,r} \times 100$$

Where I r = Cropping intensity in unit r in percentage.

$G\,C\,A_r$ = Gross cultivated Area of r th areal unit,

$N\,S\,A_r$ = Net sown Area of the r th areal unit.

Since the total agricultural production is calculated

by applying equation (1.2) for a particular point of time, the agricultural production growth rate is calculated by simple method of linear growth rate as follows :

$$r = [(P_1 - P_0)/ P_0] \times 100 \quad \ldots\ldots (1.3)$$

where r = rate of growth

P_0 = Production (out-put in rupees) of 0-th year,

and P_1 = Production of the i-th year.

It is important to note here that there are many and varied methods of calculating agricultural growth. For example, Minhas and Vaidyanathan (1965) measured growth by applying decomosition scheme of the growth components. Bhalla and Alagh (1979) have also given a good scheme for the same and included interaction factor for agricultural growth assessment. But, in the present context, simple aggregate scheme of agricultural production growth is measured with the help of above equation (1.3). Further, annual average growth rate of agricultural production is calculated for two decades (1969 - 72 to 1989 - 91) considering 1969 - 72 as base year, P_0, and 1989 - 91 as current year, P_1.

For describing the distributional pattern of agricultural attributes, Gaon panchayats (Gram panchayats) have been taken as areal units. The spatial pattern of growth centres influence have also been interpreted by preparing

maps for two points of time. To show the relationship between the influence of growth centres and agricultural development pattern, maps and diagrams have been prepared and the results are traced out with the help of superimposing these maps.

The detailed study of the functional structure of the growth centres at various level and stages, is carried out by taking into account the three major growth centres of the area, namely, Golaghat (district headquarter), Dergaon and Bokakhat (main centres).

Design of the Study

According to the objectives and research questions stated above, the whole material is arranged in coherent way in the following manner. Chapter I deals with the concepts, statement of the problem, objectives, research questions, data base methodology, while the Chapter II deals with the agricultural production factors of the area. In the third Chapter agricultural development and production processes of the area have been dealt with emphasis on the temporal change in relation to physical, cultural, and economic situations. Chapter IV deals with the detailed study of the role of growth centres in agricultural development of the area, and the last Chapter includes conclusion and suggestions.

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C H A P T E R - II

AGRICULTURAL PRODUCTION FACTORS

Resources are living phenomena, expanding and contracting in response to human effort and behaviour. To Zimmermann, the word resource does not refer to a thing or a substance, but a function that a thing or the substance may perform, or to an operation in which it may take part in, namely the function or operation of attaining a given end, satisfying a want. In the context of agriculture, according to Zimmermannian concept of resources, agriculture may include those components of crop ecology, like soil with its numerous dimensions that influence agricultural productivity, rainfall that forms, with its all associated phenomena, an important attribute to the present subsistence type of monsoon-fed cultivation like ours in this region, solar radiation and many others. Agricultural resource may also include the knowledge of existing technological aspects, like crop technology, irrigation, fertilizer, mechanisation of cultivation, planting, pruning, harvesting, storing and processing, and many others including crop rotation and crop protection etc. The most important agricultural factor is the man himself, because without him a natural resource cannot become an economic resource. Thus agricultural resources include all the functions and operations

aimed at the increasing production and productivity by way of utilizing land without mass damage to the same.

It is often alleged that some of the agricultural programmes, for example, irrigation, fail because of the lack of the detailed knowledge of the agricultural resource personalities of a region wherein the programmes is to be implemented. These schemes are sometimes partially successful and at times, failure because of lack of basic information of natural resources available in areas under consideration. For example, underestimation of rainfall, soil study, inadequate topographic survey, were the drawbacks in irrigation scheme in Mali in 1920s where, later it was found that economic yield of cotton, there, could be produced without irrigation (Arnon, 1981). It is, thus, clear that detailed information of the resource personality of the area is very much essential before going to frame any agricultural decisions and planning.

Basically Agricultural practices are the result of various physical as well as human factors. Physical factors can be classified into three types, (a) topographic features, (b) soil fertility and (c) climatic conditions. Although these are interrelated and interdependent, the study of those factors would be helpful in understanding the causes of productivity

variations.

On the other hand, human factors are also important to agricultural production. Human resources include man as beneficiary as well as an agent of production. Besides supplying the labour force to agriculture, man as population also serves as a market for the product generated by themselves, and directs the agricultural production processes, discovers new ways of utilizing new agricultural lands for more production and productivity. Age groups, sex-ratio and education through training and demonstration of modern agri-practices are some of the important aspects so far human resource in agriculture is concerned.

Before going through details of the different agricultural resources in the area, it would be pertinent to note somewhat details of the physical as well as human factors of agriculture for a better understanding of the influence by geomorphic processes in shaping the agricultural production processes and factors of Golaghat district.

A. PHYSICAL FACTORS

Golaghat district, the present study area is, physiographically, a part of the Brahmaputra valley (5,6480 sq.km.) of Assam. Although the valley exhibits quite a monotonous landscape, the study area is a combination of landscape with

attitudinal variation in the valley itself from flood plain areas of the Brahmaputra and its tributaries through high old alluvium to still higher foot hill areas of the tertiary folds in Nagaland and the Cambrian land mass in Karbi Anglong to the south and to the west respectively.

The Brahmaputra valley, the bigger of the two, other being the Barak valley (6962 sq.km.), includes the region between 25°45'N to 27°55'N. latitude and from 89°4'E to 96°2'E longitude. The valley shows quite a peculiar physical and socio-economic aspects; floods and draughts are common, and the peoples are not quite responsive to seed-fertilizer-technology culture.

Administratively, Golaghat district is one of the twenty three districts of Assam, seven of these comprising Upper Brahmaputra Valley that includes the districts of Tinsukia, Dibrugarh, Sibsagar, Jorhat and Golaghat on the south bank of the Brahmaputra and Dhemaji and Lakhimpur on the north bank. The present Golaghat district, the seventh largest district of Assam in terms of its area, was a sub-division of erstwhile Sibsagar district and later erstwhile Jorhat district till it became a district in 1987.

Golaghat district covers an area of 3541 sq.km with only 6.27 per cent of the Brahmaputra valley. The boundary is

demarcated by Nagaland state in the south, Jorhat district on the east, Nagaon and Karbi Anglong district on the West, and the northern limit by the Brahmaputra river.

The Brahmaputra valley is surrounded by the Eastern Himalayas, Patkai and Naga Hills on the north and on the east, Meghalaya plateau and Karbi Anglong (Mikir) Hills on the south. The valley is elongated but narrow with a length of 720 km. and an average with of about 80 km. The valley is narrow where projections of the Karbi plateau and the Meghalaya plateau delimit the plain to around 30 km. The south Brahmaputra plain is irregularly monotonous, as there are plain embayments created by the large tributaries entering into the plain from the plateau and hills unlike the north Brahmaputra plain which is fairly regular.

The district conforms the general characters of the southern Brahmaputra valley. It has occasional hillocks near Negheriting in Dergaon for example, highland areas along the south western boundary of the district near Numaligarh, Kazifanga and beyond.

The Brahmaputra valley is believed to have developed on the foredeep between the Tethyan geosyncline and the projection of the Decan plateau. The foredeep remained under water for long period of time and had resulted in aggradational

processes. These processes led to accumulate on the underground tongue a number of strata on succession, like Jaintia group having limestone, followed by Bareil series (having oil), Surma and Tipam series (oil), and lastly by the Dihing series spanning from Eocene to Pilocene. Alluvium was deposited at the close of the pleistocene period in the form of sand, pebble, gravel, and boulder along the foot hill regions. These are seats or terraces of the older alluvium where, now most of the townships and tea gardens have flourished. New alluvium, later, was deposited by a number of rivers rising from the Himalayas and Patkai-Naga Ranges over the tertiary beds of the Brahmaputra valley. This is estimated to be 1500m thick in average (Singh, 1971).

The Brahmaputra valley has a very gentle slope of 13 cm. per kilometre from east to west which accounts for the lateral abrasion resulting in bank erosion of the Brahmaputra, more particularly seen in the southern bank causing damage to the agricultural and residential seats. The north-south cross section of the valley shows steepness on the north due to sudden fall of elevation from 500m contour to 200m; and a relatively gentle slope on the south in Tirap and Nagaland, with more gentler slope in the west near Meghalaya and Karbi plateaus (Taher, 1974).

The presence of a number of alluvial fans coalescing to form the Bhaber Zone, exclusively in the northern part of the north Brahmaputra valley accounts for the sudden encounter of the dead plain and thereby release of boulders, pebbles, cobbles, sand and silts at the change point. These zones later did join together to form the Bhaber belt. Braiding and intermittance occur here in case of big and small rivers respectively, sometimes forming swamps in depressed areas. These are Tarai Zones which in course of time join to form what is known as Tarai Belt in parallel line with the Bhaber Belt. The Tarai Belt is the seat of occurrence of many small seasonal rivers resulting in wet soil condition with luxuriant forest growth. To the south of the Tarai, and parallel to it, lies the relatively high land, also may be referred as 'built-up' zones and still south of this zone, there lies the flood plain of the Brahmaputra where a number of swamps and 'beels' are found to embrace a number of north bank tributaries and ultimately allow to open into master rivers through sub-parallel courses.

The south Brahmaputra Valley, also consists of a series of terraces along Lohit, Tirap and Nagaland and along Karbi plateau on the upper part of the valley. But the lower part is characterised by the presence of a series of swamps and beels along the Meghalaya foothills, which were formed

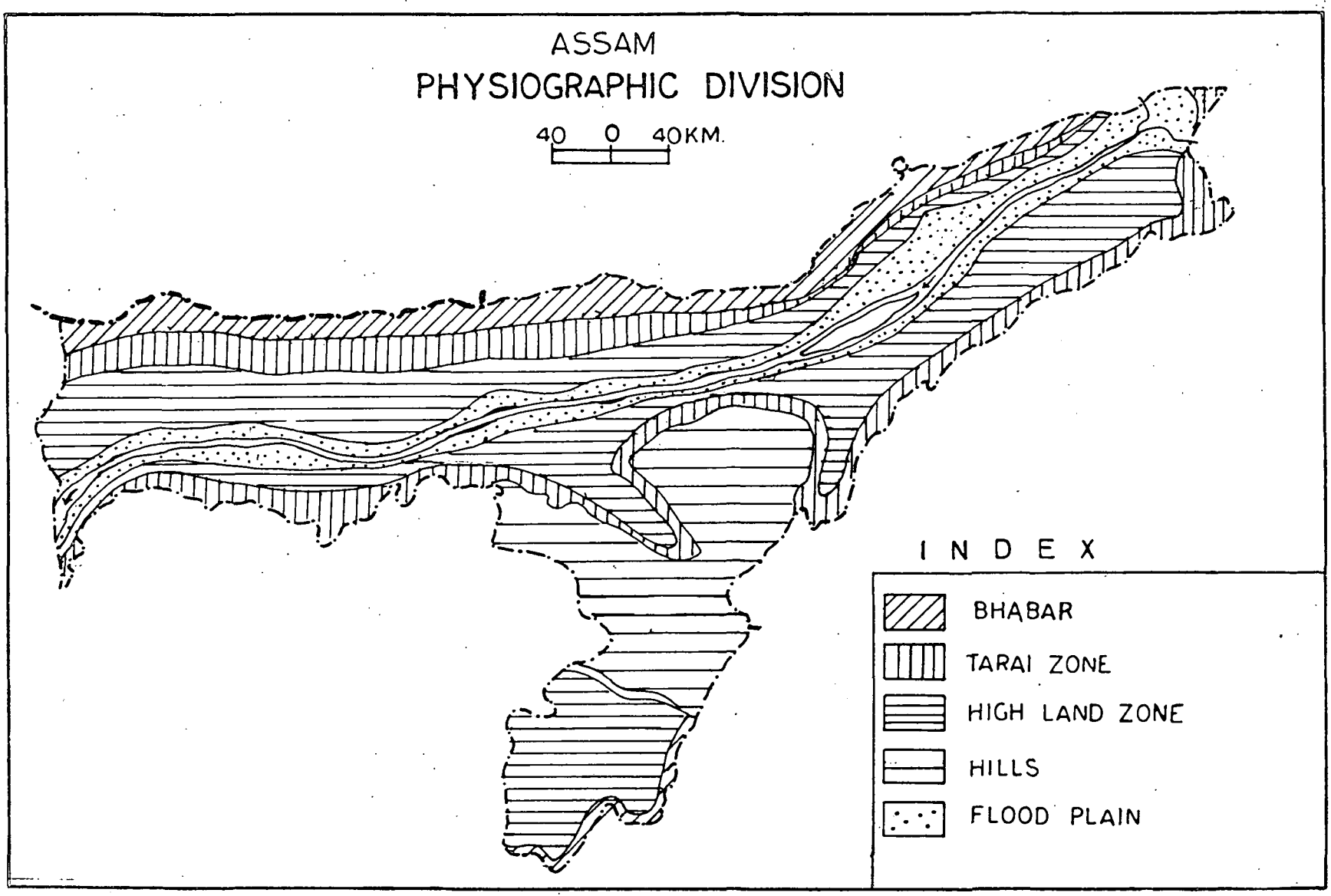
ASSAM
PHYSIOGRAPHIC DIVISION
40 0 40KM.
INDEX
BHABAR
TARAI ZONE
HIGH LAND ZONE
HILLS
FLOOD PLAIN

FIG:2.1

by processes of degradation, in contrary to aggradational processes. This is conspicuous along south Nowgong, South Kamrup and South Goalpara plains. To the north of the foot-hill terraces and swamps there lie the relatively high land areas or 'built-up' areas. Further north, irregular but extensive flood plain zone is formed which is of considerable importance as geographic unit, containing 'chars' 'chaporis' and islands of sandy loam in nature.

The study area, Golaghat district, however, lacks the characteristic Bhaber zone of the north Brahmaputra valley. This is attributed mainly due to the gentle hill-to-foot-hill contour difference per unit distance in Nagaland and adjoining study areas(fig. 2.1). Instead, Tarai belt is prevelent on the southern part of the district which offers the region conditions congenial for luxuriant forest cover. Nambar Reserve forest, Diphu Reserve forest, Rengma Reserve forest on the southern part and Kaziranga Reserve forest on the western part of the district are the notable seats of Tarai plant growth.

Northward, the Tarai belt averaging 20km. in width begins to merge with the relatively lower terraces of high-land zone. This is an extensive area in this region covering almost 60 per cent of the entire area of the district where

as it mentioned earlier, referred to as 'built-up' areas, a number of townships and tea gardens and almost entire residential functions have been accommodated. Also, most of the agricultural practices along the riverine tracts and comparatively low lying areas of the high land terraced zone known locally as 'Pothars', take place. Sital Pothar, Dadhara Pothar, Rajabahar Pothar, Leblebi Pothar, Dihingia Pothar, Chowdang Pothar, Morrongi Pothar, Rohdhola Pothar are some of the important pothars (paddy field) for crop culture. These paddy fields have very little or no irrigation facilities and sometimes are prone to floods caused by tributaries of the Brahmaputra like the Dhansiri, Difolu, Kakodonga, etc. and by the distributaries of the Brahmaputra itself like the Gelabil. These fields are also prone to infrequent drought.

Further northward, in the bank areas of the mighty Brahmaputra, a huge area is found to be packed with beels, chars and chaporis extending in most cases to the near centre of the Brahmaputra bed itself; and also with occasional Archean hillocks as in Negheriting. This sandy loam area is prone to frequent floods but rich in paddy and mustard cultivation. This flood plain zone accommodates almost entire peasants from plain tribes community and Muslim immigrants. This narrow belt

everaging 8km. in width is the area of hazards caused due to low discharge of water by the tributaries to the main channel, the bed of which is not deep enough, a phenomenon of upliftment of the bed in 1950 earthquake. Bank erosion is evident and anormous as in Dhansirimukh and Chikarighat and elsewhere, due also to the southward movement of the Brahmaputra.

The Dhansiri and Dayang rivers, both after crossing extensive areas with low gradient are forming innumerable ox-bow lakes and beels owing to their meandering courses (Fig.2.2). Perhaps the Dhansiri river is one of the most meandering rivers in the world. These lakes help thick forest cover and also make the area fertile resulting in anormous production of rice and sugarcane. Right from Chungajan to Dhansirimukh, the Dhansiri river establishes an unique fluvial dimension demanding special attention to the impact on agriculture.

1. Drainage

More than one hundred large and small rivers along with the river Brahmaputra, dominate the fluvial action and shape the physiographic scenario of the Brahmaputra valley.

Rising from the beighbouring of Manasarowar in Tibet

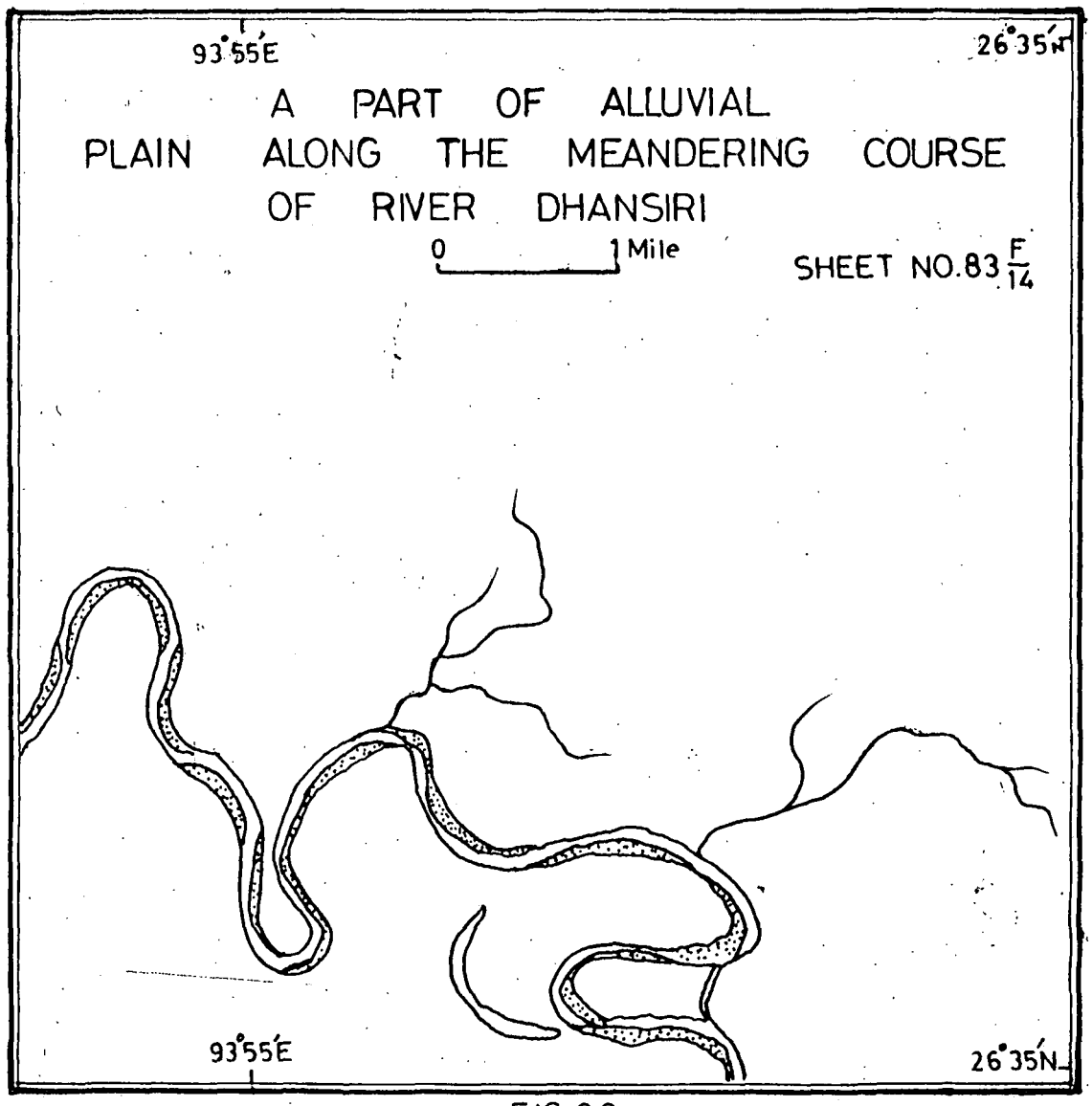
93°55'E
26°35'N
A PART OF ALLUVIAL PLAIN ALONG THE MEANDERING COURSE OF RIVER DHANSIRI
0
1 Mile
SHEET NO.83 F/14
93°55'E
26°35'N

FIG.2.2

from the glaciers like Chema Yangdang on the Trans-Himalayan zone at an altitude of 5150 mts, the river Brahmaputra flows over natural synclines for about 1400km. with different names in different regions, Matsong or Tamchok Khambab or Tsangpo in Tibet, Siang or Dihang in Arunachal Pradesh. Finally the river meets Dibang and Lohit to be named as the Brahmaputra to flow westward in Assam. It has, on the north bank, fifteen and on the south, ten rivers are fairly large and navigable throughout the year. The Subansiri, Jia-Bhareli, Manas, Sonkosh, Barnadi, Pagladia, Jia-Dhansiri, Dikrong, Jia Dhol, etc. are the important north bank rivers; and the Buri-Dihing, Dhansiri, Kopili, Dikhou, Digaru, Kulsi, Krishnai are the main rivers on the south bank.

Relatively soft tertiary rocks and heavy rainfall help the rivers of the both banks to erode and transport enormous volume of load to supplement the inherent force of erosion of the river Brahmaputra. The melting of snow in the Himalayas causing landslides also helps maintaining the high degree of load amount of the rivers that originate from melting zones. This results in, subsequently the formation of alluvial fans. The rivers, thus, resort to braid. The force during flood is enormous with a gradient of 1:25 to 1:30 magnitude. This is why north bank tributaries frequently

change their courses for obstruction of aggradational nature. The results of the fluvial processes in the valley can be seen in different parts of the valley. As the Brahmaputra is slowly moving southward, many places like Dibrugarh, Disangmukh, Nimati, Dhansirimukh, Moriahole, Palashbari, Goalpara are facing bank erosion to a considerable degree. Majuli island was created as a result of southward thrust of the Brahmaputra bed. As a result of the same fact the Buridihing and the Dhansiri rivers had to surrender a considerable length to the Brahmaputra. One important aspect is that the confluences of the north bank rivers are migrating to the south west, whereas, those of the south bank rivers are migrating to the south east (Taher, 1986).

Apart from the fluvial impact of the river Brahmaputra in Golaghat district, the Dhansiri with its tributaries play an important role in forming the present topography. The Dhansiri basin (4766.40 sq. mile) includes the eastern part of the Mikir or Rengma hills and south western part of Golaghat district. The tributaries of it include first order streams like the Chungajan, Lengtajan, Rengma or Dayang, Nambor, Thorajan and the Daigrung [illegible]. These streams flow and carry with them much silt and clay rather than pebbles, boulders, etc. as the rivers do on the north bank of the river Brahmaputra. Ephemeral rivers are absent

in this region. These rivers are mostly rainfed and thereby induce wet conditions for which, unless it is damaged by human interference, dense forests are abundant and agriculture is naturally rich in alluvial tracts. As it is mentioned earlier, the old Dhansiri was flowing beyond present Nagaon, but for southward migration of the river Brahmaputra it had attained the present length (354km.).

One of the results of the fluvial processes of the Dhansiri river is the creation of Dimapur-Borpathar platform which can be differentiated by its higher terraces with older alluvium having occasional hillocks. The formation of this platform is due mainly to simultaneous action of erosion and recession or pushing-back of the hill margins by the river.

Other important rivers are the Kakodonga (1098.98 sq.km. Drainage basin) and the Difolu river in the eastern and northwestern parts of the district. The kakodonga river originating in Naga hills, has a length of 68km. The aggradational characters of the river results in sudden floods during rainy days causing a good deal of damage to agriculture and property. In the lower course, it gives rise to well defined marshy areas to ultimately merge into the

Bhogdoi river in Jorhat district.

The Difolu river has its origin in Mikir Pahar (Karbi Anglong). The river has a very low gradient for which swamps have been formed supporting the growth of tall grasses. The drainage basin of this small river is reserved as Kaziranga Sanctuary.

Soils

The soil cover of the earth forms the basic component of crop ecology. This thin cover under different genetic and climatic conditions, determines the types and magnitudes of agriculture. The thin cover of soil itself implies how slow the formation of soil, a process is. The weathering of rocks by heat, cold, wind, water, chemical reactions like hydrolysis, oxidation, carbonation etc. at different rate of disintegration of different rocks under different climatic conditions, forms the first step of the formation of soil. Organic matter with air and water when mixed and decomposed make the all important soil, a source of life. Thus, the parent material (source rock) determines basically the soil composition, which in turn determines the cultivation pattern of different crops for the mineral requirement which differs from crop to crop. Transported soil, of course, may respond differently. Again, the different sizes of the rock particles allow the varying degree of

availability of bacteria, fungi, algae, worms and termites which, in an important perspective of agricultural production, keep on moving soil, aerating it and processing the dead organisms and plant material. Moreover the status of organic matters of soil is an important determinant of agricultural production and crop productivity. The absence, decrease, or leaching of plant nutrients generates the importance of additional technological inputs in the agricultural production processes. So far the nutrient point of view of agricultural crops, mainly nitrogen, phosphate, and potassium (N,P,K), these crop foods barring other essentials, are supplied by most of the igneous silicates such as Feldspar (NaCa AlSiO) Mica (K Al SiO) Apatite (Ca PO) Olivine (Fe Mg SiO) etc. but except for nitrogen (Wrigley, 1981). Crops get nitrogen by fixation process from atmosphere. Thus, the soil formed may be alluvial if transported from the hilly tracts and deposited in flat land. This type of soil is ideal for rice cultivation and irrigation, because here underground water level and crop nutrient are higher than nearby non-alluvial soil.

On the whole, soil parameters play a vital role in the success and failure of crop productivity. The study of parent material of soil in Golaghat district needs a

close geological perspective, but for the lack of micro-level geological informations a rather general outlook of it may also serve the purpose. Rocks of Miocene and Pilocene time makes the soil foundation (Wadia, 1984) of the district. Two types of rocks are common in the district (GSI, 1974), the older rocks hidden with the tertiary rock-formation and recent deposits. Thus the overlying tertiary sedimentary and alluvial deposited have acted as parent materials of the soils developed in the district under different physiographic situations and environmental impacts. The rock formations commonly found are sandstone, shale and conglomerate. According to Wadia (1979) the sequence nature of younger rock formation of the region are Dihing series, Dupitla series, Tipam series, Surma series, Barail series and Jaintia series(Fig. 2.3).

The valley of the Brahmaputra is formed by the alluvial deposits on which alluvial soils have been deposited by the Brahmaputra and its tributaries. In Golaghat district apart from the sedimentary soil, alluvial soils, both old and new, predominate. New alluvial soils are confined in the low lying tracts of the flood plains of the rivers like the Brahmaputra, the Dhansiri and the Kakodonga in which new silts are deposited almost every year.

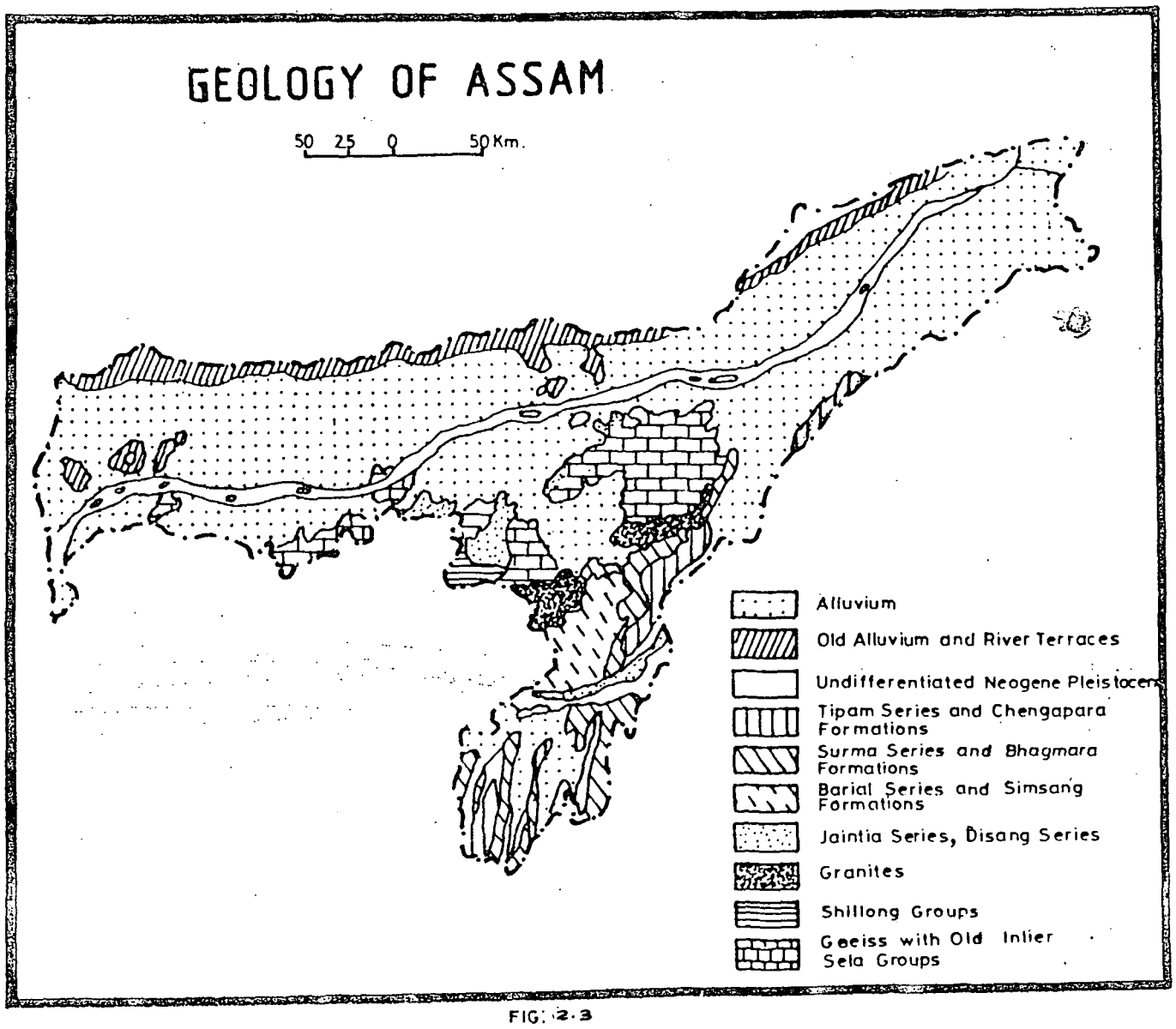
GEOLOGY OF ASSAM
50 25 0 50 Km.
Alluvium
Old Alluvium and River Terraces
Undifferentiated Neogene Pleistocene
Tipam Series and Chengapara Formations
Surma Series and Bhagmara Formations
Barial Series and Simsang Formations
Jaintia Series, Disang Series
Granites
Shillong Groups
Geeiss with Old Inlier Sela Groups

FIG: 2.3

These soils are (Fig.2.4) sandy loams or silt loams having less acidic contents and thus suitable for the cultivation of rice, mustard, potato, jute, pulses and vegetables. These soils are enriched with available phosphate, potash and exchangeable calcium (Singh, 1971). The average pH value is 5.5, soil moisture content is adequate.

The old alluvial soils are found at relatively elevated tracts which are flood free. These soils are more acidic having pH value between (4.2 to 5.5) less than that of the greater parts of the valley. These are useful for rice, sugarcane, vegetables, tea, but not conducive for mustard and pulses. The colour is yellowish, texture of soil varies from sandy to clay loams.

Laterite soil is found in the hill slopes where leaching is profound, crop nutrient is poor and agriculturally less useful. Texture varies from sandy to clay loam. Potash, Phosphates and limes are deficient. This soil supports forest and grass vegetation.

The nutrient status of the soil for Golaghat district is MMM*, that is NPK status, where M is for medium. Thus, it implies that for higher productivity

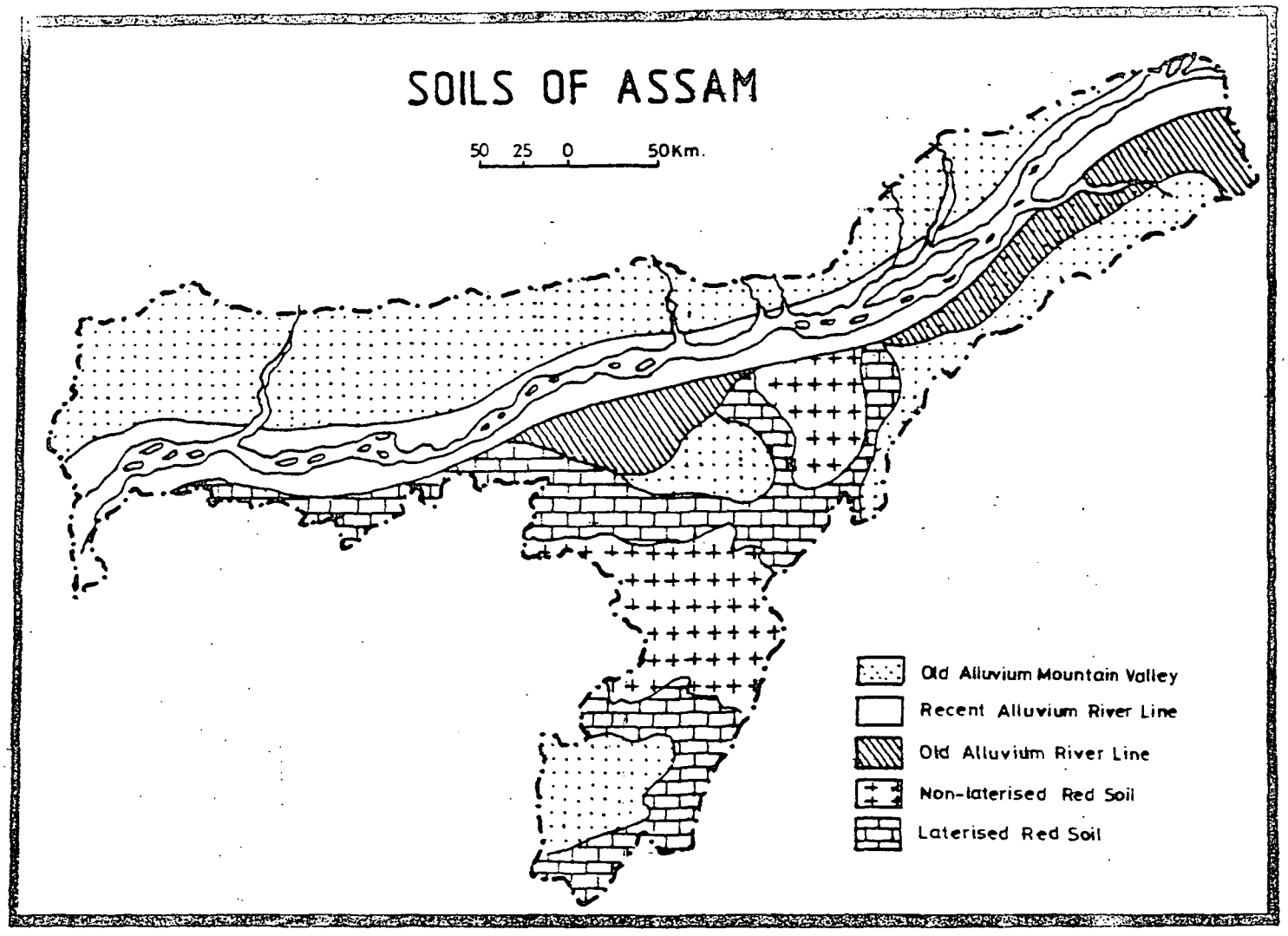
SOILS OF ASSAM
50 25 0 50Km.
Old Alluvium Mountain Valley
Recent Alluvium River Line
Old Alluvium River Line
Non-laterised Red Soil
Laterised Red Soil

FIG: 2.4

and production, application of fertilizer input over naturally medicore fertile areas is necessary. Moreover, micronutrients like manganese, zinc are rich in the sedimentary soils while boron level is low.*

Above all, these components of soil, thus, determine the progress of agriculture. The soil analysis is essential and is related to the Agricultural Development of a region.

Climatic Conditions

Agricultural productivity and production is a direct function of the climatic conditions. Different elements of climate have their separate domains of influence upon crops. Crop production may fall if temperature drops, flowering of crops may be induced by showers and so on.

Some of the important soil properties like soil moisture, nutrient maintenance ability of soil, soil pH balance even soil temperature which have immense utility in crop culture, are directly or indirectly influenced and controlled by weather conditions, such as precipitation and solar radiation (here refers to temperature of atmosphere).

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* Findings of Assam Agricultural University, Jorhat, Assam published in Agro climatic Planning, Eastern Himalayan Region(Zone 2). The Profile. Assam Agricultural University, Jorhat, Assam.

In Golaghat district as in Assam, crops mainly rice, mustard, sugarcane etc. are a direct result of weather factors. Temperature, sunlight and rainfall are major determinants of these crops. Such factors directly affect the physiological processes involved in grain production, and grain filling. Thus, from agricultural view point timely distribution of rainfall as well as fair distribution over space are necessary. Excessive rainfall coupled with storms is quite naturally detrimental which also induces diseases of crops to spread. This may also create quick run-off in comparatively high areas and water logging in some other depressed areas. Water logging is also detrimental whether it may be due to natural causes or by cultural causes like over irrigation which reduces the soil, air and temperature.

The Brahmaputra valley experiences essentially the broad south-east Asiatic Monsoon type of climate. Thornthwaite (1931) and Koppen (1931) include Assam in BB'W (Humid Mesothermal Winter Dry) and CW_g (Humid Mesothermal Warm Temperate with Dry Winter Gangetic Type) respectively. But as it happens, so often, that the weather and climate do not always confrom with broad classification as given above, scope remains in plenty to look into the climatic phenomena through a local perspective (Borthakur, 1970). The location

of the Brahmaputra valley within Assam is peculiarly located, surrounded by Eastern Himalayas, Patkai, Naga Pahar, Mikir Hills and Meghalaya plateau each one having considerable altitudes on almost all sides of the valley. This peculiarity of location generates specific mechanics and thermodynamics which influences the general and seasonal circulation of wind, distribution of pressure, temperature and precipitation. These result in the transformation of tropical monsoon climate to sub-tropical monsoon climate (Borthakur, 1986). Whereas the northern mountain protects from severe cold air masses of central Asia, the north-south parallel ranges in the south of the valley regulates maritime tropical airmass which is allowed in the valley like a windowing fan. Moreover, the alternating pressure cells of North-West India, Bay of Bengal, Indian Ocean, the local depressions, the local mountain valley winds are among the important factors in producing the climatic distinctiveness. Notable among these are the formation of eddies by local winds, which subsequently cause the growth of shallow depression, state of prolonged cloudy and rainly weather; and fogs, thunderstorms and dust raising winds. Winter fogs are common which continues for more than seventy days, and are formed mostly of evaporated water particularly from rivers, beels and marshy areas of the valley. Dust raising storms

are associated with steep gradient of pressure in the region which, in turn is related to the formation of high pressure condition over the Bay of Bengal. The westerly disturbance gain momentum over the valley particularly experienced in the pre-monsoon period in March. This is 'Bordoichila' as popularly known in the valley and is 'Kal Baisakhi' in Bengal.

Seasons

Basing on various factors as distribution of temperature, rainfall, and winds the following seasons are classified :

1. Winter - December to February,
2. Pre-monsoon - March to May,
3. Monsoon - June to September, and
4. Retreating monsoon - October and November.

The winter is characterised by dry day, cool weather (8°-15°C) with dense fog. The pre-monsoon is characterised by stormy afternoon caused by convectional phenomena, dry dust-raising winds, rains caused by Norwesters. Average rainfall and temperature are 51.87cm and 23° respectively.

Monsoon starts in early June with heavy rainfall causing decrease in temperature. In the valley, low cloud and high humidity are homogeneous all over the valley. The average temperature ranges between 20°C and 29°C, while average rainfall is 180cm. This status of weather helps agriculture activities in the valley.

Retreating monsoon is characterised by the sudden drop of rainfall and temperature to about 20 to 25cm and 22°C to 24°C.

Interestingly, within the valley itself, there are disparities in terms of precipitation, diurnal variation of temperature, wind phenomena etc. There are considerable weather and climatic differences between the two ends of the valley, the east and the west. The eastern part shares a high rainfall and records a low range of temperature, whereas, the western part gets less rainfall and records higher range of temperature.

The study area, Golaghat district, may well be looked upon these generalities of the weather and climate of the Brahmaputra valley. As agriculture is a direct function of climate, it needs a closer analysis of the most important attributes of climate of the area considering

at least twenty years of time. Rainfall, temperature and humidity, which are the main attributes of climate, have been taken into account for detail elaboration.

Rainfall

The weather data are collected from Titabor Rice Research Station which is situated in the adjoining district of the study area. The rainfall, temperature and humidity data for each of the month are collected for the last twenty years (1970 - 1991). Compiling the data of rainfall monthwise, it is found that the months of June, July and August received highest rainfall. In the month of July it has been recorded 377mm. The winter season experiences dry conditions when the mean monthly rainfall is recorded below 30mm (Table 2.1). So far as rainfall fluctuation over time is concerned, the month of July is noticeable in this respect. In this month rainfall fluctuates from 791mm(1983) to 164mm (1988), although the year 1983 received rain above normal throughout the year. On the other hand the fluctuation range is recorded lowest in the month of January (Fig. 2.5). The year 1979 was recorded dry when the annual rainfall was below the normal (155mm)(Fig. 2.6). The less rainfall in winter season implies that there is an ample need

Table : Mean Monthly Rainfall, Temperature and Humidity
2.1. **(1970-1990)**

Months	Rainfall (in mm.)	Temperaturre (c) Max.	Min.	Relative Humidity in %
January	13.57	22.65	10.32	77.28
February	32.88	24.43	12.00	77.16
March	59.72	27.41	15.14	73.31
April	197.50	28.16	18.74	77.55
May	184.74	30.00	21.98	80.57
June	284.63	31.82	24.49	79.62
July	377.09	31.90	24.82	82.14
August	294.80	32.20	24.87	81.67
September	252.86	31.15	23.95	81.05
October	116.80	29.55	21.43	83.26
November	29.42	26.82	16.04	79.18
December	14.98	23.94	10.61	76.29

Computed by the Author.

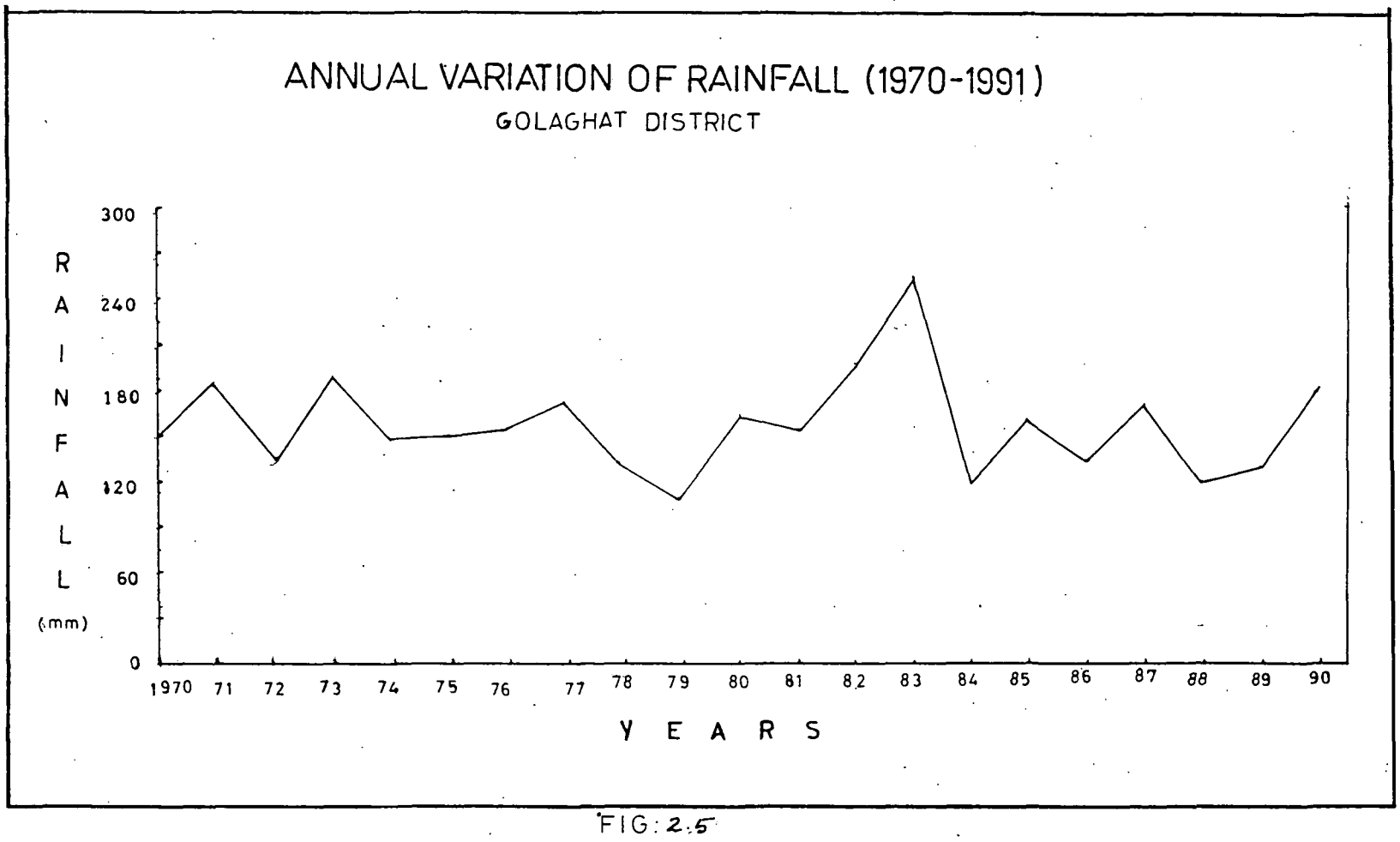
ANNUAL VARIATION OF RAINFALL (1970-1991)
GOLAGHAT DISTRICT
RAINFALL (mm)
300
240
180
120
60
0
1970 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
YEARS

FIG: 2.5

GOLAGHAT DISTRICT

MONTHLY VARIATION OF RAINFALL (1970-1990)

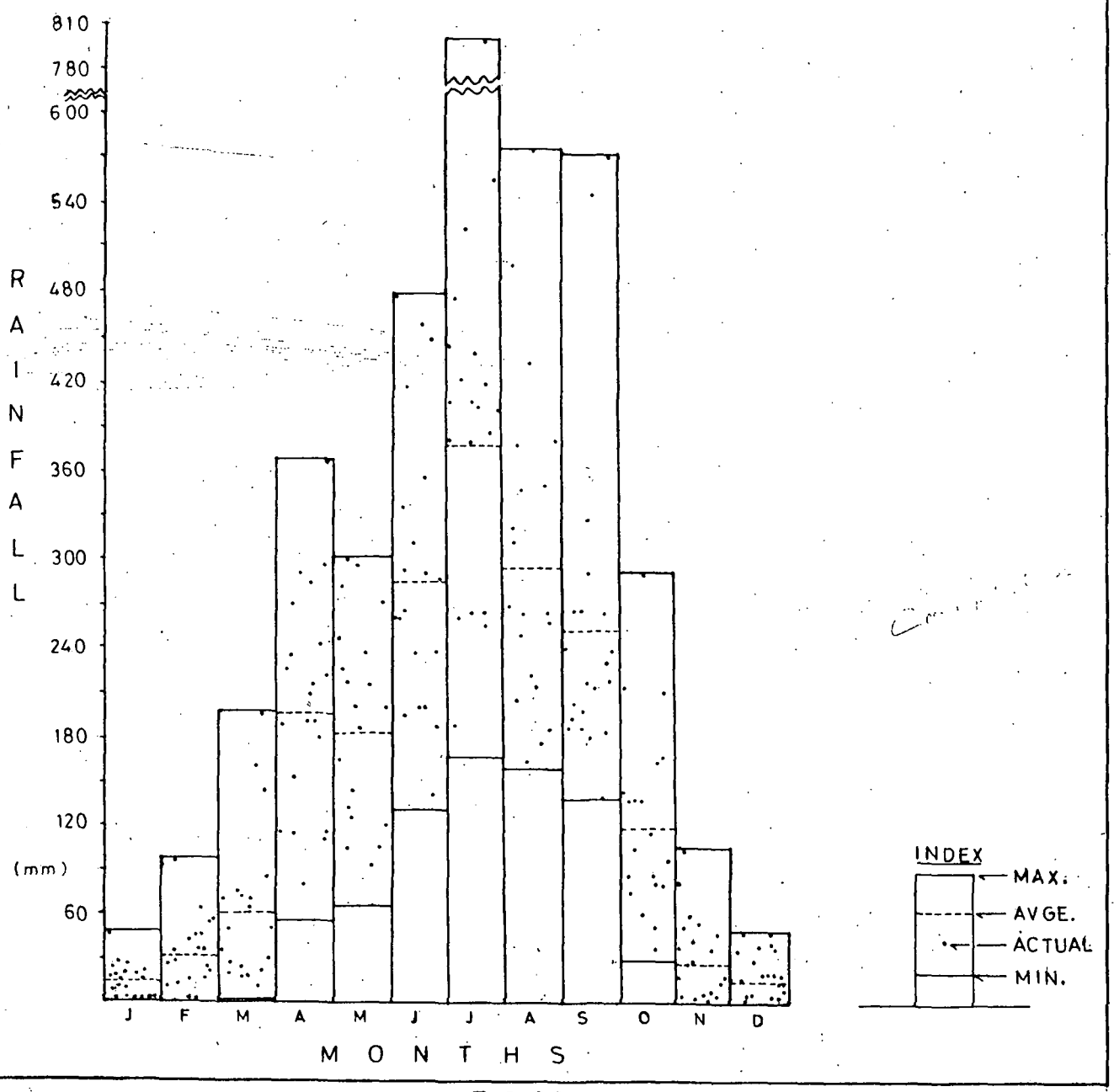

FIG:2.6

of irrigation system for rabi crops. The productivity of winter paddy can only be raised by applying irrigation facilities.

Temperature

The variation of temperature from maximum to minimum and the mean monthly figures must give the suitability of crop growth. It is recorded that the mean monthly temperature is highest in the month of August (32°C). The annual variation of mean monthly minimum temperature ranges from August (24°87°C) to January (10.32°C). It indicates that the temperature varies from 10°C to 32°C in the year. These conditions are very much suitable for the crop growth. Therefore, the crop yield potential are recorded very high in these areas.

Humidity

Golaghat district experiences fairly homogeneous high humid conditions. On account of high temperature and sufficient rainfall in the month of July, the mean monthly humidity is recorded highest (82.14 per cent) as against the low humidity conditions of the month of December (76.29 per cent).

Because of the favourable climatic conditions for paddy cultivation in the area, rice is grown twice in a year. 'Sali' paddy in summer season when temperature and humidity are higher and 'ahu' paddy in winter when climatic conditions are dry, are cultivated.

Human Factors

The human factors are key forces of agricultural development because population of a particular area requires food, and agricultural decision-making policies also follow the requirements of food for over increasing population. The human factors play the dominant role in integrating capital and technological application with labour skill. The human resource also provides the skilled labour for acceleration of the production processes specially in densely populated areas where sufficient labour force is available. Therefore, there are various theories of production with unlimited supply of labour (Lewis, 1954). The same condition is prevailing in India, specially in Assam areas where abundant agricultural labour is available. In view of these conditions of unlimited supply of labour in agricultural practices, the human factor is important to analyse.

In Golaghat district, the decision-making in

agriculture is a household rather than a community affair, where decisions like selection of a particular variety of crop for a particular land, employment of labour for crop season, amount of fertilizer to be used, or to whom land be leased for that seasons, are being made. But, decisions like mass irrigation, use of high yielding varieties seeds, common effort for harvesting and threshing are lacking. This is because of the age old system of inheritence of land with further fragmentation generation-wise. The small holding of land prevents suitable decision to frame.

(1) Population:

The population table 2.2 shows that the total population in Golaghat district was 5.37 lakh in 1971 which had risen to 8.02 lakh in 1991*. It records a growth of 49.35 per cent in two decades. The growth may be attributed to the high birth rate, low mortality rate, or to the high in-migration to the district in search of jobs. The population density increased from 152 to 229 persons per sq.km. during the last two decades (1971 - 1991).

So far population and agriculture development in the district are concerned, the skill is an important ingredient of the farming population. In regards to the skill

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* These figures are provisional collected from Provisional Tables, Census of India, 1991.

of the farmers, it may be inferred from the rural male and female literacy of the district (Table.2.3). Rural male literacy is 38.16 per cent to the total rural population and that of female is 23.87 per cent. This, of course, may not be the sole indicator of level of skill, but then, it is obvious that presently agriculture needs quite well-educated farmers when it is no longer a subsistence type but has become a farm business. Moreover, the extension programmes by village level and block level extension workers have increased the primary requisites for increasing skill in terms of different technological inputs. That is how some encouraged farmers have come out in the district. The agricultural out put by the 'progressive farmers' are helping to meet in parts the needs of the growing population in the district. The non-farm population including 0.27 lakh urban population is depending heavily on the out put of the rural farms, progressive as well as traditional undertaken by cultivators out of 7.54 lakh rural population in the district. Unfortunately, the entire population is expected to be fed and partly employed by the agriculture that is done, too, in a fragmented nature of cultivated land without much seed-fertilizer-machinery culture. This is deplorable when the status of agricultural labour is concerned, because under the present subsistent

Table 2.3
Population Increase by Categories over Time (1971 - 1991)

Particulars	Unit	Golaghat Dist. 1971	Golaghat Dist. 1991	Assam 1971	Assam 1991	Growth/Percentage District	Growth/Percentage Assam
Population	Lakh in population	5.37	8.02	146.25	229.94	49.35	52.44
Density	Persons/ Sq. Km	152	229	186	284	--	--
Male Population	--	2.85	4.17	74.44	115.79	46.32	50.10
Female "	Persons lakh	2.52	3.85	69.11	107.15	52.77	55.04
Rural Population	Persons lakh	5.08 (94.7pc)	7.54	133.36	198.24	48.43	48.65
Rural Male	"	2.68	3.90	69.75	102.36	45.52	46.75
Rural Female	"	2.40	3.64	63.61	95.88	51.66	50.73
Urban Population	"	0.29 (5.3 pc)	0.48	12.89	24.71	65.52	91.70
Urban Male	"	0.17	0.27	7.39	13.44	58.82	81.87
Urban Female	"	0.12	0.21	5.50	11.27	75.00	104.91
Rural Literate Population.	"	1.78	3.87	42.00	96.32	33.18 (38.53)	28.14 (33.76)
Total Male Literate	"	2.15	2.30	53.67	58.62	40.16	36.68
Total Female "	"	1.36	1.57	27.20	37.69	25.28	18.63

agriculture, the labour employment is negligible in 'off seasons' of agriculture. This is further accentuated, as no agro-based industries are coming up because of lack of agricultural surplus, which could employ surplus labour force.

(2) Occupational Structure:

Agricultural labourers and cultivators in the district were 11301 and 75025 persons respectively out of the total 139518 workers in 1971 (Table 2.4). Agricultural labourers increased to 25079 and that of cultivators to 157108 according to 1991 census (provisional), which shows a growth of 118.06 and 109.41 percent in two decades from 1971 to 1991. Total agricultural workers are recorded increased from 86,526 to 182187 persons during the successive period. This growth of agricultural worker (5.53 per cent per annum) has a considerable influence on the agricultural development in the district.

(3) Transport Network :

Transport facilities support easy movements of labour and agricultural products to and from the agricultural land. It provides links which largely determine the degree of flow of technology which tends to influence the

Table : 2.4
Occupational Structure of Golaghat District, 1971 and 1991

	Persons in 1971	%age to total popn.	%age to total popn	1991^*	p.c.to total popn.	p.c.to total popn.
1. Total Population	536608	100.00		801740		
2. Total workers	158448	29.53	100.00	327254**	40.82	100.00
3. Total Non-workers	378160	70.47	238.67	574486	59.18	175.55
4. Agricultural workers	91695	17.09	57.87	182187	22.72	55.67
5. Cultivators	79407	14.80	50.12	157108	19.60	48.01
6. Agricultural labourers	12288	2.29	7.75	25079	3.13	8.73
7. Industrial Workers	4182	0.78	2.64	NA	--	--
8. Workers in tertiary activities	27429	5.11	17.31	NA	--	--
9. Others	35142	6.55	22.18	NA	--	--

* Provisional figures
** marginal workers
Source : For 1971 District Census Hand Book, Sibsagar District Census of India 1971, For 1991, Provisional Tables, paper No 3 Census of India 1991 Series I Assam.

increasing agricultural production and productivity of cultivated land.

Although the transport infrastructure in the fertile flood plain areas of the river Brahmaputra is not well developed, on the whole, the system is conducive in the old alluvial areas for promotion of agricultural development. The urban centres, for that matter, are well connected to each other with surfaced roads. These urban places, namely Golaghat, Dergaon and Bokakhat also are connected to crop producing areas but with gravelled and kuccha roads. The road connectivity of Golaghat, Dergaon and Bokakhat are 6,5 and 5 respectively. This shows that Golaghat is connected from all sides which facilitates an easy transport and stimulates directly the spread effect of the centres to the surrounding areas.

The total road length in the district was 1366km. in 1987-88 of which 315km. were surfaced and 1041km. gravelled and the rest, 10 km.) was earthened road. The total road length comprised 4 per cent of the total road length of Assam. The surfaced road in the district was 4.81 per cent to the total surfaced road length of Assam. National Highway in the district is 126 km. and state highway is 95km. in length. Road intensity of the district in terms of

area and population are recorded 39km. per 100 sq.km. and 159 km. per lakh population.

Railway transport is not prominent in the district. The urban centres are not connected by railway transport system.

CONCLUDING REMARK

It may be concluded here that, inspite of favourable soil and climatic condition of the district for agricultural practices, the agricultural production, growth and productivity have been recorded very low, rather negligible in the district. It reflects that there may be weak points, either in the implementation of government agricultural programmes or the failure of lab-to-land programmes which have been implemented by Indian Council of Agricultural Researches. The causes of low productivity can be highlighted by analysing the agricultural production processes in the district, which have been discussed separately in the next chapter.

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C H A P T E R - III

AGRICULTURAL DEVELOPMENT AND PRODUCTION PROCESSES

Indeed, agricultural production and its increase cannot be studied to put them in isolation. It is the result of various factors operating in the area under different physical conditions. Therefore, the agricultural production is the result of physical factors, technological input application, as well as the social condition of farmers which are operating the piece of land. The study of agricultural production processes is, therefore, being done here to correlate the agricultural production and productivity index with its factors. The input-output relation is the focal theme to analyse the production functions in Golaghat district. In most of the geographical studies, it is concluded that the pattern of agricultural out put and productivity are the evolution of the variation in the various agricultural inputs, like the condition of land, labour, and agricultural technology (Singh & Sharma, 1985).

In Golaghat district, being a micro-areal unit, the physical conditions of land are more or less homogeneous in nature. Therefore, there is no such variation in the general pattern of land use. But the areal variation in the productivity is conspicuous because of variation occuring

in agricultural labour and application of modern agricultural technological inputs. To describe the agricultural production processes in Golaghat district, the patterns of production, growth of production and agricultural productivity have been described in detail in relation to its input factors. The changing nature of the mode of production is also analysed here to give some appropriate suggestions for their proper acceleration.

1. Agricultural Production and Productivity Patterns :

Measurement of agricultural productivity, production and production growth are the debatable aspects. Agricultural production growth cab be attributed to increase in crop land, sizable increase in the agricultural labour force, changes in crop pattern as from traditional to commercial crops, changes in crop yields, capital inputs, and technological innovations, qualitative change in the farmers behaviour through educational programmes, improvement in farm credit, roads and other transport and market facilities with assured crop price. Agricultural productivity which refers to total agricultural output per unit of cultivated land, is the function of crop-yield, area under various crops and cropping patterns. For measuring agricultural productivity, many agricultural scientists used, starch equivalents of various crops (Buck,1937)

money value index (Dayal, 1984) and so on. While Kendall (1939) used 'Ranking Coefficient Method'; which has been later on used by Shafi (1960). Stamp's (1958) method of productivity is crop-calpries-based.

As productivity relates to the aggregation of total out-put and the intensity of inputs used in farm production, agricultural out-put in terms of money value of six principal crops for all 26 panchayat areas have been considered for two points of time. Agricultural production and productivity imply land use specification and crop diversification. Here, therefore, the land use, general as well as agricultural, and cropping intensity pattern for successive points of time have been shown for better understanding of the production processes and their outcomes.

There are two important agricultural production processes, expansion and intensification of agriculture. Expansion processes are closely related to the change in the land-use categories of the area, and intensification is associated with the increase in crop yields. Extension of agricultural landuse is accelerated by various forces and factors. Ever-increasing population pressure on land demands more food and shelter. Therefore there is a significant change in landuse

which can be observed overtime. The validity of this fact can be tested by studying changing landuse pattern. On the other hand, intensification of agriculture is mainly related to the yield augmenting techniques and their application in relation to increasing agricultural productivity. As a result, crop-yield patterns and their changing nature should also be studied. In view of these aspects of agricultural production processes, four main aspects of agricultural production and productivity are studied in the present chapter. These are :

a) the growth of agricultural production of the district during the last twenty years.

b) agricultural productivity pattern and changes there in,

c) the changing nature of production factors (labour and modern technological inputs), and

d) the changing relationships between agricultural productivity and its factors over time.

A. LAND-USE PROFILE

The general landuse of an are/region depicts an idea of overall areal utilisation of resources, natural or cultural. Marked differences in landuse, in its temporal perspective, is a symbol of development. The sizable decrease in wasteland in

a span of time may well exemplify the development as far technology is concerned. Increase in fallow land may retard expansion processes of agricultural landuse as most-needed increase in production for increasing population and agro-based industries are concerned. Thus landuse shows the relative picture of the prevailing conditions of land resource utilisation of a particular region. This picture is the basis for future planning and reorganisation with a view to evolve decision making to increase production and productivity. A particular landuse at a point of time reveals the people's participation in agricultural activities.

On account of non-availability of landuse statistics according to the landuse format prepared by Ministry of Agriculture, New Delhi, the general landuse interpretation of the Golaghat district is done on the basis of following four broad categories. They are :

1. Cultivable Wasteland.
2. Fallow Land.
3. Net Area sown, and
4. Others (Flooded, Pastures and Grazing lands, settlement, Schools, Roads etc.)

The elaboration is made on temporal basis for 1969-72

and 1989-92 taking panchayats as units and also attempt has been made to classify these units by considering suitable class-intervals.

Landuse Pattern (1969-72)

On account of gentle slope and fertile land, the district experiences the largest share of land under agricultural practices. In the early seventies, net area sown was recorded nearly two-third share (62.02 per cent) of the total geographical area. The area under fallow land (current and other than current fallow) was also recorded 13.38 per cent which is noticeable figure and higher than the state and national average. The area under fallow land is high because of traditional practices are being operated without proper facilities of irrigation. The area under cultivable waste has also been recorded 9.0 per cent in the district in 1969 - 72.

So far as the areal patterns of these components of general landuse are concerned, it is obvious from the table 3.1 and figure 3.1 that the net sown areas in different Gaon Panchayats (Hereinafter written as G.P) are found to vary from 29.22 percent in Mohura to 78.99 per cent in Kamarbandha G.P. The lowest percentage of net sown area (hereinafter written as NSA) in Mohura G.P. areas is due to the fact that the maximum areas (41.17 per cent) of total Panchayat area fall

Table:-3:1

General Landuse Pattern. 1969-72

Name of Panchayats	Geographical Area.	Agricultural Waste Land		Fallow Land		Net Sown Area		Others	
	Total	Total	P.C	Total	P.C	Total	P.C	Total	P.C
Dergoan	7811.91	421.06	5.39	1049.14	13.43	5102.74	65.32	1238.97	15.86
Missamara	11857.78	675.89	5.70	1651.79	13.93	7143.13	60.24	2386.97	20.13
Naojan	5808.44	605.24	10.42	652.29	11.23	3390.97	58.38	1159.94	11.97
Sarupathor	11538.82	741.95	6.43	1193.11	10.34	8265.26	71.63	1338.50	11.60
Barapathor	15873.35	1209.55	7.62	2941.33	18.53	11066.90	69.72	655.57	4.13
Morongi	27088.62	5417.80	20.00	4721.82	17.43	15097.85	55.74	1851.15	6.83
Rangamati	10688.23	1212.66	11.35	814.14	7.62	6711.83	62.82	1995.6	18.21
Khumtai	10582.46	1087.88	10.28	1401.12	13.24	6817.22	64.42	1276.24	5.79
Gurjogania	4553.27	342.86	7.53	638.82	14.03	3307.95	72.65	263.64	5.79
Dhekial	7475.08	389.96	5.23	403.48	5.41	5662.11	75.96	998.53	13.40
Kakodonga	4023.56	391.49	9.73	376.20	9.35	2797.98	69.54	457.89	11.38
Dakhinhengera	7473.76	602.41	8.06	590.36	7.90	5868.67	68.52	412.32	5.52
Kamarbandha	4157.56	161.98	3.90	112.17	2.70	3283.93	78.99	599.48	14.42
Golaghat	5457.03	316.87	5.81	469.07	8.60	3856.35	70.66	815.14	14.94
Athgoan	4559.03	284.07	6.23	336.54	7.38	3126.37	68.58	812.05	17.81
Ghiladhari	14240.96	1172.02	8.23	1245.78	8.75	10246.19	71.95	1576.97	11.07
Kaziranga	12377.52	587.93	4.75	2044.77	16.52	5402.79	43.65	4342.03	35.08
Bokakhat	14284.63	817.42	5.28	2331.33	16.32	8340.80	58.39	2795.5	19.57
Mohura	12052.52	877.42	7.28	2691.33	22.33	3521.75	29.22	4962.02	41.17
Forest Village	N A	N A	-	N A	-	N A	-	N A	-
District	191879.93	17316.12	9.02	25664.51	13.38	119010.79	62.02	29888.51	15.58

N.B: N A - Not Available

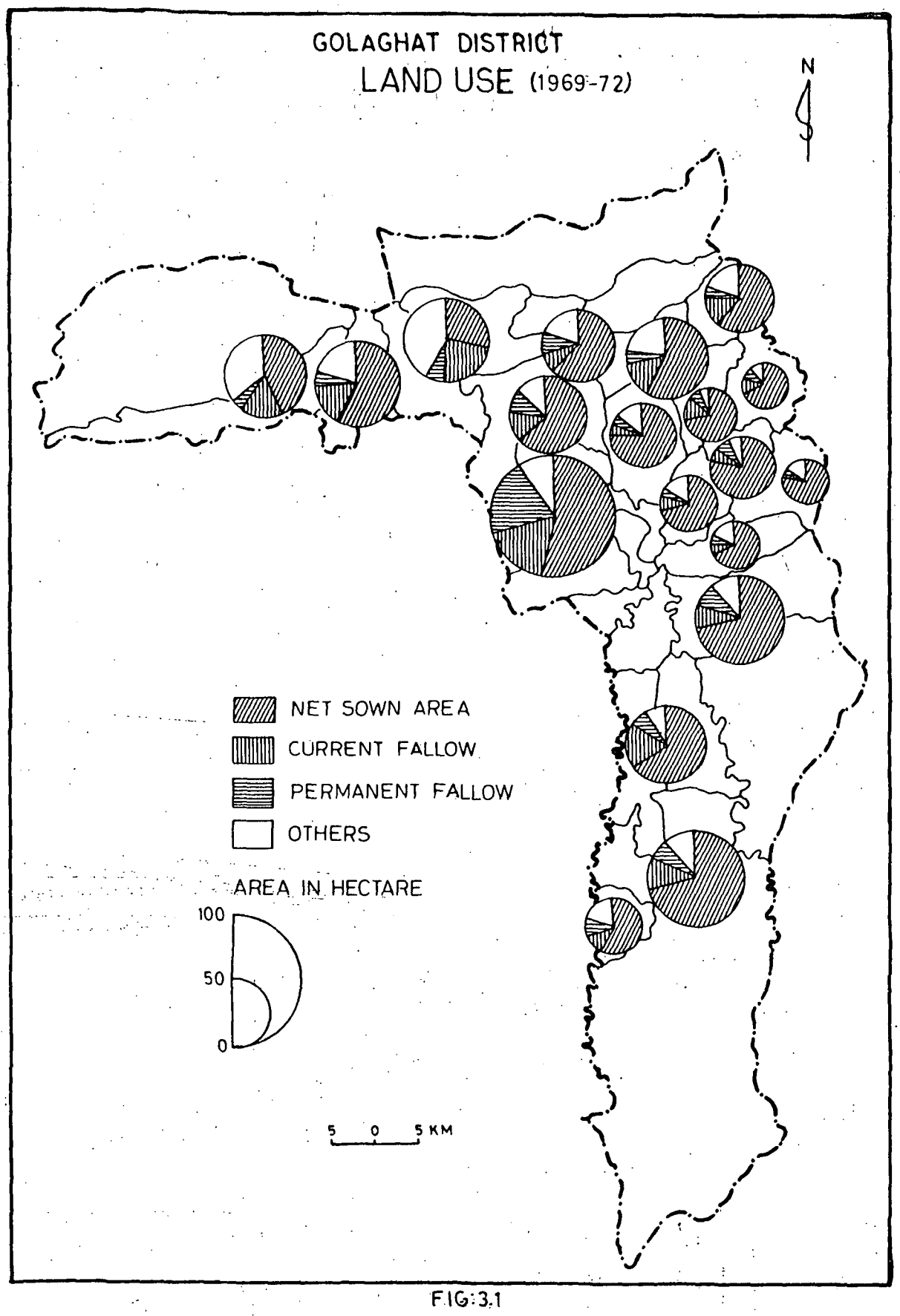
GOLAGHAT DISTRICT
LAND USE (1969-72)
N
NET SOWN AREA
CURRENT FALLOW
PERMANENT FALLOW
OTHERS
AREA IN HECTARE
100
50
0
5 0 5 KM

FIG:3.1

under 'others' category that covers flodded areas, settlement areas, grazing land, forest area, etc. High percentage under NSA in Kamarbandha, and other G.P. areas like, Dakhinhengera (78.52 per cent), Dhekial (75.96 per cent), Gurjogania (72.65 per cent), Ghiladhari (71.95 per cent), Golaghat (70.66 per cent) are due to the fact that these Panchayat areas are parts of relatively old flood-free alluvial (diluvial) tracts. Moreover, centre like Golaghat is extending agricultural facilities to these fertile areas.

So far areal variation in the pattern of distribution of fallow land is concerned, it is important to note that the areas lying in the flood-plain areas have the higher percentage of land under fallow because of flood. Mohura (22.33 per cent), Kaziranga (16.52 per cent), Bokakhat (16.32 per cent), Missamara (13.93 per cent), Dergaon (13.42 per cent) are some of the examples of this type. On the other hand the flood plains of the Dhansiri river including Morongi GP (17.43 per cent), Borpathar (18.53 per cent) also have higher fallow lands. The Panchayats with low fallow land are found in the old alluvial tracts where mostly sugarcane cultivation is practised which is annual crop. In fact, the fallow percentage may be related to the flood free old alluvial areas which are comparatively higher areas, where generally less area under

fallow are found.

The agricultural Wasteland distribution pattern shows that the land under agricultural waste are found mostly in the flood plain areas of the river Brahmaputra and the Dhansiri river. Morongi (20.00 per cent), Naojan (10.42 per cent), Khumtai (10.28 per cent), on the flood plains of the Dhansiri rivers; Rangamati (11.35 per cent), Mohurra(7.28 per cent), Dergaon (5.39 per cent), Missamara (5.7 per cent) on the flood plains of the Brahmaputra river are some of the examples of areas with high wasteland in the district. On the contrary, low percentage of wasteland are found in the comparative higher regions (Kamarbandha 3.90 per cent).

Landuse Pattern (1989 - 91)

The technological innovations and their diffusion, whatsoever, into the agricultural areas have not, much, changed the overall landuse scene during 1989-91 in Golaghat district. In this period NSA was recorded more than two-third (66.73 per cent) of the total geographical area of the district. The area under fallow land (current and other than current fallow) was recorded 10.34 per cent while the area under cultivable waste was 2.30 per cent in this period.

As the areal variation of the land under different use is concerned, it can be noticed from the table 3.2 and fig.3.2

Table:3.2
General Land use Pattern(1989 to 91)

Name ofthe Panchayats	Geographical Area	Agriculral Waste land		Fallow land		Net sown Area		Others.	
	Total	Total	P. C	total	P .C	total	Percent	Total	P.C
Dergoan	7811.91	98.66	1.26	682.86	8.74	6107.76	78.18	922.63	11.81
Missamara	11855.02	154.35	1.30	1051.80	8.87	8064.79	68.02	2584.08	21.80
Naojan	806.55	416.60	7.17	463.46	7.98	3696.65	63.66	1229.84	21.18
Sarupathan	11538.82	156.63	1.35	831.72	7.20	9650.33	83.63	900.14	7.80
Barapathar	15872.02	461.18	2.90	2213.93	13.94	11630.52	73.27	1566.39	9.07
Morongi	26900.53	432.13	1.60	3521.55	13.09	18730.92	51.04	4215.93	15.67
Rangamati	10677.64	309.24	2.89	480.99	4.50	7017.00	65.71	2870.41	26.88
Khumtai	10582.46	595.72	5.62	1046.99	9.89	8231.06	77.78	708.69	6.70
Gurjogania	4553.27	142.30	3.12	324.23	7.12	4031.73	88.54	55.01	1.21
Dhekial	7451.00	270.41	3.62	294.91	3.95	6023.96	80.84	861.72	11.57
Kakodonga	4023.56	159.44	3.96	309.10	7.68	3270.42	81.28	284.6	7.07
Dakhinhengera	7473.76	339.49	4.54	554.08	7.41	6047.66	80.91	532.53	7.13
Kamarbhandha	4157.42	39.09	0.94	95.59	2.38	3577.11	86.04	445.64	10.72
Golaghat	5457.42	269.88	4.94	488.88	8.95	3659.84	67.06	1038.82	19.04
Athgaon	4558.90	81.00	1.77	273.09	5.99	3189.56	69.91	1015.25	22.27
Ghiladhari	14260.10	183.67	1.28	1056.76	7.41	11592.10	81.29	1427.57	10.01
Kaziranga	12373.49	12.32	0.09	1819.68	14.70	5671.88	45.83	4869.61	39.36
Bokakhat	14034.39	40.03	0.28	1064.25	14.45	8865.59	62.07	3311.52	23.19
Mohura	12034.27	246.05	2.14	2252.61	18.71	3839.89	31.90	5695.72	47.33
Forest Village	NA	NA	-	NA	-	NA	_	NA	-
District	191669.53	4408.19	2.30	19826.48	10.34	132898.77	66.73	34536.09	18.02

N.B NA - Not available.

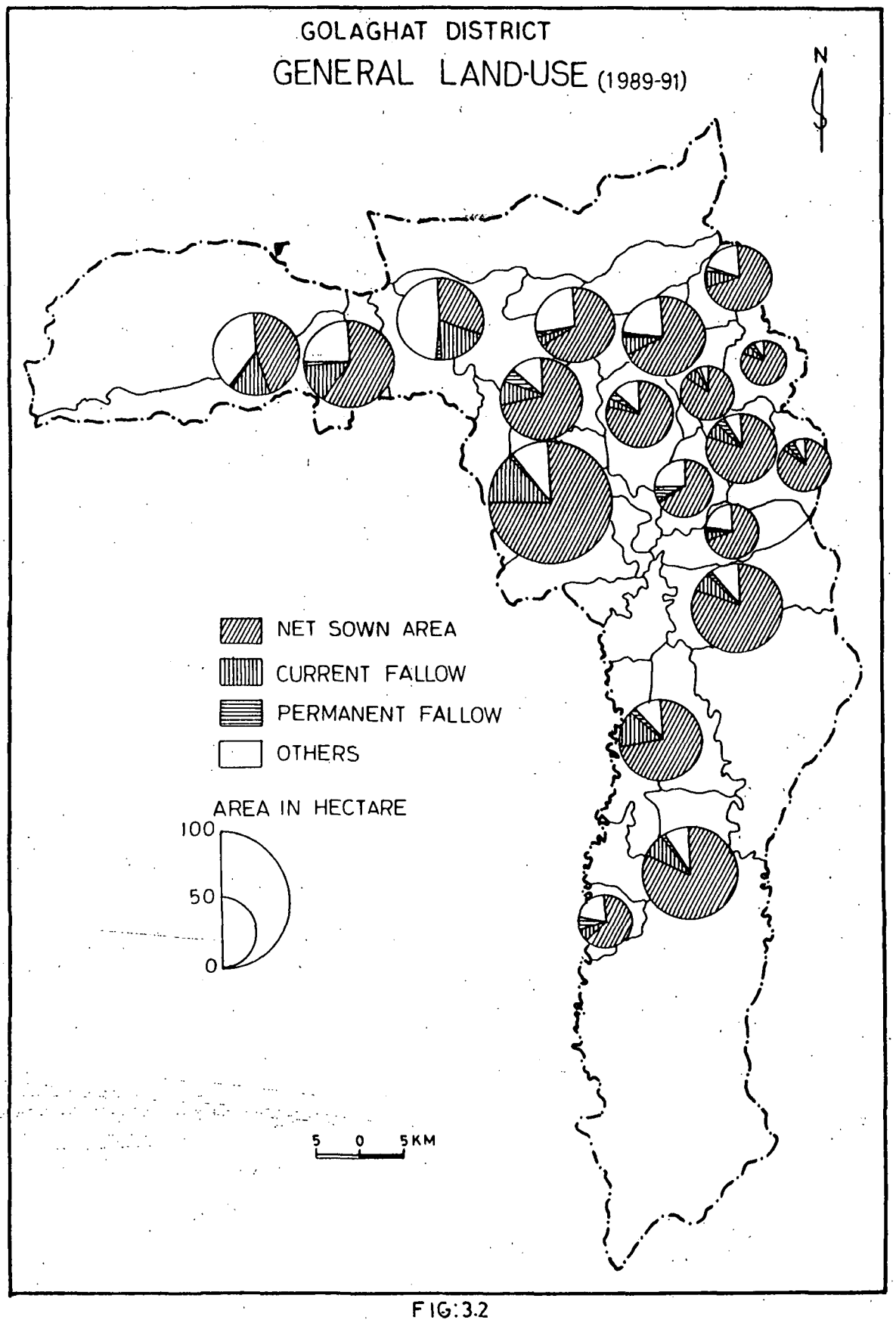
GOLAGHAT DISTRICT
GENERAL LAND-USE (1989-91)
N
NET SOWN AREA
CURRENT FALLOW
PERMANENT FALLOW
OTHERS
AREA IN HECTARE
100
50
0
5 0 5KM

FIG:3.2

that the percentages of NSA in different micro areal units (Panchayats) vary from 31.90 per cent of the total area of the district in Mahura G.P. to 88.54 per cent in Gurjogania G.P in the period. The highest net sown area is attributed to the fertile flood free areas where sugarcane cultivation dominates during this period also. The central part of the district has also high share of NSA while the western part of the district comprising Golaghat West Development Block areas are having less percentage share of NSA.

The pattern of distribution of fallow lands in different panchayat units of Golaghat district are found similar as were in 1969-72. It ranges from 2.38 percent in Kamarbandha to 18.71 percent in Mohura G.P. The northern and western part of the Brahmaputra flood plain and the flood plain tracts of the Dhansiri river and the Kakodonga river are having large areas under fallow. Usually it is noticed that these areas particularly in the Dhansiri flood plain tract are having large areas as agricultural waste.

Changes in Landuse (1969-72 to 1989 -91)

Changes in landuse can be shown in two ways. Firstly, by comparing the percentage share of landuse categories for two points of time, that is, 1969-72 to 1989-91. It will indicate simple variation in landuse categories over time. Secondly, the

Table 3.3

Change in Land-use.Golaghat Disrtict.1969.72 To 1989-91

Total land		N S A			Fallow		
1970/71	1990/91	1970/71	1990/91	increase %	1970/71	1990/91	P.C increase
7811.91	7811.91	5102.74	6107.76	19.69	1049.14	682.86	- 34.9
11857.78	11855.02	7143.13	8064.79	12.90	1651.80	1051.80	- 36.3
5808.44	5806.55	3390.97	3696.65	9.01	652.29	463.46	- 28.9
11538.82	11538.82	8265.28	9650.33	16.75	1193.11	831.72	- 30.3
15873.35	15872.02	11066.90	11630.52	5.09	2941.33	2213.93	- 24.7
27088.62	26900.53	15097.85	18730.92	24.06	4721.82	3521.55	- 25.4
10684.23	10677.64	6711.83	7017.00	4.55	814.14	480.99	- 40.9
10583.46	10582.46	6817.22	8231.06	20.73	1401.12	1046.99	- 25.3
4553.27	4553.27	3307.95	4031.73	21.88	638.82	324.23	- 49.2
7454.08	7451.00	5662.11	6023.96	6.39	403.48	294.91	- 26.9
4023.56	4023.56	2797.98	3270.42	16.88	376.20	309.10	- 17.8
7473.76	7473.76	5868.67	6047.66	3.04	590.36	554.08	- 6.2
4157.56	4157.42	3283.93	3577.11	8.93	112.17	95.59	- 14.8
5457.43	5457.42	3856.35	3659.84	-5.10	469.07	488.88	+ 4.2
4559.03	4558.90	3126.37	3189.56	2.02	336.54	273.09	- 18.9
14240.96	14260.10	10246.19	11592.10	13.14	1245.78	1056.76	- 15.2
12377.52	12373.49	5402.79	5671.88	4.98	2044.77	1819.68	- 11.0
14284.63	12034.27	8340.80	8865.59	6.29	2331.25	2064.25	- 11.5
12052.52	12034.27	3521.75	3839.89	9.03	2691.33	2252.61	- 16.3
--	--	--	--	--	--	--	--
191879.93	191669.53	119010.79	132897.77	11.67	25664.51	19826.48	- 22.75

Contd...

Agricultural Waste			Pasture & Grazingland			Name of the Panchayats
1970/71	1990/91	P.C increase	1970/71	1990/91	P.C Increase	
421.06	98.66	- 76.60	670.26	670.41	0.02	Dergaon
675.89	154.35	- 77.16	949.81	950.07	0.03	Missamara
605.24	416.60	- 31.17	336.39	336.28	- 0.03	Naogan
741.95	156.63	- 78.90	160.39	160.64	0.02	Sarupatthar
1209.55	461.18	- 61.87	187.31	188.35	0.60	Borpathar
5417.80	432.13	- 92.02	690.23	691.83	0.23	Morangi
1212.66	309.24	- 74.50	397.45	393.17	- 1.08	Rongamati
1087.88	595.72	- 45.24	603.20	595.98	- 1.20	Khumtai
342.86	142.30	- 58.50	46.44	36.68	-21.02	Gurjogania
389.96	270.41	- 30.66	481.93	405.89	-15.78	Dhekial
391.49	159.44	- 59.27	181.06	170.28	- 5.95	Kakodonga
602.41	339.49	- 43.64	246.18	50.20	-79.61	Dakhinhengera
161.98	39.09	- 75.87	347.26	237.49	-31.61	Kamarbandha
316.87	269.88	- 14.83	388.76	212.45	-41.35	Golaghat
284.07	81.00	- 71.49	403.61	403.48	- 0.77	Athgaon
1172.02	183.67	- 84.33	797.05	545.91	-51.51	Ghiladhari
587.93	12.32	- 97.90	1126.35	1000.13	-11.21	Kaziranga
817.08	40.03	- 95.10	371.40	360.78	- 2.86	Bokakhat
877.42	246.05	- 71.96	183.20	176.43	- 3.70	Mohura
--	--	--	--	--	--	Forest Village
17316.12	4408.19	- 74.54	8568.28	7586.45	- 11.46	District

contd...

Agricultural Waste			Pasture & Grazingland			Name of the Panchayats
1970/71	1990/91	P.C increase	1970/71	1990/91	P.C Increase	
421.06	98.66	- 76.60	670.26	670.41	0.02	Dergaon
675.89	154.35	- 77.16	949.81	950.07	0.03	Missamara
605.24	416.60	- 31.17	336.39	336.28	- 0.03	Naogan
741.95	156.63	- 78.90	160.39	160.64	0.02	Sarupatthar
1209.55	461.18	- 61.87	187.31	188.35	0.60	Borpathar
5417.80	432.13	- 92.02	690.23	691.83	0.23	Morangi
1212.66	309.24	- 74.50	397.45	393.17	- 1.08	Rongamati
1087.88	595.72	- 45.24	603.20	595.98	- 1.20	Khumtai
342.86	142.30	- 58.50	46.44	36.68	-21.02	Gurjogania
389.96	270.41	- 30.66	481.93	405.89	-15.78	Dhekial
391.49	159.44	- 59.27	181.06	170.28	- 5.95	Kakodonga
602.41	339.49	- 43.64	246.18	50.20	-79.61	Dakhinhengera
161.98	39.09	- 75.87	347.26	237.49	-31.61	Kamarbandha
316.87	269.88	- 14.83	388.76	212.45	-41.35	Golaghat
284.07	81.00	- 71.49	403.61	403.48	- 0.77	Athgaon
1172.02	183.67	- 84.33	797.05	545.91	-51.51	Ghiladhari
587.93	12.32	- 97.90	1126.35	1000.13	-11.21	Kaziranga
817.08	40.03	- 95.10	371.40	360.78	- 2.86	Bokakhat
877.42	246.05	- 71.96	183.20	176.43	- 3.70	Mohura
--	--	--	--	--	--	Forest Village
17316.12	4408.19	- 74.54	8568.28	7586.45	- 11.46	District

absolute change can be/has been calculated for showing the actual increase/decrease in various categories of landuse. Table 3.3 shows that there is 11.6 per cent increase in NSA in the district during the last two decades while fallow land and cultivable waste are decreased by 22.75 per cent and 74.54 per cent respectively. It implies that fallow land and cultivable wasteland are being reduced and converted into NSA. It is, further, marked that the increase in NSA is recorded higher than the district average in G.Ps., namely Morongi (24.06 per cent), Gurjogania (21.88 per cent), Khumtai (20.73 per cent), Dergaon (19.69 per cent), Kakodonga (16.88 per cent), Ghiladhari (13.14 per cent), Sarupathar (16.75 per cent), which are located in the central and north-eastern parts of the district. The higher reduction in cultivable wasteland have also been recorded in the same areas. The other areas have a negligible change in the landuse categories. It indicates that the faster change in landuse are specially in those areas which are connected with better transport network where growth centres are playing important role for the change.

B. INTENSITY OF CROPPING

Intensity of agriculture is the proportion of Gross Cultivated Area to the Net Sown Area. Agricultural intensity is a helpful parameter to show agricultural development

especially in showing areal patterns of development of the constituent units of the study area. It gives the true picture of the proportion of land that is under cultivation more than once in normal situation.

The intensity of agriculture in the district in 1969-72 has been recorded only 106 per cent which is much lower than the state average of 123 per cent. The intensity was found varying from the lowest of 1.01 in Kakodongs Gaon Panchayat area to the highest of 1.18 in area under Rangamati G.P. The panchayats above the district average were Dergaon and Brahmaputra GPs under Golaghat North Development Block, Naojan G.P under Golaghat South Development Block, Rangamati, Gurjogania and Dhekial G.Ps under Golaghat Central Development Block, Kamarbandha and Athgaon GPs under Golaghat East Development Block. The Panchayats falling below the district average intensity were Missamara G.P. under Golaghat North Development Block, Pub and Pachim Sarupathar G.P, Uttar and Dakhin Morongi, Morongi Chah Mazdoor GPs under Golaghat South Development Block, Dakhinhengera and Golaghat GPs under Golaghat East Development Block, Kaziranga, Bokakhat, Karuabahi and Mohura GPs under Golaghat West Development Block. The panchayats reaching the average intensity mark were pub and pachim Ghiladhari GPs under Golaghat East Development Block and Khumtai G.P under Golaghat Central

Development Block (Table 3.4 and Fig. 3.3).

The agricultural intensity of Golaghat district in (1989-91), are almost similar (107 per cent). The lowest for Kakdonga G.P. (102 per cent) to the highest for Naojan G.P. (117 per cent). The average intensity done for twenty six panchayats is found to be 107 percent.

The Gaon panchayats that belong to category is having the higher degree of intensity (above 107 per cent) have been recorded in the Gram Panchayats, namely, Dergaon, Missamara, Brahmaputra, Naojan, Rangamati, Athgaon, Khumtai, Gurjogania and Kamarbandha GPs. These areas of high crop intensity are located in the tracts of fertile alluvial soil where the percentage of area under more than one crop are higher which is attributed to the main diffusion centres of the district.

During the last 20 years, though the increase in crop intensity recorded is negligible (Table 3.4), yet its increase is also markedly higher in the areas of high crop-intensity. It implies that the areas situated in the northern part of the district which is the part of alluvial soil plain are noticeable for high intensity with greater increases in crop intensity The main urban centres, like Golaghat and Dergaon are also situated in/near the same areas which are helping to spread the

Table:3.4
Changes in Crop Intensity (1969-72 to 1989-91)

Name of the Panchayats	NSA (in ha)		GCA.		Crop Intensity		Change.
	Early 1970s	Early 1990s	Early 1970s	Early 1990s	Early 1990s	Early 1990s	(1969-72to 1989-91)
Dergoan	5629.34	6107.76	6154.64	6741.76	1.09	1.10	0.01
Missamana	8145.57	8064.79	8514.24	8967.99	1.05	1.11	0.06
Naojan	3265.72	3696.65	3765.96	4328.75	1.15	1.17	0.02
Sarupathar	9560.38	9650.33	9863.18	10114.83	1.03	1.05	1.02
Barapathar	11053.46	11630.52	11489.69	12189.52	1.04	1.05	0.01
Morongi	14739.04	13730.92	15165.41	14491.32	1.03	1.06	0.03
Rangamati	4675.65	7017.00	5502.49	8135.70	1.18	1.16	-0.02
Khumtai	7844.53	8231.05	8327.93	8794.85	1.06	1.07	0.01
Gurjogania	3903.42	4031.72	4183.77	4334.72	1.07	1.07	0.00
Dhekial	5331.03	6023.96	5705.06	6318.16	1.07	1.05	-0.02
Kakodonga	3150.63	3270.41	3170.92	3321.01	1.01	1.02	0.01
Dakhinhen-gera	5915.58	6047.65	6142.76	6307.75	1.04	1.04	0.00
Kamarbandha	3496.43	3577.10	3758.01	3842.10	1.07	1.07	0.00
Golaghat	3512.94	3659.83	3666.76	3847.23	1.04	1.05	0.01
Athgaon	3052.67	3189.55	3306.62	3485.25	1.08	1.09	0.01
Ghiladhari	10972.83	11592.10	11641.10	12139.20	1.06	1.05	0.01
Kaziranga	4779.63	8865.59	4881.38	5873.38	1.02	1.04	0.02
Bakakhat	8250.36	8865.59	8583.07	9299.49	1.04	1.05	0.01
Mahura	3193.72	3839.89	3297.34	3999.29	1.03	1.04	0.01
Forest Village	NA	NA	NA	NA	-	-	-
District	120473.93	127898.7	127120.37	136532.3	1.06	1.07	1.07

N.B : NA - Not available

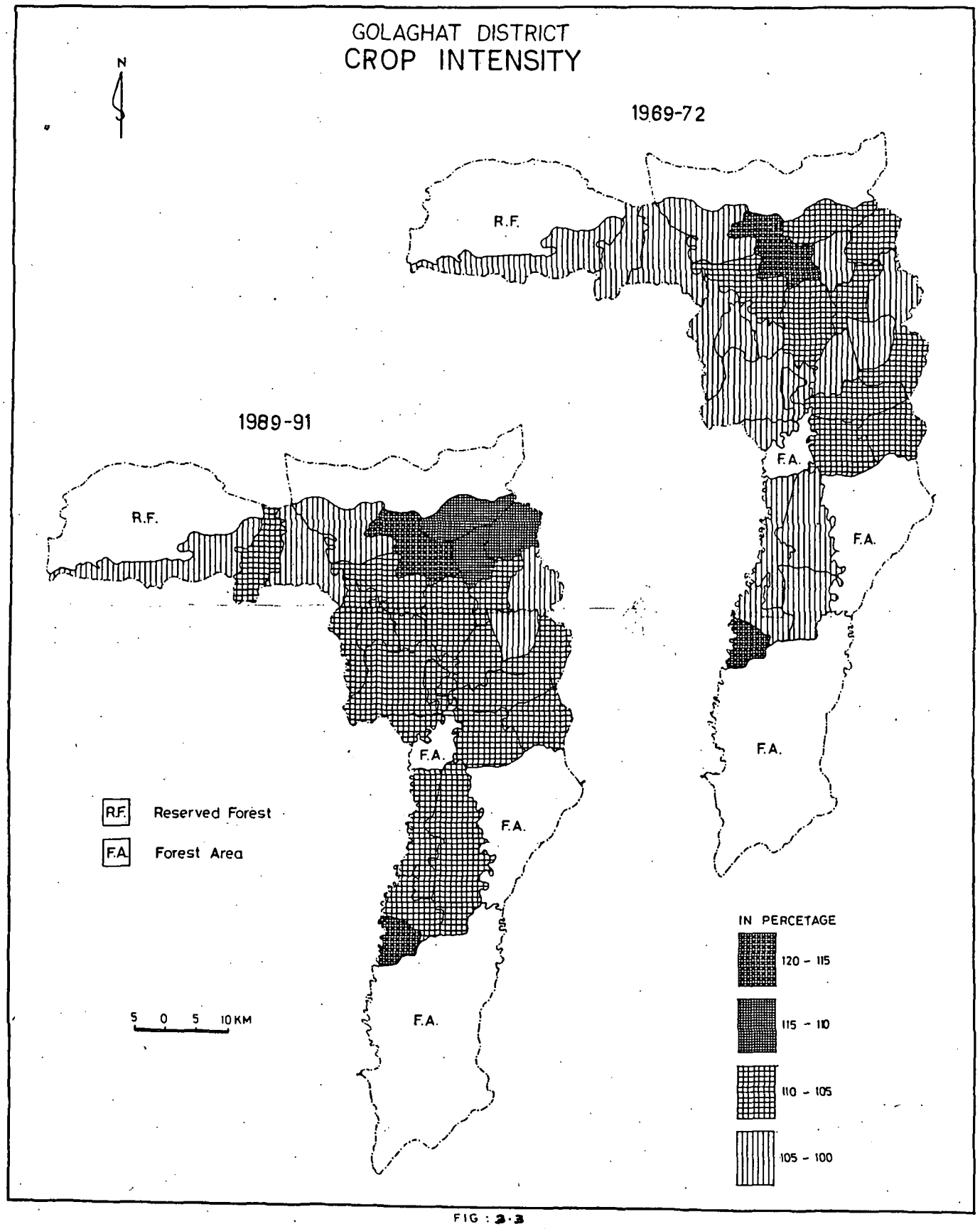
GOLAGHAT DISTRICT
CROP INTENSITY
N
1969-72
R.F.
F.A.
F.A.
1989-91
R.F.
F.A.
F.A.
F.A.
F.A.
R.F. Reserved Forest
F.A. Forest Area
5 0 5 10 KM
IN PERCETAGE
120 - 115
115 - 110
110 - 105
105 - 100

FIG : 2.3

effects of new agricultural innovations. On account of these facts, the area has the higher degree of crop-intensity.

Cropping Pattern

Cropping pattern is also one of the determinants of agricultural development. In the present study, six principal crops of the area (Paddy, Wheat as food grains; Mustard as an important oil seed, Sugarcane and Jute as commercial crops of the area and Potato as important vegetables) have been taken into account. Paddy is the dominating food grain which is sown twice in the year, Summer paddy which is locally called Ahu and winter paddy that is called Sali. It is obvious from the figures that winter paddy occupies 43.5 per cent area of the GCA (Gross Area Cultivated) while summer paddy has only 3.27 per cent of its land occupancy in early seventies. Thus, it is clear that winter paddy is the dominating crop in the area. The other crops like mustard, sugarcane, potato and jute have only 3.5, 5.0, 0.35 and 0.57 percents respectively. As a result, in the district, the entire cropping pattern are concentrating towards winter paddy crop. Therefore, there is a monocropping in the crop combinations in the district in 1969 to 1972. More or less, cropping pattern remains same after twenty years of agricultural practices in the district (Table 3.6).

There seems a negligible change in the cropping

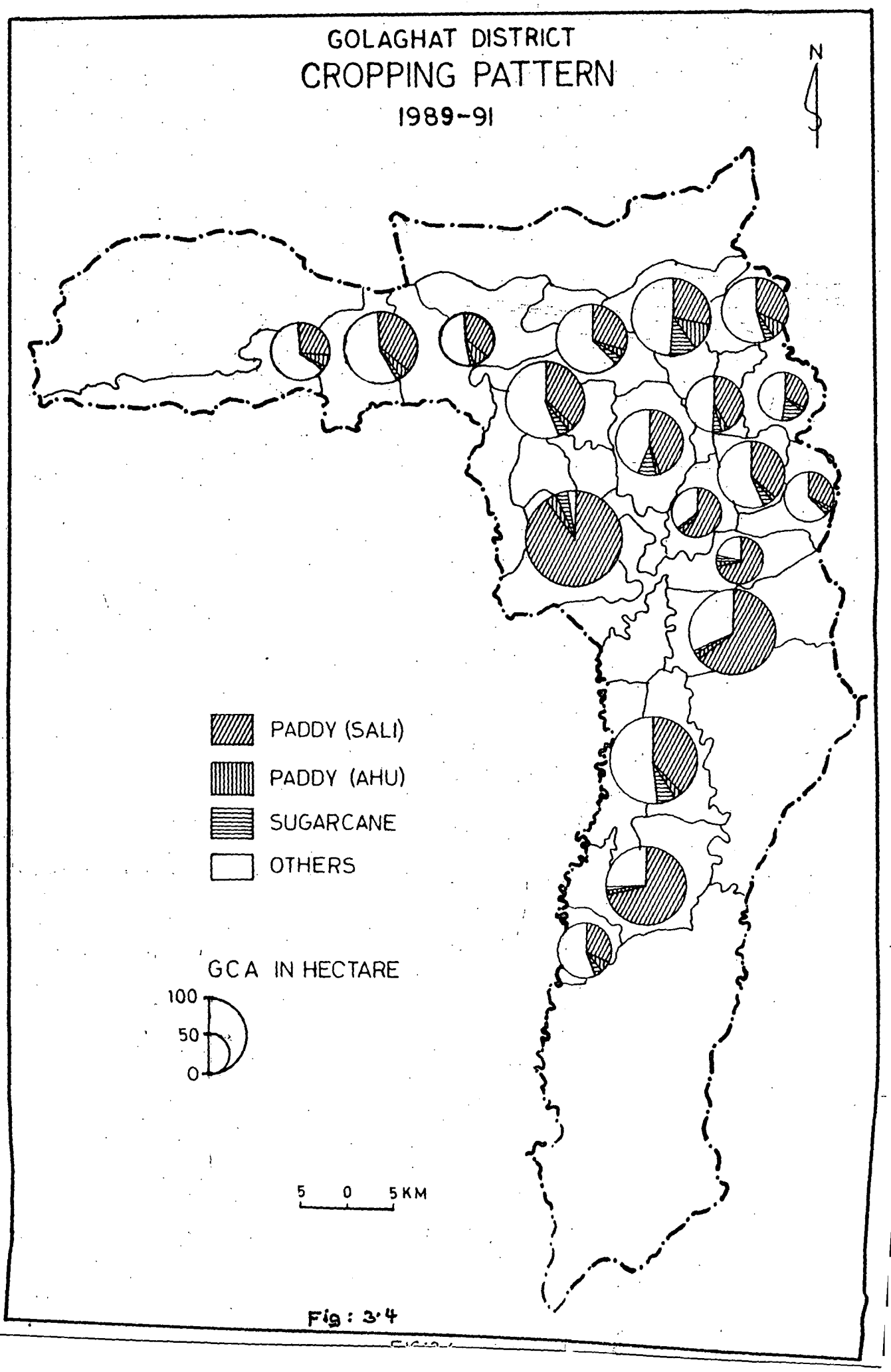
GOLAGHAT DISTRICT
CROPPING PATTERN
1989-91
N
PADDY (SALI)
PADDY (AHU)
SUGARCANE
OTHERS
GCA IN HECTARE
100
50
0
5 0 5KM

Fig : 3·4

patterns during the last twenty years of time (Table.3.5).

So far as areal variation in the cropping pattern is concerned, it is obvious from the table.3.5 that areas which are located in the central part of the district especially in the alluvial tracts of the Dhansiri River are noticeable for higher concentration of winter paddy cultivation. For example, Golaghat (58.89 percent) Athgaon (67.68 per cent), Ghiladhari Pub and Pachim (66.44 per cent) and Pub and Pachim Sarupathar (70.49 per cent) which are located in the same tract of fertile land, have been recorded as higher percentages of winter rice land occupancy than the district averages in early 1970s as well as in early 1990s. Sugarcane is the second important crop of the area, although it incorporates only 5 per cent land of the total GCA is concentrated in the lowlying areas of north east and eastern part of the district. Because of significant area under this crop in these areas, the crop intensity is marked higher. The jute crop which includes only 0.5 per cent of the total GCA in the district, is concentrated specially in the areas where winter paddy is dominated. It is possible that in these areas the land occupancy of summer paddy is less because jute is grown in summer season. It can be generalised here, that on account of winter paddy concentration in the cropping pattern, irrigation is only the important factor which can increase

Table : 3.5

Intensity and Cropping Pattern 1969-72

	Net sown Area hect.	Area sown more than one hect.	Gross cultivated Area hect.	Intensity	Ahu hect	P.C.	Sali hect.
Dergaon	5629.34	525.30	6154.64	1.09	429.36	6.98	2023.67
Missamara	4411.58	76.97	4488.55	1.02	57.70	1.29	2264.26
Brahmaputra	3733.99	291.70	4025.69	1.08	537.98	13.36	1632.53
Noajan	3265.72	500.24	3765.96	1.15	215.39	5.72	1265.29
Pal Sampathar		302.84					
Pachim Sampathar	9560.38		9863.18	1.03	175.30	1.78	6952.70
Uttar Barpathar							
Dakhin Barpathar	11053.46	436.23	11489.69	1.04	210.48	1.83	4320.32
Uttar Morongi							
Dakhin Morongi	14739.04	426.37	15165.41	1.03	315.98	2.08	5969.67
Morongi chah Mazadoor.	–	–	–	–	–	–	–
Rangamati	4676.65	825.84	5502.49	1.18	668.70	12.15	1551.87
Khumtai	7844.53	483.4	8327.93	1.06	113.35	1.36	2954.30
Gurjagania	3903.42	280.35	4183.77	1.07	96.84	2.31	1724.82
Dhekial	5331.03	374.03	5705.06	1.07	88.89	1.56	2439.42
Kakodonga	3150.63	20.29	3170.92	1.01	82.65	2.61	1052.62
Daklinhengera	5915.58	227.18	6142.76	1.04	63.25	1.03	2290.05
Kamarkandha	3496.43	261.58	3758.01	1.07	50.72	1.35	1195.67
Golaghat	3512.94	153.82	3666.76	1.04	41.75	1.14	2159.28
Athgaon	3052.67	253.95	3306.62	1.08	85.33	2.58	2237.90
Pub-ghiladhari	10972.83	668.27	11641.10	1.06	142.35	1.22	7734.82
Pachim-ghiladhari							
Kaziranga	4779.63	101.75	4881.38	1.02	284.10	5.82	1231.08
Bokakhat	8250.36	332.71	8583.07	1.04	258.35	3.01	3035.27
Kurnabahi							
Mohura	3193.92	103.62	3297.34	1.03	239.06	7.25	1187.70
Forest Village	–	–	–	–	–	–	–
District	120473.93	6446.44	127120.37	1.06	4157.53	3.27	55233.24

contd...

Intensity & Cropping Pattern 1969-72

P.C	Wheat hect.	P.C	Mustard hect.	P.C	Sugarcane hect.	P.C	Potato hect.	P.C	Jute hect	P.C
32.88	23.39	0.38	110.63	1.80	432.65	7.03	10.32	0.17	15.3	0.25
50.45	-	-	12.05	0.27	693.88	15.46	2.83	0.06	1.0	0.02
40.55	-	-	550.72	13.68	320.67	7.97	39.17	0.97	42.66	1.06
33.60	30.85	0.82	70.46	1.87	200.46	5.32	31.65	0.84	31.62	0.84
70.49	140.35	1.42	2003.4	20.31	430.6	4.37	60.53	0.61	143.3	1.45
37.60	160.30	1.40	220.46	1.92	1200.35	10.45	71.39	0.62	150.1	1.31
39.36	-	-	306.39	2.02	648.78	4.28	28.80	0.19	162.95	1.07
-	-	-	-	-	-	-	-	-	-	-
28.20	-	-	517.62	9.41	103.71	1.88	41.10	0.75	30.66	0.56
35.47	7.87	0.09	29.54	0.35	309.27	3.71	14.83	0.18	4.07	0.05
41.23	-	-	4.93	0.12	201.35	4.81	-	-	-	-
42.76	-	-	52.54	0.92	507.16	8.89	1.29	0.02	18.57	0.33
33.20	3.39	0.11	5.75	0.18	509.67	16.07	4.67	0.15	4.7	0.15
37.28	-	-	24.74	0.40	420.84	6.85	-	-	1.62	0.03
31.82	6.52	0.17	5.49	0.15	120.79	3.21	3.97	0.11	3.83	0.10
58.89	-	-	12.35	0.34	31.90	0.87	6.51	0.18	4.62	0.13
67.68	-	-	42.50	1.29	60.52	1.83	30.33	0.92	14.63	0.44
66.44	-	-	50.64	0.44	75.30	0.65	12.68	0.11	50.74	0.44
25.22	39.54	0.81	203.06	4.16	20.99	0.43	12.20	0.25	1.46	0.03
35.38	300.41	3.50	96.13	1.12	25.75	0.03	42.92	0.50	21.46	0.25
36.02	69.24	2.10	162.0	4.91	44.51	1.35	33.30	1.01	18.14	0.55
-	-	-	-	-	-	-	-	-	-	-
43.50	781.86	0.62	4481.5	3.53	6359.15	5.00	448.49	0.35	721.43	0.57

Source : District Statistical Office.Golaghat,SDC Office.Golaghat,
Dergaon, Khumtai, Bokakhat, Sarupathar.

Table :3.6 Intensity & Cropping Pattern 1989 - 1991

	Net sown Area(hect.)	Area Sown more than one hect.	Gross Cultivated area (hect).	Intensity	Ahu.(hect)	Percentage (P.C)
Dergoan	6107.76	634.0	6741.76	1.10	593.3	8.80
Missamara	8064.79	903.2	8967.99	1.11	1093.3	12.19
Brahmaputra						
Naojan	3696.65	632.1	4328.75	1.17	272.8	6.30
Pub-sarupat-har.	9650.33	464.5	10114.83	1.05	183.1	1.81
Pachim Sarupathar.						
Uttar Barapa-thar.	11630.52	559.0	12189.52	1.05	290.6	2.38
Dakhin Barapathar						
Uttar Morongi	13730.92	760.4	14491.32	1.06	317.6	2.19
Dakhin Morongi						
Morongi-Chah Mazdoor.						
Rangamati	7017.00	1118.7	8135.70	1.16	313.1	3.85
Khumtai	8231.05	563.8	8794.85	1.07	126.1	1.43
Gurjogania	4031.72	303.0	4334.72	1.07	107.2	2.48
Dhekial	6023.96	294.2	6318.16	1.05	123.9	1.96
Kakodonga	3270.41	50.6	3321.01	1.02	41.5	1.25
Dakhinhengera	6047.65	260.1	6307.75	1.04	40.6	1.39
Kamarbandha	3577.10	265.0	3842.10	1.07	53.55	1.39
Golaghat	3659.83	187.4	3847.23	1.05	60.38	1.57
Athgoan	3189.10	295.7	3485.25	1.09	110.0	3.16
Pub-Ghila-dhari.	11592.55	547.1	12139.20	1.05	159.6	1.31
Pachim Ghiladhari						
Kaziranga	5671.88	201.5	5873.38	1.04	405.05	6.89
Bokakhat	8865.59	433.9	9292.49	1.05	357.43	3.63
Kuruabahi Mohura	3839.89	159.4	3999.29	1.04	357.43	8.94
Forest Village	NA	NA	-	-	NA	-
District	127898.7	8633.6	136532.3	1.07	4986.36	3.65

Contd....

Intensity & Cropping Pattern 1989-1991

Sali hect.	P.C.	Wheat hect.	P.C.	Mustard hect.	P.C.	Sugarcane hect.	P.C	Potato hect.	P.C.	Jute hect.	P.C.
2155.2	31.97	42.2	0.63	125.1	1.86	305.6	4.53	12.5	0.19	17.7	0.6
2501.1	27.89	55.7	0.62	330.4	3.68	1016.6	11.34	48.1	0.54	58.1	0.65
1354.75	31.30	40.16	0.93	80.32	1.86	203.48	4.70	36.14	0.84	33.5	0.77
7204.9	71.23	166.8	1.65	5582.7	55.19	93.3	0.92	79.6	0.79	151.5	1.50
4583.7	37.60	209.1	1.72	426.2	3.5	899.7	7.38	78.9	0.65	209.7	1.72
13041.9	90.00	7.1	0.05	329.0	2.27	704.0	4.86	25.4	0.18	44.4	0.31
2445.9	30.06	43.9	0.54	156.6	1.92	300.0	3.69	45.5	0.56	27.4	0.37
3144.3	35.75	17.5	0.20	32.8	0.37	255.7	2.91	15.1	0.17	8.16	0.09
1853.7	42.76	2.3	0.05	6.0	0.14	225.3	5.2	1.7	0.04	2.6	0.06
2836.1	44.89	15.1	0.24	30.8	0.49	543.1	8.6	26.7	0.42	8.7	0.14
1103.3	33.22	5.9	0.18	9.2	0.28	580.4	17.48	6.0	0.18	2.6	0.08
2325.9	36.56	-	-	5.0	0.08	342.4	5.43	4.9	0.18	-	-
1212.58	31.56	7.49	0.20	7.36	0.19	133.87	3.48	2.67	0.07	2.01	0.05
2314.6	60.16	-	-	9.10	0.24	33.47	0.87	7.09	0.18	2.3	0.06
2527.8	72.53	4.0	0.12	31.8	0.91	74.4	2.14	28.3	0.81	17.7	0.51
7807.2	64.31	-	-	66.0	0.54	80.9	0.67	14.3	0.12	40.5	0.33
1575.99	26.83	54.85	0.93	248.63	4.23	30.19	0.51	19.81	0.34	2.64	0.04
3383.27	36.38	464.70	4.99	128.14	1.38	35.76	0.38	67.62	0.73	25.62	0.28
1475.50	36.89	106.43	2.66	218.88	5.47	60.91	1.52	48.19	1.20	27.84	0.69
NA	-	NA	-	NA	-	NA	-	NA	-	NA	-
64847.69	47.50	1243.23	0.91	7824.03	5.73	5919.08	4.34	568.52	0.42	682.97	0.50

Source : Distric Statistial office. Golaghat SDC office, Golaghat, Dergoan, Bokakhat, Khumtai, Sarupathar.

yield as well as land occupancy ratio of the winter paddy crop in the area, because of less irrigation facilities specially for winter season, crop intensity, cropping patterns and even crop yield are being hampered.

Crop Yield Pattern

Crop yield is an important attribute of agricultural development and productivity assessment. In the study area the yields of the principal crops are far lower than the national average, although the area is experiencing favourable climatic and soil conditions for better growth of the crops. For example, Sali or Winter paddy is the dominating crop in the area. As discussed earlier, the sali yield has been recorded only 28.37 ql/ha in 1969-72, which is increased only 2.7 per cent during the last twenty years. It indicates that the farmers are not using HYV seeds, and other modern technology for engendering the paddy yield while agro-climatic conditions are suitable for this yield (Table 3.7). The paddy yield seems decreased specially Sarupathar, Brahmaputra, Borpathar, Ghiladhari, Dhekial, Rangamati and Bokakhat G.Ps, that is the southern and western part of the district. In the central part, specially in Athgaon, Golaghat, Kamarbandha, Dakhinhengera, Kakodonga, Gurjogania, Morongi, Khumtai, Missamara, Dergaon G.Ps, and Naojan on the southern part of the district, the sali paddy yield is increased by 3 to 7 per cent during the

Table : 3.7 Increase in Crop Yield (1969-72 to 1989-91)

A-Yield in quintal(1989-91), B-Yield in quintal(1989-91),
C-Increase in Yield in percent (20 years)

Name of the Panchayats	Sali Paddy A	Sali Paddy B	Sali Paddy C	Wheat A	Wheat B	Wheat C	Mustard A	Mustard B	Mustard C	Sugarcane A	Sugarcane B	Sugarcane C
Dergoan	27.25	29.92	9.80	32.67	35.25	7.90	12.62	13.75	8.95	434.6	485.6	11.73
Missamara	28.68	29.88	4.18	-	37.35	-	13.32	14.94	12.16	470.2	490.4	4.30
Brahma-putra	30.33	29.88	-1.48	-	37.35	-	14.98	14.49	-0.27	430.4	490.4	13.94
Naojan	27.02	28.68	6.14	30.29	36.26	19.71	12.63	13.53	7.13	390.7	410.9	5.17
Sarupathar	30.50	30.20	-0.98	34.58	37.35	8.01	14.95	14.94	-0.07	395.1	410.9	4.00
Borapathar	30.00	29.88	-0.04	34.52	63.38	5.39	14.15	13.95	-1.41	392.9	415.6	5.78
Morongi	28.42	28.88	5.13	-	37.25	-	14.50	14.42	-0.55	420.6	480.3	14.19
Rangamati	28.80	28.75	-0.17	-	36.25	-	14.25	13.62	-4.42	440.4	480.3	9.06
Khumtai	25.38	26.75	5.65	34.05	36.45	7.05	12.89	13.72	6.44	391.6	412.7	5.39
Gurjogania	24.06	25.42	5.65	-	34.85	-	12.56	13.50	7.48	460.3	486.2	5.63
Dhekial	28.62	28.52	-0.35	-	35.12	-	13.49	14.42	6.89	460.2	482.8	4.91
Kakadonga	26.20	27.35	4.39	32.32	34.75	7.52	12.67	13.62	7.49	421.6	480.6	13.99
Dakhin-hengera	25.46	27.35	7.42	-	-	-	11.50	12.75	10.87	402.6	435.4	8.15
Kamarban-dha.	26.92	28.50	5.87	31.29	33.75	7.86	11.50	12.75	10.87	404.6	438.3	8.33
Golaghat	29.22	30.20	3.35	-	-	-	12.26	13.65	11.34	395.6	430.6	8.85
Athgaon	29.13	30.12	3.39	-	27.53	-	12.96	13.68	5.60	390.9	426.6	9.13
Ghila-dhari.	31.46	31.35	-0.35	-	-	-	12.74	13.24	3.92	358.3	400.1	11.67
Kazi - ranga.	29.56	30.15	2.00	32.54	37.33	14.72	13.75	13.75	0.0	360.4	410.3	13.85
Bokakhat	30.48	30.25	-0.75	33.42	38.25	14.45	14.02	14.68	4.71	370.4	412.3	11.31
Mohura.	29.96	30.05	0.3	32.75	37.45	14.35	13.92	13.92	0.0	365.4	411.6	12.69
Forest Village	NA	NA	-	NA	NA	-	NA	NA	-	NA	NA	-
District.	28.37	29.15	2.75	32.84	35.83	9.10	13.28	13.89	4.59	407.8	444.6	9.02

contd ...

N.B : NA - Not available.

Potato			Jute		
A	B	C	A	B	C
140.7	170.3	21.04	10.29	12.95	25.85
140.7	186.8	32.76	11.25	13.07	16.18
166.3	186.8	12.33	11.36	13.07	15.05
130.6	150.7	15.39	9.68	10.23	5.68
132.7	160.8	21.18	10.55	12.25	16.11
142.8	160.5	12.39	11.72	12.38	5.63
140.8	158.3	12.43	11.75	12.80	8.94
160.8	175.3	9.02	11.26	13.07	16.07
140.3	150.4	7.20	10.92	12.09	10.71
–	120.2	–	–	10.25	–
118.5	125.3	5.74	9.52	10.20	7.14
119.7	120.7	0.84	8.33	9.67	16.09
–	120.1	–	8.32	–	–
115.6	125.3	8.39	9.36	11.28	20.51
162.3	180.4	11.15	10.32	12.80	24.03
120.5	150.3	24.73	10.11	11.56	14.34
114.3	130.4	14.09	8.25	9.80	18.79
150.7	155.8	3.38	12.65	13.02	2.92
155.7	157.3	1.03	12.45	14.58	17.11
152.8	156.7	12.25	12.25	14.25	16.33
NA	NA	–	NA	NA	–
139.2	152.1	9.27	10.54	12.07	14.52

last twenty years, which is negligible. On the other hand, wheat is not the dominating crop of the area, although this is important food grain in national level, has an increase of 9.0 per cent in its yield. The areas lying in the western part of the district are noticeable for higher increase in wheat yield. Mustard yield in the district is almost constant. It varies from 13.28 ql/ha. in 1969-72 to 13.89 ql/ha. in 1989-91. But the areas of southern part of the district have decreasing trend of mustard yield during the successive period of time. On account of sugarcane and jute as the commercial crops of the area, there are 9.02 per cent and 14.52 per cent respectively are noticeable change in its crop yields. Increasing trend of yield in those crops are marked everywhere in the district (Table 3.7).

It is marked here that there is a significant increase only in the jute crop yield (14.5 per cent). It is because of more remmunerative profitable crop which would affect the productivity pattern of the district.

Agricultural Production

In fact, agricultural production is the aggregated form of the production of all crops of the district, and changes therein. The aggregated form of the production of main crops is achieved by converting crop production into its

money value with the help of applying the formula given earlier in the first chapter (Equation No. 1.2). Thus agricultural output has been calculated for each and every areal unit (Gaon Panchayat) for 1969-72 and 1989-91, so that the agricultural output growth can be assessed.

Growth of Agricultural Output

Agricultural output growth is the major attribute which reflects the processes of agricultural development of the area. The agricultural growth of the district as a whole as well as for each and every areal unit (Gaon Panchayat) has been calculated by using the growth formula (as given earlier by the equation 1.3 in the first chapter). The total magnitude of agricultural output in the district has been recorded Rs.1166.17 lakh in 1969-72, of which the maximum share is attributed/contributed by Ghiladhari (Rs.126.68 lakh) Morongi(Rs.115.63 lakh) and Sarupathar (Rs.154.13 lakh) gaon panchayats. On account of larger areal size of those panchayats they are accounting for their maximum share. During 1989-91, the total output of the district is recorded Rs.1419.96 lakh. There is, therefore, Rs. 253.79 lakh absolute increase in the district in last twenty years. It accounts for only 1.09 per cent average annual growth of the district, that is very low in comparison to that of the state and the nation.

Table : Output in Rs. 1969/72

3.11

	Ahu (hect)	Yield per Hectare Quintal	Production Q	Output in Rs.	Sahi Hect.	Yield Hect/Q	Production
Dergaon	429.36	21.36	9171.13	275133.9	2023.67	27.25	55145.0
Missamara	537.98	22.75	11239.05	367171.35	1632.53	30.33	49514.64
Brahmaputra	57.7	21.21	1223.82	36714.51	2264.26	28.68	64938.98
Naojan	215.39	19.68	4238.88	127166.26	1265.29	27.02	34188.14
Pub Sarupathar							
Pachim "	175.30	24.60	4137.08	124112.4	6952.7	30.50	212057.4
Uttar Borpathar							
Pachim "	210.48	22.78	4794.73	143842.03	4320.32	30.00	129609.6
Uttar Morangi							
Dakhin "	315.98	21.75	6872.57	206176.95	5969.67	28.42	169658.02
Morongi Chah Mazdoor							
Rangamati	688.70	22.25	14878.58	446357.25	1551.87	28.80	44693.86
Khumtai	113.35	19.32	2189.92	65697.66	2954.30	25.38	74980.13
Gurjogania	96.84	17.56	1700.51	51015.31	1724.82	24.06	41499.17
Dhekial	88.89	20.02	2779.58	53387.33	2439.42	28.62	69816.2
Kakodonga	82.65	19.82	1638.12	49143.69	1052.62	26.20	27578.6
Dakhinhen-gera.	63.25	17.63	1115.10	33452.93	2290.05	25.46	58304.67
Kamarbandha	50.72	18.73	949.99	28499.57	1195.67	26.92	32187.44
Golaghat	41.75	19.82	827.49	24824.55	2159.28	29.22	63094.1
Athgaon	85.33	19.06	1626.39	48791.69	2237.90	29.13	65190.00
Pub Ghiladhari							
Pachim "	142.35	19.20	2733.12	81993.6	7734.82	31.46	243337.4
Kaziranga	284.10	21.54	6119.51	183585.4	1231.08	29.56	36390.73
Bokakhat	258.35	22.12	5714.70	171441.1	3045.27	30.48	92819.83
Kuruabahi							
Mohura	239.06	22.02	5264.10	157923.04	1187.70	29.96	35583.49
Forest Village		--	--	--	--	--	--
District	4157.53	20.66	88214.37	2676430.5	55233.24	28.37	7600587.4

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	Output in Rs.	Wheat hect	Yield hect/Q	Production Q	Output in Rs.	Mustard hect.	Yield hect/Q	Production Q
Dergaon	2757250.5	23.39	32.67	764.15	76415	110.63	12.62	1396.15
Missa - mara.	2475731.7	--	--	--	--	550.72	14.98	8249.79
Brahma- maputra.	3246948.8	--	--	--	--	12.05	13.32	160.51
Naojan Pub Sarupathar	1709406.8	30.85	30.29	934.446	93444.6	70.46	12.63	889.91
Pachim " Uttar Borpathar	10602868	140.35	34.58	4853.303	485330.3	2003.4	14.95	29930.8
Dakhin " Uttar Morongi	6480480	160.31	34.52	5533.556	553355.6	220.46	14.15	3119.51
Dakhin " Morongi chah Mazdoor	8482901.1	--	--	--	--	306.39	14.50	4442.66
Rongamati	2234692.8	--	--	--	--	517.62	14.25	7376.09
Khumtai	3749006.7	7.87	34.05	276.973	26797.3	29.54	12.89	380.77
Gurjogania	2074958.5	--	--	--	--	4.93	12.56	61.92
Dhekial	3490810	--	--	--	--	52.54	13.49	708.76
Kakodonga	1378932	3.39	32.32	109.565	10956.5	5.75	12.67	72.85
Dakhin- hengera.	2915233.7	--	--	--	--	24.74	11.50	284.51
Kamarban- dha.	1609371.8	6.52	31.29	204.011	20401.1	5.49	11.50	63.14
Golaghat	3154708.1	--	--	--	--	12.45	12.26	152.64
Athgaon Pub Ghiladhari	3259501.4	--	--	--	--	42.50	12.96	550.8
Pachim "	12166872	--	--	--	--	50.64	12.74	645.15
Kazirang	1819536.2	39.54	32.54	1286.63	128663	203.06	13.75	2792.08
Bokakhat	4640991.5	300.41	33.42	10039.70	1003970	96.13	14.02	1347.74
Kuruabahi								
Mohura	1779174.6	69.24	32.75	2267.61	226761	162.0	13.92	2255.04
Forest Village.	--	--	--	--	--	--	--	--
District	80029376	781.86	32.84	26260.95	2626095	4481.5	13.28	64880.81

contd...

	Output in Rs.	Sugarcane hect.	Yield/ hect.Q	Production	Output in Rs.	Potato hect	Yield hect.Q	Production
Dergaon	104711.3	432.65	434.60	188029.69	1385778.8	10.32	140.68	1451.818
Missa-mara.	618733.92	320.67	430.35	138000.33	1017062.5	39.17	166.32	6514.75
Brahma-putra.	618733.92	693.88	470.20	326262.38	2404553.7	2.83	140.68	398.12
Naojan	66743.24	200.46	390.68	78315.71	577186.8	31.65	130.59	4133.174
Pub Sarupathar								
Pachim "	2244809.7	430.60	395.06	170112.84	1253731.6	60.53	132.72	8033.542
Uttar Borpathar								
Dakhin "	233963.18	1200.35	392.92	471641.52	3475998.0	71.39	142.78	10193.064
Uttar Morongi								
Dakhin "	333199.13	648.78	420.62	272889.8	2011198.1	28.80	140.80	4055.04
Morongi Chah Mazdoor								
Rangamati	553206.38	103.71	440.38	45671.8	336601.24	41.10	160.82	6609.702
Khumtai	28557.8	309.27	391.63	121119.41	892650.05	14.83	140.25	2079.908
Gurjogania	4644.06	201.35	460.27	92675.37	683017.44	--	--	--
Dhekial	53157.35	507.16	460.20	233395.03	1720121.4	1.29	118.52	152.891
Kakodonga	5463.94	509.67	421.58	214866.68	1583567.4	4.67	119.74	559.186
Dakhinhen-gera.	21338.25	420.84	402.63	169442.8	1248793.5	--	--	--
Kamarbandha	4735.13	120.79	404.55	48865.6	360139.43	3.97	115.64	459.091
Golaghat	11447.78	31.90	395.62	12620.28	93011.50	6.51	162.32	1056.703
Athgaon	41310.0	60.52	390.92	23658.48	174362.4	30.33	120.48	3654.158
Pub Ghiladhari								
Pachim "	48386.52	75.30	358.30	26979.0	198842.5	12.68	114.30	1449.324
Kaziranga	209405.63	20.99	360.42	7565.22	55755.6	12.20	150.68	1838.30
Bokakhat	101080.7	25.75	370.38	9537.29	70289.8	42.92	155.72	6683.50
Kuruabahi								
Mohura	169128.0	44.51	365.40	16263.95	119865.3	33.30	152.84	5089.57
Forest Village	--	--	--	--	--	--	--	--
District	4866060	6359.15	407.84	2667914.1	1966258	448.49	139.22	64411.84

contd...

	Output in Rs.	Jute hect	Yield/ hect.Q	Production	Output in Rs.	Total Output in Rs.
Dergaon	145181.8	15.30	10.29	157.44	10233.41	4754704.7
Missamara	651475	42.66	11.36	484.62	31500.14	5161674.6
Brahmaputra	39812	1.00	11.25	11.25	731.25	7540798.2
Naojan	413317.4	31.62	9.68	306.08	19895.30	3007160.4
Pub Sarupathar						
Pachim "	803354.2	143.3	10.55	1511.82	98267.98	15412574.5
Uttar Borpathar						
Dakhin "	1019306.4	150.4	11.72	1762.69	114574.72	12021520.0
Uttar Morongi						
Dakhin "	405504.0	162.95	11.75	1914.66	124453.06	11563432.0
Morongi Chah Mazdoor						
Kaziranga	660970.2	30.66	11.26	345.23	22440.05	4254267.9
Khumtai	207990.8	4.07	10.92	44.44	2888.89	4973589.1
Gurjogania	--	--	--	--	--	2813635.3
Dhekial	15289.1	18.57	9.52	176.79	11491.12	53344255.7
Kakodonga	55918.6	4.70	8.33	39.15	2544.82	3086527.1
Dakhinhengera	--	1.62	8.32	23.48	876.10	4219694.5
Kamarbandha	45090.1	3.83	9.36	35.85	2330.17	2071386.3
Golaghat	105670.3	4.62	10.32	47.68	3099.10	33927761.3
Athgaon	365415.8	14.63	10.11	147.91	9614.10	3898995.9
Pub Ghiladhari						
Pachim "	144932.4	50.74	8.25	418.61	27209.33	12668239.2
Kaziranga	183830.0	1.46	12.65	18.47	1200.49	2581976.3
Bokakhat	668350.0	21.46	12.45	267.18	17366.51	6673489.6
Kuruabahi						
Mohura	508957.0	18.14	12.25	222.22	14443.98	2976252.9
Forest						
Village						
District	6441184	721.43	10.54	7825.57	575160.5	116616934.8

Table: 3.12
Output in Rs. 1989 - 9

	Ahu hect.	Yield/ hect.q	Production q	Output in Rs.	Sali hect.	Yield/ hect.q	Production
Dergoan	593.3	21.65	12844.95	385348.35	2155.2	29.9	64483.58
Missamara	1093.3	22.41	24500.85	735025.59	2501.2	29.88	74483.58
Bramaputra							
Naojan	272.8	20.55	5606.04	168181.2	1354.8	28.68	38855.66
Pub-sarupathar	183.1	23.45	4293.69	128810.85	7204.9	30.20	217587.9
Pachim-sarupathar.							
Uttar Morongi	317.1	20.65	6548.12	196443.45	13041.9	29.88	389691.62
Dakhin Morongi							
Morongi chah Mazadoor.							
Rangamati	313.1	21.75	6809.93	204297.75	2445.9	28.75	70319.62
Khumtai	126.1	19.85	2503.09	75092.55	3144.3	26.75	84110.02
Gurjogania	107.2	18.75	2010.0	60300.00	1853.7	25.42	47121.05
Dhekial	123.9	19.25	2385.08	71552.25	2836.1	28.52	80885.58
Kakodonga	41.5	20.15	836.23	25086.75	1103.3	27.35	30175.26
Dakhinhengera	40.6	18.45	749.07	22472.1	2325.9	27.35	63613.36
Kamarbandha	53.6	19.12	1024.83	30744.96	1212.6	28.50	34559.1
Golaghat	60.4	20.55	1241.22	37326.6	2314.6	30.20	69900.92
Athgaon	110.0	19.85	2183.5	65505.0	2527.8	30.12	76137.3
Pub ghiladhari	159.6	19.55	3120.18	93605.4	7807.2	31.35	244755.7
Pachim ghiladhari							
Kaziranga	405.05	21.75	8809.84	264295.1	1576.0	30.15	47516.1
Bokakhat	337.8	22.75	7683.81	230514.4	3383.3	30.25	102343.9
Kuruabahi	357.4	22.15	7917.07	237512.2	1475.5	30.05	44338.8
Mohura							
Forest Village	NA	NA	NA	NA	NA	NA	NA
District	4986.36	107579.85	64847.69	1918089.7			

contd...

Output in Rs 1989/91

Output in Rs.	Wheat hect.	Yield Hect/q	Production	Output in Rs	Mustard hect.	Yield hect/q	Production	Output in Rs.
3224179.2	42.2	35.25	1487.55	148755	125.1	13.75	1720.1	129009.4
3736643.4	55.7	37.35	2080.39	208039	330.4	14.94	4936.18	370213.2
1942783.2	40.2	36.26	1457.65	145765	80.3	13.53	1086.46	81484.4
10879399.0	166.8	37.35	6229.98	622998	5582.7	14.94	83405.50	6255415.4
6848047.8	209.1	36.38	7607.06	760706	426.2	13.95	5945.49	445911.75
19484599.0	7.1	37.35	264.47	26447	329.0	14.42	4744.18	355813.5
-	-	-	-	-	-	-	-	-
3515981.3	43.9	36.38	1597.08	159708	156.6	13.62	2132.89	159966.9
4205501.3	17.5	36.45	637.87	63787	32.8	13.72	450.02	33751.2
2356052.7	2.3	34.85	80.16	8016	6.0	13.50	81.0	6075.0
4044278.6	15.1	35.12	530.31	53031	30.8	14.42	444.14	33310.2
1508762.8	5.9	34.75	205.02	20502	9.2	13.62	125.30	9397.8
3180668.3	-	-	-	-	5.0	12.75	63.75	4781.25
727955.0	7.5	33.75	253.12	25312	7.4	12.75	94.35	7076.25
3495046.0	-	-	-	-	9.1	13.65	124.22	9316.13
3806866.8	4.0	27.53	110.12	11012	31.8	13.68	435.02	32626.8
12237786	-	-	-	-	66.0	13.24	873.84	655538.0
2375804.9	54.85	37.33	2047.6	404760	248.6	13.75	3418.66	256399.7
5117195.9	464.7	38.25	17774.8	1777480	128.14	14.68	1881.10	141082.1
2216938.8	106.43	37.45	3985.8	398580	218.9	13.92	3046.81	228510.7
-	-	-	-	-	-	-	-	-
	1243.23	-	26348.98	-	7824.03	-	115009.08	

Contd...

Sugar cane hect.	Yield/ hect.q	Production	Output Rs.	Potato in hect.	Yield/ hect.q	Production Q
305.6	485.55	148384.08	1093590.7	12.5	170.25	2128.12
1016.6	490.35	498489.81	3673869.9	48.1	186.75	8982.67
203.5	410.85	83607.98	616190.8	36.1	150.70	5440.72
93.3	410.85	38332.31	282509.0	79.6	160.80	12799.68
899.7	415.55	373870.34	2755424.4	78.9	160.50	12663.45
704.0	480.28	338117.12	2491923.2	25.4	158.30	4020.82
300.0	480.25	144075.0	1061823.8	45.5	175.26	7974.33
255.7	412.67	105514.61	777642.6	15.1	150.35	2270.28
225.3	486.18	109558.8	807448.9	1.7	120.23	204.39
543.1	482.75	262181.5	1932277.8	26.7	125.34	3346.58
580.4	480.62	278951.9	2055875.1	6.0	120.65	723.9
342.4	435.6	109067.3	1098625.7	4.9	120.05	588.24
133.9	438.26	58683.01	432493.8	2.7	125.32	338.3
33.5	430.62	14425.8	106317.9	7.0	180.35	1262.45
74.4	426.55	31735.3	233889.3	28.3	150.30	4253.49
80.9	400.05	32364.0	238523.0	14.3	130.38	1864.43
30.19	410.26	12385.8	91282.9	19.81	155.82	3086.79
35.76	412.30	14743.9	108662.2	67.62	157.25	10634.64
60.91	411.60	25071.6	184770	40.19	156.72	7552.34
NA	--	--	--	--	--	--
5919.08	--	2679559.2	--	568.52	--	90135.19

Contd...

Output in Rs	Jute hect	Yield/hect Q	Production Q	Output in Rs.	Total Output in Rs.
212812.5	17.7	12.95	229.22	14898.9	5208594.2
898267.5	58.1	13.07	759.36	49358.9	9671417.5
544027.0	33.5	10.23	342.71	22275.8	3520707.4
1279968.0	151.5	12.25	1855.87	120631.8	19569732.0
1266345.0	209.7	12.38	2596.09	168745.6	12440551.0
402082.0	44.4	12.80	568.32	36940.8	2294249.0
797433.0	27.4	13.07	358.12	23277.7	5922497.5
227028	8.2	12.09	99.14	6443.9	5389247.2
20439	2.6	10.25	26.65	1732.2	3260064.0
334658	8.7	10.20	88.74	5768.1	6474876.0
72390.0	2.6	9.67	25.14	1634.2	3693648.7
58824.5	-	-	-	-	4365371.9
33836.0	2.0	11.28	22.56	1466.4	2258884.4
26245.0	2.3	12.80	29.44	1913.6	3776075.2
425349.0	17.7	11.56	204.61	13299.8	4588548.7
186443.0	40.5	9.80	396.9	25798.5	12847693.5
308679.0	2.64	13.02	34.37	2234.2	3503455.8
1063460.0	25.62	14.58	373.54	24280.1	8462674.7
755234.0	27.84	14.25	396.72	25786.8	4047332.5
--	--	--	--	--	--
-	682.97	-	8467.5		141798.621

Table : 3.8
Growth of Agricultural Output in Golaghat District.
(1969-72 to 1989-90)

Name of the Panchayats	Total Output in (Lakh Rupees)		Change		Annual Growth in percent
	1969-72	1989-91	Absolute	Percentage	
Dergaon	47.55	52.09	4.54	9.55	0.48
Missamara	109.02	96.71	-12.31	-11.29	-0.56
Naojan	30.07	35.21	5.14	17.08	0.85
Sarupathar	154.13	195.70	41.57	26.97	1.35
Borpathar	120.22	124.41	4.19	3.48	0.17
Morongi	115.63	229.94	114.31	98.85	4.90
Rongamati	42.54	59.22	16.68	39.21	1.96
Khumtai	49.74	53.89	4.15	8.36	0.42
Gurjogania	28.14	32.60	6.07	15.87	0.79
Dekhial	53.44	64.75	11.31	21.16	1.06
Kakodonga	30.87	36.94	6.07	19.67	0.98
Dakhinhengera	42.20	43.65	1.45	3.45	0.17
Kamarbandha	20.71	22.59	1.88	9.05	0.45
Golaghat	33.93	37.76	3.83	11.30	0.56
Athgaon	38.99	45.89	6.90	17.69	0.88
Ghiladhari	126.68	128.48	1.80	1.42	0.07
Kaziranga	25.82	35.03	9.21	35.69	1.78
Bokakhat	66.73	84.63	17.90	26.81	1.34
Mohura	29.76	40.47	10.71	35.99	1.80
Forest Village	--	--	--	--	--
District	1166.17	1419.96	253.79	21.76	1.09

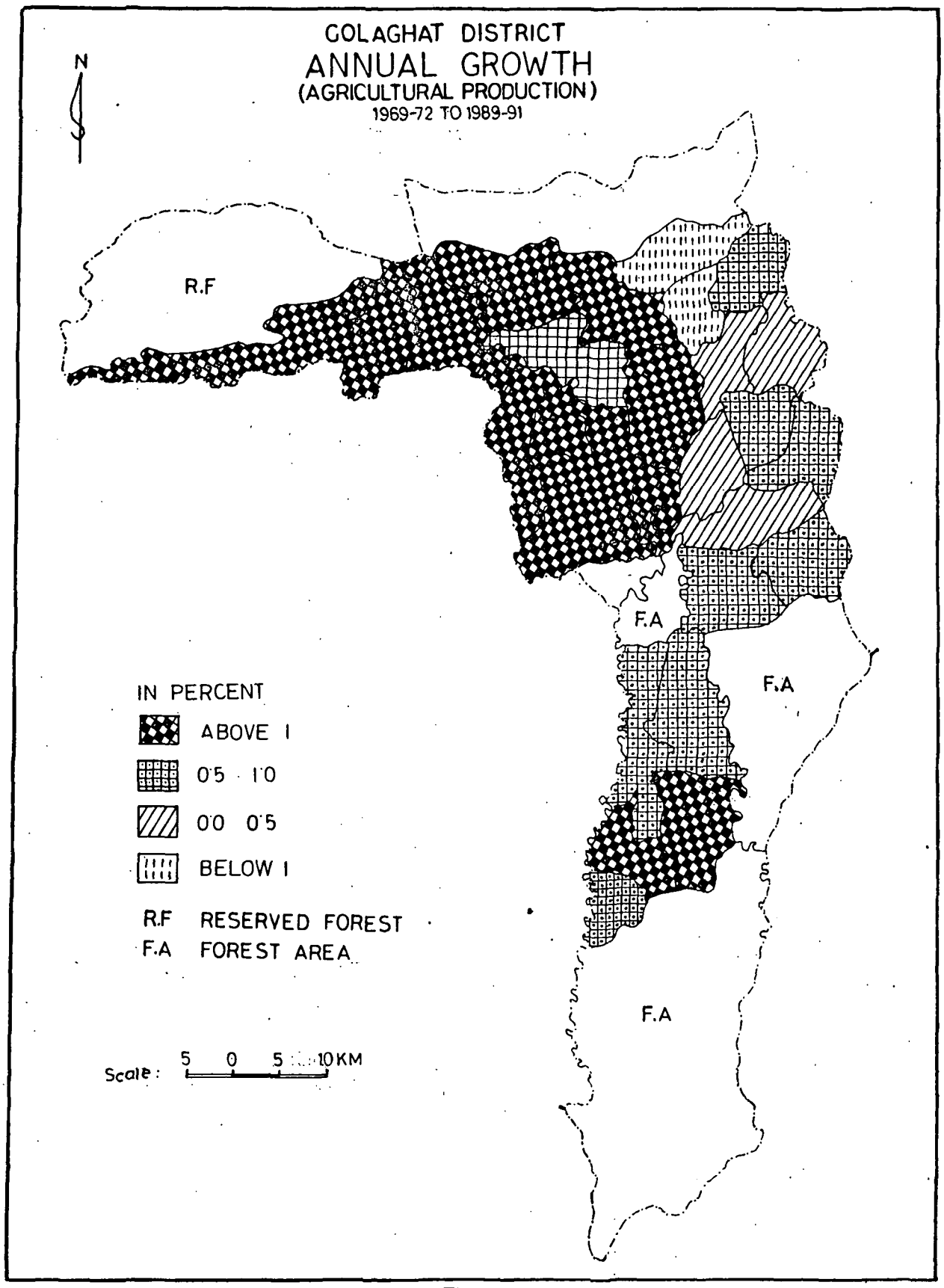
GOLAGHAT DISTRICT
ANNUAL GROWTH
(AGRICULTURAL PRODUCTION)
1969-72 TO 1989-91
N
R.F
F.A
F.A
F.A
IN PERCENT
ABOVE 1
0·5 1·0
0·0 0·5
BELOW 1
R.F RESERVED FOREST
F.A FOREST AREA
Scale : 5 0 5 10 KM

Fig: 3.5

So far as areal variation in the growth pattern in the study area is concerned, Morongi gaon panchayat has the highest annual growth rate in the district (4.90 per cent). The areas lying in the western part of the district are noticeable for higher growth of agricultural output, namely, Kaziranga (1.78 per cent), Bokakhat (1.34 per cent) and Mohura (1.80 per cent) (Table 3.8). Other G.Ps with high annual growth of output are Sarupathar (1.35 per cent), Rangamati (1.96 per cent). On the other hand, the lower growth has been recorded for Ghiladhari, Dakhinhengera, Borpathar, Khumtai, Dergaon, Missamara (-0.56 per cent) Naojan, Gurjogania, Kakodonga, Kamarbandha, Athgaon and Dhekial. This low growth of output may be due to (i) the diminishing return of agricultural land (Missamara, Brahmaputra, Barpathar, Ghiladhari, Dhekial G.P. etc.).

(ii) Low use of irrigation and HYV seeds in the diluvial (old alluvial) areas like Gurjogania, Kakodonga, Dhekial, etc. and (iii) due to traditional method of agriculture.

High growth in output may be attributed to the increase in the land productivity. It is generalised by many geographers and agricultural scientist that agricultural output growth is positively related to agricultural land productivity.

AGRICULTURAL PRODUCTIVITY

Development is a process through which resources are activised for improved life and output generation. Agricultural development can be equated with the level and the rate of agricultural productivity. Agricultural development is unquestionably a multidimensional concept of which crop productivity is one of the vital aspects (Gopalakrishnan, 1964). Crop productivity is the yield per hectare of various crops. Diversification of crops and agriculture (promotion of dairying, cattle rearing, bee keeping, fishing, etc.) and commercialization of agriculture are some of the characteristics of agricultural development.

Agricultural productivity is one of the dimensions of the concept of agricultural development. The level of development and the rate of development depends on mainly productivity which itself is associated with the growth of production. Level simply represents a picture of agricultural situation at a definite point of time whereas the rate of development encompasses achievement in a point of time over another. On the other hand, growth of production/output may be attributed to the growth of cropland (Alan Huston, 1968). Minhas and Vadyanathan (1965) concluded that growth is a function of variability in the culturable area and yield per hectare. Growth of production of various crops in

different regions is also due to variation in irrigated areas (S.K. Rao, 1971) in those regions. S. Bhalla (1977) suggests that increase in agricultural output is an outcome of various inputs and technology. This is also true that production of crops increases with the increase in agricultural productivity.

Agricultural productivity relates to the growth of production in an very economic and most efficient way so that change in pattern of production towards intensification and switch over to higher value crops are inevitable. Agricultural productivity may be defined as the ratio of index of total out put to the index of input used in agricultural production. It is a function of variety of factors like physical (soil, climate, relief etc.), Socio-economic (occupational structure of the population, type of farming etc.) and technological (irrigation, fertilizer, mechanisation etc.) These factors altogether put agricultural productivity to show areal variation to a greater degree (Subbaiah and Ahmad, 1980). In a country like ours and in micro units, where land availability is outnumbered by labour, it is better to measure the agricultural productivity in relation to per unit of area.

Agricultural Productivity for 1969-72 and 1989-91

The agricultural output growth shows the absolute picture of production increase. But level of agricultural

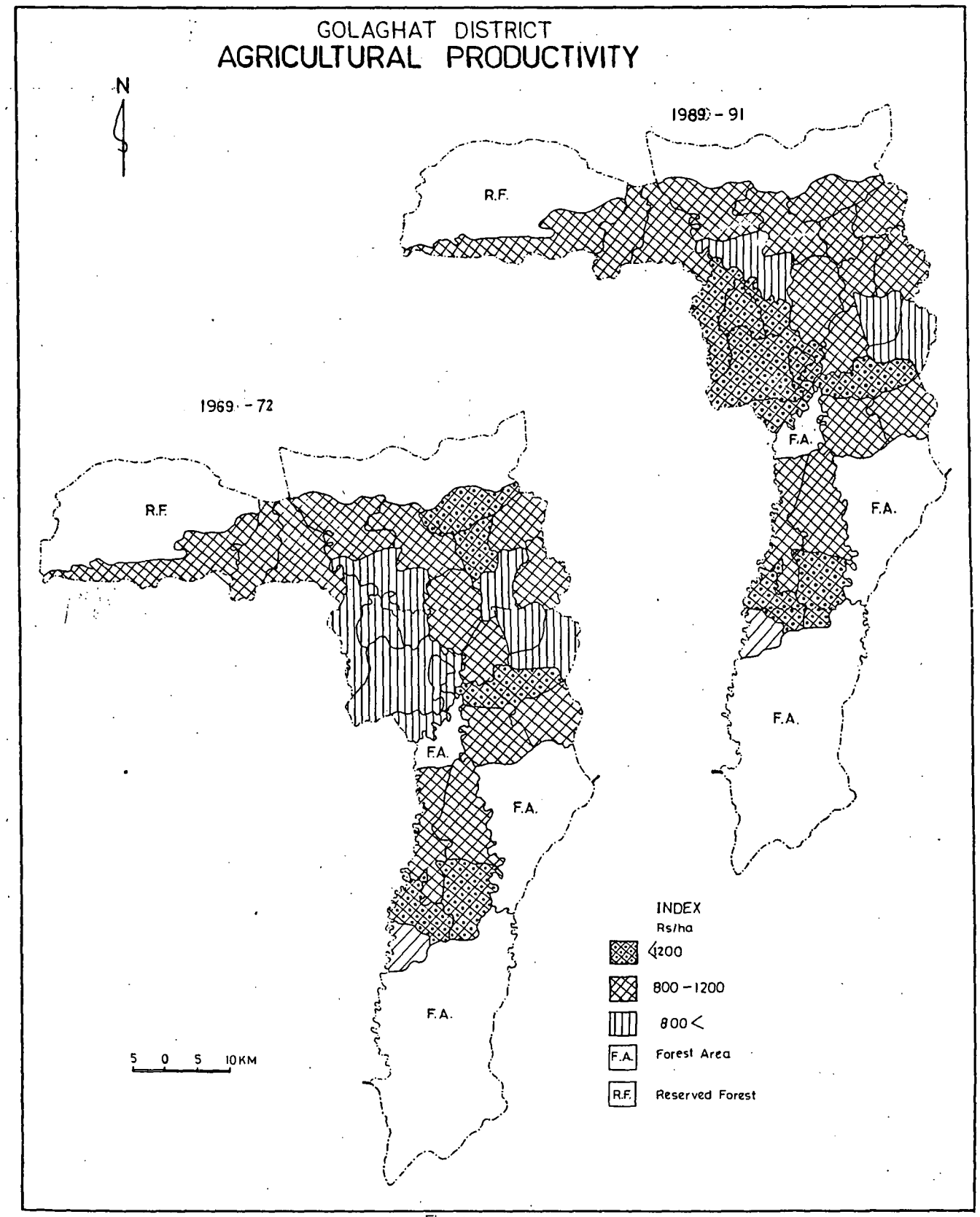
GOLAGHAT DISTRICT
AGRICULTURAL PRODUCTIVITY
N
1989 - 91
R.F.
F.A.
F.A.
1969 - 72
R.F.
F.A.
F.A.
F.A.
F.A.
5 0 5 10KM
INDEX
Rs/ha
<200
800 - 1200
800 <
F.A. Forest Area
R.F. Reserved Forest

Fig. 3.6

development can be revealed by analysing the pattern of agricultural productivity which is agricultural output per areal unit of cultivated land. With the help of the equation 1.1 as mathematically interpreted in the first chapter of the present study, the agricultural productivity of each and every gaon panchayat for early 1970s and early 1990s have been calculated. In fact, the areal variations in productivity patterns are simply because of the variations occuring in crop yield and crop area which have been analysed in the previous section.

In 1969-72, the agricultural productivity of land for the district was Rs.967.98 per hectare which is much lower than that of the state and the nation. Low agricultural productivity is accounted for the limited use of technology in agriculture in that period.

So far as the variation in agricultural productivity of different gaon panchayats in 1969-72 is concerned, it is found that the flood plain areas of the Dhansiri river are prominent. The areas here are, for example, Sarupathar (Rs. 1612.13/ha), Barpathar (Rs.1087.58/ha), Athgaon (Rs.1277.24/ha). Other areas with high agricultural productivity are found in flood plains of the river Brahmaputra, for example, Missamara (Rs.1338.45/ha), Mohura (Rs.931.91/ha) Rangamati(Rs.909.68/ha)

etc. (Table. 3.9).

The agricultural productivity for 1989-91 is calculated to be Rs.1108.70/ha for the district. The fertile areas of the Dhansiri and the Brahmaputra rivers along with the technological inputs are the attributes of the agricultural productivity in the period. The variation of agricultural productivity is recorded in different panchayat areas with highest in Sarupather (Rs. 2027.88/ha) and lowest in the western part of the district (Kaziranga - Rs.617.69/ha). As in 1969-72 period, the Dhansiri flood plain areas, in 1989-91 period also, are recorded with higher productivity as compared to areas of the flood plains of the river Brahmaputra and other small rivers like the Kakodonga and others.

So far the changes in the agricultural productivity of land in the district is concerned, it is found that there is an increase of 14.54 per cent in the last twenty years. Thus, the annual increase of 0.73 per cent in agricultural productivity indicates the stagnant development of agriculture in the district (Table. 3.9). This low increase in productivity was mainly due to low yield of various crops (Table. 3.7), and insignificant change of net sown area (Table. 3.3) in the district during the period of twenty years.

The changing agricultural productivity patterns during

1969-72 and 1989-91 have been shown by grouping the areal units into three categories, namely (i) high (Rs.1200/ha and above), (ii) Medium (Rs.800/ha - Rs. 1200/ha), and (iii) low agricultural productivity (Rs.800 and below) by taking Rs.400 as interval for delimiting the classes (Table.3.10 and Fig.3.6).

The high agricultural productivity is found in the areas where favourable land conditions prevail, specially when both alluvial and diluvial soil equally distributed. This category includes 27955.63 hectares of land in 1969-72 that accounts for 14.57 per cent of the total area of the district. The northern part (Missamara) and the southern part of the district (Sarupathar) are high productivity areas because of the natural fertility of the soil of those flood plain areas.

The medium agricultural productivity category includes more than half of the total area of the district in 1969-72. It occupies the western, northern and central part of the district with occasional exception such as in Naojan. This category is found to occupy 97691.11 ha. (50.91 per cent) of the total land in the district.

The low productivity category occupies an area of 66233.19 ha. which accounts 34.52 per cent of the area of the district. The eastern part of the district with old alluvial

Table: 3'10
Changing Agricultural Productivy Pattern
(1969-72 to 1989-91)

Agricultural Productivity Categories	Total Area (in ha.) 1969-72	'89-91	Change Abs.	%	%age to total area 1969-72	1989-91	Difference
High Rs.1200 &above	27955	38439	10483	37.5	14.57	20.0	5.49
Medium Rs.800-1200.	97691	11863	20951	21.45	50.91	61.90	10.99
Low (Rs.800-below)	66233	34587	-31646	-47.80	34.52	18.04	16.48
District	191879	191669	210	0.11	100.00	100.00	0.66

Table : 3.9
Changes in Agricultural Productivity (1969-72 to 1989 -91)

Name of the Panchayats	Productivity in Rs.		Change		
	1969 - 72	1989 - 91	Absolute	Percentage	Annual
Dergaon	844.63	852.78	8.15	0.96	0.05
Missamara	1338.45	1199.22	-139.23	-10.40	-0.52
Naojan	920.83	952.40	31.57	3.48	0.17
Sarupathar	1612.13	2027.88	415.75	25.79	1.29
Borpathar	1087.58	1069.65	-17.93	-1.65	-0.08
Morongi	784.54	1674.63	890.09	113.45	5.67
Rangamati	909.68	844.02	-65.66	-7.22	-0.36
Khumtai	634.02	654.75	20.73	3.27	0.16
Gurjogania	720.81	808.60	87.79	12.18	0.61
Dhekial	1002.48	1074.85	72.37	7.22	0.36
Kakodonga	979.65	1129.41	149.76	15.29	0.76
Dakhinhengera	713.32	721.83	8.51	1.19	0.06
Kamarbandha	592.43	631.48	39.05	6.59	0.33
Golaghat	965.79	1031.76	65.97	6.83	0.34
Athgaon	1277.24	1438.62	161.38	12.64	0.63
Ghiladhari	1154.51	1108.31	-46.20	-4.00	-0.20
Kaziranga	540.20	617.69	77.49	14.34	0.72
Bokakhat	808.87	954.55	145.68	18.01	0.90
Mohura	931.91	1054.02	122.11	13.10	0.66
Forest Village	--	--	--	--	--
District	967.98	1108.70	140.72	14.54	0.73

Source :
Census of India 1971 & 1991 (Provisional Table)
Series -I Paper III Assam,

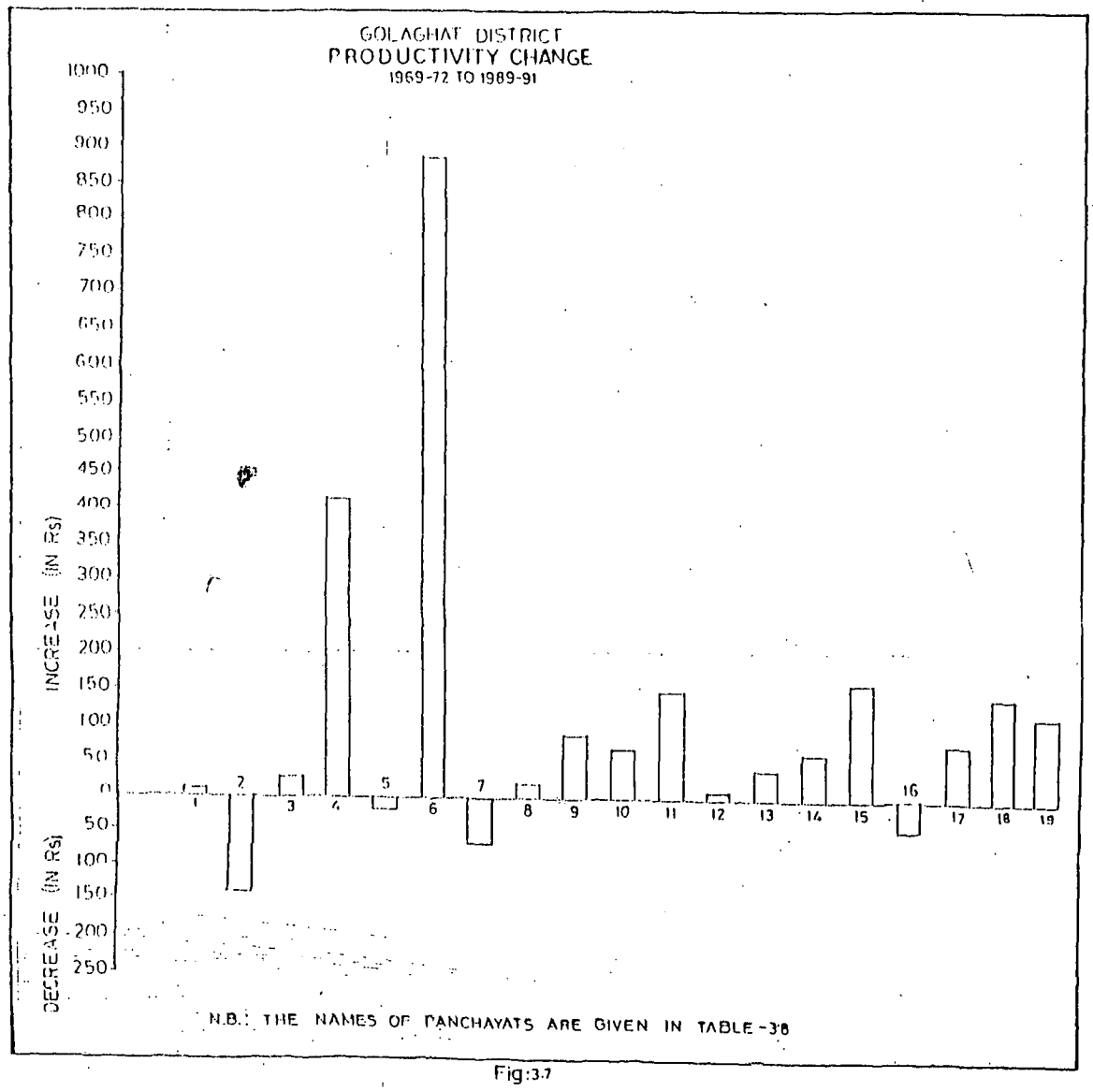
GOLAGHAT DISTRICT
PRODUCTIVITY CHANGE
1969-72 TO 1989-91
INCREASE (IN Rs)
DECREASE (IN Rs)
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
50
100
150
200
250
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
N.B.: THE NAMES OF PANCHAYATS ARE GIVEN IN TABLE-3.8

Fig:3.7

soil like Gurjogania, Dakhinhengera, Kamarbandha is categorised as low productivity area during 1969-72.

In 1989-91, high agricultural productivity category occupies 38439.35 ha. (20.06 per cent) of the total area of the district. The fertile tracts of the Dhansiri river record highest agricultural productivity (Sarupathar and Morongi).

The medium agricultural productivity areas are found along the northern, western and eastern parts of the district with the exception of Naojan on the south western part of the district. The soil fertility and the influences of the main centres account for the comparatively high agricultural productivity in these flood plain areas during 1989-91.

Low productivity category includes areas of old alluvial soil as in Dakhinhengera, Kamarbandha on the north-eastern part of the district and in marshy areas like in Kaziranga. It covers the increase in those formerly low productivity areas like Sarupathar, Gurjogania, Kakodonga, Athgaon, Bokakhat, etc. after a span of two decades is very much important so far agricultural development is concerned. It is important to note here that some of the high agricultural productivity area like Missamara, Brahmaputra and Rangamati have shown decreasing trends. The productivity decline is due to decline in crop yield specially in paddy and mustard in the fertile alluvial tracts of the

river Brahmaputra and the Dhansiri. This may be because of (a) decreasing natural fertility (b) non-use of fertilizer, (c) perpetual attack on crop plants by floods during their growth, (d) the attack of pests after each flood attack, and (e) continuation of traditional and agricultural practices, etc.

⊙. CHANGES IN PRODUCTION INPUTS

The intensification of production processes in any area is accelerated by some production factors. According to economists, land, labour and technology are the three main factors in which land is considered as natural phenomenon. But geographers' approaches to look into these are little bit different. Physical conditions of land are considered as bases of agricultural production and productivity while labour and technology are the operational factors for acceleration of agricultural production processes. Although animal force is also important factor specially in Indian conditions, where human labour and animals are used simultaneously in agricultural activities, modern technology is also important to study the production factors. On the whole, agricultural work force, (cultivator and agricultural labourer), and modern technology (irrigation, use of fertilizer, mechanisation and use of high yielding variety seeds), are the important production factors which should be studied in detail with regard to its total

magnitude and per hectare cultivated area.

I. Agricultural Work Force and Its Change

Agriculture in India in general, is still in early stages of transformation in the sense that both human labour and animal (draught animals including horse and milch buffalo) and traditional crop seeds have not been considerably replaced by modern technology and mechanization. This is typically true in Assam as well as in Golaghat district. Because of high growth in population (Table 2.3) the increase in labour has been a common phenomenon which may be an attribute for increased agricultural productivity (0.07 per cent per annum). The population table shows a fluctuating growth for Assam (around 19 per cent) till 1951, while during 1951 to 1971 and 1971 to 1991 the growth is as high as 35 per cent and 55 per cent respectively. The total population in Assam in 1971 and 1991 are 14.6 millions and 22.2 million* respectively showing 55.44* per cent growth in two decades (* provisional census, 1991).

Golaghat district experienced a high (57.81 per cent) growth of population during 1971 and 1991. Migration into the district and high birth rate may be the causes of the high growth. The density is up from 152/sq.km) in 1971 to (229/sq.km) in 1991 as against 284 persons per square k.m. of the state, and sex-ratio according to 1991 census (provisional) is 922.

Table: 3.16
Decadal Growth of Population in 1901-91) (in percentage)

Years	Golaghat District	Assam
1901		
1911	16.25	16.99
1921	20.14	20.48
1931	18.29	19.91
1941	1.48	20.40
1951	19.52	19.93
1961	26.04	34.98
1971	30.85	34.95
1991	53.09*	52.44*

* - Denotes Population Growth for two decades

Source : Census of India, 1991, Series-4, Assam, Provisional Population Totals.

The work force comprises 27.46 per cent of the total population in 1971 has gone up to 40.82 per cent in 1991(provisional). The total workers in different work categories like agriculture worker, industrial worker, workers in tertiary activities had to provide livelihood to the total non-workers (59.18 per cent, 1991) including children, students, ageing peoples, etc. Thus dependency ratio of the district is 1.45 which is less than the state level of 1.75.

Agricultural work force (cultivation plus agricultural labourers) in Golaghat district accounts for 57.08 per cent to the total working force in 1971 and 55.67 per cent in 1991. It has increased by 110.47 per cent during the period between 1971 and 1991. The occupational structure table for the district shows that only 2 per cent industrial worker to the total working force, 17.31 per cent of workers are engaged in tertiary activities and 22.18 per cent is in other services. This structure shows agricultural labour domination in the entire occupational set up in the district.

Agricultural work force, according to census classification includes cultivators and agricultural labourers. Working as cultivator means he or she who is engaged either as employer, single worker or family worker in cultivation of land, owned or held from government or held from private persons or institutions for payment in money; kind or share (cultivation

includes supervision or direction of cultivation)*. Agricultural labourers means he or she who works for another person's land for wages in money, kind or share, without having any risk in cultivation.*

Cultivators in Golaghat district has marked a high growth of 109.41 per cent during the two decades from 1971 to 1991. From the table 3.14, it is revealed that this growth of 109.41 per cent is because of the growth of total workers by 134.56 per cent, and to the growth of total population by 57.81 per cent during the two decades period from 1971 to 1991. The increase in growth of cultivators may also be attributed to the inclination towards more crop production by the majority of family members in their own or occupied land in the 'char' areas of the rivers and encroached forest land or government alloted land. As compared to the growth of cultivators in the district, the growth of agricultural labourers (118.06 per cent) in the district is noteworthy. This increase may be attributed to the population growth (57.81 per cent), in-migration to the district in search of land resource and better wages or may be due to the tendency to get themselves employed in great numbers as labour input to the agriculture for higher production, by the large farmers in the district.

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* Census of India. 1971.

Table : 3.14
Agricultural Workers by Blocks.

CD Block	Net Sown area in hectare		Population		Total worker			P.C to total Population		Cultivator	
	1970/71	1990/91	1971	1991	1971	1991	Increase (%)	1971	1991	1971	1991
Gola-ghat North.	1377.91	14172.55	118449	181449	16525	40421	144.61	13.95	22.28	10130	20866
Gola-ghat South.	38618.60	38708.42	82185	134970	30342	82316	171.29	36.92	60.99	21153	42725
Gola-ghat Central.	24906.26	28574.14	98204	148937	29105	62026	113.11	29.64	41.65	13705	31198
Gola-ghat East.	26950.45	28066.23	145064	216880	43215	87041	101.41	29.79	40.13	22496	41549
Gola-ghat West.	16223.71	18377.36	64144	119868	20331	55450	172.74	31.70	46.26	7541	20771
District.	120473.93	127898.70	508046	801740 (increase 57.81)	139518	327254	134.56	27.46	40.82	75025	157,108

contd...

	Increase (in %)	P.C to total		Agricultural			P.C to total worker.	
		1971	1991	1971	1991	Increase (in %)	1971	1991
Golaghat North.	105.98	61.30	51.62	995	3490	250.75	6.02	8.63
Gola-ghat South.	101.98	69.72	51.90	3672	6221	69.42	12.10	7.56
Golaghat Central.	127.64	47.09	50.30	2581	4614	78.77	8.87	7.44
Golaghat East.	84.70	52.06	47.03	2758	7706	179.41	6.38	8.85
Golaghat West.	175.43	37.09	37.46	1495	3048	103.88	7.35	5.50
District	109.41	53.77	48.01	11501	25079	118.06	8.24	7.66

CD Block	Population		Total Worker		(Increase in %)	P.C to total Population		Cultivator	
Assam	14625152	22294562	4088493	8108785	72.88	29.95	36.37	2283698	3622017
India	548160000	836605522	130373000	314903642	141.54	23.78	37.64	78177000	110588822

	Increase (in %)	P.C. to total Worker		Agricultural Labourer		(Increase in %)	P.C. to total Worker	
		1971	1991	1971	1991		1971	1991
Assam	58.60	55.85	44.66	405,440	911,386	124.79	9.92	12.89
India	41.46	35.12	38.75	47489,000	74649217	57.19	36.43	26.15

1971 Data from Basic Statistics Relating to
Community Development Blocks in Assam 1977-78
Directorate of Economics and Statistics
Government of Assam, Guwahati.

The table reveals that the growth of total worker in the district is 137.56 per cent that is more than that of the state level (72.88 per cent), but it is marginally less than the national level (141.54 per cent) whereas the increase in percentage of cultivators is recorded at 109.41 per cent in the district during last two decades that is more than that of the state, (58.60 per cent) as well as of the national level (41.46 per cent). It implies that the in-migrants who are coming from the outside state are settling in the district as cultivators by purchasing piece of agricultural land. The evidences of the same fact may be ensured by showing the changes in agricultural labourers. In regard to the agricultural labourer, district level growth of agricultural labourers is found to be less (118.06 per cent) than the state level (124.79 per cent). It may be concluded that the district has higher percentage share of total workers as compared to that of the state. Similarly, cultivator - agricultural labour ratio is higher in the district which indicates effective implementation of productivity enhancement in the district.

The panchayat-wise variation of total worker in the distrfict in the specified period is obvious from the table where the 1991 data of different units have been estimated keeping in mind the average increase for the district because panchayat wise break up of workers is not available in the

provisional census figures 1991. Very high increase in work force is found in two CDBs, namely, Golaghat West Development Block area (172.74 per cent) and Golaghat South Block (171.29 per cent). While very low increase has been recorded in Golaghat East Block (101.41 per cent), Golaghat Central (113.11 per cent) and Golaghat North Block (144.61 per cent) during the two decades time from 1971 to 1991.

The increase in cultivator during the same period of time was remarkable. An increase of 175.43 per cent is the highest recorded in Golaghat West Block area. This is due to land fragmentation and size of operational landholdings. Land tenures is the major factor which diminishes the land size because of family's property division. The second attribute may be the farming carried out in new areas in the chars and chapori areas by many a cultivators coming from outside the state. The same reasons may be attributed to the increase of cultivators in Golaghat North Development Block (105.98 per cent). Golaghat Central Development Block also records high increase of cultivators during the period (127.64 per cent). Other Blocks having lower increasing rate of cultivators are Golaghat South and Golaghat East. It may be noted from the table that the agricultural labourers increase during the period is comparatively higher (179.4 per cent) in Golaghat

East Development Block wherein the cultivator's increasing rate in the same period is marked the lowest (84.70 per cent). This may be attributed to the more labour input in farming by cultivators which is not increasing in large numbers. The increasing labour rate in these areas may be because of fast increase in agricultural labour wages. In Golaghat North Block also this is true where 250 per cent increase of agricultural labour is found. But the lesser growth of agricultural labourers in Golaghat South (69.42 per cent) and Golaghat Central (78.77 per cent) is recorded.

Labour Input

In the above passage, the total volume of agricultural work force, its increase and distributional patterns have been described. In fact, the agricultural work force may be studied in order to consider it as a 'production factor'. In the sence of agricultural labour input, the total agricultural worker per unit of cultivated land has to be calculated because this index will give the impression of availability of agricultural labour (cultivator and agricultural labourers) which is being used for accelerating production processes in the area.

The table 3.15 reveals the strength of agricultural labour per hectare of cultivated land for each Gram Panchayat as well as of the district as a whole. The labour per hectare

Table : 3.15

Block wise Productivity of Agricultural Workers.

Total workers 1971	1991	Increase	%age to total workers		Agl.worker per100hec. of NSA.		Change		Agl.worker productivity	
1971	1991		1971	1991	1971	1991			1971	1991
11125	24356	118.93	67.32	60.26	0.81	1.71	.90		1.41	0.61
24852	48946	97.16	81.82	59.46	0.64	1.26	.62		1.69	1.19
16286	35812	119.89	55.96	57.74	0.65	1.25	.60		1.57	0.69
25254	49255	95.04	58.44	56.59	0.94	1.75	.81		1.04	0.57
9036	23818	163.59	44.44	42.95	0.56	1.30	.74		1.35	0.67
86526	182187	110.56	62.02	55.67	0.72	1.42	.70		1.37	0.78

in the district is found to be 72 persons per 100 hectare in 1971 which has risen to 142 persons per 100 hectare in 1991. This change of 70 persons per 100 hectare during the last 20 years is because of the significant increase of agricultural worker in absolute term from 86.5 thousand to 182 thousand persons (110.56 per cent) in the district.

The change in the agricultural labour input per hundred hectare in the district (70 agricultural worker) is not so high. However, the increase in agricultural labour per areal unit is found higher in Golaghat North Block (91 persons), Golaghat East (81 persons) and West Block (74 persons). Although there is a significant increase in agricultural labour input as it has been recorded 98 per cent during 1971 to 1991, yet the increase in agricultural production is comparatively very low as described earlier. It means that there is a insignificant effect of labour input on production processes. The details regarding input - output relations would be described later on in the next section. On the other hand, technology is also important input for agricultural practices which should be analysed here with proper emphasis. The increase in labour input was recorded very low in the Golaghat Central Block (60 labourers per hundred hectares), and Golaghat South Block (62 labourers per hundred hectares).

2. TECHNOLOGY AS AN INPUT

Indian agriculture witnessed a major change in 1965-66, when for the first time, genetically superior crop technology was injected to it. That was the change point separating pre and post-green revolution period, a literature frequently used in dealing with the Indian agriculture(Bhalla & Tyagi, 1989; Singh & Sharma, 1985). This idea of crop technology input was conceived primariyly to attain self sufficiency with respect to agricultural product, or atleast for a concurrent agricultural revolution in order to get surplus agro-products for many of the industries. Along with the inclusion of improved crops in agriculture, the other inputs of the technological package such as irrigation, fertilizer, plant protecting facilities had become essential because under these new package of inputs, high yielding varieties of crops have a high response potential. At the same time the new crop technology also demanded labour intensity and a substantial shift to machines over the traditional ones. The degree or to what extent the adoption of these technology are helping increase in production and productivity is an important aspect to be studied. As mechanised farming is an expensive process and traditional farming can certainly not pay the cost involved the alternative is to raise productivity by putting technology like high yielding high value crops, irrigation and pesticides

and low cost agricultural machineries, because expenditure can't become modern, whilst income remains primitive in regions like that of the present study area.

Modern technology in agriculture includes components like irrigation, high yielding varieties of seeds; uses of fertilizers and machine tools. Each of these components is complementary to one another. Moreover, these components together results in uneven production depending on soil/climate suitability, of course not ignoring the hazards of extreme climates like drought and floods of regions. Under normal conditions with no extremes of climate, the important aspect to be emphasized more here in the district is to see the existing lacuna of agricultural potentiality in different areas. For example, the soil moisture is adequate, soil composition is suitable for important crops, soil fertility is not adequate, labour productivity is less, crop yield is unsatisfactory, are some of the characteristics, pros and cons of agricultural suitability of the district. Now the choice of technology input should be properly injected into the agriculture upon which the development of agriculture rests. So preference may be made as crop technology, fertility input, irrigation and machinery use in the agriculture in regions like this.

HYV Seeds Distribution

The inclusion of high yielding varieties (hereinafter

as HYV) seeds as crop technology generally is one of the integrated components of agricultural development. Although HYV seeds have varying adaptation rates regionwise under varied environmental conditions (I. Arnon, 1981), the successful adaptation of some of the HYV seeds in several parts of India is noteworthy. The most prominent varieties are HYV wheat and rice which make the green revolution a success in those parts of India. In Assam also, this adaption of HYVs has already been started since 1968. While India with Mexican variety of wheat raised production by 64 per cent during 1965 and 1970. Increase in yields of rice in Assam is probably halted due to the adoption of HYV rice without attendant inputs. The poor farmers definitely get improved seeds, but cannot afford to purchase the all important additional inputs without which the integration of inputs remain incomplete. This definitely is a factor why there is no revolution of production in Assam. Moreover improved variety of seeds require more human labour than to native varieties (Desai, 1970). It increases labour requirement for different operations such as harvesting, threshing and handling of higher yields, weeding etc., thus labour input is complementary rather than substitution in the agricultural practices in India. This is particularly true here in Golaghat district of Assam.

The HYVs generally adopted in the district, are

Pankaj, Masuri, Manohar Sai, IET-6666,5656,1444 varieties of paddy, Sonalika & Mexican wheat, jute JRO-632, Mustard, M-27, Potato-kufri Jyoti (K/J) and, sugarcane-747,997. As the HYVs are not sensitive to differences in daylight and short maturity period of seeds help to put them in cultivation for three times a year particularly of the HYV paddy, with supplementary inputs like irrigation, fertilizer and proper plant care.

During the year 1989-90 the district as a whole used total seeds of winter paddy nearly 48.4 thousand quintal out of which only 15.8 per cent HYV seeds are applied. Likewise, the percentage share of HYV seeds applied have been amrked highest (66 per cent) in mustard crop and in wheat 66.8 per cent. While jute and sugarcane which are the commercial crop of the area only 25.8 and 52.5 per cent HYV seeds to total seeds is applied. It implies that wheat, though, it is not the dominating food, is having commercial tendency in which the HYV seeds high percentage share of HYV seeds is applied (Table.3.17). The use of these improved seeds has resulted in definite increase in yield per hectare but for the lack of other associated technological inputs the rate is low. The natural fertility and soil moisture has to some extent help HYVs to adapt.

Blockwise variation of use of HYVs can be seen from

Table : 3.17 Percentage Application of HYV seeds. (1989-90)

Sl. No.	Crops Name	Total area (in ha.)	Total seeds used (in ql.)	HYV Seeds (in ql.)	Percentage of HYV seeds
1.	Winter paddy	64847.69	48441.22	7647.70	15.79
2.	Muatard	7824.03	876.68	578.60	66.00
3.	Sugarcane	5919.08	44215.50	23245.00	52.57
4.	Wheat	1243.23	6965.20	4654.00	66.82
5.	Jute	682.90	51.02	13.10	25.68

N.B. : The quantities of total seeds of various crops have been calculated by collecting seed data at primary level visiting some villages.

the table 3.16 . The farmers' adoption of HYV varies because of the micro-agro ecological factors, as well as institutionalised facilities offered by the presence of growing growth centres in different areas of the district. The fertile northern half of the plains of the district, the central alluvial areas have used most HYVs of winter rice, whereas HYVs wheat was mostly adopted in the western part of the district in Golaghat West Development Block areas and in central part of the district. This may be due to high receptivity of the farmers, proper extension services by the state agricultural department and agro-ecological conditions prevailing there. The adoption of improved sugarcane in Golaghat South Development Block is because of the suitable soil and climate in general and to the services rendered by sugarcane Research Station in Buralikson. Golaghat West Development Block is yet to adopt HYVs seed, may be because of the unsuitability of environmental conditions including soil and may be HYVs sugarcane is not recommended by extension workers. Traditional jute is not extensively replaced by HYVs jute except in Golaghat South and Central Development Block. This may be because of the crop (jute) is not a major cash crop in the district for the farmers do not like taking risks in the cultivation of HYVs jute in small-sized plots of land.

Block-wise Distribution of

Table: 3.16 HYV,Seeds in Golahat Distric (1988/89) HYVs in quintals

Name of the Block	Autumn Rice	Winter Rice	Wheat	Jute	Sugarcane	Mustard	All seeds Total
Golahat North D.B	-	1005.0	940.0	-	9.8	525.0	2479.8
Golahat South DB	28.0	884.0	250.0	125.0	2000.0	3018.0	6305.0
Golahat Central	28.0	4156.0	1075.0	6.0	210.6	2039.0	7514.6
Golahat East .D.B	123.8	1461.7	49.0	-	104.0	129.7	1868.3
Golahat	15.0	140.0	2340.0	-	-	75.0	2570.0
District	194.0	7646.0	4654.0	131.0	2324.5	5786.7	20737.7
		(36/87)	(22.44)	(0.63)	(11.12)	(27.90)	

Source : Status Report. 1988/89.

Assam.Agricultural University.

Jorhat.

Percent in bracket.

It may be safely concluded that early maturing photoperiod-insensitive HYVs of rice have made more production.

(i) Land Under HYV Crops

The breeding of early-maturing rice is predominant among the HYVs seeds in the agricultural scenes in Golaghat district for which farmers, though in small numbers, are getting higher production along with limited inputs like minor irrigations and use of fertilizers. It is obvious from the table 3.18 that there is a 3.55 per cent annual increase of land under HYV crops to the gross cultivated area in 1990-1 over 1970-71. This is a considerable increase in terms of the poverty-striken farmers and the resultant low income. In Assam, generally government establishments provide most of the HYV seeds to farmers and also provide them with technical parts of the adoptions. Yet others get it from nearby growth centres with, of course, procedures and methods alongwith improved seeds. But whatever increase in production results in, is not to the mark that can be expected out of HYV land with attendant outputs.

The spatial distribution and growth of land under HYV crops can be seen from the table 3.18 b. It shows panchayat areas having magnitudes above the district percentage of HYV land to the Gross Cultivated area were Naojan, Sarupathar,

Table : Land under HYV and Growth (1969-72 to 1989-91

3.18

Name of the Panchayats	1969 - 72 NSA hect.	GCA hect.	HYV land hect.	P.C to GCA	1989 - 91 NSA	GCA
Dergaon	5629.34	6154.64	310.81	5.05	6107.76	6741.76
Missamara Brahmaputra	8145.57	8514.24	310.77	3.65	8064.79	8967.99
Naojan	3265.72	3765.96	397.69	10.56	3696.65	4328.75
Sarupathar Pachim Sarupathar	9560.38	9863.18	1260.51	12.78	9650.33	10114.83
Uttar Barpathar	11053.46	11489.69	811.17	7.06	11630.52	12189.52
Dakhir Borpathar	14739.04	15165.41	1210.20	7.98	13730.92	14491.32
Rangamati	4676.65	5502.49	259.72	4.72	7017.00	8135.70
Khumtai	7844.53	8327.93	113.26	1.36	8231.05	8794.85
Gurjogania	3903.42	4183.77	115.05	2.75	4031.72	4334.72
Dhekial	5331.03	5705.06	446.71	7.83	6023.96	6318.16
Kakodonga	3150 63	3170.92	80.86	2.55	3270.41	3321.01
Dakhinhengera	5915.58	6142.76	87.23	1.42	6047.65	6047.75
Kamarbandha	3496.43	3758.01	38.70	1.03	3577.10	3842.10
Golaghat	3512.94	3666.76	137.87	3.76	3659.83	3847.23
Athgaon	3052.67	3306.62	123.00	3.72	3189.55	3485.25
Pub Ghilandhari Pachim Ghilandhari	10972.83	11641.10	838.16	7.20	11592.10	12139.20
Kaziranga	4779.63	4881.38	179.15	3.67	5671.88	5873.38
Bokakhat	8250.36	8583.07	450.61	5.25	8865.59	9299.49
Karuabahi	3193.72	3297.34	118.37	3.59	3839.89	3999.29
Forest Village.	NA	NA	NA	--	NA	NA
District	120473.93	127120.37	7289.84	5.73	127898.7	136532.3

contd...

(1969 - 92)

Name of the Panchayats	HYV land hect	P.C. to GCA.	Variation in P.C. of HYV	HYV Growth	Growth in P.C
Dergaon	601.36	8.92	3.87	93.48	4.67
Missamara	387.42	4.32	0.67	24.66	1.23
Brahmaputra					
Naojan	591.74	13.67	3.11	48.79	2.44
Pub Sarupathar	1546.56	15.29	2.51	22.69	1.13
Pachim Sarupathar					
Uttar Barpathar	1806.49	14.82	7.76	122.70	6.40
Dakhin Borpathar					
Uttar Morongi	2220.07	15.32	7.34	83.45	4.17
Dakhin Morongi					
Rangamati	485.70	5.97	1.25	87.01	4.35
Khumtai	313.10	3.56	2.20	176.44	8.82
Gurjogania	249.25	5.75	3.00	116.64	5.83
Dhehial	715.22	11.32	3.49	60.11	3.01
Kakodonga	101.62	3.06	0.51	25.67	1.28
Dakhinhengera	71.57	2.72	1.30	96.69	4.83
Kamarbandha	98.36	2.56	1.53	154.16	7.71
Golaghat	374.34	9.73	5.97	171.52	8.58
Athgaon	332.49	9.54	5.82	170.32	8.52
Pub Ghiladhari	1245.48	10.26	3.06	49.00	2.43
Pachim Ghiladhari					
Kaziranga	311.29	5.30	1.63	73.76	3.69
Bokakhat	709.55	7.63	2.38	57.46	2.87
Kuruabahi	209.96	5.25	1.66	77.38	3.87
Mohura					
Forest Village	NA	--	--	--	--
District	12471.57	9.13	3.4	71.08	3.55

Morongi, Dhekial and Ghiladhar G.P areas in 1970-71. The other areas like Kamarbandha, Dakhinhengera, Khumtai were having below 2 per cent share of cultivated area under HYV crops. This might be due to the extension services of the concerned departments and to the diffusion of this technological innovations including HYV technology by the nearby growth centres. The low hectarage of HYV land may be due to farmers' decisions against adoption of such HYVs which involved risks and restraints.

During the last twenty years till 1990-91, the land under HYV crops has not much changed. The district total of HYV land has been increased by 9.13 per cent. This may be due to the slight improved situation in irrigation and use of fertilizer. The shares of GCA of HYV crops are higher in Morongi, Sarupathar, Barpathar, Naojan, Dhekial, Ghiladhari, Golaghat and Athgaon. The other panchayat areas are having low % share of it, like in Dakhinhengera, Kamarbandha, Missamara, Khumtai, Gurjogania, Rangamati, Kaziranga and Mohura. The low yield and lower levels of agricultural productivity have shown that the district is yet to 'take off' the momentum for agricultural development.

The annual growth pattern of HYV shows that Golaghat, Athgaon, Kamarbandha, Khumtai, Gurjogania, Borpathar G.P areas have higher rate increase of the areas ofHYV crops.

This is important to note that the areas previously having low percentage of increase, have now increased in its land under HYV crops. This is remarkable so far areal disparities in concerned for balanced growth of agriculture in the district.

ii. Irrigation

Other things being equal, the crop yield should be higher in an irrigated field than in an unirrigated one (Singh, 1981). The increase of productivity of agriculture is achieved through proper use of irrigation along with other components of the agricultural production factors. The necessaity of adoption of this technology in agriculture is immense, though it varies region to region depending on the availability of moisture content in the soil and atmosphere. This particular aspect in Assam is considerably helping the cultivators in most of the areas in khariff season where assured irrigation is absent. The moisture content decreases at the advent of dry winter period, when most of the farmers suffer from the scarcity of water. This is the period when agricultural labourers suffer most because of the low demand of labour. Irrigation would have created additional demand for them where the labourers would be used in irrigation, complementary inputs of irrigation and in harvest and sale processes of the additional

crop yields. Farmers employ, in general, higher doses of labour input in the cultivation of irrigated crops (I. Arnon, 1981).

Moreover, Assam is endowed with large water resources for purpose of irrigation which have remained mostly unharnessed. The central ground water board for the Brahmaputra valley computed the total ground water recharge at 9418 million cubic metres (MCM). There is also considerable amount of surface discharge during monseons in the valley.

In Assam the organisational set up for harvesting water resources is of recent origin. Assam state Minor Irrigation Development Corporation (ASMIDC) is one such organisation which is promoting considerably, particularly in the field of installing shallow tube wells, low lift points etc. and in arranging pumpset irrigation to the farmers.

The irrigation was not significant during 1970-81 but in 1981-91 the irrigated land had been increased to 7·o per cent which is far below the national level (20.96 per cent) to the GCA,1976).

The major irrigation schemes in Golaghat districts are as follows :

1. Mohura Mouza Scheme
2. Pabhajan Scheme

3. Khumtai Scheme
4. Thengalgaon Scheme
5. Athgaon Scheme
6. Molohani Tuporea Scheme
7. Gorongajan Scheme
8. Borpathar Mouza Scheme
9. Bokolai Village Scheme
10. Socialist Pathan Scheme
11. Ikorani Scheme
12. Bongalgaon, and
13. Dergaon

The Golaghat North, Golaghat South and Golaghat West Development Blocks are getting higher percentage of irrigated water where mostly Dhansiri Water and ground water have been utilised. It may be noted here that the potential for water harvesting in different Block areas are very bright which can be inferred from the table, 3.19 . If these rivers in different Block areas are utilised for the controlled application of water to crops for supplementing the available soil/moisture, high yield can be expected in the district.

FERTILIZER INPUT

The value of fertilizers in increasing the yields of various crops is immense. Fertilizers feed the soil with nutrients which is removed by way of cultivating crops. This removal

of plant nutrient in soil is different for various crops.

With an indication of the amount of nutrients in the soil and the amount taken up by a particular crop, it might be thought that fertilizer application could be made on the basis of soil analysis (Wrigley, 1982). The importance of use of fertilizer and soil analysis, therefore cannot be ignored. The low output even after application of chemical fertilizers can be accounted for the complaints very often lodged by farmers. On the other hand, very nominal increase is obtained when fertilizers are applied in an otherwise unchanged subsistance agriculture. Most of the experiments shows that fertilizer alone can decrease the rate of yield or at best maintain the low yield level characteristics of traditional agriculture (Cline, 1971). The implication is that the proper input of fertilizer alongwith high yielding varieties seeds and irrigation make the revolutionary combination of inputs for a very high growth of agricultural production.

The rapid adoption of fertilizers in Golaghat district in recent years over the 1970s is a step forward for increasing agricultural productivity and a better output from various crops. During 1970s, the non-adoption of chemical fertilizer might be attributed due to (a) lack of basic knowledge (b) lack of capital because of low return out of the previous year's production, and (c) advice and credit is insufficient.

Farm Mechanisation

Agricultural productivity and production to a considerable extent rely on the farm mechanisation. The use of mechanical equipments in agriculture helps in extension of cropland. Moreover, when multiple cropping is practised, the gap of time between crops is little which can be well adjusted by the use of machines. The mechanical techniques supplement other biological inputs, like fertilizer, plant protective technology, high yielding varieties crops to increase farm productivity. Mechanisation, here, refers to the use of tractors, pumpsets, tubewells and threshers. It also refers to the use of improved types of iron-based land tools, draught driven implements and power driven equipments. Thus modernisation of agriculture, that is the process of planned change of agriculture, is an outcome of combined inputs like, among others, farm mechanisation.

In Golaghat District, mechanisation in true sense of the term, is not achieved in various activities of agricultural practice, on account of the cheap availability of agricultural labour force. However, big farmers, having larger size of agricultural land and progressive farmers use bigger tilling machines, mostly power-tillers (Japanese type). The use of tractors in agriculture which is predominant only in tea industry, has been almost replaced by power-tillers

because of the fragmented farm sizes in the district and comparatively lower prices of these. Since small and marginal farmers form a bulk of agricultural community in the district, it is found that small tools like sprayers, paddy weeders, iron ploughs pumps for irrigations, sugarcane crushers (animal and power operated), Animal carts are some of the implements that are used in the district.

CHAPTER - III

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C H A P T E R -IV

ROLE OF GROWTH CENTRES IN AGRICULTURAL DEVELOPMENT

The increasing disparity in the pattern of development in rural and urban areas presently demands strategic efforts to minimise them. The associated problems that stem from it are manifold. Decline in agricultural productivity in rural farms, migration of both skilled and unskilled labourers to urban centres causing over population, etc., are notable consequences of developmental sectoral planning in India with greater emphasis on urban centres and a separate treatment for it. As a result, stagnation in the development in rural areas occurs; rural remains always primitive and backward (Pathak, 1990). Moreover, linkages between the rural and urban remain poor. Therefore, there is a problem of primacy in the spatio-functional organisation in the areas. In an effort to lessen the gap between the differential development of the areas, growth centre approach for micro-level planning and spatial development can be useful.

It is a fact that neither all spaces provide facilities for developmental activities, nor these provide services at the same time. Because of these inequalities in functions, development flourishes at some selected favourable points wherefrom functions and facilities are diffused outward (Sen, 1972).

These points of concentrated functions or growth centres play important role in raising the developmental pace in rural areas by way of injecting technology into agriculture and processing agricultural surplus. In the process, rural-urban migration can be checked by employing the rural mass in different agriculture and agro-based establishments.

Thus, the problems arising out of the growing disparity between rural and urban areas may be controlled, and at the same time balanced development can be achieved.

The contribution of growth centres to agriculture development has already been elaborated in Chapter I. In short, the contributions are of four types, namely, production- processing contribution, market contribution, factor contribution and contribution of diffusion of innovation and labour surplus absorber-contribution to the rural areas. Therefore, the aim of the present chapter is to interprete the spatial patterns of these five types of contribution in the Golaghat district over twenty years.

Methodology

To study the contribution of the growth centres for the development of agricultural activities, the first task is closely associated with the identification of the main growth centres in the district which are playing important role in the pace of

agricultural development. For the selection of the growth centres of the district, it is assumed that the main urban centres which are urban by definition but their functional structure is closely related to agricultural activities. Besides, few important larger villages which are growing fast in their functional structure are also selected for the present purpose. Thus there are five important growth centres in the area whose population growth is found higher than the other villages (Table 4.1).

So far as the first aspect of the contributions of growth centres to the agricultural development is concerned, the agro-based establishments of industrial as well as household industries and their growth at those centres would provide a sound base to understand the production processing of the local agricultural resources of the area. For the purpose, the growth of this type of agricultural functions are interpreted in its spatial perspective.

The agricultural market is the important functions which provide agricultural facilities to the farmers. The presence of periodic and permanent markets (retail or wholesale dealers of agricultural machine tools and other agricultural items) and their intensity at growth centres with the increase over time would signify the market contribution of the growth

Table : 4.1
Population growth 1971-'91, Growth Centres

Name of the centres	Population		Status	Growth in Percentage
	1971	1991	1971	
Golaghat	18590	28722	Urban	54.50
Dergaon	9972	12200	Urban	22.34
Bokakhat	3830	6977	Rural	82.17
Sarupathar	3669	--	Rural	--
Furkating	1223	--	Rural	--
District	536608	801740		49.41

Sourcs : Census if India 1971 & 1991 (Provisional)
District Census Hand Book, Sibsagar District.

centres. Here, the distributional pattern of market and their growth are interpreted considering quantitative data related to market functions. These functional aspects of growth centres would also be help for delimiting the influence zone of the growth centres. According to Christaller (1933), greater the functional magnitude of the centres, larger will be their influence zones and vice-versa. The growth centres of any area especially at micro-areal level, play vital role to contribute the production factors to the surrounding areas. Production factors mean the agricultural inputs, like, technology, capital and labour. In fact, the abundant labour is available in rural areas engaging in agricultural activities. Therefore, there is insignificant role of growth centres for labour contribution to the development of agriculture. However, skilled labour is being contributed to the rural areas by those centres. Technology is the main production factor which is diffused through those centres. For the same, the data of main agricultural innovations which are being diffused from those centres have been collected by preparing questionnaire and compiled in a proper way to test the validity of the facts related to agricultural technology and its impact in the surrounding areas.

To analyse the spread processes of agricultural innovations in Golaghat district, the quantitative data of principal

agricultural innovations like fertilizer, irrigation, high yielding varieties seeds, pesticides and agricultural loans from banks and credit societies have been collected for 1970-71 and 1990-91, so that the change of agricultural innovations over time can be understood. The spread effects of those innovations are closely related to transport network of the area. Therefore, the transport efficiency and road accessibility maps are prepared and compared with the influence zones of those growth centres.

If those growth centres are conceived as the centres of spread or diffusion in the entire system of core-periphery relations in agricultural development process, then, they are acting as integrated part of the channels of innovation spread (Hagerstrand, 1965). There are diversified views in the study of diffusion processes. In fact, there are two important aspects of the growth of those centres and their spread processes, which are closely related to the present context. First is related to <u>diffusion factors</u> of agricultural innovations (transport network), and the second is associated with the <u>receptivity</u> of the farmers/peasants of the area who are engaging themselves in traditional form of agricultural activities. The first factor would provide the channels of spread of innovations, but the second one is the level of farmers' perception which is based on the level of education, technical know-how of

new agricultural innovations and income level of the farmers of the area. To give the answers of those questions, the spatial linkages of those growth centres and their influence zones have been delimited. To correlate the growth of those centres with the entire area, their functional structures are studied in relation to their spread patterns. The validity of these facts is tested by preparing the maps and diagrams. The necessary tabulated data have also been presented for its sound base.

Interpretation

In order to get the proper answer of those questions that have been posed under the methodology head, concerned data are tabulated accordingly. The interpretation of the tables gives the inherent characteristics of the growth centres' emergence and their influences towards the surrounding areas. The results can be interpreted in the following manner.

1. Towns as Agro-production Processing Centres

It is predicted that the agro-based industries of the growth centres must be growing on the basis of following the trend of surplus production. Therefore, there would be a positive relationship between the growth of agro-based industries and production surplus of the area. It means when production surplus increases the growth of the centres will be increasing fast. On the other hand, it may also be assumed

that the agro-based industries may be based on production-processing for which production is supplied from outside. The validity of the fact can be examined by correlating the agricultural production structure of the area and the strength of the agro-based industries established on the growth centres.

Table 4.2 reveals that the paddy production in the district in 1990-91 was about 200 thousand tonnes out of which only 14 thousand tonnes was processed by the rice mills established in the main growth centres. It is interesting to note here that there are various traditional means of husking paddy locally, mostly by the villagers to use it for domestic purpose and occasionally for sale in the periodic markets. Only the surplus quantity of paddy is being husked by the modern techniques in the growth centres and elsewhere in the district, and the quantity supplied to the rice mills is less. It means, inspite of paddy as dominant crop of the area, that it is locally consumed and not grown for commercial purpose. Therefore the establishments of rice mill of those centres are based on local availability of paddy. There seems an insignificant increase in the number of rice-mills from eight in 1970-71 to ten in 1990-91. Further, the production of wheat in the district, and the processing of it at the growth centres in the district are somewhat different. The total production of wheat is only about 4.6 thousand tonnes while the flour mill capacity is found out to be

6.7 thousand tonnes annually, that is more than the production of wheat. It indicates that the backward linkages (raw material availability) of the flour mills are based on the wheat production transported from outside the district. But the backward linkages of mustard oil mills, which are also noticeable in the area, are based on the mustard production of the district, because enough surplus production of it has been recorded in 1990-91. In general, it can be conduded that the establishments, namely, rice mills and oil mills are growing on the basis of its relevant raw materials available in the local markets. While the growth of flour mills is totally based on the outside effect of its raw materials availability.

Table.4.2. Crop Production and Its Processing in the District (1990-91)

(figures in thousand tonnes)

Quatity processed at growth centres			Crop production		
Rice mill	Flour Mill	Mustard oil Mill	Paddy	Whaeat	Mustard
14.0	6.7	2.8	202.6	4.6	11.5

2. Growth Centres as nodal point of Market Function

Markets are the points of advantageous location where producers and consumers interact. In periodic markets, the

growers usually exchange the daily needs. In a way, market as such play little role in changing the agricultural scenario. Of course, it cannot be ignored the impact of periodic markets upon the small farmers. The impact lies in the fact that, in a general way, peasants get all the traditional agricultural equipments from such markets. They also collect minor seeds of vegetables from such markets which indirectly inspire poor farmers to be more reliant on vegetables rather than on staple or fibre crops. The markets are playing the vital roles in commercialisation of the agricultural landscape. There are many and varied studies on the location of agricultural activities which refer to the locational aspects in which distance is an important factorfor agricultural intensification and its changing pattern from traditional agricultural to commercial production pattern (Thunen, 1826; Dunn, 1954).

According to Thunen, economic rent of agricultural production decreases with the increase in the distance from the market location, because of increase in transport cost for agricultural production. Locational theories of agriculture state that the market location play the pivotal role in the advancement of agricultural activities, because market centres provide modern technology of agriculture to the surrounding areas. The farmers must rely, then, on the permanent markets for procuring seeds (traditional and high yielding varieties)

like paddy, wheat, potato, mustard, etc. and machineries like power tillers, pumpsets and so on. It implies that the major share of transaction of capital for seeds and macinaries, and for primary agricultural products, is carried on in the permanent market, the constituent parts of which are the dealers and agri-business organisations.

It is, then. obvious from the above elaboration that markets, in all possible way induce farmers to grow commercial crops and enterpreneurs to produce more agricultural equipments. Thus markets fill the gap between the producers and consumers (Fletcher, 1965).

The validity of the facts can be examined in present reference to analyse the available market facilities related to agricultural production factors and their diffusion processes. The market facilities in the growth centres, namely Golaghat, Dergaon and Bokakhat in Golaghat district, are significant and well organised. Although the number of periodic markets (weekly) in the growth centres are less, the number of establishments dealing with the agricultural equipments are quite large. As it has already been explained earlier in this chapter, that periodic markets bear little significance in regards to agricultural development, the permanent markets comprising various dealers in the growth centres, on the other hand, bear the responsibility of contribution towards the agricultural development in the

lower order settlements. This particular aspect can be substantiated by the fact that the growth number of agricultural dealers in centres like Golaghat and Bokakhat are recorded around 200 per cent during 1970-71 and 1990-91 (Table 4.3). This increase of such a magnitude definitely carries the implication of the degree of contribution towards agriculture by these markets in the growth centres. It is important to note that Bokakhat as compared to the other centres has developed fast in terms of markets dealing with agricultural technology. Dergaon, another growth centre is also recorded to grow steadily (133.3 per cent in twenty years ending 1990-91) in terms of permanent agricultural markets.

It is noticed from the same table 4.3 that the increase of periodic weekly markets in Golaghat, Dergaon and Bokakhat is very nominal. This is because of the presence of regular markets at those growth centres (Sharma, 1989).

3. Production - Factor Contribution

The production factors of agriculture especially those which are innovated in and diffused by the growth centres of the district, constitute the factor contribution of the growth centres. There are many production factors to be analysed in the present reference. But two, among many are considered major factors, namely, technology and agricultural labour which refer to the intensification of agriculture. Agricultural labour input would be

Table : 4.2.a
Crop Surplus/Deficiency, 1990-91.

Crop	Production in lakh ql.	Annual Consumption in lakh ql.	Surpl Defici
Paddy	20.26	29.26	-9.00
Wheat	0.46	2.93	-2.47
Mustard	1.15	1.46	-0.45

Computed by the Author.

Table :4.3 Growth of Market in Growth Centres, 1970-71 to 1990-

Name of the	Total Market (Periodic)		Growth of markets	Permanent Dealers (Agricultural)		Grc in
Centres	1970-71	1990-91	percentage	1970-71	1990-91	
Golaghat	1	2	100	10	29	190
Dergaon	2	3	50	6	14	133
Bokakhat	1	1	0	4	12	200

dealt with separately in the next section of the present chapter, when the impact of agricultural labour surplus would be interpreted in relation to agriculture and growth centres of the area. It needs a prior apprehension of the numeral availability of establishments that deal with the supply of agricultural innovations like technology and credit facilities. Table 4·7 shows such establishments with number and their increase during 1970-71 to 1990-91 in Golaghat (growth centre). It is revealed that some of agricultural facilities in the growth centre are found in plenty and others are limited, for example, the number of establishments that distribute the high yielding varieties seed, fertiliser and pesticides; and machine tool repairing, pumpset repairing shops are found more than the establishments dealing with agricultural innovations like machine tools and pumpsets. It implies the selected and gradual adoption of agricultural innovations, which may be due to the result of frequent extension-cum-demonstrations programmes by government workers of agricultural department. The non-availability or at best less number of machine tool and pumpset dealers may be attributed to the inadequate capacity of the farmers to buy such machines for themselves. The details of the distribution of such facilities are interpreted by considering the strength of various establishments related to agricultural technology.

3.1. Availability of Agro-based Establishments at Golaghat Centre (1970 - 71 to 1990 - 91)

In 1970-71, the agricultural facilities that have been

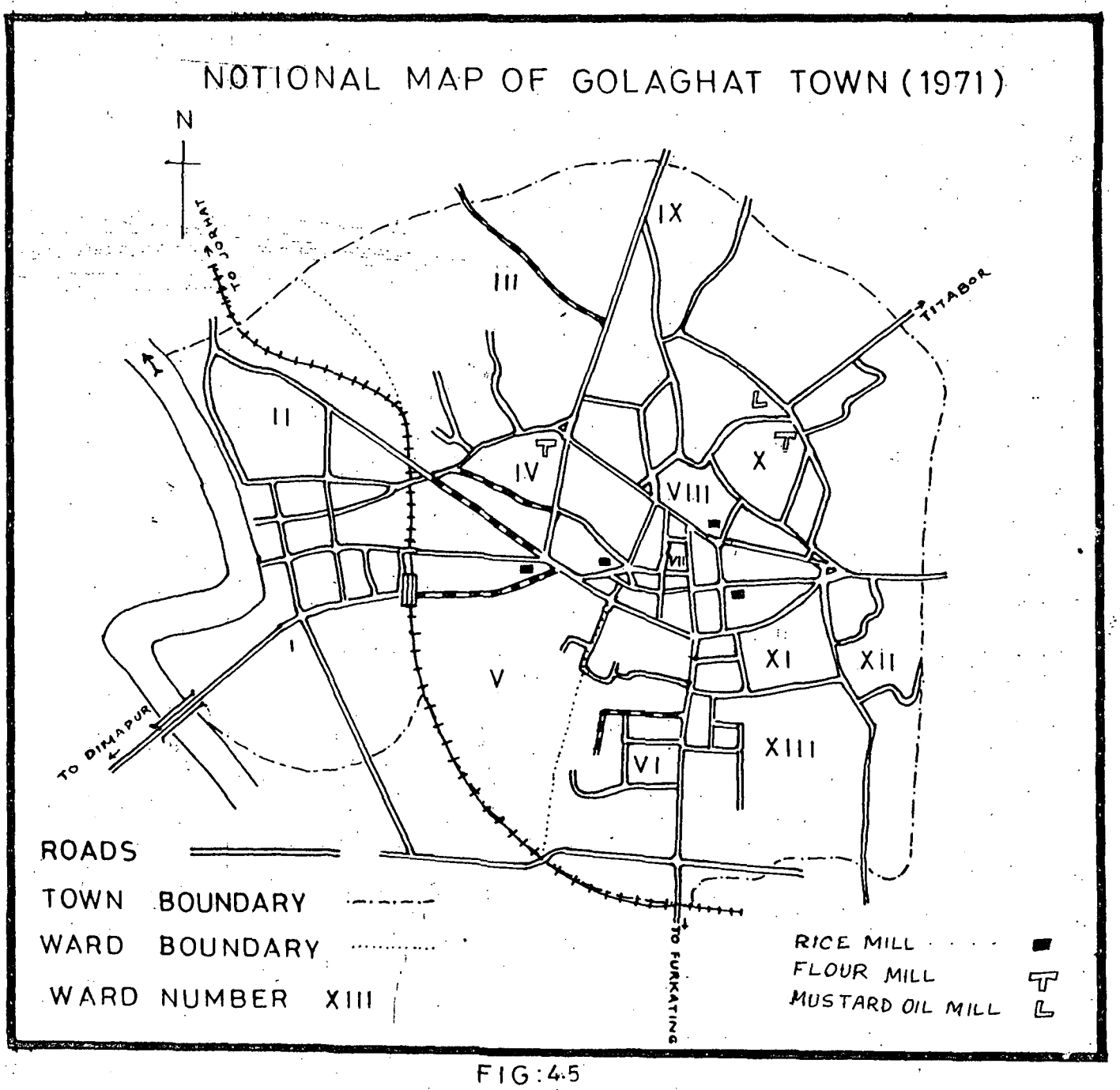

NOTIONAL MAP OF GOLAGHAT TOWN (1971)
N
TO JORHAT
TITABOR
TO DIMAPUR
TO FURKATING
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII
XIII
ROADS
TOWN BOUNDARY
WARD BOUNDARY
WARD NUMBER XIII
RICE MILL
FLOUR MILL
MUSTARD OIL MILL

FIG:4.5

diffused through the growth centre, Golaghat, are found limited. There were two dealers each for HYV seeds, fertilizer and pesticides, machine tool dealer, one repairing shop and a godown (storage facility) in the centre. It is significant that there was no pumpset dealer at the centre in 1970-71. It indicates that there was no pursuation of irrigation facilities in the area. The bank facility for agricultural purpose was found one only (Table. 4.7).

But the last twenty years there was a significant increase in the infrastructural facilities at Golaghat Centre. Say for example in 1990-91, the number of seed stores, fertilizer depots, more importantly, machine tool dealers are found more in the growth centre. Machine tool, pumpset and tubewell repairing shops have been increased to 400 and 500 per cent respectively. This is because of the increasing need of the farmers in an effort to produce more crops. The centre has three HYV seed stores, six fertilizer stores, four pesticide shops, two machine tool dealers, five machine tool repairing shops, six pumpset and tubewell repairing shops and two godowns in 1990-91. It is significant from the agricultural point of view that there are two pumpset dealers in the centre. Bank facilities have also been rendered to 763 farmers from six banks in Golaghat growth centre.

So far as the change in the number of agricultural

Table : 4.7 Agricultural facilities and change in Golaghat, 1970-71 to 1990-91.

Agricultural Innovation	No. of establishments		Change	
	1970-71	1990-91	Absolute	Percentage
1. No. of seed stores	2	3	1	50
2. No. of fertilizer depots	2	6	4	200
3. No of pesticide shops	2	4	2	100
4. No. of machine tool dealers	1	2	1	100
5. No. of machine tool repairing centres	1	5	4	400
6. No. of pump set dealers	-	1	1	00
7. No. of pump set & tubewell repairing centres	1	6	5	500
8. No. of storage facilities	1	2	1	100
9. No. of Banks	1	6	5	500
10. No. of benificiaries	NA	763	-	-

N.B. : Primery investigation

Table : 4.4
Distribution of Agro-based Estsblishments in Growth centres, 1970-71.

Name of the Growth Centres	Rice mill	Flour mill	Mustard oil mill	Spice mill	Chira mill	Food Processing units	Sugar mill
Golaghat	4	2	1	2	2	4	-
Dergaon	2	2	2	2	2	3	1
Bokaghat	2	1	1	1	2	2	-

Table: 4.5
Distribution of agro-based Establishments Growth Centres, 1990-91.

Name of the Growth Centres	Rice mill	Flour mill	Mustard oil mill	Spice mill	Chira mill	Food Processing units	Sugar mill
Gloghat	5	3	1	4	3	6	-
Dergaon	3	2	2	3	4	4	1
Bokakhat	2	1	1	3	2	3	-

Source : Primary Investigation.

Table : 4.6
Growth of Ago-based Establishments in Growth Centres, 1970-71 to 1990-91

Name of the Growth Centres	Number of Agro-based indestries		Growth in percent
	1970-71	1990-91	
Golaghat	15	19	26.67
Dergaon	14	17	21.43
Bokakhat	9	12	33.33

innovations during 1970-71 to 1990-91, is concerned, repairing of machine tool and bank facilities are found to increase 400 and 500 per cent respectively at Golaghat centre. Seed stores, fertilizer and pesticide shops, machine tool dealers and storage facilities have increased 50 to 200 per cent. The increase of fertilizer shops (200 per cent) indicates that there is a significant adoption of fertilizer in the area. The increase of fertilizer use is significant over time, however, there seems a very low degree of fertilizer use. Similarly the increase in the number of banks (500 per cent) during the period has contributed in financing agricultural practices.

Overall increae of the agricultural innovations at Golaghat growth Centre is recorded significant. However, the present level of use of those innovations is very low in the area. Therefore, the increase in production and productivity is found insignificant in the area.

3.2. Availability of Agro-based Establishments at Dergaon Centre (1970-71 to 1990-91)

Dergaon, as growth centre has been found contributing by way of providing innovations to agriculture. Table 4.8 reveals the fact that, apart from other services, repairing services and bank facilities to farmers have been rendered mostly to the surrounding areas.

In 1970-71, the establishments that dealt with the

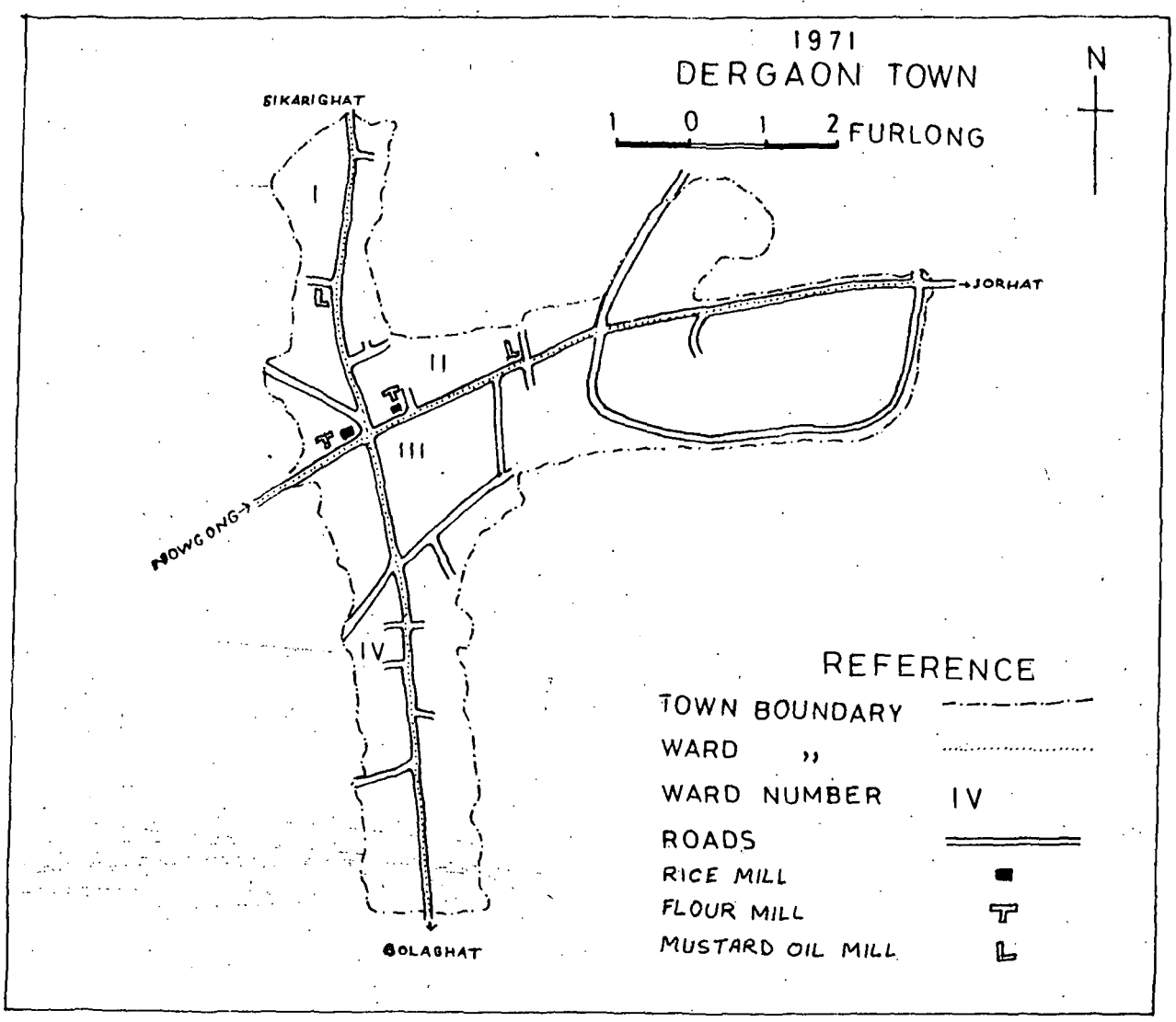

1971
DERGAON TOWN
N
1 0 1 2 FURLONG
SIKARIGHAT
JORHAT
NOWGONG
GOLAGHAT
I
II
III
IV
REFERENCE
TOWN BOUNDARY
WARD ,,
WARD NUMBER IV
ROADS
RICE MILL
FLOUR MILL
MUSTARD OIL MILL

FIG:4.6

agricultural facilities of all types were limited to only one (Table. 4.8), except for the fact that there were no pumpset dealer and storage facility in Dergaon. It reveals that the linkage of the growth centre with its hinterland has been found weak in 1970-71. The farmers must have been dependent on other nearby growth centres.

In 1990-91, the state of affair is a bit changed because the number of dealers of various agricultural facilities at Dergaon centre have been increased. This is further substantiated by the presence of two establishments each of seed, fertilizer and pesticides, three establishments each for machine tool repairing and pumpset repairing shops and four banks in the growth centre. The number of beneficiaries availing agricultural loan from these banks is 669 in 1990 - 91.

The numeral change of the establishments over time of twenty years (1970-71 to 1990-91) is nominal. Repairing centres and banks have been increased 200 and 300 per cent respectively, whereas seed, fertilizer and pesticide shops increased 100 per cent. Machine tool dealing remained same as in 1970-71. One godown has been established which facilitates storage in the growth centre. Thus, the Centre is providing agricultural facilities to the other settlements.

3.3 Availability of Agro-based establishments at Bokakhat Centre (1970-71 to 1990 - 91)

Bokakhat as growth centre in the district serves the

Table :4.8 Agricultural facilities and change in Dergaon, 1970-71 to 1990-91.

Agricultural Innovations	No. of establishments		Change	
	1970-71	1990-91	Absolute	Percentage
1. No. of seed stores	1	2	1	100
2.No. of fertilizer depots	1	2	1	100
3. No. of pesticide shops	1	2	1	100
4. No. of machine tool dealers	1	1	00	00
5. No. of machine tool repairing centres	1	3	2	200
6. No of pumpset dealers	-	-	-	-
7. No. of pumpset & tubewell repairing centres	1	3	2	200
8. No. of storage facilities	-	1	1	00
9. No. of Banks	1	4	3	300
10. No. of benificiaries	NA	669	-	-

hinterland with limited number of establishments so far dealing with agricultural innovations. Table. 4.9 shows that there was only one store each for seed, fertilizer, pesticides and pumpset and tubewell repairing shops and one bank. There was no machine tool dealer and machine tool repairing shop, pumpset dealer and storage facility (godown) in the centre in 1970-71. This indicates that the influence of the centre was nominal in the early 1970s.

In 1990-91, most of the agricultural innovations were diffused from the growth centres to its hinterland. The change of these innovations during 1970-71 to 1990-91 was marked by the increase in the bank facilities and repairing facilities; (200 and 100 per cent respectively). The change in absolute term shows that there are increase in machine tool dealing, machine tool repairing, pumpset dealing, pumpset and tubewell repairing, storage facilities and banking facilities, during the period of twenty years. It is important to note here that a total of 111 farmers were benefited with agricultural loan from the banks of this growth centre. Thus, the growth centre is extending services to agriculture in the surrounding areas of its hinterland.

It is, then, established that the three important growth centres of the district, namely, Golaghat, Dergaon, and Bokakhat have been influencing the agricultural in general, and the degree of agricultural decision making in particular. In fact, the

Table : 4.9

Total Quantity of Agricultural Establishments and their change, 1970 - 71 to 1990 - 91

Bokakhat.

Name of the Agricultural Innovations	No. of Establishment 1970-71	1990-91	Change Absolute	Percent
1. No.of seed stores	1	1	0	0
2. No. of fertilizer depots	1	1	0	0
3.No. of pesticide shops	1	1	0	0
4.No. of machine tool dealers	-	1	1	-
5. No.of machine tool repairing shops	-	3	3	-
6. No. of Pumpset dealers	-	1	1	-
7. No. of Pumpset and tubewell repairing centres	1	3	2	200
8. No. of storage facilities	-	1	1	00
9. No. of Banks	1	2	1	100
10. No. of Benefic-iaries	NA	111		

NA. Not Available.

Source : Primary Survey

agricultural development is a function of various important agricultural decisions made by the farmers, which again are shaped and monitored by the innovations available in the growth centres. It is, in this context, important to examine and explain the magnitudes of agricultural innovations diffused from the growth centres in the district.

4. Diffusion of Agricultural Innovations and Spread Effects

In the preceding section of the chapter, the structural changes and magnitudes of agricultural innovations have been interpreted for each growth centre of the district. The diffusion of those innovations and their causes are also important to study because it would provide us a sound base of the implications and utilisations of those innovations in terms of spread and areal imbalances. In fact, various hypotheses of growth centres approach of development imply that the intensity of transport network plays a vital role in the diffusion of agricultural innovations (Katz, 1955). These facts can be examined to delimit the boundaries of the hinterland of those growth centres and to correlate the spread effects of agricultural innovations with the trnasport network.

Diffusion can be defined as the acceptance of some specific items, over time, by adopting units - individual, groups or communities (Katz, 1955). Diffusion has, presently, been considered as catalytic function in agricultural development.

The tendency of comparatively rapid growth of agriculture as a whole, have been possible only through the diffusion of agricultural innovations. Thus the areas which are mostly exposed to diffusion are found to develop. The diffusion or spread of innovations to agriculture attracts closer review of agricultural situation arising out of it. Because, as a result of the diffusion of innovations new problems might be created which demand new solutions and thereby engender new ideas. Infact, diffusion is also related to farmer's decision making, depending on the intensity of information about it (Brown, 1981).

Diffusion of agricultural innovations is related to the receipt and acceptance or rejection of information regarding innovations (Ilbery, 1985). Because, new information and innovations either take time to be adopted or rejected for the difference of opinion by the farmers regarding the suitability and certainty of innovations. This is also related to the educational status of the farmers or farmer characteristics (Jones, 1963). For example, educated farmers seek and use new innovations to a greater degree than the less educated, and they tend to be early adopters of innovations. Diffusion of innovations and their spread effects are two-way processes for the development of agricultural landscape. The first process is related to the availability of innovations on the growth centres through which they are being diffused; while the second process is closely

associated with the mass-media and specially in the present context, personal contact of the farmers, regarding new innovations, which are to be adapted by them. But these processes of innovation diffusion are accelerated by one important factor, that is the availability and intensity of road network and transport costs.

According to Hagerstrand (1952), there are three important regularities in the system of diffusion processes (Fig. 4.1); they are :

(a) The hierarchical effect, or tendency of earlier adoption by individuals in large places than in down the hierarchy.

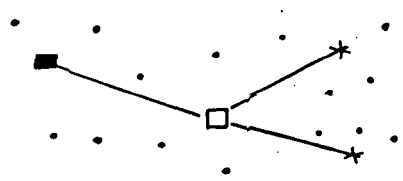
(b) The neighbourhood effect, or tendency for diffusion among settlements, first in rural-urban fringe, and so on.

(c) The logistic effect, or tendency of the cumulative level of adoption over time to approximate an S-shaped curve.

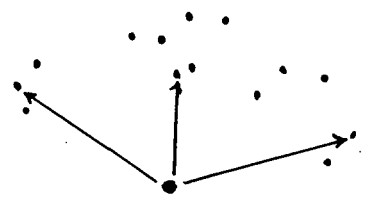
Through these regularities, the magnitudes and intensity of diffusion of agricultural innovations, can be interpreted and weakness of the growth centres can be highlighted for strengthening the infra-structural facilities in the future. Thus the whole material can be arranged into two main heads, under which strength of the agricultural innovations of the area and their spread effects

EMPIRICAL REGULARITIES IN DIFFUSION

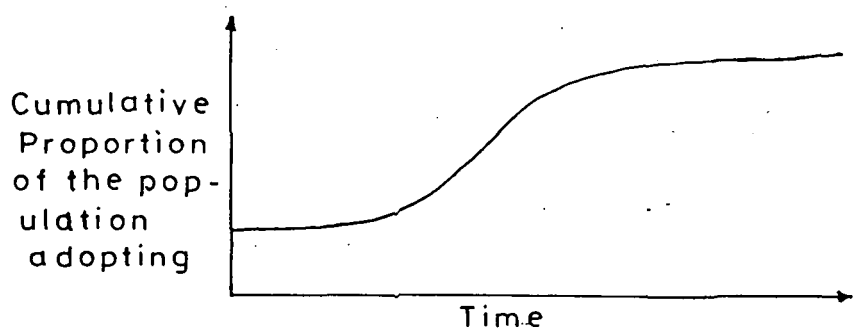
A. The Hierachy Effect For Diffusion In Space



B. The Neighbourhood Effect For Diffusion In Space



C. The S-Curve For Diffusion Through Time



Source: Ilbery, B.W.(1985)

Fig.4.1

can be studied.

4.1. Diffusion of Innovations Through Growth Centres

The discussion includes, here, four important and easily availed innovations of modern agriculture that have been diffused from the three important growth centres of the district at two different points of time so as to see the change therein. The innovations are HYV seeds, fertilizer (chemical), pesticides, and of course agricultural credit. The growth centres are Golaghat, Dergaon and Bokakhat. The time period considered here, is 1970-71 to 1990-91.

Growth Centre : Golaghat

In 1970-71, 240 ql. of HYV seeds 40 m.tonnes of fertilizer and 30 kg. of pesticides were diffused by Golaghat growth centre to the surrounding areas. But in 1990-91, the quantities of HYV seeds, fertilizer and pesticides were 3804.32 ql., 340 m. tons and 350 kg. respectively (Table 4.10). This indicates the adoption of innovations by the farmers in a big way for more agricultural production.

The degree of increase of these innovations are recorded very high at Golaghat centre. The HYV seeds increased 1485.13 per cent during twenty years ending 1990-91; fertilizer increased by 750 per cent and pesticides by 1066.67 per cent the period of time. The increase of such dimension certainly denotes the degree of contribution of the growth centre towards agricultural development of

Table - 4.10

Total quantity of Agricultural Innovation diffused, 1970-71 to 1990-91 of Golaghat District.

Golaghat Growth Centre

Items	Units	Quantity		Change	
		1970-71	1990-91	Absolute	Percent
1. Seed(HYV)	Quintal	240	3804.32	3564.32	1485.13
2. Fertilizer	M.ton	40	340	300	750.00
3. Pesticides	Kg.	30	350	310	1066.67
4.Agricultural Credit. Golaghat	Lakh Rs	NA	335.85	--	--

contd./...

Dergaon

Items	Units	Quantity		Change	
		1970-71	1990-91	Absolute	Percent
1. Seed(HYV)	Quintal	80	150	70	87.5
2. Fertilizer	M.ton	20	172.09	152.09	760.5
3. Pesticides	Kg.	15	150	100	900
4.Agricultural Credit.	Lakh Rs	NA	28.89	--	--

contd./...

Bokakhat

Items	Units	Quantity		Change	
		1970-71	1990-91	Absolute	Percent
1. Seed(HYV)	Quintal	10	18	8	80
2. Fertilizer	M.ton	5	40	35	700
3. Pesticides	Kg.	12	50	38	316
4.Agricultural Credit.	Lakh Rs	NA	3.91	--	--

PERCENTAGE INCREASE OF INNOVATIONS
IN GROWTH CENTRES (1970-71 to 1990-91)

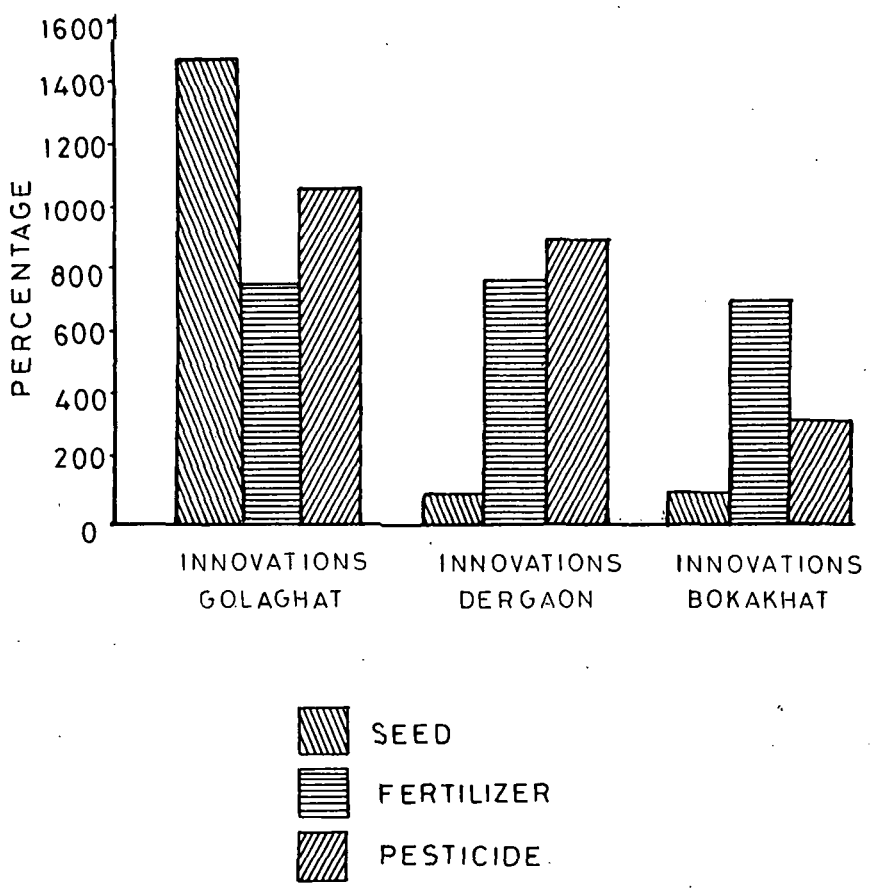


Fig.44

the region.

Similarly, the agricultural credit from banks of the growth centre (Golaghat) is quite high, 335.85 lakh Rs. which has immense bearing on the agricultural development in the hinterland (1990-91).

Growth Centre : Dergaon

Table reveals that a total of 80 ql. of HYV seeds, 20 m.tonnes of fertilizer and 15 kg. of pesticides were diffused by Dergaon Growth Centre to the influence zone. In 1990-91, on the other hand, it is recorded that the quantity of innovations is increased fast. It is important to note here that the amount of fertilizer and pesticides were more as compared to the HYV seeds (150 ql). It may indicate the adoption of HYV seeds in the influenced zone of the growth centre is not much prominent.

So far the change in the magnitudes of innovations is concerned for the period between 1970-71 and 1990-91 in Dergaon centre the diffusion of pesticides records highest (900 per cent). This is followed by the diffusion of fertilizer (760.5 per cent) and HYV seeds (87.5 per cent). The change in diffusion of these innovations is an implication of the importance of the growth centre and its contribution towards agricultural development.

Growth Centre : Bokakhat

The diffusion pattern of the agricultural innovations in Bokakhat is not much different from that of Dergaon centre. Here, the diffusion of fertilizer is important rather than pesticides and HYV seeds.

In 1970-71, the quantity of innovations diffused to agriculture in Bokakhat was much less, HYV seeds was 10 ql; fertilizer 5 m. tonnes and pesticides was 12 kg. (Table 4.10). The quantities of these innovations which have been diffused lesser at that centre are because of very low degree of adoption of those innovations by the farmers. The low level of farmer's income and ignorance of these innovations may be the major causes of lesser degree of diffusion processes.

In 1990-91, the tendency of using the available innovations has increased. It is noticed that the quantity of HYV seeds was 18 ql., fertilizer 40 m. tonnes and pesticides 50 kg. that had been diffused to the surrounding settlements. It amounts to 80 per cent increase in HYV seed, 700 per cent in fertilizer and 316.67 per cent increase in pesticides during the period of 1970-71 to 1990-91.

The agricultural credit from the banks in Bokakhat was 3.91 lakh Rs. which shows a considerable capital investment in agriculture in the surrounding areas of this growth centre(1990-91).

5. Spread Effects of Growth Centres

Indeed, spread effects of any innovations are the results of two important components of the areal personalities. First of which is related to the intensity and connectivity of roads, which transmit the effects ofthe growth centres to the surrounding areas. The second important component is related to the availability of the innovations at growth centres. It has already been discussed, theoretically, that income and literacy levels of the farmers are the important factors for the intensity of diffusion waves of the agricultural innovations. Therefore in the present section of the chapter, the spread effects would be described by delimiting the influence zones of the growth centres within which the intensity of innovation adopters and the role of existing transport network to intensify the spread effects of those innovations would be studied. The analytical results can be drawn to correlate the hinterland characterisitics of agricultural innovations with the road network of the area.

In general, the hinterland, characteristics of the main growth centres of Golaghat district which have been shown in the table. 4.12 are the indication of a regular hierarchic ordering of the growth centres. For example, catchment area of Golaghat centre is 1026 sq.km. which covers (29.30 per cent of the area of the district) shows greater capacity of radiating the effects of the agricultural innovations. Dergaon centre influences only

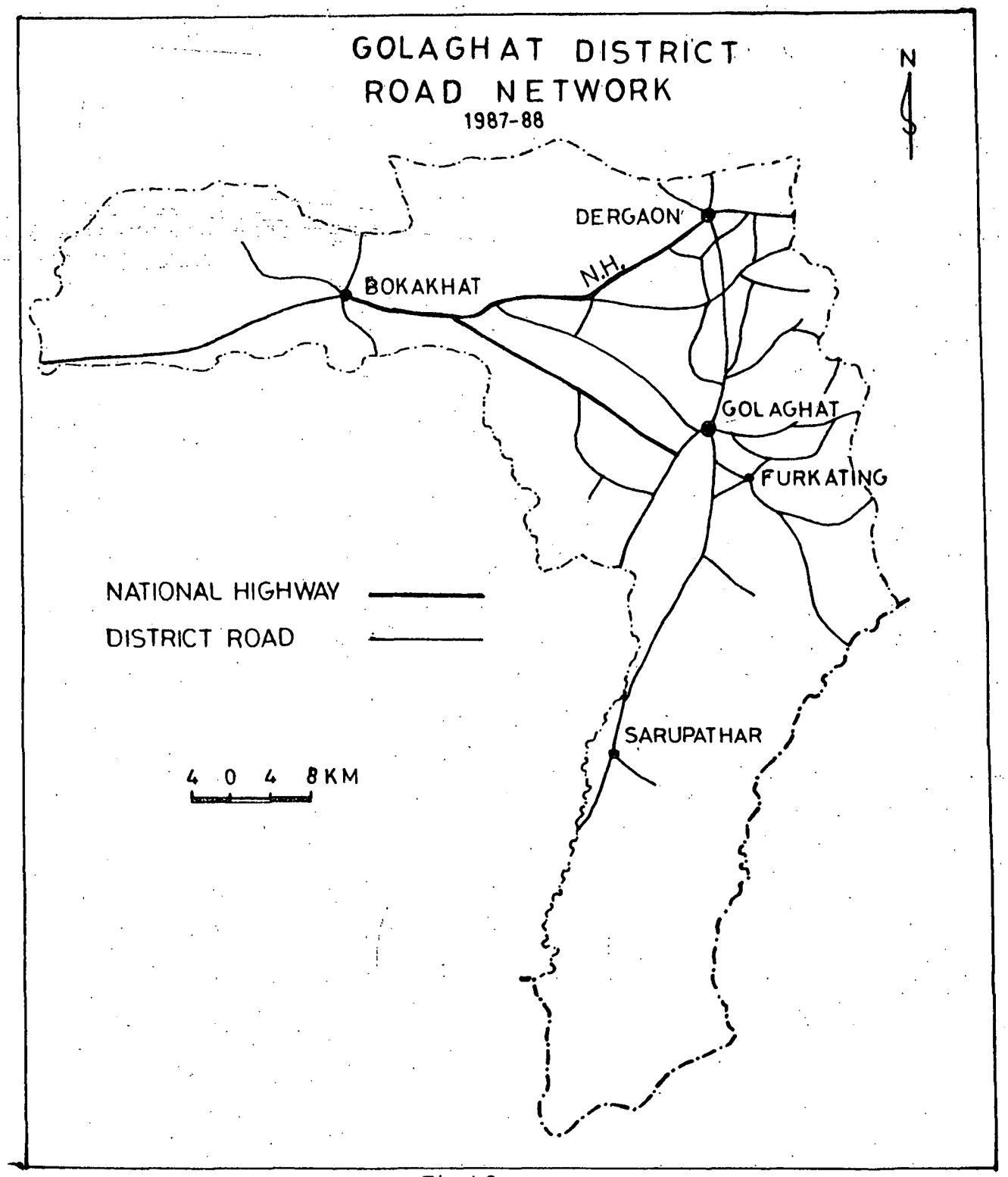

GOLAGHAT DISTRICT
ROAD NETWORK
1987-88
N
DERGAON
N.H.
BOKAKHAT
GOLAGHAT
FURKATING
SARUPATHAR
NATIONAL HIGHWAY
DISTRICT ROAD
4 0 4 8 KM

Fig.4.2

GOLAGHAT DISTRICT

ROAD ACCESSIBILITY MAP

1987-88

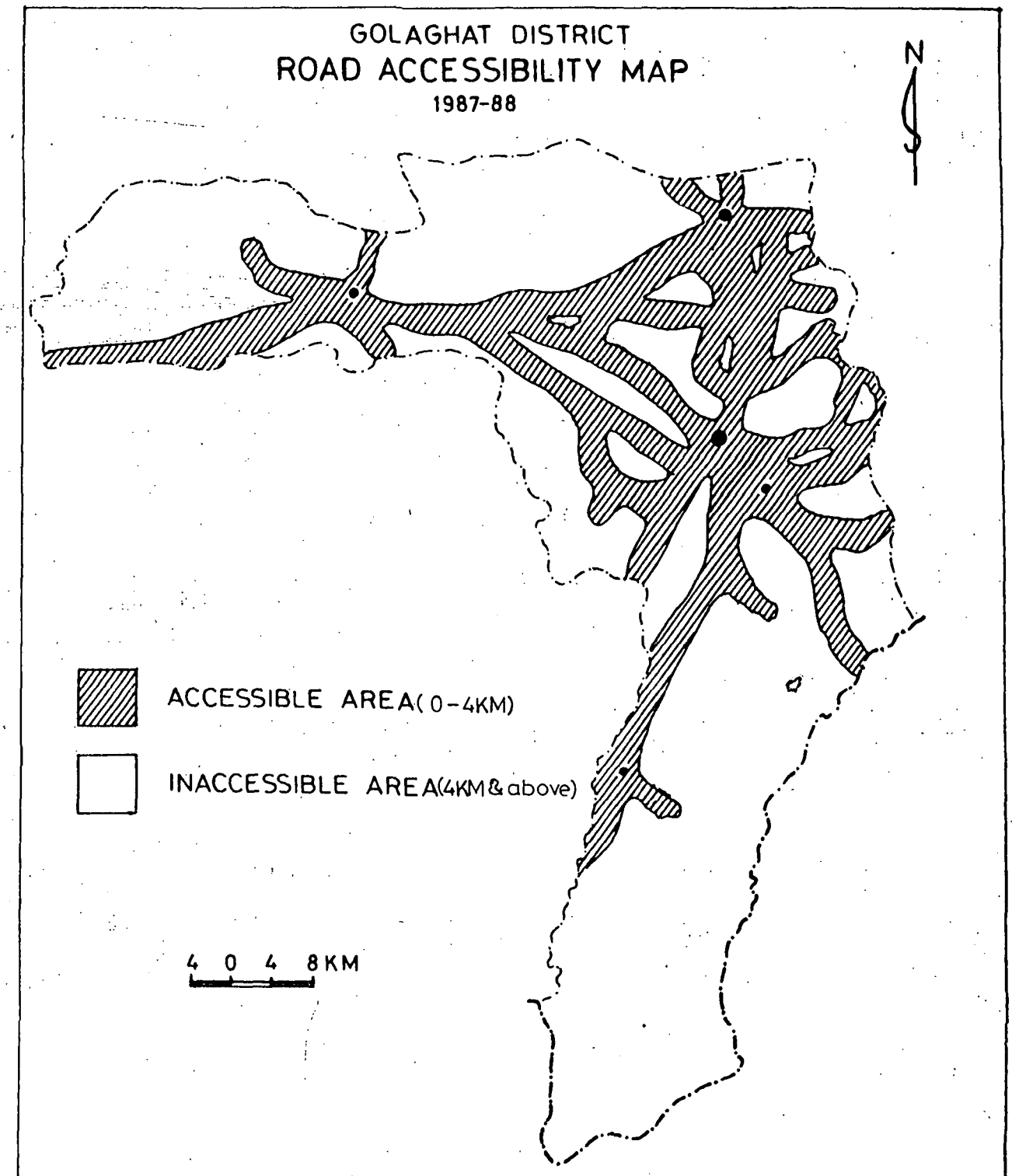


Fig.4.3

646 sq.km. area of its surrounding areas which is second order growth centre of the district. It is interesting to note here the population density within the catchment area of Dergaon growth centre is recorded higher (253 persons/sq. km) than Golaghat (198 persons/ sq. km) on the basis of 1971 census population. The road intensity within the catchment area of the Golaghat Growth Centre is recorded marginally lower (0.67 km/ sq.km). Bokakhat is a lower order growth centre which has 0.40 km intensity of the road network, although the connectivity at Bokakhat and Dergaon are same (Table 4.12).

On the otherhand, if we visualise the intensity of agricultural innovation diffusion within the catchment areas of these growth centres, it is found that Golaghat is the only centre which diffuses high yield variety seeds (3.7 ql/sq.km) fertilizer (3.3 ql/sq.km.) pesticides (0.34 kg/sq.km) and agricultural credit (0.32 lakh Rs/sq. km.). The intensity of those innovations are recorded less at Dergaon and Bokakhat centres (Table. 4.11).

On the whole, it can be concluded that Golaghat is the main diffusion centre of the area but because of marginally low road intensity within its catchment area, the effects of those innovation have not been diffusing upto the maximum extent and hence the spread effects are weak in the catchment areas of the

Table : 4.11
Intensity of Various Agricultural Innovations in the Catchment areas of Growth centres, 1990 -91

Name of the Centres	Catchment area '000 ha.	Quantity per thousand hectare			
		seeds HYV ql.	Fertilizers ql.	Pesticides Kg.	Agricultural Credit Lak.Rs.
Golaghat	102.61	37.08	33.14	3.41	3.27
Dergaon	64.63	2.32	26.63	2.32	0.45
Bokakhat	33.69	0.53	4.16	1.48	0.12

NB : Sarupathar and Furkating are also larger villages having very low influence in surrounding areas, therefore they are not included in the table, (refer fig.).

Table : 4.12
Population by Age Groups, Golaghat District and Dergaon town, (1971)

Age Group	District Population	Percentage of the total	Population Dergaon town	Percentage of the total
0-14	839346	45.68	3853	38.64
15-19	180166	9.81	1058	10.61
20-24	145272	7.91	1435	14.39
25-29	141260	7.69	1011	10.14
30-39	217174	11.82	1260	12.64
40-49	148477	8.08	738	7.40
50-59	91174	4.96	367	3.68
> 60	74313	4.04	242	2.42
Age not stated	207	0.01	8	0.08
Total	1837389	100.00	18590	100.00

Source : Source : Census of India, Series-III, Part II (B). Assam.

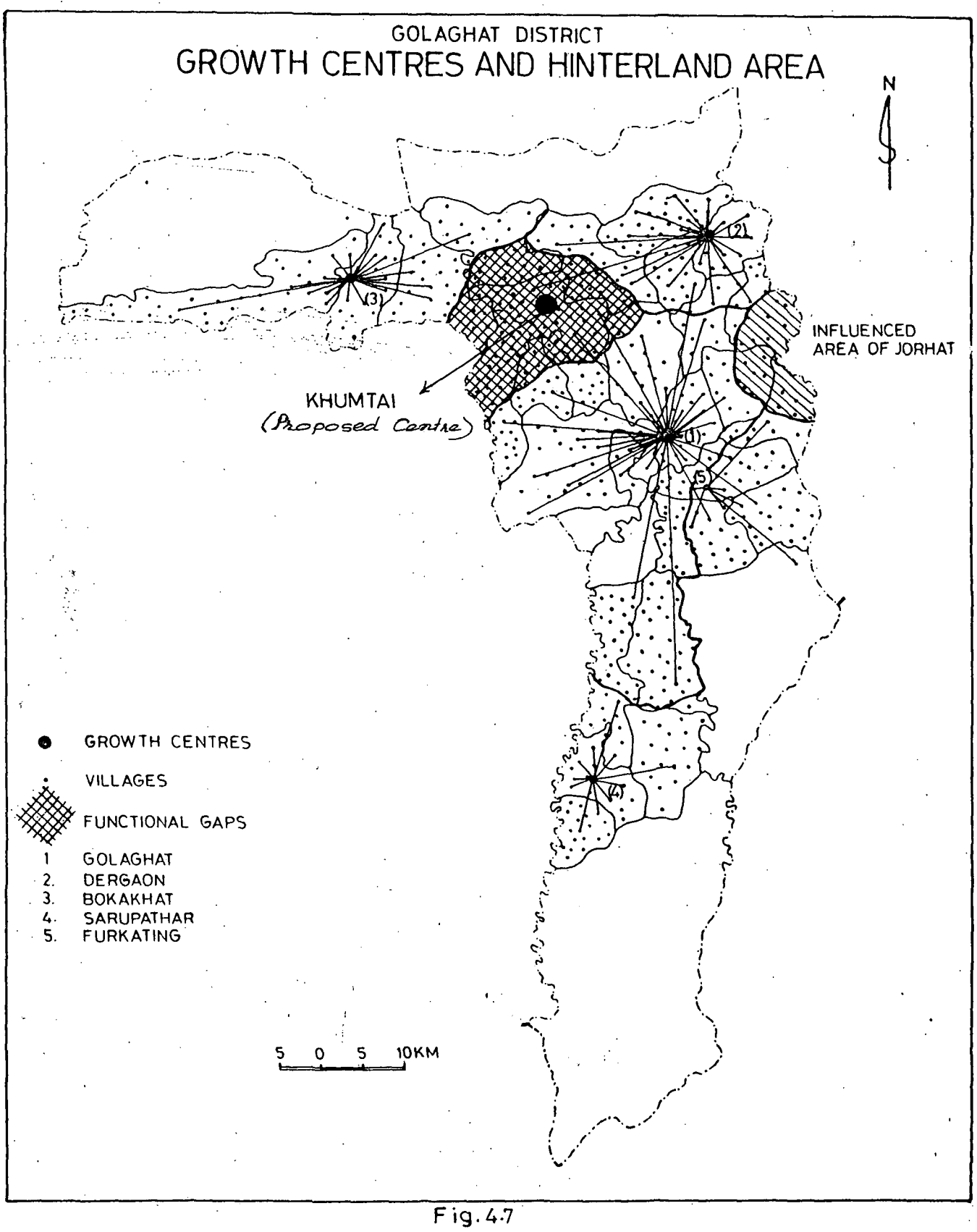

GOLAGHAT DISTRICT
GROWTH CENTRES AND HINTERLAND AREA
N
(2)
(3)
INFLUENCED
AREA OF JORHAT
KHUMTAI
(Proposed Centre)
(1)
(5)
(4)
GROWTH CENTRES
VILLAGES
FUNCTIONAL GAPS
1 GOLAGHAT
2. DERGAON
3. BOKAKHAT
4. SARUPATHAR
5. FURKATING
5 0 5 10KM

Fig. 4.7

centre. This fact also can be stated by correlating the map of road network with the catchment area of the centre (fig. 4.2 and fig. 4.7). The degree of road accessibility is also recorded low in these areas.

It is obvious from the fig. 3.14 that in the central part of the district, the productivity is low inspite of the availability of fertile land and favourable climatic conditions for agricultural growth. But for the less influence of growth centres and weak transport network of the area. The central part of the district is not developing (fig. 4.2).

6. Growth Centres as labour surplus Absorber

On account of low level of agricultural production, productivity and agricultural growth of the district as described in chapter III, it is obvious that there is lot of labour surplus and condition of disguised unemployment in the rural areas. Therefore, there can be seen migration from the surrounding areas of the growth centres towards them. Infact, the difference of daily wage rate must determine the rate of migration from rural to urban areas. Thus, it is hypothesised that the growth rate of the growth centres must be higher than the growth of the rural areas of the district. This fact can be examined to calculate the growth of the total district as well as of those growth centres (Table. 2.2).

The growth of the Golaghat centre has been recorded

lower (54.50 per cent) during the last twenty years than that of the Bokakhat (82.17 per cent) which is the newly emerging centre of the district. Therefore the migration from the rural areas to that centre is significantly higher than Golaghat which is in first order centre of the district. The growth rate of Dergaon centre is recorded lower than the district as a whole (Table 4.22). It indicates that the growth is persisting higher at the newly emerging growth centres. But here the question arises that the agricultural innovation facilities should be provided to those newly emerging centres of the district. The detailed proposed functional structure would be discussed later. These emerging centres would be discussed separately in the next chapter.

The occupational structure of the towns according to age groupwise may answer the question of migrating tendencies of labour force from rural to urban areas. By comparing age-wise population of these growth centres with the total district population, it is found that Golaghat centre constitutes 55 per cent of its population falling within the age group of 15 to 60 years old (which constitute the working class population), it is higher than the district average; at Dergaon centre which constitute nearly 60 per cent population of this category is remarkable (Table 4.13). It means that the migration of rural to urban areas are between 15 to 60 age group, which are job seekers. The share

of child population has been recorded lower at those growth centres than the district average (Table. 4·13). In the end it can be concluded that the population growth is higher at Golaghat centre because of greater migration of the working class population of rural areas. While the growth of Dergaon centre is less than the district average because of the saturation of the working class population in the centre. Therefore the job potential are less at Dergaon than other new emerging centres of the area.

Table: 4.12
Characteristics of Catchment areas of Growth Centers(1990-91)

Hinterland	Golaghat	Dergaon	Bokakhat
1.Catchment Area (in Sq. Km)	1026.1	646.3	336.9
2.Population(1971)	203184	163404	49452
3.Density of Population persons per sq. km.	198.02	252.83	146.79
4.Number of Villages	372	267	78
5. Road length* (in km.)	470	270	134
6. Road Intensity km./thousand hec.	5.76	5.98	3.97
7. Road Connection	6	5	5

* Motorable roads; surfaced and unsurfaced road

Table : 4.13
Population by Age Groups, Golaghat District and town Golaghat (1971)

Age Group	District Population	Percentage of the total	Population Golaghat town	Percentage of the total
0-14	839346	45.68	7681	41.32
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25-29	141260	7.69	1707	9.18
30-39	217174	11.82	2302	12.38
40-49	148477	8.08	1472	7.92
50-59	91174	4.96	835	4.49
> 60	74313	4.04	661	3.56
Age not stated	207	0.01	20	0.11
Total	1837389	100.00	18590	100.00

Source : Census of India, Series-III, Part II (B). Assam.

Table :
Occupational Structure of Growth Centres (1971)

Growth Centres	Total Workers	Economic Sectors					
		Primery		Secondary		Tertiary	
		Workers	%age	Workers	%age	Workers	%age
Golaghat	5600	269	4.80	1012	18.07	4319	77.13
Dergaon	3730	202	5.42	420	11.26	3108	83.32
Bokakhat	1222	385	31.51	143	11.70	694	56.79
District	158448	126837	80.05	6226	3.93	25385	16.02

Source : Census of India 1971. Village and Town Directory,Population Tables,Assam.

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C H A P T E R - V

CONCLUSION AND SUGGESTIONS

Agriculture is the main economic sector of Assam as well as of Golaghat District, and most of the farmers produce at subsistence level which characterise, naturally, low production resulting in chronic poverty in many parts of the district. This is further worsened by the rapidly-increasing population when the existing agriculture has not enough provision to provide them food and, more important, provision of productive work to the surplus labour force in the district, is limited. As a result, agriculture in the district suffers from stagnant or very slow agricultural growth rate, low production level and productivity, inspite of favourable agro-climatic conditions of the study area. Infact, the growth centres of the area are also helpful to diffuse the agricultural innovations to the surroundings. There are various processes of agricultural development which are being operated through those growth centres. The agricultural growth rate of the area may be lower because of less effects of those growth centres on the agricultural landscape of the district. In this connection, an attempt has been made to examine the validity of the facts whether the growth centres of the area are influencing the agricultural landscape in proper way or not.

The working 'definition' of growth centre has been

taken up, here, as the urban centres and newly emerging rural centres that stimulate further growth in their hinterlands which subsequently provide growth in agricultural production and structural change in both, the centres and hinterlands. The district experiences the presence of new emerging centres that are contributing agricultural facilities to their hinterlands.

In the foregoing pages the salient features relating to the geographical personality of the district which have direct or indirect control on the agricultural production pattern have been described. These features which have been grouped under agricultural production processes, include human factors, topographic features, soil fertility and climatic conditions of the district. The soils of the study area are mostly sandy loam having a pH value of 5.5 (acidic). Old alluvium soil, where sugarcane is extensively produced has lower pH value (4.2 to 5.5). So far as climatic conditions like rainfall temperature and humidity of the district are concerned, they are suitable and conducive for agricultural purpose. Any growth target can be achieved in the district with a planned input of new agricultural technology. Because here, rainfall and temperature conditions are suitable although these vary in different months of the year; temperature is recorded $10^{o}C$ in the month of January and $32^{o}C$ in the month of August, while most of the

rainfall is precipitated during the months of June, July and August. Humidity is recorded highest in July and lowest in December.

Under such physical influences on agriculture in Golaghat District, the production processes of agriculture also have been studied. Physiographically, Golaghat District is a part of the Upper Brahmaputra Valley which constitutes mostly new and old alluvial plain areas. Alluvium was deposited at the close of Pleistocene period where, presently, most of the townships, residential pockets and tea gardens in the district have been flourished. Paddy fields (Pothars)are exclusively found in the low lying areas of both new and old alluvial soils. These areas are often prone to floods and droughts alike. In the flood plain zones on the northern part of the district, chars and chaporis, 'beels'are enormously found, where, in chars and chaporis, mostly plain tribal peoples and Muslim immigrants produce both Kharif and rabi crops, mostly rabi ones.

The district has two important river systems, one is the Brahmaputra and other a minor system is the Dhansiri river system which has immense influence on the agriculture and forests in the district. The important aspects such as the land-use change overtime, intensity and patterns of cropping, crop

yield pattern, crop production and its growth and agricultural productivity, agricultural work force and its change, labour input technology input such as HYV crops, irrigation, fertilizer and farm mechanization have been studied. In these prevailing geographical conditions of the area the following conclusions have been drawn.

1. There is a insignificant change in the general landuse pattern in the district during the last two decades ending 1990-91. Net sown area has been increased only at a rate of 0·58 Percent annually from 119010·8 ha. in 1969-72 to 133897·8 ha. 1989-91. Other categories of landuse remain more or less same in that period. It means there is no much change in the general landuse patterns, and horizontal expansion processes of agricultural landuse are insignificant in the area.

2. The change in NSA, although, it is insignificant, has been observed in almost all the Gaon Pancheyat Areas, particularly in the flood free old alluvium areas which are contiguous to the growth centres.

3. Irrigation is the major element of intensifying the agricultural production processes, although, the area is under humid condition which requires not much irrigation as such , for summer crops but is found inadequate for winter crops. However, irrigation facilities, may be made available for winter paddy which is a principal crop, dominating the cropping pattern in

the district and there are lot of irrigation potentials.

4. The intensity of agriculture in the district at the beginning of 1970s was very low (106 per cent) which had increased (rather stagnant) to only 107 per cent at the beginning of 1990s. Although, it is found that some panchayat areas particularly in the alluvial fertile tracts of the rivers have higher intensity of cropping.

5. The yields of principal crops are very low which indicates that farmers use very little of modern technology to increase the crop yields. But occasionally, in some GP areas the yields of certain crops like paddy and sugarcane in fertile alluvial soils, are comparatively higher.

6. Agricultural production of the district is characterised by: (a) the low intensity of cropping, (b) monoculture of paddy, (c) the decreasing natural fertility of agricultural land, (d) low adoption of agricultural technology, (e) small land holdings of the farmers, (f) the lack of knowledge to understand agricultural as industry that is transformation of subsistence to commercial farming, and (g) the weak infrastructure in the hinterlands of growth centres. These factors, altogether, have resulted in low level of agricultural production in the district, The growth of production is thes 1.09 per cent per annum (1969-72 to 1989-91) of all crops aggregated in terms of money value output.

7. Agricultural productivity is required vertical expansion of agriculture in the district. But the agricultural productivity both in 1969-72 and in 1989-91 are very low as compared to those of the state of Assam and the nation. The annual increase in productivity is only 0.73 per cent per annum during the period of twenty years. This is due mostly to low yield of various crops and insignificant change in the net sown area of the district. Although, high agricultural productivity is found in the areas where favourable land conditions prevail in the district, like in alluvial tracts of the river Brahmaputra and the Dhansiri.

8. On account of the weak push forces (that is related to diffusion of agricultural technological input, like fertilizer depots, tool repairing centres; storage facilities etc.), the growth of agricultural output and increase in agricultural productivity are found to be stagnant.

9. Analysing data related to the availability of the agricultural functions, it is found that the functional structure of the growth centres is very weak, even the spread effects of those centres to hinterlands are negligible, because of poor road and transport network and poor accessibility. Therefore, the centres are growing in isolation and there is a functional gap in the district. Mostly central western part of the district

has no influence of the nearby growth centres. Therefore there is leakage of agricultural resources/products from the study area which are being processed outside the district.

10. So far the contributional aspects of the growth centres are concerned, it is found that the production -processing contribution of the centre is weak, because there are only 48 agro-based industries of which rice mills and mustard oil mills process the local products 08 per cent of the district and flour mills - process agriculture products that comes from outside the district.

In terms of the relative abundance of the markets that deal agricultural products and requirements are not so adequate, especially those dealing with agricultural machineries, big and small.

The diffusion contribution is found to be inadequate because of weak linkages of the growth centres with the hinterlands. The diffusion through mass media is also in early stages for receptivity of agricultural innovations by the farmers in the district. The extension agricultural programmes are ineffective in the area because of lack of infrastructural facilities.

The progressive farmers, as a result, come out to be very few. The personal contact so far the diffusion of informations of new innovations are concerned, is important in the district.

The effects of weak innovation processes of agricultural functions and concentrated pattern of spread effects of the growth centres in the area result the obliterated patterns of agricultural development.

Suggestions

The following suggestions can be made in order to consider these weak points of the agricultural development of the district. The suggestions would forward the main strategic points of the improvements of infrastructural facilities for the balanced level and self sustained growth of agriculture. They are :

1. The percentage share of establishments related to agricultural activities in the functional structure of the growth centres decreases when observed it from lower order to higher order growth centres of the district. It means that growth centres of larger order have the smaller share of establishments related to agricultural activities mainly because of the effects of tertiarisation of the functional structure of the higher order centres, for example, Golaghat growth centre has a total of 19 establishments of agricultural activities (20.67 per cent) while Bokakhat, which is lower order centre of the district has 12 establishments out of total 40 (30 per cent). It indicates that the lower order centres are playing significant role while their diffusion processes are stronger than the higher order centres. Although the catchment areas of the higher order centres are

higher, it can be suggested here that the strong functional structure of those growth centres of higher order, related to agricultural innovations, is required. Thus, the HYV seed depots, fertilizer depots and other agricultural extension services should be intensified at Golaghat centre so that it may radiate their effects to the surrounding areas to diffuse innovations in a proper way.

2. The important establishments regarding agricultural activities have not been observing at lower order, namely, Dergaon and Bokakhat. Therefore, it is suggested that bank facilities and proper market facilities should be established on those centres.

3. Infact, the spread effects of those agricultural innovations are weak which can be strengthened to extend and intensify the proper road network of the area. Few new routes can be constructed, and the following kuccha roads should be replaced by pucca road.

1. Kamarbandha to Jorhat
2. Badliper to Khumtai
3. Dergaon to Adharsatra via Missamara
4. Dergaon to Chikarighat
5. Kamargaon to Mohuramukh

These proposals of road network would increase the road intensity of the area as well as strengthen the connectivity of

the growth centres.

4. It is concluded earlier that the central western part is less influenced by the spread effects of the growth centres. It is proposed that atleast one larger village of this area, namely, khumtai, which has a population of 1148 persons should be so made to emerge out as small order growth centres through which the package of green revolution technology would be diffused to its surroundings (Fig. 4.7).

In the end it can be said that if these provisions would provide in the area, the obliterated patterns of agricultural development might be changed into uniform pattern with its well balanced development of agricultural activities of the area. These conclusion and suggestions which have been drawn here, can further be strengthened to extend the present study in its comprehensive manner.

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APPENDIX

Titabor Station : Monthly Rainfall Overtime (in mm)

Months	1970	71	72	73	74	75	76	77	78	79
Jan	46.9	17.8	25.8	9.4	20.0	10.0	0.0	28.4	1.5	0.0
Feb	24.5	12.4	36.2	29.0	0.7	14.4	98.7	43.0	17.4	4.4
Mar	35.6	69.4	51.4	25.8 (.86)	20.2 (.67)	5.4 (.18)	75.9 (2.53)	72.8 (2.42)	24.5 (0.82)	18.9
Apr	117.1 (3.9)	189.8 (6.3)	225.9 (7.5)	233.7 (7.8)	269.3 (9)	153.5 (5.1)	115.1 (3.8)	296.6	51.1	81.9
May	247.8 (8.2)	164.6 (5.5)	221.7 (7.5)	283.0 (9.4)	216.9 (7.2)	106.6 (3.5)	131.9 (4.4)	299.9 (10)	127.5 (4.2)	143.9
Jun	262.6 (8.7)	479.9 (15.9)	266.0 (8.7)	337.8 (11.2)	196.1 (6.5)	418.0 (13.9)	291.0 (9.7)	263.5 (8.76)	308.4 (10.3)	233.4 (7.8)
Jul	405.8 (13.5)	378.4 (12.6)	186.5 (6.2)	471.9 (15.7)	418.3 (14.0)	259.3 (8.6)	521.3 (17.4)	379.5 (12.6)	404.4 (13.5)	263.4 (8.7)
Aug	268.7 (8.95)	309.7 (10.3)	318.5 (10.6)	495.2 (16.5)	202.2 (6.7)	375.3 (12.5)	344.1 (11.5)	257.6 (8.2)	264.5 (8.7)	163.0 (5.43)
Sep	184.6 (6.1)	236.3 (7.9)	187.9 (6.3)	202.5 (6.7)	264.5 (8.7)	265.8 (8.7)	181.6 (6.1)	193.3 (6.5)	214.5 (7.1)	178.0 (5.9)
Oct	141.2 (4.7)	208.9 (7)	82.8 (2.7)	73.4	103.8	134.9	28.2 (1.9)	134.0	57.2	136.0 (4.5)
Nov	13.7 (.5)	77.0 (2.6)	6.5 (.2)	37.9 (1.2)	47.2 (1.6)	25.6 (.8)	29.2 (.9)	56.0 (1.9)	102.0 (3.4)	38.71 (1.3)
Dec	0.0	32.1 (1.1)	1.6 (.5)	45.2 (1.5)	4.3 (.1)	5.8 (.2)	6.3 (.2)	24.3 (.8)	0.0	36.1 (1.2)
	1748.5	2176.3	1610.8	2144.8	1763.5	1774.6	1823.3	2049.5	1573	1297.1
Annual	4.86	6.05	4.47	6.24	4.9	4.93	5.06	5.69	4.37	3.6

Months	80	81	82	83	84	85	86	87	88	89	90
Jan	15.8	10.3	0.0	20.2	25.4	2.5	15.8	1.8	6.1	6.1	21.2
Feb	46.9	46.6	62.5	37.4	5.1	38.0	17.0	23.8	22.9	54.2	55.3
Mar	65.4	71.8	13.8	162.5 (5.52)	11.8 (.4)	198.0 (6.6)	22.5 (.75)	144.7 (4.8)	82.4 (2.75)	30.4 (1)	51.0 (1.7)
Apr	191.5	209.8 (7.0)	286.3 (9.5)	192.5 (6.4)	180.7 (6)	244.3 (8.1)	298.6 (9.9)	104.5 (3.7)	115.9 (3.9)	222.1 (7.4)	367.2 (12.24)
May	201.6 (6.7)	297.2 (9.9)	185.2 (6.2)	234.2 (7.8)	215.5 (7.2)	92.6 (3.1)	104.7 (3.5)	64.9 (2.2)	269.0 (9.0)	118.6 (4)	202.3 (6.7)
Jun	201.2 (6.7)	197.4 (6.6)	457.1 (15.2)	355.2 (11.8)	288.5 (9.6)	446.2 (14.9)	130.0 (4.3)	187.2 (6.2)	139.8 (4.6)	234.0 (7.8)	284.1 (9.5)
Jul	438.5 (14.6)	401.2 (13.4)	416.0 (13.9)	791.2 (26.4)	265.7 (8.7)	382.9 (12.7)	253.7 (8.4)	553.4 (18.45)	164.0 (5.5)	164.0 (5.5)	399.5 (13.3)
Aug	156.9 (5.2)	219.3 (7.3)	431.0 (14.4)	574.2 (19.1)	208.6 (7)	173.1 (5.8)	348.4 (11.6)	264.4 (8.8)	182.9 (6.1)	254.5 (8.5)	378.6 (12.6)
Sep	325.8 (10.8)	211.4 (7)	288.2 (9.6)	544.7 (18.1)	135.5 (4.5)	262.5 (8.7)	181.5 (6.0)	569.2 (19)	228.4 (7.6)	217.4 (7.2)	235.9 (7.7)
Oct	288.8 (9.6)	85.4 (2.8)	111.2 (3.7)	78.1 (2.6)	49.6 (1.6)	33.4 (1.12)	163.7 (5.4)	76.1 (2.53)	166.2 (5.5)	207.9 (6.9)	92.1 (3.06)
Nov	0.0	3.0 (.1)	51.0 (1.7)	7.0 (.2)	0.4	10.0 (.33)	33.0 (1.1)	4.7 (.2)	45.6 (1.5)	12.0 (.4)	18.0 (.6)
Dec	0.0	46.0 (1.5)	38.2 (1.3)	16.4 (.55)	11.0 (.36)	6.8 (.23)	5.0 (.16)	15.3 (.5)	14.0 (.5)	4.8 (.2)	1.4 (.3)
	1932.4	1799.4	2340.5	3013.6	1397.8	1890.3	1573.9	2010	1437.2	1526	2106.6
Annual	5.34	5	6.5	8.37	3.88	5.25	4.37	5.58	3.99	4.24	5.85.

Appendix - 2
Monthly Temperature (Minimum) Over Time (in centigrade
Titabor Station : (Rice Research).

Months	1970	71	72	73	74	75	76	77	78	79	80
Jan	11.2	9.7	11.3	10.4	9.9	9.5	--	9.7	11.4	13.0	11.5
Feb	11.0	11.2	12.3	12.0	11.0	12.9	13.7	11.8	12.5	12.8	13.3
Mar	15.5	14.6	11.0	15.6	15.1	14.9	16.3	16.6	15.6	16.4	16.9
Apr	16.4	19.5	18.9	20.5	19.3	19.5	19.3	19.2	19.2	18.5	22.1
May	22.3	21.9	22.3	23.0	22.8	24.8	22.2	21.3	22.6	23.5	23.2
Jun	24.8	24.5	25.6	24.4	24.7	24.8	25.0	25.1	24.7	25.2	25.9
Jul	25.6	24.7	25.4	25.2	24.5	24.7	24.8	25.3	25.4	25.4	25.3
Aug	24.8	24.7	24.8	24.8	25.0	25.1	24.7	24.3	26.2	26.3	25.5
Sep	24.5	24.4	24.1	24.3	24.0	24.2	24.4	23.8	24.5	25.0	25.8
Oct	21.3	21.5	21.4	22.0	23.5	22.8	20.8	19.9	24.5	23.3	23.0
Nov	15.2	14.4	14.9	16.5	17.5	16.2	17.4	15.5	24.9	17.9	16.3
Dec	9.8	9.8	10.3	11.2	10.3	9.5	11.5	11.3	13.1	12.7	12.9

Months	81	82	83	84	85	86	87	88	89	90
Jan	11.6	10.2	11.0	8.3	--	9.6	8.5	8.5	9.5	11.2
Feb	12.6	11.6	11.1	9.2	--	11.8	12.1	11.2	12.1	13.9
Mar	19.2	15.1	12.5	11.8	--	14.2	15.6	15.1	15.8	14.9
Apr	20.4	19.0	13.6	14.0	--	19.1	19.6	19.4	18.6	17.7
May	24.5	22.6	18.8	12.2	--	22.0	21.3	22.6	23.0	22.7
Jun	27.3	23.8	21.9	--	--	21.2	24.6	24.9	24.8	24.6
Jul	26.5	23.6	21.9	--	--	24.2	24.3	25.4	24.6	24.8
Aug	27.1	23.5	21.7	--	--	23.7	24.4	25.9	25.4	24.7
Sep	26.2	21.0	20.8	--	--	20.2	23.5	24.6	25.0	24.7
Oct	23.7	15.9	17.9	--	--	16.3	20.8	24.0	22.3	22.2
Nov	17.8	11.2	11.3	--	15.0	14.5	15.3	--	15.4	17.5
Dec	10.8	8.8	9.0	--	11.3	7.9	9.4	11.1	9.8	11.6

Appendix 3

Temperature (Maximum) in °C Titabor Station (Rice Research)

Months	1970	71	72	73	74	75	76	77	78	79
Jan	22.6	22.3	22.5	23.4	--	23.0	20.0	22.3	20.0	23.2
Feb	24.8	23.8	23.7	25.2	--	28.1	24.3	23.1	24.0	24.5
Mar	27.1	29.8	27.9	26.1	28.4	30.1	27.8	27.8	26.3	28.5
Apr	29.9	28.7	25.9	--	27.6	30.1	29.6	25.0	30.0	29.6
May	26.4	30.1	28.7	--	30.5	32.6	30.0	28.7	31.0	26.6
Jun	31.1	31.6	31.3	--	31.8	31.6	31.0	29.9	31.5	32.0
Jul	31.4	32.1	32.1	--	30.7	31.5	31.9	32.1	31.5	30.8
Aug	32.3	31.4	32.9	--	32.3	32.5	31.9	30.7	31.9	31.3
Sep	31.6	31.7	30.6	--	30.9	31.3	31.8	30.2	30.9	31.0
Oct	25.3	29.2	30.0	--	31.8	30.6	29.7	27.1	30.7	28.3
Nov	26.6	25.4	27.1	--	28.4	27.0	26.9	25.1	25.5	26.7
Dec	27.4	23.5	25.0	--	24.0	24.3	23.6	21.0	23.9	22.7

Months	80	81	82	83	84	85	86	87	88	89	90
Jan	21.5	22.7	22.4	22.4	23.1	23.6	23.6	24.2	24.0	22.4	24.4
Feb	22.7	23.6	22.8	23.2	23.9	23.6	25.0	26.5	26.7	23.6	23.5
Mar	25.2	24.9	27.3	24.7	30.0	27.6	28.7	26.1	28.0	29.0	24.3
Apr	27.8	26.3	27.0	28.2	28.4	28.4	28.4	28.9	28.9	28.9	25.5
May	28.0	30.7	30.8	29.4	29.0	31.1	31.6	31.6	30.3	31.6	30.8
Jun	30.8	32.0	30.9	32.6	33.0	31.8	33.2	33.7	33.4	32.8	30.3
Jul	31.7	31.0	32.2	32.3	32.0	31.5	33.0	32.6	32.3	30.9	33.4
Aug	30.6	31.5	32.5	32.5	32.0	33.4	33.0	32.4	32.2	33.2	33.4
Sep	30.9	31.0	31.7	31.1	29.3	31.5	30.9	31.2	31.5	31.9	31.7
Oct	28.3	30.6	29.4	30.3	28.4	30.4	28.3	31.0	31.0	31.0	29.6
Nov	26.2	27.9	26.0	27.3	25.7	27.0	27.5	28.2	--	25.7	29.3
Dec	24.2	23.9	22.0	22.7	23.5	25.0	23.9	25.0	24.5	23.5	25.2

Appendix - 4

Monthly Humidity (Morning) in Percentage over time

(Titabor Rice Research.)

Months	1970	71	72	73	74	75	76	77	78	79	80
Jan	100	99	100	100	100	98	--	99	94	92	94
Feb	99	98	99	95	99	99	100	96	95	90	90
Mar	95	98	90	96	97	98	97	96	94	86	89
Apr	96	95	97	93	97	96	95	97	86	86	90
May	93	93	96	93	94	95	93	96	90	91	92
Jun	93	93	92	94	92	95	95	94	91	93	91
Jul	93	92	93	93	96	93	93	91	91	91	91
Aug	93	94	93	95	97	95	92	92	94	90	90
Sep	94	95	93	95	95	97	93	93	95	95	90
Oct	98	99	98	98	97	98	98	95	94	94	95
Nov	97	99	100	99	99	100	94	94	94	93	93
Dec	99	100	100	100	100	-	100	93	94	93	96

Month	81	82	83	84	85	86	87	88	89	90
Jan	92	93	93	91	89	92	93	93	91	91
Feb	83	90	91	91	86	90	90	92	90	91
Mar	90	91	89	90	86	87	90	90	90	91
Apr	91	92	91	85	91	89	91	88	91	91
May	92	90	89	86	90	91	90	91	90	90
Jun	84	90	89	87	92	90	90	90	91	89
Jul	91	90	88	90	92	92	89	93	92	90
Aug	88	87	89	90	88	92	92	92	92	91
Sep	90	89	89	91	81	93	93	94	90	92
Oct	92	93	92	92	89	91	93	93	93	92
Nov	92	92	92	89	91	91	92	-	91	92
Dec	92	92	93	89	83	94	94	93	89	91

Appendix -5

Monthly Humidity (Evening) in percentage Titabor station (Rice Research)

Month	1970	71	72	73	74	75	76	77	78	79	80	81	82
Jan	57	61	66	56	65	56	-	57	56	50	72	63	68
Feb	50	73	59	54	52	55	61	54	68	43	61	56	6
Mar	46	72	53	45	47	41	58	56	69	41	66	59	61
Apr	58	65	72	59	69	62	58	74	53	49	63	61	71
May	79	69	75	71	68	71	69	73	61	66	71	74	67
Jun	73	73	73	75	71	71	70	76	73	68	71	63	70
Jul	73	71	74	68	77	74	74	69	73	73	72	72	70
Aug	73	71	70	74	71	74	78	72	74	72	74	74	73
Sep	75	72	74	74	76	75	76	64	71	75	73	70	69
Oct	74	76	68	71	73	76	72	66	71	75	78	69	67
Nov	59	61	55	71	65	63	70	70	68	59	64	64	52
Dec	54	58	56	79	63	-	62	59	67	59	67	60	61

Appendix-5 Contd...

Month	83	84	85	86	87	88	89	90
Jan	56	64	63	55	54	55	58	65
Feb	59	54	56	44	50	54	56	67
Mar	59	49	63	48	64	53	41	58
Apr	64	65	68	62	62	64	58	72
May	65	75	66	61	65	72	66	75
Jun	62	21	70	65	70	69	71	74
Jul	64	74	73	62	72	73	74	87
Aug	66	72	69	71	71	72	66	70
Sep	69	75	76	75	76	72	75	74
Oct	70	72	66	75	71	76	73	76
Nov	64	52	58	67	61	-	65	69
Dec	60	61	56	61	57	57	63	58

Appendix -6 Land Use (1989-91)

	Total land hectare	Total	P.C	Current Regd.Fallow	Non Regd Fallow	Total	Current Fallow Regd
Dergaon	9811.91	6107.76	78.18	127.98	554.88	682.86	8.74
Missamara & Brahmaputra	11855.02	8064.79	68.02	194.64	857.16	1051.80	8.87
Naojan	5806.55	3696.65	63.66	288.09	175.37	463.46	7.98
Pub Sarupathar	11538.82	9650.33	83.633	306.02	525.70	831.72	7.20
Pachim Sarupathar							
Uttar Borpathar	15872.02	11630.52	73.27	993.98	1219.95	2213.93	13.94
Dakhir Borpathar							
Uttar Morangi							
Dakhir Morangi	26900.53	20424.36	51.04	1944.71	1576.84	3521.55	13.09
Morangi Chah Mazdoor							
Rongamati	10677.64	7017.00	65.71	146.99	334.00	480.99	4.50
Khumtai	10582.46	8231.06	77.78	182.20	864.79	1046.99	9.89
Gurjogania	4553.27	4041.73	88.54	185.94	138.29	324.23	7.12
Dhekial	7451.00	6023.96	80.84	110.98	183.93	294.91	3.95
Kakodonga	4023.56	3270.42	81.28	172.76	136.54	309.10	7.68
Dakhinhengera	7473.76	6047.66	80.91	399.06	155.02	554.08	7.41
Kamarbandha	4157.42	3577.11	86.04	65.60	29.99	95.59	2.38
Golaghat	5457.42	3659.84	67.06	316.06	172.82	488.88	8.95
Athgaon	4558.90	3189.56	69.91	223.03	50.06	273.09	5.99
Merapani	NA	--	NA				
Gawariguri	"	--					
Tarani	"						
Dayangpar	"						
Pub Ghiladhari	14260.10	11592.10	81.29	459.84	596.92	1056.76	7.41
Kaziranga	12373.49	5671.88	45.83	1568.81	250.87	1819.68	14.70
Bokakhat	14281.39	8865.59	62.07	994.91	1069.34	2064.25	14.45
Karuabahi							
Mohura	12034.27	3839.89	31.90	774.70	1477.91	2252.61	18.71
Forest Village	NA	-	-	-	-	-	-
District	191669.53		66.73			19826.48	10.3

	Permanent Fallow Regd	P.C	School Rds. Cemetery Settlement	P.C	Flooded	P.C	Forest & Grazingland	P.C
Dergaon	98.66	1.26	168.94	2.16	679.65	8.70	670.41	8.58
Missamara & Brahmaputra	154.35	1.30	365.06	3.07	1347.92	11.37	950.07	8.01
Naojan	416.60	7.17	127.18	2.19	92.77	1.59	336.28	5.79
Pub Sarupathar	156.63	1.35	332.66	2.88	226.37	1.96	160.64	1.39
Pachim Sarupathar								
Uttar Borpathar	461.18	2.90	502.28	3.16	501.34	3.15	188.35	1.18
Dakhir Borpathar								
Uttar Morangi								
Dakhir Morangi	432.13	1.60	525.30	1.95	1051.14	3.90	691.83	2.57
Morangi Chah Mazdoor								
Rongamati	309.24	2.89	277.91	2.60	909.24	8.51	393.17	3.68
Khumtai	595.72	5.62	283.53	2.67	401.07	3.78	595.98	5.63
Gurjogania	142.30	3.12	91.83	2.01	32.40	0.71	36.68	0.80
Dhekial	270.41	3.62	223.29	2.99	288.62	3.87	405.89	5.44
Kakodonga	159.44	3.96	68.81	1.71	72.02	1.78	170.28	4.23
Dakhinhengera	339.49	4.54	180.46	2.41	49.80	0.66	50.20	0.67
Kamarbandha	39.09	0.94	95.18	2.28	53.41	1.28	237.49	5.71
Golaghat	269.88	4.94	382.86	7.01	144.04	2.63	212.45	3.89
Athgaon	81.00	1.77	123.43	2.70	218.07	4.78	403.48	8.85
Merapani	NA	--	NA	--	--	--		
Gawariguri	"		"					
Tarani	"		"					
Dayangpan	"		"					
Pub Ghiladhari	183.67	1.28	300.13	2.10	448.86	3.14	545.91	3.82
Pachim Ghiladhari								
Kaziranga	12.32	0.09	221.95	1.79	1440.29	11.64	1000.13	8.08
Bokakhat	40.03	0.28	347.80	2.43	1451.81	10.16	360.78	2.52
Kuruabahi								
Mohura	246.05	2.04	165.86	1.37	2935.74	24.39	176.43	1.46
Forest Village	NA	-	-	-	-	-	-	-
District	4408.19	2.30	4784.46	2.50	12344.56	6.44	7586.45	3.96

Source : S.D.C. Offices of Golaghat, Dergaon, Bokakhat Khumtai, Sarupathar.

Appendix – 7 Land Use (1969 – 72)

	Total land hect.	Total	P.C	Total	Current Fallow	P.C	Permanent Fallow Regd.
Dergaon	7811.91	5102.74	65.32	1049.14	13.43		421.06
Missamara	11857.78	7143.13	60.24	1651.79	13.93		675.89
Naojan	5808.44	3390.97	58.38	652.29	11.23		605.24
Pub Sarupathar	11538.82	8265.26	71.63	1193.11	10.34		741.95
Pachim Sarupathar							
Uttar Borpathar	15873.35	11066.90	69.72	2941.33	18.53		1209.55
Dakhin Borpathar							
Uttar Morongi	27088.62	15097.85	55.74	4721.82	17.43		5417.80
Dakhin Morangi							
Morangi Chah Mazdoor							
Rangamati	10684.23	6711.83	62.82	814.18	7.62		1212.66
Khumtai	10582.46	6817.22	64.42	140.12	13.24		1087.88
Gurjogania	4553.27	3307.95	72.65	638.82	14.03		342.86
Dhekial	7454.08	5662.11	75.96	403.48	5.41		389.96
Kakodonga	4023.56	2797.98	69.64	376.20	9.35		391.49
Dakhinhengera	7473.76	5868.67	78.52	590.36	7.90		602.41
Kamarbandha	4157.56	3283.93	78.99	112.97	2.70		161.98
Golaghat	5457.43	3856.35	70.66	469.07	8.60		316.87
Athgaon	4559.03	3126.37	68.58	336.54	7.38		284.07
Merapani	NA	NA	--		--		
Gamariguri	"	"	--				
Tarani	"	"	--				
Dayangpan	"	"	--				
Pub Ghiladhari	14240.96	10246.19	71.95	1245.78	8.75		1172.02
Pachim Ghiladhari							
Kaziranga	12377.52	5402.79	43.65	2044.77	16.52		587.93
Bokakhat	14284.63	8340.80	58.39	2331.25	16.32		817.08
Kuruabahi							
Mohura	12052.52	3521.75	29.22	2691.33	22.33		877.42
Forest Village	NA	–	–	–	–		–
District	191879.93	119010.79	62.02	25664.51	13.38		17316.12

	P.C	School Rds. Cemetery Settlement	P.C	Flooded	P.C.	Forest & Grazingland	P.C
Dergaon	5.39	164.05	2.10	689.01	8.82	670.26	8.58
Missamara	5.70	353.36	2.98	1392.10	11.74	949.81	8.01
Noajan	10.42	127.20	2.19	92.35	1.59	336.39	5.79
Pub Sarupathar	6.43	266.55	2.31	226.16	1.96	160.39	1.39
Pachim Sarupathar							
Uttar Borpathar	7.62	479.38	3.02	503.19	3.17	187.31	1.18
Dakhin Borpathar							
Uttar Morangi	20.00	554.35	2.05	1050.20	3.88	690.23	2.55
Dakhin Morangi							
Morangi Chah Mazdoor							
Rongamati	11.35	226.51	2.12	909.23	8.51	397.45	3.72
Khumtai	10.28	226.46	2.14	400.02	3.78	603.20	5.70
Gurjogania	7.53	84.24	1.85	31.87	0.70	46.44	1.02
Dhekial	5.23	251.27	3.37	255.02	3.42	481.93	6.47
Kakodonga	9.73	68.80	1.71	71.62	1.78	181.06	4.50
Dakhinhengera	8.06	157.83	2.11	36.01	0.48	246.18	3.29
Kamarbandha	3.90	94.78	2.28	53.41	1.28	347.26	8.35
Golaghat	5.81	247.52	4.54	144.04	2.64	388.76	7.12
Athgaon	6.23	125.03	2.74	210.04	4.61	403.61	8.85
Merapani							
Gamariguri							
Tarani							
Dayangpan							
Pub Ghiladhari	8.23	312.05	2.19	416.60	2.93	797.05	5.60
Pachim Ghiladhari							
Kaziranga	4.75	204.23	1.65	1440.74	11.64	1126.35	9.10
Bokakhat	5.72	345.69	2.42	1451.32	10.16	371.40	2.60
Kuruabahi							
Mohura	7.28	163.91	1.36	2939.61	24.39	1[illegible].20	[illegible]
District	9.02	4453.21	2.32	12312.54	6.42	85[illegible].28	[illegible]47

Source : SDC offices of Golaghat, Dergaon, Bokakhat, Khumtai, Sarupathar.