

**ABSTRACT**

**SOCIO-ECONOMIC STUDY OF MILK PRODUCER  
COMMUNITIES IN GREATER GUWAHATI REGION**

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**Prof. Surendra Singh**



**A Thesis  
Submitted for the Award of  
The Degree of Doctor of Philosophy in Geography**

*Submitted to*  
**Department of Geography  
School of Human and Environmental Science  
North-Eastern Hill University  
Shillong-793022  
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# **SOCIO-ECONOMIC STUDY OF MILK PRODUCER COMMUNITIES IN GREATER GUWAHATI REGION**

## **1.0 Introduction**

The ever increasing population of Greater Guwahati Region (GGR) have generated more demand for fresh fluid milk that brings into being the concentration of milk producers in and around the city market. Such conditions are prevalent in almost all cities of the country as well as across the world. The production of milk by milk producers is an obligatory aspect of agricultural geography. It reflects the relations of prevalent physical and socio-economic environment of an area. Even if the physical factors like relief, drainage, climate etc. put surface limits to dairy activities, within which a part of preference usually leftovers, in such situations, social, economic and political factors also influence the farmers' ultimate decision for the dairy farm operation. There are many socio-economic factors, which are intricately interrelated with each other organize significantly the dairy farming of a region. Naturally, the characteristics of the farmers' family, the prevailing marketing opportunities, the existing means of transport facilities that a 'practicing milk producer' enjoys, have significant impact on the concentration of dairy activities in an area. So, dairying is an interactive activity with the physical environment of land and socio-economic conditions of milk producers and demand for fluid milk.

In the growing agricultural economies, the location of a viable market has a significant bearing on the spatial dimensions of dairy farm. For that reason, the spatial characteristics of land use as well as the related production inputs are significantly influenced by the presence of ever expanding market. In this context, the location of commercial horticulture near the cities has become much more costlier because of high price of land as well as to the proximity of an immediate market. For the same reason, the demand of the city market for fresh milk has a marked influence on the spread of dairy farming around the cities, irrespective of climate and soil.

Despite of generalizing these facts, it seems to be quite natural that the concentration of milk producers in and around a city environ is due to some interrelated grounds. The extreme perishability of fresh liquid milk, which is an essential part of our morning's first cup of tea, does not allow much distance isolating

milk shed and kitchen where bottleneck of preservation, pasteurization, refrigeration and quick and efficient transportation facilities continue to prevail. Moreover, the towns and cities are generally mixture of literate, health conscious human population who are detached from direct contact with the food production process but they have need, demand as well as purchasing power that create a strong, quick and assured market potential for fresh liquid milk. The decisive consequence is the native agro-climatic situation, which in response to the situation as mentioned above took the form of milk production activities in and around a city despite of innumerable constraints.

Though climatically Assam falls in the poorest region on the dairy map of India, it is not so much conducive for milk producing activities. However, its capital city Guwahati comprises a large numbers of milk producers functioning in and around the city region in the present day. The germination of systematic dairying in Assam was started only after the British annexation of Assam. The British developed some areas by establishing administrative, commercial, educational, industrial, civil, and cantonment institutions. These institutions directly or indirectly have created demand for regular supply of milk and milk products. Some of the communities such as the *Gorkhas* who came with Britishers as security personal, watchman (*Darowan* or *chowkider*) are usually hill-men having hardworking nature and expertise in cow-keeping. Besides doing their prime duty, additionally they practised dairying to supply fresh liquid milk to the consumer. Moreover, a large number of *Gorkha* defence personal have settled permanently in the urban areas of Assam after retirement. Many of them occupied the outskirts of urban areas and supplied milk and fuel to town dwellers. The main consideration of the *Nepali* settlers is the availability of fodder for their cows. At the present moment, the majority of the business of fresh liquid milk is in the hands of these *Nepali* graziers. In view of the above fact, it is noteworthy to say that the various factors seem to have interacted in the emergence of milk producers communities in the Greater Guwahati Region since early times and a comprehensive study in this context is essential.

## **2.0 Statement of the Problem**

India has a long history of its people association with domesticated animals, especially cattle. Each farming family in the country used to have certain number of

cattle for the purpose of ploughing, pulling carts and producing milk. The age long experience, expertise and culture inherited through generations by the milk producers distributed all over the country to-day make India to retain number one position as world's largest milk producing country by pushing the United States to second position. India's milk production grew almost 4.2 percent as against the world's average growth of less than 1.0 percent. In India, milk has a special role to play for its many nutritional advantages as well as providing supplementary income to some 70 million farmers in over 5,00,000 remote villages. And milk remains as the number one commodity product by India pushing wheat and rice behind.

When looked at the status of dairy farming in Assam, the picture appears to be gloomy in spite of launching a number of promotional programmes like operation flood during the plan periods. The per capita availability of milk in the state was 51 gm / day during the 1970s which increased to 94 gm/day in 1995. This figure is much lower than the national average of 214 gm/day and the ICMR recommendation of 250 gm/person/day.

The dairy related picture in the urban areas of Assam including the Guwahati City is still more challenging as there has been significant gap between the ever-expanding demand and the almost stagnant supply of fresh liquid milk. During the last four decades, the population of Guwahati City has increased from 43,615 in 1951 to 5,77,591 in 1991 and now it is estimated that the population of the city will touch the mark of 15,00,000 during 2005. The survey report of town Milk Supply Scheme, Guwahati reveals that the Guwahati City presently needs 2.0 lakh litres of fresh liquid milk to cater to the demand of city consumers. But the city is now getting approximately 60-80 thousand litres of milk daily from different dairy units located in and around Guwahati City (Town Milk Supply Scheme, 2005). The tea-stalls, restaurants, hotels, nursing homes, hospitals and other commercial establishments almost tripled in their numbers during 1961 to 1991 periods. Such an expanding population and organization provide a big market and commercial base for dairy produce. According to a Report from the Department of Town Milk Supply, Guwahati, there is present demand of about 2.5 lakh litres of fresh liquid milk daily to meet the minimum requirements of the city consumers. However, the same Report reveals that the supply amounts to less than 80,000 litres daily. Thus, there is a tremendous scope for improving the state of milk production in and around Guwahati City in order to minimise the gap between the demand and supply. Mention may be

made here that there are more than 4,000 households of milk producers having varying herd sizes scattered in and around Guwahati City.

The existing concentration of primary milk producers in and around the Guwahati City more or less reflects the conformity to other city's concomitant, particularly in respect of locational and functional dimensions of milk production. It is pertinent to note here that more than 4,500 households of primary milk producers comprising a significant percentage of small, marginal and landless people of different communities have been practicing the milk production and its associated activities in and around Guwahati City. However, their relentless effort to this venture has failed to comply with the ever-expanding urban demand for fresh milk. According to a conservative estimate, presently the Guwahati City has been suffering a daily short supply of nearly 2,00,000 litres of fresh milk.

Keeping all these points in view, an attempt has been made here to study the existing status, problems and prospects of milk producer communities in and around Guwahati City through the locational and functional perspectives. Such a study may provide an information base on the issues and scientific knowledge on the nature and trend of the development of this important sector of urban economy.

### **3.0 Objectives**

In light of the above discourse, the present work has been planned to fulfil the following objectives as:

- i) to identify the concentration of the milk producers in and around Guwahati City,
- ii) to characterise the socio-economic status of milk producer communities in the study area, and
- iii) to analyse the economics of milk production, consumption and need relating to raw milk produce as envisaged in the study area.

### **4.0 Research Questions**

Milk producers of the study area consist of different socio-economic background. It is presumed that they cleverly determine the milk consumer behaviour and their locational and other environment in their own way for having optimum benefit. Accordingly, this study will thrust to explore the relevance of following set of questions-

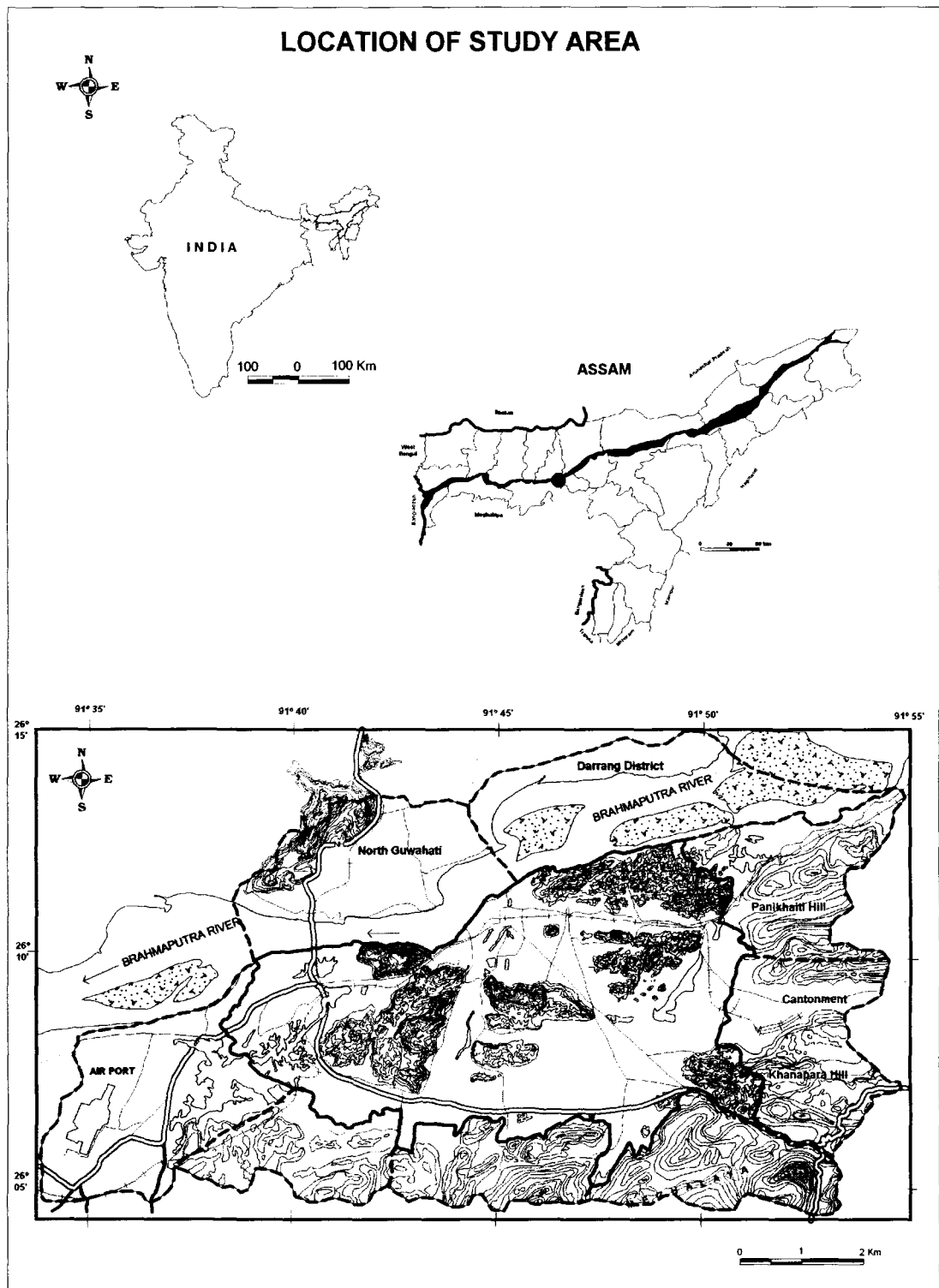
i) What are the main causes of variations in socio-economic characteristics of DHHs?

ii) How do the milk producers of the study area would understand the laws of advantage in terms of production, consumption and marketing of their milk produce in the city market of Guwahati? In fact, socio-economic status of milk producers may implicitly governed by the productivity and profitability of dairy activities performed at producer's household level. This discussion may provide the explanation of the third objective of the present proposed research.

## **5.0 Study Area**

Study area of the Greater Guwahati Region has two segments: the inner administrative segment which is the Guwahati Municipal Corporation composed of 60 Municipal Wards belonging to the district of Kamrup Metro and the outer segment that is the fringe of the city surrounded by the parts of the districts of Kamrup Rural and Morigaon of Assam and the Ri-Bhoi of Meghalaya State.

The spatial limit for each direction is operational in accordance with the maximum occurrence of commercial dairy farms. As such, the localities toward northern limit spread up to the foothills of Silapahar and the eastern limit covers Satgaon, Panikhaity and Khanapara hills. The southern limit is stretching from Jorabat along with the border localities of Ri-Bhoi district of Meghalaya State, northern part of Garbhanga and Rani Reserved Forests and the western limit goes up to Patgaon and eastern parts of Rani mouza of Kamrup district of Assam. Physiographically, the area lies between the northern extensions of the Meghalaya plateau and the alluvial plains of the Brahmaputra River. The area is closely knitted with hilly topography with average altitudes of 300 metres having plains and wetlands of different dimensions. The land resources of the area comprise of the settled area (24.63%), water bodies (8.37%), hills (19.48%), low-lying area (7.72%) and other usable land (37.16%) (Town and Country Planning Organisation, 1987).



Source: Part of SOI Toposheets No.78 N/12, 78 N/16, Survey of India, Dehra Dun

**Fig-1.0: Study Area: Greater Guwahati Region (Topography and road network)**

## 6.0 Methodology and Database

Present study contains the areas of Guwahati City and its fringe based on cross section data pertaining to the year 2006. In order to interpret the spatial patterns in the

context of socio-economic status of milk producer communities, appropriate methodological considerations have been adopted in processing the collected data for inference of concerned results. The following main steps are taken for the explanation of problems in the present piece of research work.

**6.1 Delineation of the Study Area:** Spatial limit of the study area is delineated by considering the location of the active milk producer households in different Municipal Wards as well as in the fringe of Guwahati City, which diverge from the city centre towards all directions wherefrom the city consumers get continuous supply of fresh liquid milk. The outer boundary of the city fringe area is arbitrarily demarcated so that the milk producers of these localities get their proper representation.

**6.2 Selection of Attributes:** There are a variety of attributes, such as, location e.g. the locations are of two kinds i.e. the absolute and the relative location. The attributes of absolute location are latitude, longitude, street address etc. However the relative location is a position with respect to other locations; it can be expressed in values other than the usual distance units. Distance between two locations may be expressed in terms of geometric length (physical distance), economic context (in terms of transport costs) and psychological perceptions of the environment of location. Under such interpretations of location and distance, the physical distance between the locations of market centre and DHHs has been considered for the present study assuming that the transport costs of milk supply is positively related to physical distance between two locations within the study area.

Relativity of geographical phenomena and characteristic features of such phenomena are highlighted using 'classificatory approach'. Therefore, selection of the relevant attributes is made on the basis of the requirements for this present study. The base attributes for the classification are divided into four groups:

- (i) The locational characteristics of DHHs were highlighted by considering three main attributes of locational factors, namely (a) geographical location of DHHs, (b) concentration of DHHs and (c) distribution of population.
- (ii) The socio-economic characteristics of DHHs were presented by using three key base variables, namely (a) demographic (i.e. family size, sex ratio), (b) social (i.e. community, literacy, educational status) and (c) economic (i.e. family labour, hired labour, herd size of milch cattle).

(iii) The characteristic features of DHHs for their economic status was pursued by taking into account the variables related to production and productivity. They are as labour productivity, cattle productivity and capital productivity of milk.

iv) The profitability is a leading economic consideration for mobilising/intensifying the dairy activity in any area of the world. Profitability aspects of DHHs were dealt here with considering its relative variables, namely, revenue received and expenditure incurred relating to milk production and milk marketing of DHHs.

In fact, the classification of collected data of relevant attributes of DHHs was made by considering the above basis for the entire analysis. In the end, the synthesis of the gathered facts were also pursued by using 'Principal Component Analysis' which provides the correlations and suitable nexus of attributes to infer the common features of considered socio-economic attributes.

**6.3 Sample Design:** Since the basic purpose of the present study is to examine the spatial pattern of the socio-economic characteristics of milk producers, the study would be mainly based on primary data. The sampling method in the present study is designed in such a way that can successfully explain the pattern of distribution, production, consumption of DHHs and their relationships to understand their socio-economic status in the study area. Therefore, the samples of dairy households are collected for giving the explanations of various objectives proposed in the present investigation. The sample DHHs were selected on the basis of 'Stratified Random Sampling Technique'. The following bases of stratification were taken into account:

(i) Topographic location of DHHs refers to geo-environmental parameter which has implicit effect of other factors of dairy development. So, it is a sound geographical base and had been considered as main factor for sample selection.

(ii) Distance from city market centre and distance from nearest vehicular road which would help in selecting the DHHs to provide the locational considerations and market accessibility of DHHs.

(iii) Community of dairy households were considered as social attributes for stratification and sample selection. It would provide data from each and every community of DHHs.

(iv) Present study is being pursued in the geographical manner in which spatial organisation of DHHs and the spatial pattern of their related attributes are much more

relevant to analyse. So, the samples of DHHs were also collected considering that they (samples) must represent from each and every areal unit (i.e. ward/fringe)

On the basis of above criteria, a number of 370 dairy households out of total 4,682 that are 7.90 percent of the total, have been selected from each and every ward/fringe of the study area.

**6.4 Collection and Analysis of Data:** Relevant primary data for present investigation were collected from the respondents with the help of a designed questionnaire. The questionnaire was prepared by keeping in mind all the socio-economic attributes for classification and related base variables for establishing 'cause-effect relationship'. The base variables also incorporated in schedule. For example, the data of the socio-economic factors were collected through this schedule/questionnaire. The main elements included in the questionnaire are given as:

- (a) location and total number of the milk producers' household in the cluster (ward no., fringe no., distance of the household from the city centre, and distance of the household from nearest vehicular road),
- (b) topographic feature of the dairy household's locality (foot-hills, built-up areas, wetland front, and river bank),
- (c) socio-economic information (religion, caste, community, number of family members, age, sex, monthly income and expenditure, sources of income other than milk production (i.e. agriculture, business, private service, government service, government pensioner); educational status (i.e. illiterate, primary middle school, high school, higher secondary, graduate, post-graduate, technical qualification, and others); production and consumption pattern of the household (types of milch cattle, cattle in milk, breed of milch cattle, daily milk production, lactation period, sale prices of milk, household consumption of milk, and quantity of surplus milk), supply / marketing of milk from the household (mode of consumption of milk, quantity of milk sold, producer's milk delivery system, means of carrying milk, place / ward no. of milk supply, distance between milk producing unit and places of milk delivery), feeds and fodders (name of the sources of fodders, the distance between fodder source and milch cattle shed, monthly cost for green fodders, dry fodders, and concentrates).

Besides the primary data from the field, secondary data were also collected from relevant sources such as Census of India Report, the Statistical Handbook published by the Government of Assam, Dairy Cooperatives, District Animal

Husbandry Department, and Town Milk Supply Scheme. Some other relevant information has also been collected from various books, journals and periodicals.

The data collected for this investigation are rationalised, processed and tabulated for the analysis. The inferences of facts were drawn from the data by using appropriate statistical tools like regression analysis, correlation matrix and depicting results through maps and diagrams.

## **8.0 Main Findings**

The basic thrust of the present work is to address on two primary issues on the Milk Producer Communities in Greater Guwahati Region viz. socio-economic status and locational matters. The production and distribution of a perishable food item like fresh fluid milk and the focus of affluent and affordable milk consumers on a city environ is inseparable issues. Milk Producer Communities may achieve in their own way in different urban environ in response to diverse socio-economic milieu; accordingly Greater Guwahati Region is no exception for this matter. After detail analysis in the context of milk producers of the Greater Guwahati Region, it has revealed some interesting facts regarding nexus between socio-economic status and locational behaviour of the Milk producer Communities in the study area. These are stated below:

### **Location and Concentration of Milk Producers (Chapter-III)**

1. The concentration of population usually noted high to very high in and around the central hub of the city. Likewise, the same feature is prevalent in Greater Guwahati Region also. However, density of population is recorded high in the wards located along the main roads. The road network contributes in the concentration of population and resultant increase in its density.
2. There is only 2.30 percent of share of total households engaged in dairying in the study area, which shows a significance of milk product and milk supply to the city region. However, the concentration of DHHs is found very high in the fringe areas, which are more convenient for settling the dairy communities because topographically such areas are convenient to nursing the milch cattle population and available fodder and natural grasses for grazing.

3. If concentration coefficient of dairy households is plotted against the population density on scatter diagram, it is very clear that the areas of low density of population have higher concentration of dairy household and *vice versa*. As a result, the trend of distribution is found concave in nature, which shows inverse relationship. The DHHs are concentrated in the areas of low population density of peripheral wards/fringes in Greater Guwahati Region.

4. Generally, the location of dairy households is more influenced by three factors:

a) The availability of water bodies or wetlands in the wards/fringes, provide more space for shed-waste disposal and usable water for milch cattle population.

b) The hills or foot-hills are the natural choice for *Nepalese*, the dominant dairy communities of Greater Guwahati Region. It provides natural landscape for much needed easy, clean and convenient gradient of slope for milch cattle rearing practice in spite of having poor road communication facilities.

c) The density of roads in most of the river front localities (15.29 km/sq km) of Guwahati City provides facility to supply of fresh milk to 'milk-demanding areas' as well as for 'easy-home delivery' of milk.

#### **Socio-Economic Characteristics of Milk Producer Communities (Chapter-IV)**

(1) The areas of most accessible market centre of city are dominated by small size DHHs of male dominated-*Bihari* community, which are less literate and less educated. However, they diversify their source of income through adopting part-time employment of non-dairy activities like services in nearby hotels, shops and perform small business like selling of fruits and vegetables, running grocery shop and so on. They supply milk in the establishments of market city centre like hotels, medical hospitals, sweet-shops and nearby residents comparatively at higher rate to increase their milk revenues.

(2) Contrary to it, there is another scenario of socio-economic status of DHHs, which is prevalent in foot-hills areas located in outer fringe. These foot-hills areas are dominated by well-educated *Nepali* DHHs, who earns high income by managing more number of milch cattle in herd size. They maximize their income by using natural resources and cattle-food through free collection of the grasses available in those areas of grass-favourable-ecology. Cheap dry rice-straw is used during dry winters, which connects economic links of these areas with close-by rural areas.

## **Milk Production and its Productivity (Chapter V)**

(1) In the distribution of labour productivity of dairy households, it is found that labour productivity is predominantly high in the peripheral localities as well as in the places away from the vehicular road. In this context, the role of increasing pressure of settlement due to the rapid urbanization in the central parts of Greater Guwahati Region cannot be denied. Moreover, the expenditure on maintenance and living costs of sheds is lesser in the peripheral localities. Alternately, the business establishment of the core areas of Greater Guwahati Region provides easy 'off farm' (non-dairy activities) employment or self-employment opportunities for the family labourers of milk producers to meet their additional and higher living cost. This situation virtually contributes to declining trends of the labour productivity in the central localities in the study area.

(2) In the context of the distribution of the cattle productivity, a reverse situation of the distribution of labour productivity is found to prevail in the study area. It is due to the acute scarcity of suitable landholdings for the construction of cattle sheds in central localities of Greater Guwahati Region, most milk producers rear smaller herds of milch cattle. Naturally, such smaller herds enjoy the higher shares of feeds intake with better care. Consequently, it results in higher cattle productivity of milk.

(3) Capital productivity of milk producers is influenced by high revenue earning from milk (due to high prices) and low expenditure pattern of DHH. In average capital productivity of Rs. 700 per unit of Rs. 1,000 investment is recorded with its significant variation. Moderate capital productivity was mapped in the peripheral areas of fringe ecology because of less investment on dairy activity. Main factor of high capital productivity in Greater Guwahati Region is high percentage share of milch cattle in herd size, which contributes to productivity by increasing milk production.

(4) On the whole, the peripheral fringe areas have high concentration of dairy activities because of high labour as well as capital productivities, which concentrate family labour in this activity.

## **Milk Profitability and Socio-Economic Status of Dairy Households (Chapter-VI)**

- (1) The profitability of milk does not have relation with the household income. The other source of income increases the total income of the household. It does not influence the dairy activities.
- (2) There is a disguised employment problem in the DHHs, those who have large family size, low literacy rate, low sex ratio results in consequent low profitability.
- (3) The concentration of DHHs is more in low profitability classes. The low profitability areas are most dispersed in the peripheral areas with much higher investment on herd-size in spite of free access to green grasses and cheap dry fodder.
- (4) Among the profitability distribution of DHHs, it is found that profitability per per milch cattle is higher in the cases those who spent more share of expenditure on green fodder and tends to decrease investment share from green fodder to concentrates and then to medicines. It shows per unit of costs on different items of expenditure vary. Per unit of fodder is cheaper than concentrates and concentrates are cheaper than medicines, that affect the variability of investment and also the profitability pattern in the Greater Guwahati Region.

Overall characteristic features of the socio-economic status of milk producers of Greater Guwahati Region are summed up as follows:

- (1) It is obvious from the analysis that there is a dominance of two communities *Biharis* and *Nepalese*, which have different historical background, social set-up, and economic base. So, the socio-economic characteristics of milk producers have two sets of their status, though both are having poor status. However, *Biharis* are more conservative in thinking, less aware of modern technological adoption and more traditional, while *Nepalese* are much better in adoption of appropriate technology related to herds of cows and health and hygiene of the milch cattle. They are more literate and educated and even more enterprising.
- (2) On the whole, it is found that the Dairy Households, who have large household size are less literate and employ more family labour to operate the dairy activities. Sex ratio and literacy rate are found very low in the DHHs of *Bihari* communities. However, milk producers belonging to the *Nepali* communities have high literacy rate with high income from dairy activities. Dairy is the only activity for their income, which increases labour productivity also.

(3) So far as locational aspects of these two communities are concerned, milk producers belong to *Biharis* are more concentrated in central part of the study areas because they have a cultural background to stay attached with the business communities like *Rajasthanese* who are living in the CBD and have been performing low profile jobs related to their business. Moreover, being the minority community, both the communities have a feeling to settle or reside within the peripheries with their own communities to share their work culture. Such attitude ultimately develops some dairy pockets dominated by each of both communities in the study area. On the other hand, the *Nepalese* are culturally hill people who prefer to settle in calm and quiet natural environment. Accordingly, both the hardworking communities perceived their preferred location in the environ of Greater Guwahati Region wherefrom they have been consistently supplying the much needed fresh fluid milk to the city consumers of Greater Guwahati Region as well.

(4) The Rivers Brahmaputra and Bharalu- the prominent wetlands fronts like Borsola and Sarusola *Beel* - with several others that are spreading in the central parts as well as in the Northern peripheries of the study area, provide immense scope to operate milk-producing activities specially for the *Bihari* milk producers. It is because these wetlands are the natural absorber of cowshed waste, perennial source of green grass cover as well as the fish for regular catching, which are the utmost need for them. Alternately, the denuded hills provide the *Nepalese* a gradient gentle slope to have natural outlet for the disposal of their cattle shed-waste. The hills with frequent valley cuts are the most viable source of natural grass cover and the *Nepalese* are recognized as the sole proprietor of that grass domain. Such facility naturally fuels their cultural instinct to rear milch cattle in the surrounding hill topography of Greater Guwahati Region. Ultimately, the magnet of milk market in the city region and the urban pressure, both the opposite interacting agent on milk producers temporarily compensates over the space wherefrom milk producers of Greater Guwahati Region sustain their economic opportunity with their best possible effort.

NB.: The Thesis consist 51 Tables, 49 Figures, 5 Appendices and 12 Plates.

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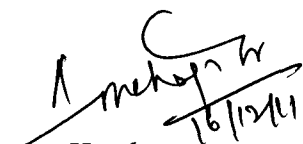
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## DECLARATION

I, *Jogesh Chandra Deka*, hereby declare that the subject matter of this thesis entitled 'SOCIO-ECONOMIC STUDY OF MILK PRODUCER COMMUNITIES IN GREATER GUWAHATI REGION' is the record work done by me, that the content of this thesis did not form basis of the award of previous degree to me or to the best of my knowledge to anybody else and that the thesis has not been submitted by me for any research degree in other University/Institution.

This is being submitted to North-Eastern Hill University, Shillong for the degree of Doctor of Philosophy in Geography.



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(A.C. Mohapatra)  
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**HEAD**

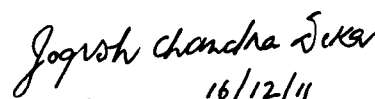
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## APPENDICES

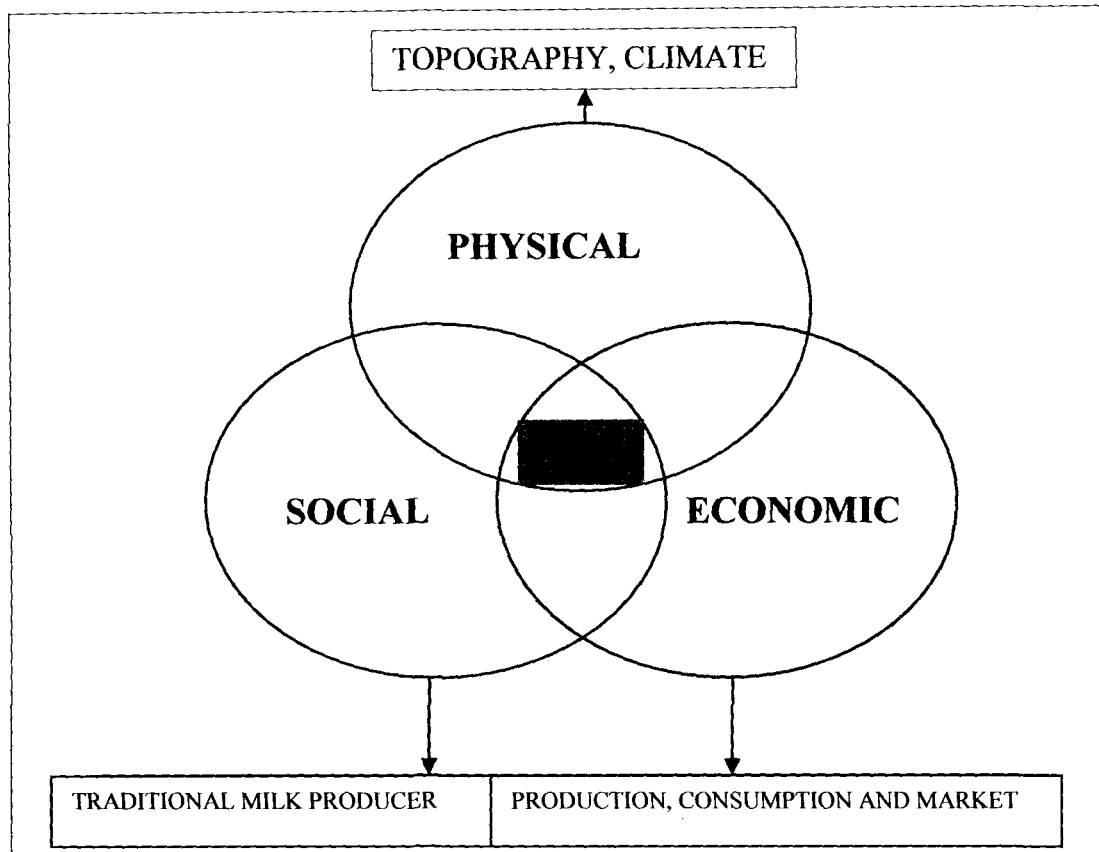
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# **Chapter-I**

## **Introduction**

The ever increasing population of Greater Guwahati Region (GGR) have generated more demand for fresh fluid milk that brings into being the concentration of milk producers in and around the city market. Such conditions are prevalent in almost all cities of the country as well as across the world. The production of milk by milk producers is an obligatory aspect of agricultural geography. It reflects the relations of prevalent physical and socio-economic environment of an area. Even if the physical factors like relief, drainage, climate etc. put surface limits to dairy activities, within which a part of preference usually leftovers, in such situations, social, economic and political factors also influence the farmers' ultimate decision for the dairy farm operation. There are many socio-economic factors, which are intricately interrelated with each other organize significantly the dairy farming of a region. Naturally, the characteristics of the farmers' family, the prevailing marketing opportunities, the existing means of transport facilities that a 'practicing milk producer' enjoys, have significant impact on the concentration of dairy activities in an area. So, dairying is an interactive activity with the physical environment of land and socio-economic conditions of milk producers and demand for fluid milk (Fig-1.1).

Milk is nature's most complete food. With appropriate policies, strategies and planning, milk producing communities can improve the livelihood and well-being of rural communities and urban consumers alike while making profit for the dairy operators at each stage of the dairy value chain (Ser-Od Tsetsgee et al. 2008). A city is a permanent concentration of relatively large numbers of people who do not produce their own food; on the contrary, Robertson opines that the initial growth of the city became possible only after the invention of agriculture (Robertson, 1980).



**Fig-1.1: Dairy Activity and Environmental Conditions**

However, the milk producing practices in a city environ have been on-going in spite of having a variety of constraints. The direct market response to urban demand and the zones of commercial green fodder based milk production are found in and around the areas of the cities. In the *peri-urban* localities, dairy becomes a specialization with owned or leased land resources. These are used for fodder, not for food crop production providing a transitional zone between urban consumption and rural agricultural production. The growth of Indian cities in recent centuries has been accompanied by the expansion of these zones of specialized rural milk production. Moreover, the technological innovation of the bicycle has been seized upon to extend the area of milk procurement without undue increase in costs. Along with such beneficial side effects, there has been the generation of rural employment through the milk production and transportation process (George, 1985).

In the growing agricultural economies, the location of a viable market has a significant bearing on the spatial dimensions of dairy farm. For that reason, the spatial characteristics of land use as well as the related production inputs are significantly influenced by the presence of ever expanding market. In this context, the location of commercial horticulture near the cities has become much more costlier because of high price of land as well as to the proximity of an immediate market. For the same reason, the demand of the city market for fresh milk has a marked influence on the spread of dairy farming around the cities, irrespective of climate and soil (Kumar, 1995).

Despite of generalizing these facts, it seems to be quite natural that the concentration of milk producers in and around a city environ is due to some interrelated grounds. The extreme perishability of fresh liquid milk, which is an essential part of our morning's first cup of tea, does not allow much distance isolating milk shed and kitchen where bottleneck of preservation, pasteurization, refrigeration and quick and efficient transportation facilities continue to prevail. Moreover, the towns and cities are generally mixture of literate, health conscious human population who are detached from direct contact with the food production process but they have need, demand as well as purchasing power that create a strong, quick and assured market potential for fresh liquid milk. The decisive consequence is the native agro-climatic situation, which in response to the situation as mentioned above took the form of milk production activities in and around a city despite of innumerable constraints.

Though climatically Assam falls in the poorest region on the dairy map of India, it is not so much conducive for milk producing activities. However, its capital city Guwahati comprises a large numbers of milk producers functioning in and around

the city region in the present day. The germination of systematic dairying in Assam was started only after the British annexation of Assam. The British developed some areas by establishing administrative, commercial, educational, industrial, civil, and cantonment institutions. These institutions directly or indirectly have created demand for regular supply of milk and milk products. Some of the communities such as the *Gorkhas* who came with Britishers as security personal, watchman (*Darowan* or *chowkider*) are usually hill-men having hardworking nature and expertise in cow-keeping. Besides doing their prime duty, additionally they practised dairying to supply fresh liquid milk to the consumer. Moreover, a large number of *Gorkha* defence personal have settled permanently in the urban areas of Assam after retirement. Many of them occupied the outskirts of urban areas and supplied milk and fuel to town dwellers. The main consideration of the *Nepali* settlers is the availability of fodder for their cows. At the present moment, the majority of the business of fresh liquid milk is in the hands of these *Nepali* graziers (Das, 1970). In view of the above fact, it is noteworthy to say that the various factors seem to have interacted in the emergence of milk producers communities in the Greater Guwahati Region since early times and a comprehensive study in this context is essential.

However, before entering into the problem in detail, an attempt has been made to conceptualise the following methodological aspects for being the main focus of this study. The methodological terms that are used in this research are defined in the present context. The term ‘spatial dimension of dairy farming’ refers to the dimension of dairy farms’ land use and its urban growth, which adjust their extents with reference to the distance from the city centre. The intensity of dairy land use patterns by distance from the city centre in an urban environ is the ultimate effect of the spatial organization of ‘milk producers’ activities. Before starting the discussion on

articulation of the research problems of milk producers in Greater Guwahati Region, some definitions are imposed to understand the proper meaning of the following terms:

i) The term '*milk producer communities*' refers to as some groups of practicing milk producers having distinction based on their socio-economic background who keep cows under stall-fed or open-grazed conditions and support milk supply in the city market. The '*milk producer communities*' are homogeneous enough in terms of their location and needs. These communities are relatively stable and rely on isolation to protect them from the influence of economic liberalisation as may be seen in urban economy of the country.

ii) The expression '*dairy farm*' refers to a milk producer occupies a piece of land for dairy activities on the basis of leased, rented or by free possession, The milk producers who supervise the landlord's farm in lieu of using its small portion of land for dairy activities, are also defined under this category because they are directly associated with dairy activities occupying the land of the other proprietor.

iii) The name '*Greater Guwahati Region*' denotes here the spatial extent of '*Guwahati Municipal Corporation*' as demarcated in the Government Census Report of 2001. In addition, it also contains the surrounding areas just closed to the Guwahati Municipal Corporation limit which are frequently used here as the *peri-urban* or fringe of the city wherefrom the Guwahati City consumers get perpetual supply of fresh cow milk.

iv) The term '*socio-economy*' implies the economic impact resulted from the social capital as possessed by the different milk producers; these attributes are, however, more difficult to quantify but are related to real forceful issues. Social capital is used here means those values, attitudes and behaviour of milk producers that

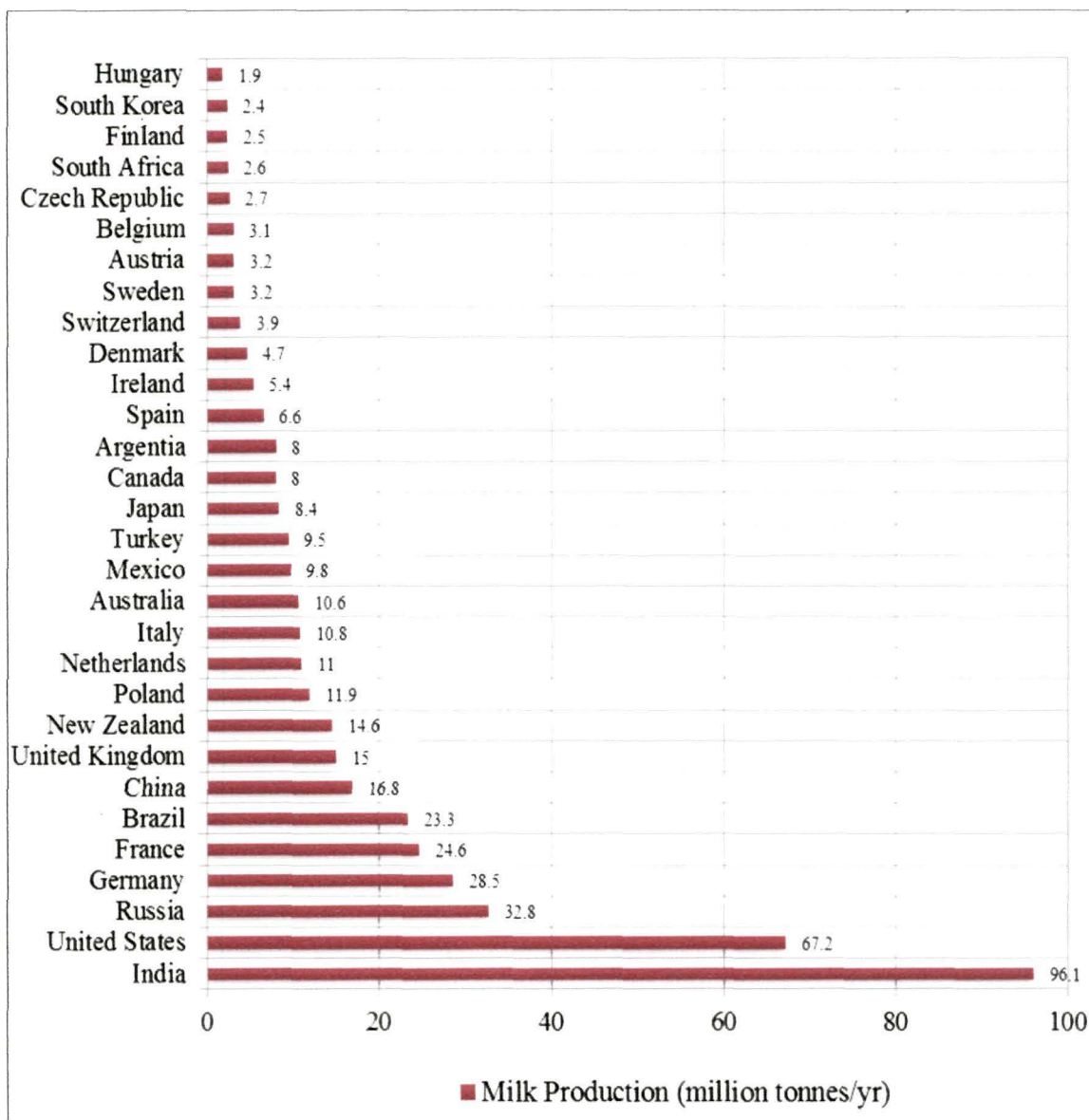
translate into productive economic activities of dairy households (DHHs). A good work ethic or traditional expertise in a DHH work force is an example of positive social capital.

v) The term '*locational and functional dimensions*' implies the position of the co-dependence of milk producers where they are located and where they operate their day to day dairy related activities, which are somewhat unique in character. Both the geographic location and function inevitable for the milk producers can help further to explain the complex interrelationships and co-dependencies within the dairy farming system.

vi) The term '*city centre*' indicates the locality of Deputy Commissioner Office, Panbazar, Guwahati, wherefrom the transport network to all directions of the Guwahati City is conveniently accessible.

### **1.1 Statement of the Problem**

India has a long history of its people association with domesticated animals, especially cattle. Each farming family in the country used to have certain number of cattle for the purpose of ploughing, pulling carts and producing milk. The age long experience, expertise and culture inherited through generations by the milk producers distributed all over the country to-day make India to retain number one position as world's largest milk producing country by pushing the United States to second position (Fig-1.2). India's milk production grew almost 4.2 percent as against the world's average growth of less than 1.0 percent. In India, milk has a special role to play for its many nutritional advantages as well as providing supplementary income to some 70 million farmers in over 5,00,000 remote villages. And milk remains as the number one commodity product by India pushing wheat and rice behind.



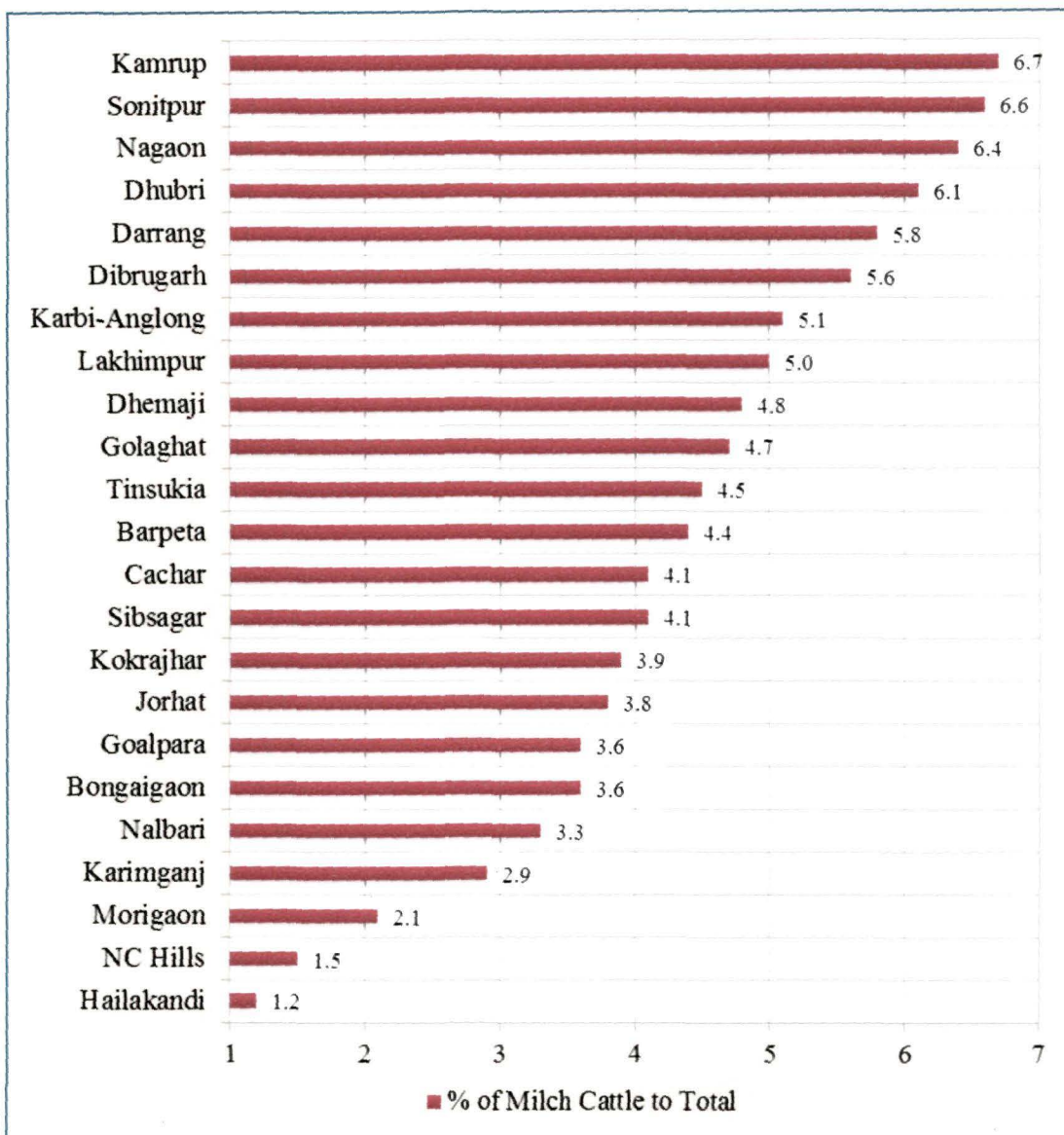
Source: OECD Agricultural Outlook Tables, 2005, accessed from <http://www.oecd.org/search> on 29 /10/ 2009

**Fig-1.2: Milk Production of Some Selected Countries, 2005**

Country’s output now covers 100 million tonnes and is valued at nearly two lakh crore rupees (Bulletin, 2008). In spite of such a revolutionary achievement in terms of production of this agricultural commodity, the level of production and consumption has not been satisfactory everywhere. There is significant regional variation in this regard. Various surveys indicate that the average per capita milk intake is as low as only 20 gm/day in parts of the Eastern region as against 400 gm/day in the Northern region of the country.

When looked at the status of dairy farming in Assam, the picture appears to be gloomy in spite of launching a number of promotional programmes like 'Operation Flood' during the plan periods. The per capita availability of milk in the state was 51 gm / day during the 1970s which increased to 94 gm/day in 1995. This figure is much lower than the national average of 214 gm/day and the ICMR recommendation of 250 gm/person/day.

The dairy related picture in the urban areas of Assam including the Guwahati City is still more challenging as there has been significant gap between the ever-expanding demand and the almost stagnant supply of fresh liquid milk (Fig-1.3). During the last four decades, the population of Guwahati City has increased from 43,615 in 1951 to 5,77,591 in 1991 and now it is estimated that the population of the city will touch the mark of 15,00,000 during 2005. The survey report of town Milk Supply Scheme, Guwahati reveals that the Guwahati City presently needs 2.0 lakh litres of fresh liquid milk to cater to the demand of city consumers. But the city is now getting approximately 60-80 thousand litres of milk daily from different dairy units located in and around Guwahati City (Town Milk Supply Scheme, 2005). The tea-stalls, restaurants, hotels, nursing homes, hospitals and other commercial establishments almost tripled in their numbers during 1961 to 1991 periods. Such an expanding population and organization provide a big market and commercial base for dairy produce. According to a Report from the Department of Town Milk Supply, Guwahati, there is present demand of about 2.5 lakh litres of fresh liquid milk daily to meet the minimum requirements of the city consumers. However, the same Report reveals that the supply amounts to less than 80,000 litre daily. Thus, there is a tremendous scope for improving the state of milk production in and around Guwahati



Source: Statistical Handbook of Assam, 2005

**Fig-1.3: District-wise Milch Cattle Population of Assam, 2005**

City in order to minimise the gap between the demand and supply. Mention may be made here that there are more than 4,000 households of milk producers having varying herd sizes scattered in and around Guwahati City.

The existing concentration of primary milk producers in and around the Guwahati City more or less reflects the conformity to other city's concomitant, particularly in respect of locational and functional dimensions of milk production. It is pertinent to note here that more than 4,500 households of primary milk producers

comprising a significant percentage of small, marginal and landless people of different communities have been practicing the milk production and its associated activities in and around Guwahati City. However, their relentless effort to this venture has failed to comply with the ever-expanding urban demand for fresh milk. According to a conservative estimate, presently the Guwahati City has been suffering a daily short supply of nearly 2,00,000 litres of fresh milk (The Assam Tribune, 2002).

Eventually, such a situation creates the problems of milk production due to the widening gap of its demand and supply for the consumers of the Guwahati City. It makes the fresh milk production as an economically viable vocation. It opens up a new vista of an amazing market prospects in Guwahati City virtually with no competitors. Alternately, it has also been observed that the existing gap of supply and demand for fresh fluid milk has made easy access of spurious milk to the consumers' of Guwahati City also. Now, it is perceived that the Guwahati City may not escape from such effects caused by the above widespread and traditional situation. Therefore, a need is felt to understand the problems and prospects of milk producers' communities in and around Guwahati City in the backdrop of emerging requirements of the desirable commodity like fresh fluid milk.

Guwahati City and its surroundings, as has already been mentioned, have strong market potential for fresh milk produce. However, the area still lacks adequate and efficient type of transportation system to carry highly perishable products like raw milk. This has compelled the milk producers to grow their dairy farms either within the city environ or its close proximity. As a perishable product, fresh raw milk also needs a quick and efficient marketing system so that it can reach the consumers within a short time. However, the lack of adequate infrastructure facilities including marketing often gives rise to a number of problems in the smooth functioning of this

sensitive but most essential service. It is also to note that the unplanned growth of traditional type of dairy farming, which is dependent on grasses and other vegetation available in the hills and wetlands distributed in and around Guwahati City, directly or indirectly may create some environmental problems. Keeping all these points in view, an attempt has been made here to study the existing status, problems and prospects of milk producer communities in and around Guwahati City through the locational and functional perspectives. Such a study may provide an information base on the issues and scientific knowledge on the nature and trend of the development of this important sector of urban economy.

## **1.2 Objectives**

In light of the above discourse, the present work has been planned to fulfil the following objectives as:

- i) to identify the concentration of the milk producers in and around Guwahati City,
- ii) to characterise the socio-economic status of milk producer communities in the study area, and
- iii) to analyse the economics of milk production, consumption and need relating to raw milk produce as envisaged in the study area.

## **1.3 Research Questions**

Milk producers of the study area consist of different socio-economic background. It is presumed that they cleverly determine the milk consumer behaviour and their locational and other environment in their own way for having optimum benefit. Accordingly, this study will thrust to explore the relevance of following set of questions-

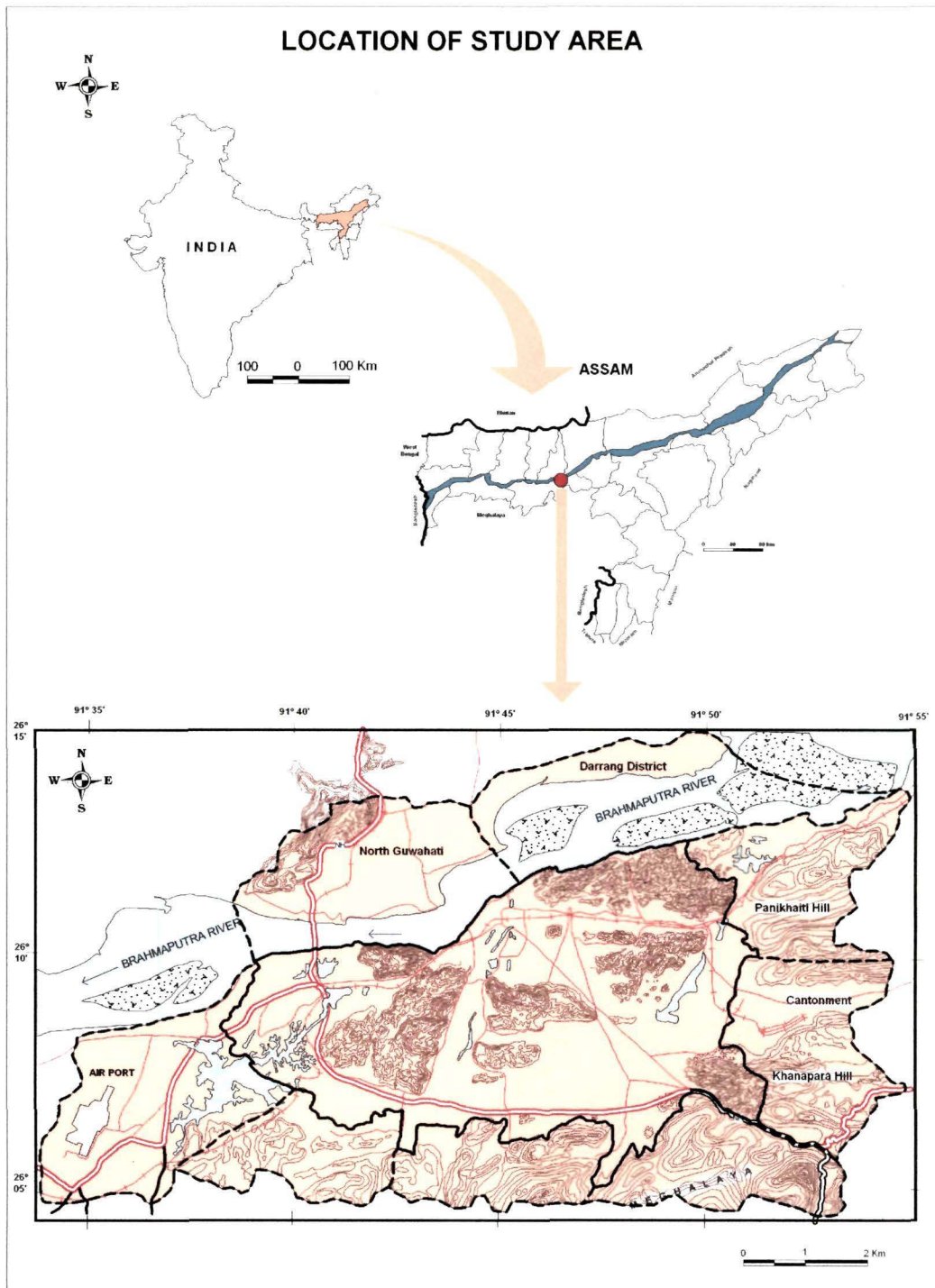
- i) What are the main causes of variations in socio-economic characteristics of DHHs?

ii) How do the milk producers of the study area would understand the laws of advantage in terms of production, consumption and marketing of their milk produce in the city market of Guwahati? In fact, socio-economic status of milk producers may implicitly governed by the productivity and profitability of dairy activities performed at producer's household level. This discussion may provide the explanation of the third objective of the present proposed research.

#### **1.4 Study Area**

Study area of the Greater Guwahati Region has two segments: the inner administrative segment which is the Guwahati Municipal Corporation composed of 60 Municipal Wards belonging to the district of Kamrup Metro and the outer segment that is the fringe of the city surrounded by the parts of the districts of Kamrup Rural and Morigaon of Assam and the Ri-Bhoi of Meghalaya State.

**1.4.1 Location and Extent:** The study area extends between  $91^{\circ} 35'$  E to  $91^{\circ} 55'$  E longitudes and  $26^{\circ} 05'$  N to  $26^{\circ} 15'$  N latitudes with an area of about 470 sq km. The spatial limit for each direction is operational in accordance with the maximum occurrence of commercial dairy farms. As such, the localities toward northern limit spread up to the foothills of Silapahar and the eastern limit covers Satgaon, Panikhaity and Khanapara hills. The southern limit is stretching from Jorabat along with the border localities of Ri-Bhoi district of Meghalaya State, northern part of Garbhanga and Rani Reserved Forests and the western limit goes up to Patgaon and eastern parts of Rani mouza of Kamrup district of Assam (Fig-1.4).



Source: Part of SOI Toposheets No.78 N/12, 78 N/16, Survey of India, Dehra Dun

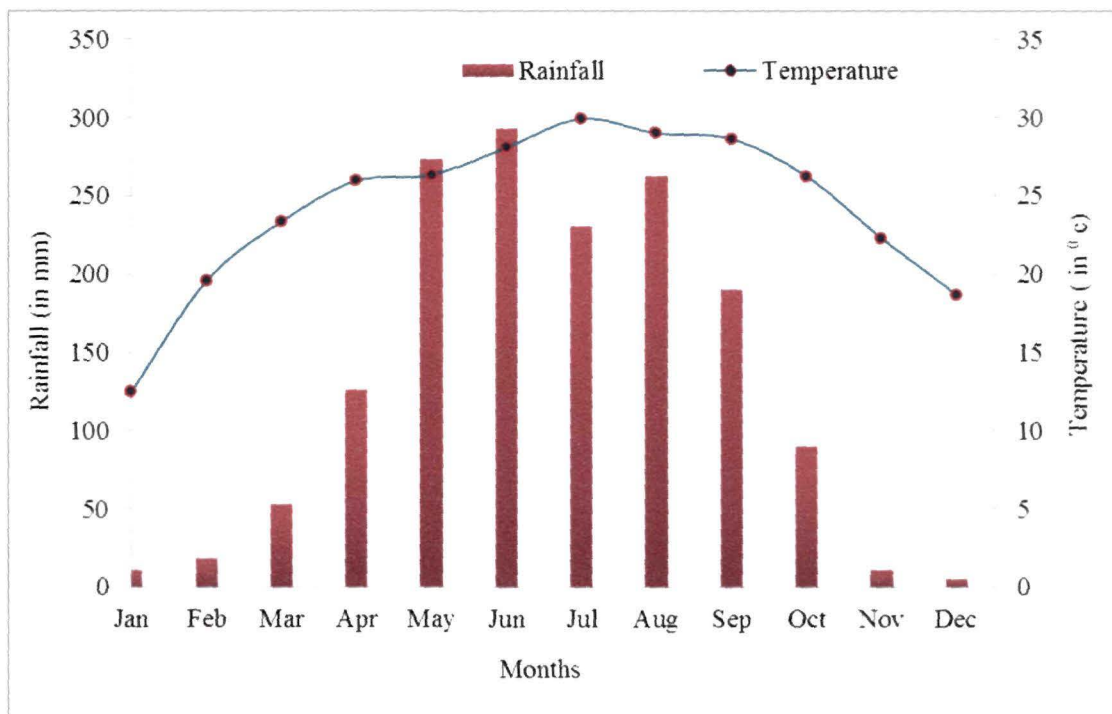
**Fig-1.4: Study Area: Greater Guwahati Region**

**1.4.2 Physiographic Setting:** Physiographically, the area lies between the northern extensions of the Meghalaya plateau and the alluvial plains of the Brahmaputra River. The area is closely knitted with hilly topography with average altitudes of 300 metres having plains and wetlands of different dimensions. The land resources of the area

comprise of the settled area (24.63%), water bodies (8.37%), hills (19.48%), low-lying area (7.72%) and other usable land (37.16%) (Town and Country Planning Organisation, 1987). The core area of the city lies in a horseshoe shaped valley traversed the north by Brahmaputra River, the south by Japorigog, Nilachal and Fatasil hills, the east by Kharghuli and Sunsali hills and the west by Kamakhya hills. The Beltola plains that cover an average area length and breadth of about 15 km and 4 km respectively is surrounded by Jaintia and Khasi hills on the south, Narakasur and Sonaighuli hills on the west and Japorigog hills on the north. The Jalukbari- Azara plain, which includes the Deepor *beel* area, lies on the western part of the city Master Plan areas. The North Guwahati-Amingaon area on the north of the river Brahmaputra is situated on a flat plain interrupted by some small rolling hillocks. The altitudes of the hillocks, which are dotted on city's areal extent, range from 100 to 300 m. The average elevation of the valley of the city is 52 m from the mean sea level. The diversified physiographic setting of the study area provides an additional impetus for the growth and sustenance of cow keeping and milk production activities as well. The hills and dales which are lesser priorities for the city developers make an opportunity to easy entry the dairy farmers to settle temporarily. As soon as the urban pressure touches the dairy farming communities in unbearable limit in their existing location, they have to shift their area of operation to the same kind of safer locations.

**1.4.3 Climate:** Climate of Greater Guwahati Region is almost that of the valley of Brahmaputra. In this context, Borthakur (1986) stated that the entire North-East Region has a distinctive climatological attributes not comparable to any other parts of the sub-continent. But, still it has some variations due to its local conditions, such as nearness to the hilly region, existence of local topography like hillocks, water bodies, and swamps and its latitudinal position. The principal characteristics of the climate of

Greater Guwahati Region are slightly cold and foggy winter, moderately cool spring and hot and humid summer. During a year, generally from February to May the weather becomes dry and moisture less with smooth and steady rising trend of heat. A rain with thunderstorms predominates the month of April and May. The average temperature varies from 12<sup>0</sup>C to 31<sup>0</sup>C during this period. From June to October, Guwahati receives sufficient rainfall. Floods and water-loggings become a common phenomenon during this period. Excessive heat and humidity last out up to the month of August. The mean temperature during this period varies from 22<sup>0</sup>C to 32<sup>0</sup>C.



Source: Modified Final Master Plan and Zoning Regulations for Guwahati, Town and country Planning Organisation, Government of Assam

**Fig-1.5: Rainfall and Temperature of Greater Guwahati Region**

From November to January, the weather becomes cool and foggy with very little or no rainfall at all. The average temperature varies from 24<sup>0</sup>C to 10<sup>0</sup>C during these months (Fig-1.5). The average humidity ranges between 82.3 and 65.4 percent in the Greater Guwahati Region. It is notable that the impact of climate on the diversified local topography at different seasons made some sorts of favourable conditions in the

growth of seasonal green grass cover which are utilised by the dairy communities. It seems that during the summer, most of the dairy farmers are dependent on the high land or otherwise the hilly grass coverage because of the inundation of most lowland areas, whereas a reverse situation is arisen in the winter because of scarce rainfall most of the hills grass coverage becomes scanty. In the winter season, most of the wetlands of city environ have edible green grass cover for cattle population. The open air marshy lands scattered in the city environ warmed with the mild winter sunlight, make a favourable environment for the luxuriant growth of winter grass cover.

**1.4.4 Population Characteristics:** The growth of general population as well as the emergence of dairy communities in the study area has a significant bearing. In the early times, it is obvious that the local population have reared cattle only for draught purposes; milk was then a by-product only. However, after the British annexation, a large number of milk habit people have arrived in the city for administrative, business, education, construction, and defence purposes. Subsequently, these immigrants people from inside states or abroad have virtually planted the seeds of commercial milk production and marketing whereby an environment of new consumerism of milk and milk products initiated.

It is worth to mention here that the legacy of milk production and marketing of present day Guwahati City is still in the hands of immigrant population. After the arrival of British the decadal variations of population in Guwahati show a clear and steady growth in the first fifty years from the beginning of its census operation i.e. in the period: 1891-1941(Table-1.1). During the decade 1941-51 Guwahati City enjoys an abrupt rise of population, which is 47.35 percent against that of the state's growth of 19.9 percent. During the two decades 1971-91 or within a span of 20 years Guwahati City shows an unprecedented variation of population increase with the rate

of 96 percent in the census history of Assam which in fact, nearly 4 times more than that of the state's corresponding growth rate. Such a tremendous increase of population actually caused due to some intricately interrelated factors. The formation of Meghalaya state in 1973 and subsequent shifting of capital including a large number of office and business premises from Shillong to Dispur carry a heavy flow of

**Table-1.1: Decadal Growth of Population in Guwahati and Assam**

Decade	Decadal Variation of Population Growth (%)	
	Guwahati	Assam
1891-1901	2.11	11.8
1901-1911	7.03	16.9
1911-1921	32.40	20.4
1921-1931	32.22	19.9
1931-1941	35.78	20.4
1941-1951	47.35	19.9
1951-1961	130.90	34.9
1961-1971	99.00	34.9
1971-1991	96.00*	26.6*
1991-2001	38.60	18.92
2001-2011	18.95	16.93

Source: (i) Statistical Handbook of Assam, 1995, pp.16-17, (ii) Census of India, 1941, Vol. ix, Assam, p.8 (iii) <http://www.online.assam.gov.in>

\*Figures show average of two decades

migrants to Guwahati. It is obvious from the fact that, the growth rate of the shops and commercial establishments in Guwahati during the decade 1961-71 was only 32.45 percent and after shifting of capital in 1974, it increased nearly 3 times with a growth of about 85.00 percent. The Guwahati Municipality with the area of 14.19 sq km in 1971 becomes the Municipal Corporation in 1974 with its area of 216 sq km. There was 59.73 percent immigrant population in Guwahati Municipal Corporation in 1971 (Table-1.2). Thus, Guwahati is continuing its growth with its areal and population extent. It is surprising to note that about 89 percent of the population of the district of Kamrup alone resides in Guwahati City as per 1991 census.

The growing unemployment in the rural Assam, influx to city for educational purpose and subsequent settlement of rural elite, inflow of female population for marital status caused by the male dominated city dwellers, natural growth etc. are the prime factors for geometric growth of population in Guwahati City. The tremendous growth of the population in the city directly or indirectly contributes in the growth of milk consumers and milk business as well.

**Table-1.2: Indigenous and Immigrant Population Composition of Guwahati City (1971)**

		Population	%
Total		1,23,783	100.00
Indigenous		50,417	40.73
Immigrants		73,366	59.27
<b>Migration from- a) within Assam-</b>			
	i) Kamrup	12,524	17.07
	ii) Other districts	11,093	15.12
<b>b) Outside Assam but within country-</b>		<b>41,958</b>	<b>57.19</b>
	i) Bihar	17,580	41.90
	ii) West Bengal	5,295	12.62
	iii) Rajasthan	4,393	10.47
	iv) Meghalaya	4,280	10.20
	v) Uttar Pradesh	4,036	9.62
	vi) Others	6,373	15.19
<b>c) Outside India-</b>		<b>7,791</b>	<b>10.62</b>
	i) Bangladesh	5,454	70.00
	ii) Nepal	1,247	16.00
	iii) others	1,091	14.00

Source: TCPO (Town and Country Planning Organisation) (1987), Modified Final Master Plan and Zoning Regulations for Guwahati, Government of Assam, p.15

### 1.5 The Scope of the Study

Present study on the socio-economic characteristics of milk producers would be useful for decision makers, policy implementing agencies and the researcher who are more associated with the animal husbandry and economic aspects of dairy development. The study is unique in its character and would provide the clues for proper development of urban fringe areas especially the Guwahati Urban Area where

dairy activity is one of the important aspects of urban economy. The study may provide the basis of the development of dairy to the following sections of human society of Greater Guwahati Region:

- i) The planners may utilise the primary data base and its subsequent result for future planning strategies.
- ii) The upcoming generation of milk producers in Greater Guwahati Region may revisit their strength and weaknesses that are incorporated in this research work.
- iii) The imminent researchers may get an information base from the present work since there is no literature available so far especially on geographical perspective on the socio-economic status of milk producers.
- iv) The social service providers or extension educators relating to dairy service may utilise these information for their dairy extension service.
- v) It is expected that the milk and milk products business enterprises would get some of their required information from these research findings.

## **1.6. Methodology and Database**

Present study contains the areas of Guwahati City and its fringe based on cross section data pertaining to the year 2006. In order to interpret the spatial patterns in the context of socio-economic status of milk producer communities, appropriate methodological considerations have been adopted in processing the collected data for inference of concerned results. The following main steps are taken for the explanation of problems in the present piece of research work.

**1.6.1 Delineation of the Study Area:** Spatial limit of the study area is delineated by considering the location of the active milk producer households in different Municipal Wards as well as in the fringe of Guwahati City, which diverge from the city centre towards all directions wherefrom the city consumers get continuous supply of fresh

liquid milk. The outer boundary of the city fringe area is arbitrarily demarcated so that the milk producers of these localities get their proper representation.

**1.6.2 Selection of Attributes:** There are a variety of attributes, such as, location e.g. the locations are of two kinds i.e. the absolute and the relative location. The attributes of absolute location are latitude, longitude, street address etc. However the relative location is a position with respect to other locations; it can be expressed in values other than the usual distance units. There is a large number of ways of describing distance and location in a relative context (Kristof, 1959). For example, distance between two locations may be expressed in terms of geometric length (physical distance), economic context (in terms of transport costs) and psychological perceptions of the environment of location. Under such interpretations of location and distance, the physical distance between the locations of market centre and DHHs has been considered for the present study assuming that the transport costs of milk supply is positively related to physical distance between two locations within the study area.

Relativity of geographical phenomena and characteristic features of such phenomena are highlighted using 'classificatory approach'. Therefore, selection of the relevant attributes is made on the basis of the requirements for this present study. The base attributes for the classification are divided into four groups:

(i) The locational characteristics of DHHs were highlighted by considering three main attributes of locational factors, namely (a) geographical location of DHHs, (b) concentration of DHHs and (c) distribution of population.

(ii) The socio-economic characteristics of DHHs were presented by using three key base variables, namely (a) demographic (i.e. family size, sex ratio), (b) social (i.e.

community, literacy, educational status) and (c) economic (i.e. family labour, hired labour, herd size of milch cattle).

(iii) The characteristic features of DHHs for their economic status was pursued by taking into account the variables related to production and productivity. They are as labour productivity, cattle productivity and capital productivity of milk.

iv) The profitability is a leading economic consideration for mobilising/intensifying the dairy activity in any area of the world. Profitability aspects of DHHs were dealt here with considering its relative variables, namely, revenue received and expenditure incurred relating to milk production and milk marketing of DHHs.

In fact, the classification of collected data of relevant attributes of DHHs was made by considering the above basis for the entire analysis. In the end, the synthesis of the gathered facts were also pursued by using 'Principal Component Analysis' which provides the correlations and suitable nexus of attributes to infer the common features of considered socio-economic attributes.

**1.6.3 Sample Design:** Since the basic purpose of the present study is to examine the spatial pattern of the socio-economic characteristics of milk producers, the study would be mainly based on primary data. The sampling method in the present study is designed in such a way that can successfully explain the pattern of distribution, production, consumption of DHHs and their relationships to understand their socio-economic status in the study area. Therefore, the samples of dairy households are collected for giving the explanations of various objectives proposed in the present investigation. The sample DHHs were selected on the basis of 'Stratified Random Sampling Technique'. The following bases of stratification were taken into account:

(i) Topographic location of DHHs refers to geo-environmental parameter which has implicit effect of other factors of dairy development. So, it is a sound geographical base and had been considered as main factor for sample selection (Table-1.3).

**Table-1.3: Topography-wise break-up of Selected DHHs**

Topographic Unit	DHH		Selected DHH		Deviation
	total	%	total	%	
1) Foot-hills	3,470	74.11	222	60.00	-14.11
2) Wetland front	1,097	23.43	82	22.16	-1.27
3) River bank	55	1.17	13	3.51	+2.34
4) Built-up areas	60	1.28	53	14.32	+13.04
<b>Total</b>	<b>4,682</b>	<b>100</b>	<b>370</b>	<b>100</b>	<b>0</b>

(ii) Distance from city market centre and distance from nearest vehicular road which would help in selecting the DHHs to provide the locational considerations and market accessibility of DHHs (Table-1.4 and Table-1.5).

**Table-1.4: Distance-wise break-up of Selected DHHs (from city centre)**

Distance from city centre	DHH		Selected DHH		Deviation
	total	%	total	%	
1) Above 30 km	114	2.43	9	2.43	+ 0.00
2) 30-25 km	253	5.40	20	5.41	+ 0.00
3) 25-20 km	518	11.06	33	8.92	- 2.14
4) 20-15 km	1,577	33.68	93	25.14	- 8.55
5) 15-10 km	1,580	33.75	109	29.46	- 4.29
6) 10-5 km	485	10.36	62	16.76	+ 6.40
7) below 5 km	155	3.31	44	11.89	+ 8.58
<b>Total</b>	<b>4,682</b>	<b>100</b>	<b>370</b>	<b>100</b>	<b>0</b>

**Table-1.5: Distance-wise break-up of Selected DHHs (from nearest vehicular road)**

Distance from nearest vehicular road	DHH		Selected DHH		Deviation
	total	%	total	%	
1) Above 800 m	833	17.79	50	13.51	- 4.28
2) 800-600 m	769	16.42	45	12.16	- 4.26
3) 600-400 m	1,025	21.89	81	21.89	0.00
4) 400-200 m	977	20.87	93	25.14	+ 4.27
5) below 200 m	1,078	23.02	101	27.30	+ 4.27
Total	4,682	100	370	100	0

(iii) Community of dairy households were considered as social attributes for stratification and sample selection. It would provide data from each and every community of DHHs (Table-1.6).

**Table-1.6: Community-wise break-up of Selected DHHs**

Community	DHH		Selected DHH		Deviation
	total	%	total	%	
1) <i>Nepali</i>	2,883	61.58	229	61.89	+ 0.31
2) <i>Bihari</i>	1,495	31.93	117	31.62	- 0.31
3) <i>Assamese</i>	290	6.19	20	5.41	- 0.78
4) <i>Bengali</i>	8	0.17	2	0.54	+ 0.37
5) <i>Rajasthani</i>	6	0.13	2	0.54	+ 0.41
Total	4,682	100	370	100	0

(iv) Present study is being pursued in the geographical manner in which spatial organisation of DHHs and the spatial pattern of their related attributes are much more relevant to analyse. So, the samples of DHHs were also collected considering that they (samples) must represent from each and every areal unit (i.e. ward/fringe) (Table-1.7)

On the basis of above criteria, a number of 370 dairy households out of total 4,682 that are 7.90 percent of the total, have been selected from each and every ward/fringe of the study area.

**Table-1.7: Sample selection from different Wards/Fringes**

Ward/Fringe code	No. of total DHH	No. of selected DHH	% of selected DHH
1	9	3	33.33
2	18	2	11.11
3	5	2	40.00
4	7	1	14.29
5	4	3	75.00
6	11	2	18.18
7	6	2	33.33
8	3	2	66.67
9	12	2	16.67
10	30	5	16.67
11	21	4	19.05
12	79	12	15.19
13	48	5	10.42
14	8	2	25.00
15	13	5	38.46
16	19	4	21.05
17	23	4	17.39
18	4	3	75.00
19	5	3	60.00
20	8	4	50.00
21	14	3	21.43
22	28	2	7.14
23	29	2	6.90
24	18	3	16.67
25	9	3	33.33
26	3	2	66.67
27	6	2	33.33
28	5	2	40.00
29	3	2	66.67
30	2	1	50.00
31	2	2	100.00
32	2	1	50.00
33	1	1	100.00
34	3	2	66.67
35	4	1	25.00
36	5	2	40.00
37	15	1	6.67
38	3	2	66.67
39	2	1	50.00
40	8	3	37.50
41	24	3	12.50
42	5	3	60.00
43	2	2	100.00

44	17	3	17.65
45	31	1	3.23
46	96	4	4.17
47	18	4	22.22
48	13	2	15.38
49	67	7	10.45
50	22	2	9.09
51	35	1	2.86
52	59	5	8.47
53	19	2	10.53
54	83	5	6.02
55	25	3	12.00
56	35	4	11.43
57	6	1	16.67
58	35	5	14.29
59	27	2	7.41
60	16	2	12.50
61	58	4	6.90
62	789	47	5.96
63	959	21	2.19
64	1,410	90	6.38
65	103	12	11.65
66	62	9	14.52
67	84	7	8.33
68	87	11	12.64
<b>Total/average</b>	<b>4,682</b>	<b>370</b>	<b>7.90</b>

**1.6.4 Limitations:** There were some limitations in selecting household samples and conducting surveys as:

The data were collected from the field from January to December during the year 2006. The month-wise break-up of data collection are given below (Table-1.8).

(i) The criterion of 'seasonality' was not considered in conducting the DHH survey. During the year 2006, the survey was conducted in every month when there were normal conditions of milk supply and raw material availability required for herd subsistence in the study area.

(ii) A few dairy households change their location and happen to be migratory seasonally. As per the demand of milk and variation in milk prices they change the location of their household. Such households could not be considered in the survey.

**Table-1.8: Month-wise break-up of data collection (2006)**

Month	No. of collected sample household	% of collected sample household
1) January	22	5.90
2) February	17	4.55
3) March	42	11.31
4) April	32	8.60
5) May	35	9.41
6) June	31	8.33
7) July	47	12.66
8) August	12	3.20
9) September	22	5.90
10) October	37	9.95
11) November	42	11.31
12) December	33	8.92
Total	370	100.00

(iii) There were presence of buffaloes and goats kept in the herd size and also produce milk for sale purpose. But such cases are negligible and were not considered in the survey.

**1.6.5 Collection and Analysis of Data:** Relevant primary data for present investigation were collected from the respondents with the help of a designed questionnaire (Appendix-I). The questionnaire was prepared by keeping in mind all the socio-economic attributes for classification and related base variables for establishing 'cause-effect relationship'. The base variables also incorporated in schedule. For example, the data of the socio-economic factors were collected through

this schedule/questionnaire. The main elements included in the questionnaire are given as:

(a) location and total number of the milk producers' household in the cluster (ward no., fringe no., distance of the household from the city centre, and distance of the household from nearest vehicular road),

(b) topographic feature of the dairy household's locality (foot-hills, built-up areas, wetland front, and river bank),

(c) socio-economic information (religion, caste, community, number of family members, age, sex, monthly income and expenditure, sources of income other than milk production (i.e. agriculture, business, private service, government service, government pensioner); educational status (i.e. illiterate, primary middle school, high school, higher secondary, graduate, post-graduate, technical qualification, and others); production and consumption pattern of the household (types of milch cattle, cattle in milk, breed of milch cattle, daily milk production, lactation period, sale prices of milk, household consumption of milk, and quantity of surplus milk), supply / marketing of milk from the household (mode of consumption of milk, quantity of milk sold, producer's milk delivery system, means of carrying milk, place / ward no. of milk supply, distance between milk producing unit and places of milk delivery), feeds and fodders (name of the sources of fodders, the distance between fodder source and milch cattle shed, monthly cost for green fodders, dry fodders, and concentrates).

Besides the primary data from the field, secondary data were also collected from relevant sources such as Census of India Report, the Statistical Handbook published by the Government of Assam, Dairy Cooperatives, District Animal Husbandry Department, and Town Milk Supply Scheme. Some other relevant information has also been collected from various books, journals and periodicals.

The data collected for this investigation are rationalised, processed and tabulated for the analysis. The inferences of facts were drawn from the data by using appropriate statistical tools like regression analysis, correlation matrix and depicting results through maps and diagrams.

### **1.7 Arrangement of Material**

The entire material was coherently arranged into seven chapters including the introductory part of the thesis. Chapter-II deals with the review of literature to show the deficiency of relevant literature and gives the importance of the present work. The main analysis of locational, socio-economic and productivity characteristics of DHHs were presented in four main Chapters from Chapter-III to Chapter-VI. In the end, the generalisation and synthesis of the results including conclusions and findings were arranged in Chapter-VII.

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## **Chapter - II**

### **Review of Literature**

#### **2.0 Introduction**

The research work undertaken in present study was realised to pursue by different scholars in understanding the locational and functional dimensions of milk producer communities, the milk production and consumption behaviour, the socio-economic status of milk producers, feeding organization for dairy cattle and the supply and demand factors for dairy produce. They are of great importance to review them critically. The review on this theme may be undertaken in a variety of ways. It might have subject-oriented, content-based, city-environment dominated or a locale-specific. In fact, this research is the representative of the locational and functional aspects of milk producer communities in its national as well as regional perspectives.

The review of relevant literature has been considered to refer the world-wide literature on such aspects of dairy communities. The pertinent old facts are given due importance, because they sometimes show unexpected facets when viewed from a new angle (Broek and Webb, 1978). The specific studies conducted in India and especially in North-Eastern region are given due weightage in the review to highlight the area-specific findings on the studies of rearing milch cattle practices. Moreover, reviewing the concerned literature already available is also useful for understanding the difficulties that might be encountered in the present study as also the probable methodological limitations. In this backdrop, a detail review of the work available from different sources like academic journals, books, conference proceedings, government reports, etc. has been attempted to study such material relating to milk producer communities under the following heads as:

1. the locational and functional dimensions of dairy households,
2. the production, consumption and profitability of dairy activities,
3. the socio-economic status of milk producers, and
4. the feeds and fodders characteristics for dairy development.

### **2.1 The Locational and Functional Dimensions of Milk Producers**

Documented literature in the context of locational and functional aspects of milk producer communities is scarce. However, some of the authors have put forward a diverse range of common observations to afford an overall principle as well. According to Barney and Smith (1998) the general focuses of milk producer communities have been studied by categorising them into three, namely: i) the existing dairy communities, ii) the traditional dairy communities, and iii) the virtual dairy communities. Those who observed most current dairy communities are much less dairy friendly. Dairying is no longer a major economic force in most current communities. Traditional dairy communities are homogeneous enough in terms of needs. The public image of traditional dairy farmers is one of the honest hard-working folks, which is an asset to the community. Moreover, the virtual dairy communities are groups of people who share common interests, identities, history, culture, and values. They also share a common sense of how they relate to one another. However, the above categorization as made by Barney and Smith is not discernible in case of dairy communities for the Greater Guwahati Region. Here the dairy communities are not categorized on the basis of the degree of their commitment to their profession as observed above; nevertheless it is here more relevant the 'community background of dairy households' for appropriate classification as well.

Nevertheless, the community based milk production activities have

multifaceted dimensions. The real dimension of the activities of dairy communities is not only established on the development of cow, but the true development of man and society as Kurien (1997) stated. Furthermore, the major features of third world agriculture result the changing balance of urban and rural sectors and the rapid growth of towns and cities. In the past, the rural communities lived more or less self-contained lives, remote from urban concerns and producing milk largely for themselves, but the growth of towns has created a market for both the produce of the countryside and for displaced rural labour (Dickenson, 1996). It is quite reasonable to state that the growing urban centres is directly proportional to the emergence of consumers which subsequently helps in contributing the outgrowth of dairy communities who produce perishable goods like milk and milk products. The perishable nature of consumable goods generally determines the distance between the location of its production and the kitchen of the consumers.

In the frame of International perspective on dairy farming, Tarrant (1974) stated that, though all features of the Earth including farms appear unique in many respects; nonetheless, they have some features in common. Farmers must certainly do not react on the same way to the pressure of environment, but the fact that they do react provides a basis for generalisation. In the context of the dairy communities residing in the Greater Guwahati Region, it is fact that they enjoy a common physical and non-physical environment in case of their dairy farm operation. However, the different communities have preferred different location to operate their dairy farm unit in the Guwahati region.

Historically, Atkins (1978) stated the condition of dairy farming practice nearly 200 years ago in the city of London and accordingly explained that, in the 19th century, no English city had served itself from its rural connection. The largest of

them all still conducted extensive backyard agriculture, not merely half-a-dozen hens of a coop of soap boxes, but cow stalls, sheep-folds, pigsties above and below ground in and out of dwellings, on and off the streets, wherever this rudimentary factory farming could be made to work.

Being urban sprawl problems in the developing as well as under developed countries, the locational aspects of milk producers in the city and their larger concentration was highlighted by Nouri et al. (1975) considering farm practice in the city region of Tehran where the largest concentration of large producers is observed in the Tehran area. They suggested new complexes are to be planned around every large city in Tehran. The trend is for the promotion of large herds with hundreds of cattle under one manager (Mohtashem, 1975).

Another study conducted in Baluchistan and Pakistan by Babar (1975) on the locational aspects of milk production and its associated problems stating that the supply of milk from the producers is taken to consumers directly in cans or in other kinds of utensils. This traditional way of milk supply may not be able to serve the consumers living in the far distant and even to the processing plants established by the Government in cities for supplying processed milk in polythene bags and sterilized bottles. The scattered and small production per-unit-producer has decreased the marketable surplus as these are not disposed of by the producers due to complicated channels of marketing and high marketing costs. The producers have been maintaining milk cows and buffaloes inside cities and towns to provide the consumers with daily supplies of milk but this has resulted in multifarious problems of sanitation, health, and congestion. As per the role of human agent in the decision making behaviour in the event of agricultural practices, Ser-Od Tsetsgee et al. (2008) concluded that, in Bangladesh where land is a serious constraint, small holders stall

feed their cows at home. In these processes, committed people and enterprises (stakeholders) are more important than geography, climate or politics influencing the socio-economic status of milk producers.

So far as conditions of the locational and functional dimensions of dairy activities in the urban areas in India are concerned, the urban authorities of metropolitan cities have always been imposed bans on the milk producers living in the core areas of the city. For example, Delhi Metropolitan Area, which is delineated into two zones: the first zone of immediate influence of Delhi (25-30 km from central city) called Metropolitan area and the second zone of influence around Delhi Metropolitan Region or National Capital Region (from 30 to 100 km), this outer zone mainly procures essential supplies of milk, meat, fresh vegetables, fruits etc. and other perishable items. Furthermore, Shikha (1978) observed that there are many small private dairies within the urban limits of Delhi and these are spread all over in Delhi. These dairies supply milk to the local residential areas around them. These dairies were shifted to outer Delhi during emergency in 1975 but again they have partly shifted back to urban Delhi.

The dairy farming practices in the city of Mumbai also have some common factors as Greater Delhi. It is observed that in the city of Mumbai, there is no class of milk wholesalers as such, but they are referred to as 'stable owners' or milk producers. It is estimated that there are more than 60 stable owners associations scattered all over the Greater Mumbai. The group of stable owners are formed on the basis of their language, religion, area etc. For example, there are 12 such associations in Aarey milk colony area, 3 associations in Kurla, 2 associations in Goregaon, 5 associations in Jogeswari, 7 associations in Andheri and 3 associations in Khar to Vileparle. Among them, the Mumbai Milk Producers Association (MMPA) is the

largest one. It consists of about 587 stable owner members in the year 1977-78 with more than 25,000 animals (Kalyani, 1985).

Mahanta (1987) highlights the role of environmental and cultural elements such as relief, climate, and soil conditions as well as the tradition of the inhabitants in the location of dairying. Due to the diversity of these factors, same kinds of dairying are not favoured and adopted everywhere. The Indian dairy sector also surfaced with some distinctive region-wise appearance as influenced by these factors that is essentially superimposed to agricultural region of India.

Though the environmental and cultural factors have some positive impact in the growth of dairying as highlighted above, yet the economic factors like the demand for fresh liquid milk as well as the behaviour of milk consumer helps significantly to surface the dairying activities. Singh (1975) studied the impact of the relief, climate and tradition in the distribution milk producers communities. He found that the mountainous and hilly areas had greatest density of livestock raising combinations due to the low proportions of cropped area and high proportions of grazing lands. And these are largely the result of the form of surface rainfall characteristics, soil types, traditions and subsistent food grain farming.

Jain (1986) examined the prevailing mixed farming pattern, crop products and dairy products which had two major sources of income to the family of India. Income from crop farming is subject to the seasonality and fluctuations from year to year due to the vagaries of nature. Steady and round the year income from dairying reduces the oscillations in the farmers' income.

Pandey et al. (1998) studied that, since livestock keeping is labour intensive and is a vocation without holidays, it offers continuous employment and income generating opportunities throughout the year. This activity involves sufficient use of

labour with almost each member of the family contributing in one way or the other. The children or old people normally take the animals for grazing. The men attend to the items of work such as bringing fodder from fields, chaffing the fodder, distributing the feeds, and fodder to animals. The women contribute towards milking the animals, cleaning the stalls in addition to doing the other household chores.

## **2.2 Reviews on Production, Consumption and Profitability**

The National Commission on Agriculture (1976) in its interim report recommended that as a method for providing rural employment and increasing milk production in the country, dairying be encouraged on the holdings of small farmers and also by landless labourers. This would result in i) increased employment and more regular employment throughout the year, ii) increased milk production, iii) maximisation and stabilization of income, iv) regular flow of income and increased efficiency, and v) effective defence against risk and uncertainty in agriculture. In many countries where dairy development has made significant progress such as Denmark, United Kingdom, New Zealand, USA, etc., the average annual milk production per cow is 3,000-4,000 kg. Whereas in India the average annual milk production per cow is 157 kg and buffalo is 504 kg (NCA, 1976).

## **2.3 International Perspective on Milk Production**

Atkins (1978) studied the viability of milk production in the context of city dairy practice and stated that it is conceivable that milk production in London might have continued to be viable. In European cities as diverse as Paris and Liverpool towns, milk was successfully produced well into the twentieth century, as it is being produced now-a-days in many Third World cities. Griffin (1997) studied the world trend of milk production and stated that looking at milk production at the world level, one is struck by the continuous growth in output shown up until 1990; the world into

developed and the developing countries, it can be seen that the decline in output has taken place in the developed countries. In contrast, developing countries have increased their output over the period of time.

**2.3.1 National Perspective on Milk Production:** At a national perspective on milk production, George (1985) conducted a study on the production of milk through city dairy farming practices. He stated that city dairy farming is not only surviving but also at times, it is doing much better way. This phenomenon is not restricted to Bombay city. An analysis of the document of Bangalore on milk production clearly stated that milk yield decreases with the distance from the centre of Bangalore city and urban cattle produce 4,000 litres of milk annually that is more than rural stock.

Aneja and Puri (1997) stated that the public sector dairies meet 40% of the liquid milk demand in class-1 cities. The remaining balance is shared between the private, organised and traditional sectors. The traditional sector is more concerned with home delivery with one month credit. Further, the traditional *dudhwala* is willing to sell small quantities of milk which may be 250 ml or less for use as in tea or coffee.

The dairy units, which are coming up in and around Guwahati city to supply fluid milk to the urban consumers are generally owned by private producers, contribute 60.30 percent of the total milk supply to the city market. The processed milk and milk products from outside the state on the other hand has a market share of about 31.10 percent. The West Assam Milk Producers' Co-operative Society popularly known as *Purabi Dairy* has a market share of 5.20 percent, while the Government Dairy has 3.30 percent only (Bora, 1993).

George (1985) studied the economic viability of dairy practices in *peri-urban* localities and concluded that there were distinct benefits from such *peri-urban* land based specialised dairying for urban populations. Milk is produced efficiently and

intensively. Procurement, preservation and transport are not particularly problematic and uneconomic as the distances involved are not great; consequently the prices received by the consumer can be satisfactory and such a transitional area acts as buffer between urban demand and rural supply.

Singh (1974) interpreted the economics of milk production for Indian peasants that a very limited number of farms in India are specialised for dairying but the majority of cultivators keep one or two milch stock according to their means, size of holding and the nature of farming. It is combined with crop production as a necessity. The milch stock of India is cows and she buffaloes. Agriculture and raising of the food are so dependent on the efficiency of the cow that is called 'cow culture' because she is the mother of bullock and integral part of agriculture. Indians have realised the usefulness of this animal from time immemorial. Thus, the cow has been playing and will continue to play a very important role in the agricultural economy of India, which is subsistent food grain and plough-oriented.

The national scenario with regards to the milk production in our country as observed in the above may not reflect the settings of milk production activities in case of the cities or towns of India. Most of the traditional dairy communities, which are scattered in and around the Guwahati City are becoming milk producers by choice. They bear a strong family background on this profession. The assured milk market supports them to continue the profession generation by generation.

Jain (1986) studied the importance of keeping milch cattle in the agricultural situation of India and stated that, the prevailing mixed farming pattern, crop products and dairy products are two major sources of income to the family of India. Income from crop farming is subject to the seasonality and fluctuations from year to year due to the vagaries of nature. Steady and round the year income from dairying reduces the

oscillations in the farmers' income.

Banerjee (1996) stated that India possesses immense opportunities regarding dairying and the United Nations Food & Agricultural Organization (FAO) described India as the 'slumbering giant' of the international dairy trade. Swaminathan (1998) observed that today India has about 16 percent of the global population and 15 percent of the world's farm animal population but only 2 percent of the world's arable land, 1 percent rainwater, 0.5 percent forests and 0.5 percent of grazing land. In spite of such imbalance of the endowment of natural resources, out of 956 million population nearly 70 million marginal, small and landless dairy farmers scattered over 6 lakh villages and nearly 550 towns and cities of the country have able to make India 'Number two Producer of Milk' in the world just after USA producing about 203 million litres of fresh liquid milk daily with an annual value of output of Rupees fifty thousand crores which is more than that of individual earnings of paddy, oilseed or wheat (Kurien, 1997). Facing the similar national situation in regards to resource endowment as observed by Swaminathan, most of the dairy households Greater Guwahati Region are one of the less privileged classes. Most of the dairy households do not have their own landholdings. Most of them have been operating their dairy unit under heavy uncertainty. In spite of their having innumerable constraint they have been contributing highest share in milk marketing in city market till date. Favourable climate is also one of the factors for the growth of cattle. Saharia (1995) studied the diverse climatic conditions prevalent in different parts of the country which have reasonable impact in the development of cattle in terms of production and health. Hence the housing and the management systems of cattle should also suit to the particular climatic condition prevalent in the region to obtain optimum production from the animal.

Das (1980) has observed that good cattle are generally found in dry areas and inferior cattle in the areas of heavy rainfall. In rice growing regions, cattle are generally found to be greatly deteriorated, both as regards their physical development and capacity for work and milk production.

Ambatkar and Majgaonkar (1994) studied the disadvantages confronted by the city milk producers and explained that in big cities like Bombay and Calcutta, only the milk animals are kept. These city milk producers' cannot afford to maintain dry and low productivity animals.

**2.3.2 Local Perspective on Milk Production:** There are also a number of studies relating to the impact of human labour on dairying. Singh and Singh (1991) studied the reports of the milk yield relating to the dairy cows maintained in urban and rural areas and found the daily herd average milk yield of crossbred cows in urban areas to be 10.38 litres.

Analyzing the role of human element, Shah and Singh (1994) reported that crossbred cows in Bareilly district of Uttar Pradesh yielded a daily herd average of 4.98 litres of milk in rural and 5.39 litres in urban areas. The difference of yield in milk production of crossbred cows in rural and urban areas indicates that the urban crossbred cows are better maintained in comparison to that of the rural counterpart. It is a common observation that most of the dairy farmers of the greater Guwahati region, maintained smaller to larger herd size of milch cattle. Naturally the smaller herd size maintained inside the city region would get better nurtured which leads to better milk yields. The work of Chatterji and Goswami (1965) is one of the good references in this context. They studied some aspects of livestock economy with particular reference to cattle in rural India with the data obtained from National Sample Survey. The study revealed that the non-cultivator households managed cattle

and buffaloes better than the cultivator households in India.

Phukan et al. (1975) conducted a study on dairy farming in the Brahmaputra valley of Assam. They considered two categories of dairy farmers, namely, the agricultural cum dairying households and primary dairying households. Results of the study show that the agricultural-cum-dairy households marketed only a part of their milk production (about 400 litres per year per farm) while the dairy farmers marketed about 85 percent of their production (about 4164 litres per farm per year). The income from dairy was found to be Rs. 3630.00 per farm in case of dairy farmer while the total income (including other sources) was Rs. 4,045.00 per farm per year. The agricultural-cum-dairy farmers had a total income of Rs. 3,557.00 per farm per year, on an average. The optimum size of household's dairy farms appeared to be around 10 to 15 animals per farm. This size gave a net return of about Rs. 5000.00 annually. It is concluded in the study that the Brahmaputra valley had a vast potentiality for dairy farming on commercial lines.

Gohain (1974) studied the cattle economy of Sibsagar and Kamrup districts of Assam. The study revealed that the farm households had realised 14.83 percent of their total income from milk production, 1.08 percent from the sale of livestock and 1.14 percent from poultry and piggery. Thus, livestock and poultry contributed 16.64 percent of the total households' income. It further indicated that the major source of income of dairy farmers in the form of dairy business including sale of livestock accounted for 86.56 percent of households' income in the upper and central part of Brahmaputra valley.

Khongla (1975) observed that the level of altitude was found to influence the milk yield in dairy cattle raised by the local farmers in Guwahati-Shillong Milk-shed area. The Guwahati-Shillong Milk-shed area is one of most dairy concentrated

localities of Greater Guwahati Region. The dissected undulating hills with frequent valley cuts topographies are becoming more suitable to dairy farmers to locate their dairy farming practice extensively.

#### **2.4 Studies related to Milk Consumption**

In general, Aneja and Puri (1997) studied the status of milk consumption and stated that milk is the most important livestock product from the lowest income level in urban areas. The consumption of milk and milk products increase as income of households increases in urban areas.

Bagha (1998) studied the importance of milk consumption and put forward the golden saying of McCollum in this context that the people who have achieved, who have become large, strong vigorous, who have reduced their infant mortality, who have best trades in the world, who have an appreciation of art, literature and music, who are progressive in science and in every activity of human intellect are the people who have used liberal amounts of milk and its products. Some of the milk habit consumers perceived that the adequate quality milk consumption leads the consumers to the height of all kinds of development. Often, some of the milk habit consumers argue that the States of Punjab, Haryana or Gujarat of India are becoming comparatively higher per capita income states because of their higher per capita intake of milk.

At international perspective, that milk is being utilized in various forms for human consumption since time immemorial (Dall, 1994). The modern scientific researchers have proved it to be an excellent and perfect food item than any other single food. Keeping its nutrition value in view, certain minimum consumption levels have fixed by different agencies such as World Health Organisation (WHO) recommending the minimum consumption per capita of 280 gm of milk per day.

Indian Council of Medical Research (ICMR) recommends 248 gm/day per head. At present, the average per capita consumption of milk is 741 gm/day in Switzerland, 623 gm/day in United States of America, 501 gm/day in United Kingdom and 637 gm/day in New Zealand and the World average being 303 gm/day per capita.

The diet of an average Indian comprises 51 gm of protein per day. In the case of vegetarians, milk is the only source of animal protein. The meat eating people obtain about 4 percent of the protein in the diet from milk products. Against this in the developed countries, 62 percent of protein in diet comes from animal source and nearly half of it from milk and milk products (NCA, 1976). As food habit of most of Indian population is vegetarian, they consume more milk. Therefore, milk is part of Indian Culture called 'cow culture'. So, milk has cultural significance in India.

The experts of Indian Council of Medical Research (ICMR) have recommended about 300 gm milk per day for children of less than 7 years, 250 gm for 7 to 18 years, 200 gm for adults whereas an additional need of 125 gm is mentioned for expectant mother. These recommendations are for vegetarians. For non-vegetarians recommended requirements range from 200 gm/day for children to 160 gm/day for adults. The minimum nutritional requirement per head per day is about 201 gm of milk (Sukhatme, 1970). According to a conservative estimate, the milk consumers of Guwahati city are getting supplied fresh fluid milk far less from their normal daily requirement. This supply and demand gap for fresh fluid milk is generally maintained by the packaged powdered milk coming from outside the state. Most of the consumer does not prefer to consume these kinds of milk. Instead, this powdered milk is extensively used in tea stalls. It is a common phenomenon that the milk consumers of Greater Guwahati Region very often have been detecting an undesirable taste of powdered milk in their delivered milk by private vendors.

The source of strength of the Indian milk consumer lies in behind that whether he is rural or urban; he has to have his glass of milk as far as possible. There is no substitute for it to safeguard his health and welfare. This attitude, inherited for centuries has made India the world's largest consumer market (Shah et al.1987). Visualising this fact, Pandey (1998) concludes that 60 percent of Indian population is vegetarian and milk has a very special place in the Indian diet. It is an essential part of our morning's first cup of tea or coffee.

The consumption of milk relates to the development of progress, a nation achieves, is evident from the fact in developed nations where the consumption of milk is very high (approximately 750 gm/person/day) (Bagha, 1998). In India, the State of Punjab, which is the most developed, also has the maximum per capita consumption of milk, which is quite comparable to the developed countries. The average milk consumption in India is only 178 gm/person/day while the minimum recommended by the Nutritional Research Council is 220 gm/person/day.

Various surveys indicate that the actual average milk intake is as small quantity as 20 gm/day in parts of the Eastern Region as against a high of 400 gm/day in the Northern Region. These levels reflect the vast scope for rise in milk demand in the foreseeable future (Dairy India, 1997). It is a fact that most of the indigenous people of North Eastern Region have the dietary habit of non- vegetarian. The habit of milk and milk products consumption are coming here along with the British annexation. Consumption of cattle milk by human being is still remaining as a taboo for a section of people of this region. Consequently, the average general milk intake become much less over the national average. However, this general milk consumption situation is not reflects in the cities and towns of North-Eastern Region because of its complex population composition.

The success of Indian dairying is rolled due to some agro-economic factors. Cattle keeping are an age-old cultural, traditional or hereditary character of mass population in India (Hatibaruah, 1999). Naturally, it becomes a subsidiary or complimentary income source to the farmers. Cattle often seems to act as a bearer cheque for the farmers, or in modern context cattle perhaps may be treated as a walking factories converting huge quantities of crop residues into valuable food or power houses generating vast amount of energy for crop production and rural transport and serve as a fertilizer factories providing the much needed organic manure for crop production.

It is worth to mentioning here that a sizable section of the dairy communities of the study area have been using their farm residues i.e. the dung as fuel and fertilizer. The male cattle in their farm are sometimes disposed to meet the expenses during the dry period of their milch cattle.

Madan Mohan (1989) studied the importance of rearing of cattle which is recognised in India since time immemorial. In olden times, the richness of a household was measured on the cattle strength it possessed. In course of time, the cattle were also used as a medium of exchange. Doshi (1950) conducted a study on economics of milk production and distribution in Kaira district (Gujarat) and found that milk production costs were influenced by depreciation charges on animal, cost of fodders, wages, salaries, and rent of stable. He also noted that the milch animals in cities gave more milk than that in village as the city stable owner selected better breeds of animals and too greater care in feeding the animals. The fact that dairying could play a more constructive role in promoting rural welfare and reducing poverty is increasingly being recognized. For example, milk production alone involves more than 70 million producers in India, each raising one or two cows/buffaloes. Cow dung

is an important input as organic fertilizer for crop production and is also widely used as fuel in rural areas. Cattle also serve as an insurance cover for the poor households, being sold during times of distress (NMPF, 2006).

Considering local perspective of socio-economic status of milk producer communities in Assam, Baruah (1985) studied their spread effects. He stated that the Nepalese who presently constitutes the largest share as the milk producers began to land in Assam since the early part of the 19<sup>th</sup> century and, subsequently, they have monopolised the dairy industry of the land. The British establishments also have attracted some other milk habit people especially from the northern part of India. The people from Bihar, Rajasthan, Punjab, and Uttar Pradesh have strong milk habit. In course of time, some of them have opted for milk and milk products business. A similar observation was made by Hunter (1975) that the trade of Kamrup is almost entirely in the hands of *Rajasthanese*. They confined their business in the town of Guwahati and Barpeta. It is important to note here that the *Rajasthanese* are vegetarian in nature. They have strong milk habit and have traditional expertise in making sweets from milk and milk products for their home consumption and for trading purpose too. These situations consequently create a room for potential market for fresh liquid milk.

Bujarbaruah (1992) made an extensive field investigation and observed the strength, weakness and opportunities of some dairy related activities in Assam and stated that today, a district has an average 20-25 dispensaries, besides there are institutions to control various diseases and implement programmes of cattle development. In spite of this situation, there is a gap between the profession and the farmer beneficiaries. Moreover, dairy farming is recognized as an alternate a source of non-commercial energy and manure. Ramaswamy has calculated that 80 million work

animals in the country can generate 40 million Horse Power (HP) or 30,000 Mega Watt (MW) of electric energy, which is the existing capacity of the power sector. Khadi and Village Industries Commission, New Delhi has estimated that if 75 percent of the dung produced in India by bovines are tapped, the country can generate 195 Mega Watt Hour power (MWH) of energy every year which would be more than half of the current electricity production (Jain, 1986).

Naidu (2000) studied the opportunity and economic viability of the by-products of dairy sector and stated that with annual export earnings of around Rupees seven thousand crore leather sector accounts for the 4<sup>th</sup> rank among the major commodities exported from India. This sector provides direct employment to more than two million people. Though the dairy sector directly or indirectly possesses immense economic potentialities in India still it has some limitations in context of natural environment that prevails in the country. Singh et al. (1995) studied and stated that both crop raising and animal husbandry depend on natural environment, which has limitations. It is possible to change the natural ecosystem in arid or semiarid areas, but this can be done only at a very heavy cost. Dairying can equitably distribute the gains and permeate even the weakest sections of society. It can be developed into a major weapon for attack on rural poverty, unemployment and underemployment (Bujarbaruah, 1982). Singhal (1999) quoted a recent survey conducted by the Food and Agriculture Organisation (FAO) which has declared India as the top milk producer surpassing USA. He again stated that this credit goes to millions of small and marginal farmers, and landless and landless labourers for their untiring efforts and the institutional support provided by various agricultural universities and central research and development organizations. This has happened because of only marginal improvement in animal productivity in our enormous low productive milch animal

population.

Mishra (2006) analysed the present situations of milk producers' communities of Greater Guwahati Region and stated that despite their die-hard work, they live in a poor life. Many of them are in debt to the *kabuliwalas* - the private money lenders. They borrow amount ranging from Rs.50,000 to Rs. 1,00,000 at a high rate of 6-10 percent interest per month on the sum taken on credit. So, most of their sale proceeds go to paying the debt leaving them empty the debt leaving them empty handed at the end of the month. On the other hand, the middlemen between rural based producers and urban based consumers plays excessive role in restricting the income of milk producers (Madan Mohan, 1989).

## **2.5 Studies on Milk Profitability**

Dairying in Bangladesh is growing fast but faces problems of high input and low output prices leading to lower profitability. Due to globalization and the impact of world milk price changes, dairy farmers need to find ways of reducing costs and increasing returns in order to be more competitive. It is suggested that, farmers need to adopt new cost reducing management strategies and the government should take initiatives to reform the institutional arrangements by liberalizing input markets, developing basic infrastructure and facilitating access to yield increasing technology which can, ultimately, reduce costs, improve on productivity and farm profit (Uddin et al. 2010). The study revealed that crossbred cows were more economical and gave higher yield than the indigenous cows, inclusion of a few crossbred cows can increase the income of a dairy entrepreneur and provide gainful and round the year employment of its family labour. So, inclusion of crossbred cows should be popularized simultaneously with artificial insemination programme to augment milk production of the indigenous and crossbred cows more scientifically and profitably

(Islam et al. 2008). In order to reach minimal milk production cost it is necessary to achieve high milk yield, the number of the herd should be optimal and the existing labour force on the farm should be used efficiently (Priekulis et al. 2009). Genetics may also play a role in dairy efficiency. Daughters from high genetic merit bulls produced more milk than low genetic merit bulls even though feed intake was not different. With current milk prices, one way to maintain profitability without sacrificing milk production or herd health is by enhancing feed efficiency (Hutjens, 2010). Milk producer communities in India earned an average profit of 1.4 rupees per litre without accounting for family labour. This value declined to 0.4 rupees per litre when the cost of family labour was included at market wage rates. This decline was more evident on small and medium dairy households (DHHs) as they use mostly family labour for dairy farming activities. Ignoring the cost of family labour, the average profitability of milk production was higher in the northern region at 1.5 rupees per litre, compared to 1.3 rupees per litre in the west. However, when family labour was accounted for, the DHHs in the western region made higher profits per litre of milk at 0.7 rupees per litre, compared to 0.4 rupees per litre in the northern region. This is because the market wage rate used in costing family labour is higher in the northern region than in the western region. In the case of dairy farming practice, small-scale milk producers in India have higher profits than do large-scale milk producers, even after family labour was costed. However, this cannot be easily generalized to other cases, since results of profitability analysis (excluding family labour costs) for Brazil and Thailand suggest that there were no significant difference in terms of profit per litre between small and large-scale milk producers (Sharma et al. 2011).

## 2.6 Studies Relating to the Feeds and Fodders Characteristics

Dairy farmers are recyclers of products that other industries discard like cottonseed and distiller's grain. These products are nutritious feed sources for cows, but if not used for that purpose would otherwise end up in a landfill (Dairy Farming Today, 2009).

Patel et al. (1993) studied the feeds and fodders situation in India and stated that India's livestock population requirements of green fodder are 612 million tonnes but the availability is hardly 224 million tonnes. A shortage of 388 million tonnes of green fodder makes to use marginal lands for planting fodder tree species. Similarly, there is an acute shortage of fuel wood. By 2000 AD, the fuel wood requirement in India is expected to reach 225 million tonnes as against present production of 11 million tonnes. Agro forestry tree species fulfils the felt needs of rural people for fuel, fodder, timber, packing material etc. A study conducted by Shah et al. (1994) found that traditional dairy trade is a large employment provider. It includes several hundred thousands of *dudhias*, *gowalas* and *halwais*. However, they are under no regulation of any kind except the pressure of surviving in the market place. They also found that milk vendors acquired competitive advantage with the help of door delivery, flexible pricing and imaginative credit policy (Dairy India, 1997). Singh (1965) examined the feed milk relationship and cost of production of milk on farms in the Delhi area. It was found that feed costs accounted for the largest share (72%) of the total costs of production of milk. Rationality on feed costs would lead to reduction in the costs of production of milk. With reference to available fodder for milch cattle in Assam, Das (1980) studied the common feeding practices for cattle in Assam and stated that peasants in Assam take little care in feeding cattle. Cows are generally let loose or allowed to graze in the dilapidated professional grazing grounds. During the winter,

when the fields are barren, the cattle do not get enough grass and the cultivators also do not think of supplementary feeds for their cattle. The only fodder that the bullocks get is dry rice straw. As such the cattle are underfed and ill-fed. During the summer season, acute problem of feeding the cattle has been created by the submergence of the grasses under flood water and by the full coverage of the fields by the *Sali* paddy crops in the flood free areas. The banks and the slopes of the embankments and the public roads are the only grazing grounds. The cattle subsist mainly on paddy stalks and coarse grass which grows in tanks that are almost silted up. After the flood is over, the cattle take the grasses that were submerged under flood water and infected with various germs of diseases and bacteria. As a result, the most valuable cattle population suffers from and dies of various diseases and epidemics in large numbers.

Satter (1989) studied the feeds and fodders situation in the state of Assam and stated that the one of the burning problems being faced by the farmers is high cost of feed and non-availability of quality fodder during the flood, drought, and other national calamities. Except maize, wheat bran, rice polish, mustard oil cake and other feed ingredients come from outside the state which the feed becomes very high especially because of transport bottleneck. Acute scarcity of fodder was felt in the entire state during the successive floods. To cope with the situation, it is proposed to setup fodder seed production with fodder banks facilities one in each district. The Department of Animal Husbandry and Veterinary of Assam is maintaining 5 Fodder Demonstration Farms. Their main objectives are of production and supply of seeds, root and seedlings to farmers to popularize the fodder farming under the present agro-climatic condition in the state (Saikia, 1999). In addition, Talapatra (1958) suggested the use of indigenous grasses of various descriptions which are available during the season. The predominant species of the indigenous grasses which could be collected

in large quantities for feeding the cattle may be broadly categorised as (a) the highland pasture grasses of which *ulu* (a kind of green grass) occupies about 70-80 percent of the land in most of the grazing areas of the state, (b) the aquatic grasses, (c) the semi aquatic, and (d) the hill grasses.

## **2.7 Concluding Remarks**

There are various problems of milk producers relating to their location of dairy activities, socio economic status as well as milk supply methods and means of transportation from milk producers to the consumers. In the locational perspective, it can be said that they are being shifted from central part of city to the peripheral areas but the proper arrangement of their milk supply was not made; so they disobeyed the municipal laws and came back again to the central part of the city. This issue is more related to the spatial organisation of dairy activities in urban environment. It is obvious from the review that generally the socio-economic status of milk producer families is low in urban societies because they belong to cattle rearing communities living primarily in rural areas and migrated to nearby cities to raise their income. Therefore, they follow the traditional system of dairy development in the modern urban societies.

The overall review of the studies given above brought out that in the case of locational and functional aspects of milk producer communities, almost all the relevant studies emphasised the considerable existence of the city market forces which are important in the concentration of dairy practices in an urban environ. And the impediments confronted by the milk producer communities in an urban environ are ultimately negotiated in favour of the presence viable market. The distance factor from the city market to the operational dairy households is also an important aspect for affecting the output-input of milk yields. Most of the studies suggest that the better

and balanced feed and fodder intakes to dairy cows yield higher production of milk. However, the share of milk production consumed by DHH remained almost constant. Most of the studies ensure that the primary milk producers are the ultimate decision makers about the location of their dairy farm as well as of the selling of their milk produce. In this perspective, the locational characteristics of dairy households are to be studied in detail separately considering Greater Guwahati Region as an observatory of dairy industry.

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## **Chapter-III**

### **Location and Concentration of Milk Producers**

#### **3.0 Introduction**

There are numerous studies on the locational aspects of milk producer communities within India and outside (Bohra et al. 2009, Konavalchuk et al. 2008, Ser-Od et al. 2008, Cruise et al. 1991 and Singh et al. 2006). However, it is fact that the location and socio-economic status of milk producers are more concerned with the two types of factors as:

- a) the requirement of milk which is more related to the concentration as well as the density of population within the city region, and
- b) the locations of milk producers, which help to understand the supply of milk in localities; it also considered as factor of milk supply in terms of minimizing the costs of milk production through optimizing the supply of (a) the feeds and the fodders from source point to the end user and (b) the milk to consumers.

Keeping these points in mind, the issues of locational as well as geographical factors of milk producers are addressed in this Chapter. The distributional pattern of population and related locational aspects of the milk producer communities living in the study area are also presented to support the locational aspects of DHHs.

#### **3.1 Population Distribution and its Concentration**

**3.1.1 Population Size:** Looking at the map of ward-wise distribution of population size, it is obvious that population is distributed unevenly (Fig-3.1).

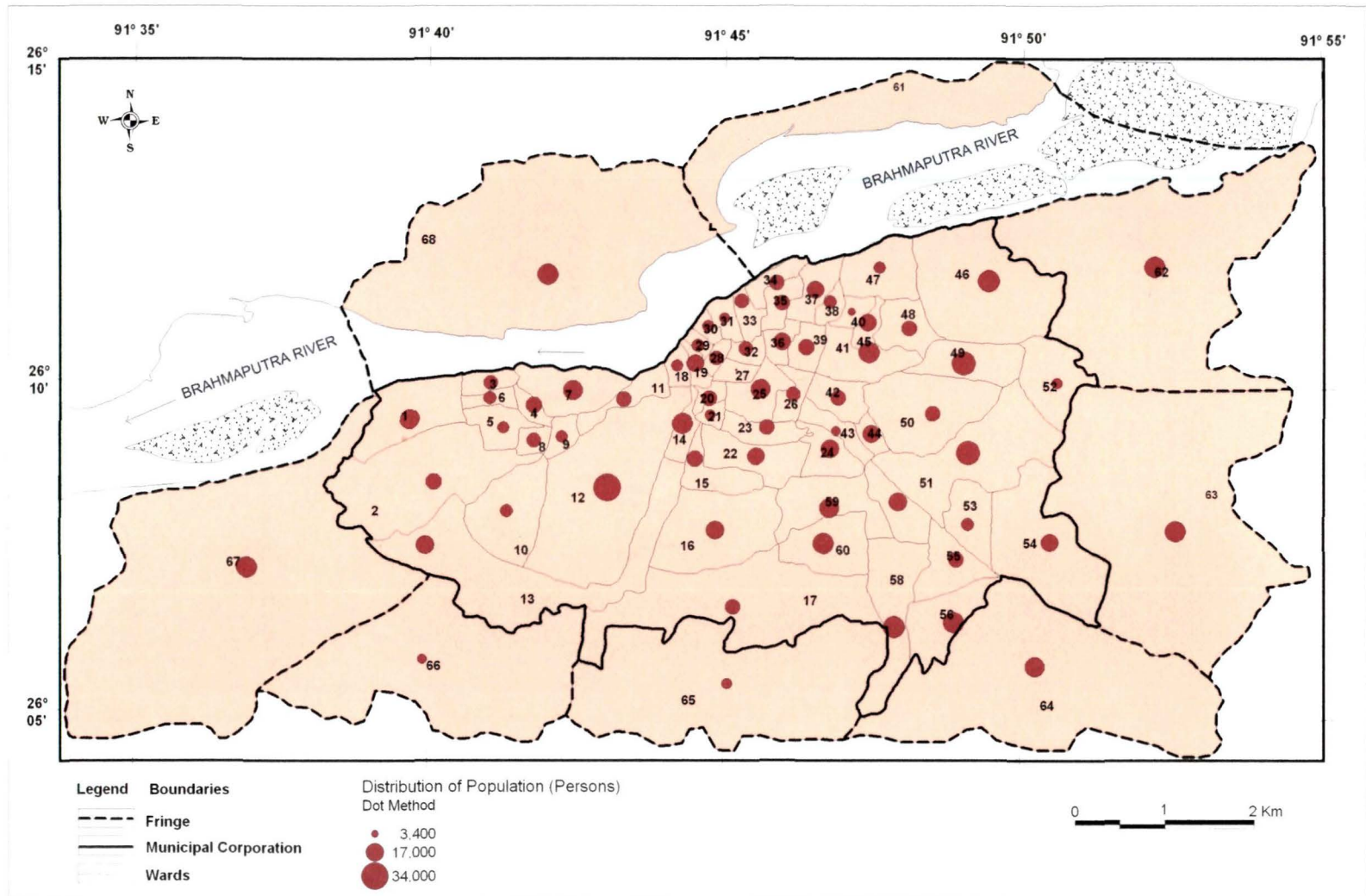


Fig-3.1: Distribution of Population in Greater Guwahati Region (2001)

The central parts of the city around Central Business District (CBD) have fairly large size of population (5,000 to 15,000 persons), while the moderate hilly terrain of low water table located in the frontier of Guwahati Municipal Corporation (as Municipal Ward No. 12, 49, 51) have much more larger population size (above 25,000 persons) (Fig-3.1, Table-3.1). This comparison of population size is related neither to the areal extent nor the population share of the municipal wards. This shows a crude distribution and indicates a scenario of the fact that the milk requirement is higher in the wards of high concentration of population size and *vice versa*. The wards of the central parts of Guwahati City are smaller in its areal extent, so the population in these wards is certainly lesser. However, it is not true for the fringe areas where, in spite of having larger areal extent, they have smaller population size.

The wards that bear larger population size are located in the hilly terrain of North-Eastern, South-Eastern as well as South-Western parts of the city, namely the Narangi, Bonda and Chandrapur localities in the North-Eastern sides, Hengrabari, Satgaon in the Eastern part and Fatasil NC and Gosala Pahar in the South-Western sides. The distribution of such higher population in the North-Eastern sides is due to the location of many tiny and small-scale industrial ventures in Narangi-Bonda-Chandrapur localities. The higher population distributions in Hengrabari and Satgaon localities are because of its closeness to the Dispur capital area, where good roads connectivity prevails. Moreover, most of the areas of Fatasil NC and Gosala pahar in the South-Western part are covered with Government unutilized land where middle or lower income group people have used to settle in these localities.

**Table-3.1: Distribution of Population in Greater Guwahati Region (2001)**

Population size (persons)	Population		Area (sq km)		No. of HH		Ward code	No. of Wards
	total	%	total	%	total	%		
1) Very large (above 25,000)	86,149	9.20	25.57	5.47	20,219	9.88	12,49,51	3
2) Moderately large (25,000-20,000)	1,90,957	20.38	196.34	41.99	39,212	19.16	14,41,46,58,60,62,63,67,68	9
3) Large (20,000-15,000)	2,55,295	27.25	83.14	17.78	56,655	27.68	1,7,13,16,19,22,24,25,44,45,54,56,57,59,64	15
4) Moderate (15,000-10,000)	2,65,722	28.37	91.00	19.46	59,580	29.11	2,3,4,11,15,17,20,23,26,27,32,33,34,35,36,37,39,42,48,50,55,61	22
5) Small (10,000-5,000)	1,30,271	13.91	46.94	10.04	27,432	13.40	5,6,8,9,10,18,21,28,29,30,31,38,43,47,52,53,65	17
6) Very Small (below 5,000)	8,380	0.89	24.57	5.25	1,592	0.78	40,66	2
Average (13,776)	9,36,774	100	467.56	100	2,04,690	100		68

Source: Census of India, 2001, Office of the Director of Census Operations, Assam, Guwahati

N.B.: HH- Household

**3.1.2 Population Concentration** (based on Concentration Coefficient): Concentration of any attribute in the distribution may be calculated by many number of ways. The degree of population concentration is measured by calculating share of the population of a ward to total population of the study area, which has finally divided by its average to arrive at the relativity of population share. It is formulated as:

$$\text{Concentration Coefficient} = [(\text{Population of ward} / \text{Population of study area}) \div \text{Average figures of population share}] \dots \dots \dots (3.1)$$

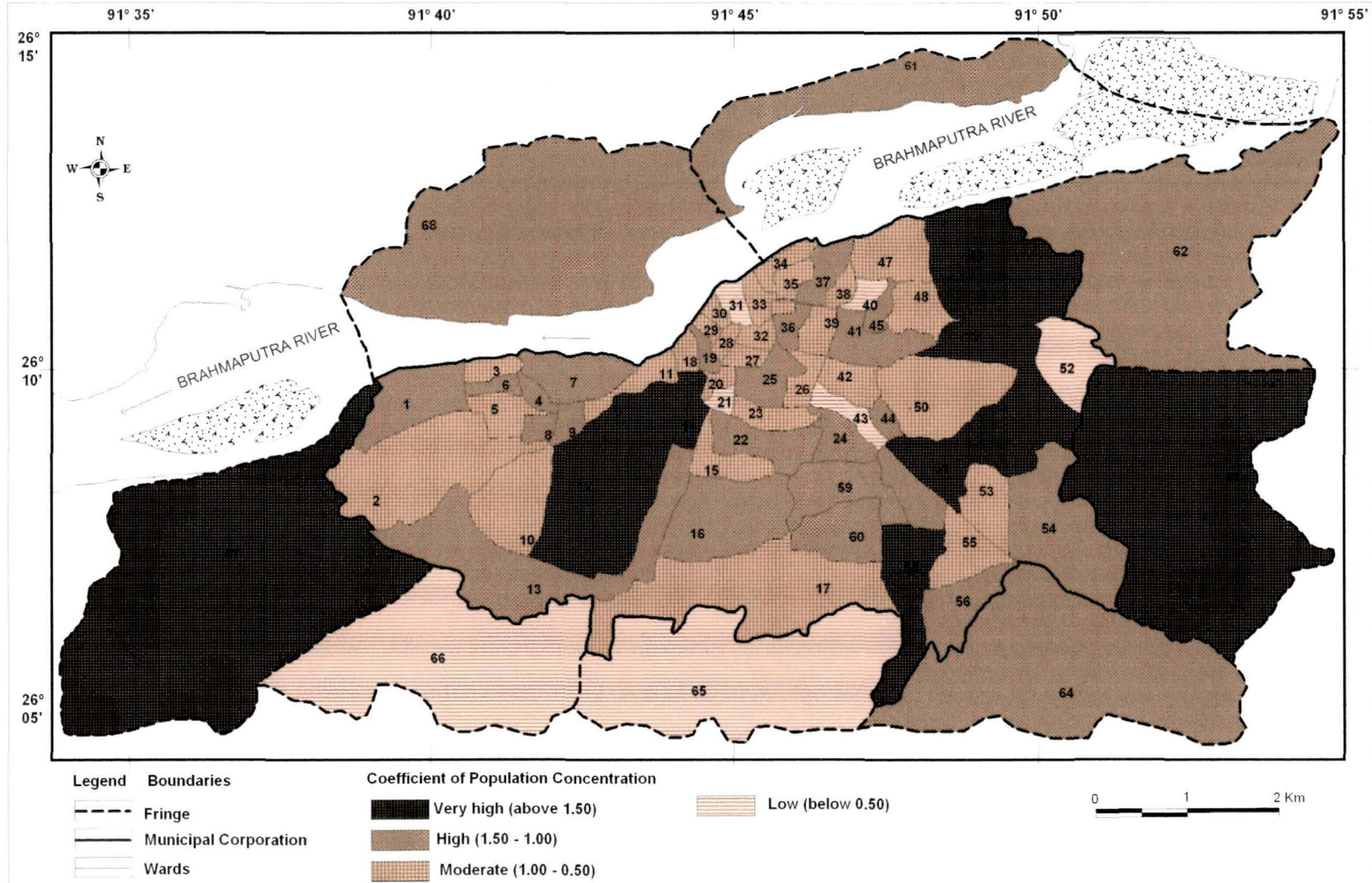


Fig-3.2: Concentration Coefficient of Population in Greater Guwahati Region

Due to the variation in the population size, the concentration of population in the study area is not uniform (Fig-3.2, Table-3.2). Very high concentration of population (above 1.50 coefficient of concentration) is shown only in eight numbers of municipal wards (Wards 12, 14, 46, 49, 51, 58, 63 and 67).

The South-Western parts (Wards 12 and 14) constituting a large area of Fatasil Reserve Forest have very high degree of concentration of population. Most of the land in these parts belongs to unutilized government land having hilly terrain with frequent valley cuts. Most of the peripheries of these wards traversed with business, industrial, and railway colonies having good transportation networks. The Fatasil Ambari localities (Ward 14) are adjacent to the city's prominent business cluster like Athgaon, Tokobari and Kumarpara that attracts a high concentration of population.

A section of landless people gets easy access to encroach the land of these localities that leads to high concentration of population. The North-Eastern parts of the study area (Wards 46 and 49) constituting the Ramcha, Chunsali and Hengrabari hills (located in the vicinity of Guwahati Refinery) are also have very high concentration of population. Bamunimaidan Industrial Complexes and Railway Transit Yard at New Guwahati are also part of the same areas of high concentration. Growing industrial complexes, migration of low wage labourers of the rural population in these transitional areas are main causes of high migration. Moreover, the areas of Hengrabari and Mathgharia localities that cover the Northern extension of Hengrabari Reserve Forests have high population concentration because of the establishment of railway residential colonies, goods yards of railways and many business complexes. Low-income group of city dwellers are also living in these areas. Likewise, the commercial extensions of Beltola localities (Ward 58) have high

concentration of population because of its convenient locational advantage to Dispur Capital as well as the business avenues of Beltola region.

There are some areas in the outskirts of city (Fringe 63) located in the Eastern side, namely Taltala, Hathimura, Amchang, Jorabat, Kumarkuchi, Haldhibari) and also in the Western corner (i.e. greater Azara localities in Fringe 67) have very high concentration of population. These two fringe localities have all weather road accessibility to central city market, which facilitates more population concentration. The areas of high concentration of population (1.0-1.5 coefficient) are dispersed either in the middle parts (residential areas) of the city or in the peripheral areas (Fig-3.2).

On the whole, these two categories of high and very high concentration of population accounts for about 61.5 percent population of the study area.

**Table- 3.2: Ward-wise Concentration of Population (2001)**

Category of concentration coefficient	Concentration coefficient	Population		Area (sq km)		DHH		Ward code	No. of Ward
	average	total	%	total	%	total	%		
1) Very high (above 1.50)	1.78	1,95,676	20.89	130.50	27.91	1,363	29.11	12,14,46,49,51,58,63,67	8
2) High (1.50-1.00)	1.26	3,80,807	40.65	216.33	46.27	2,745	58.63	1,7,13,16,19,22,24,25,36,37,41,44,45,54,56,57,59,60,61,62,64,68	22
3) Moderate (1.00-0.50)	0.75	3,22,075	34.38	65.58	14.03	324	6.92	2,3,4,5,6,8,9,10,11,15,17,18,20,23,26,27,28,29,30,32,33,34,35,38,39,42,47,48,50,53,55	31
4) Low (below 0.50)	0.40	38,216	4.08	55.15	11.80	250	5.34	21,31,40,43,52,65,66	7
Average/Total	1.00	9,36,774	100	467.56	100	4,682	100		68

The areas of moderate and low degree of concentration of population (below 1.00 coefficient) that include about one-third population (38.46%) are dispersed in the areas of the central, middle as well as the outer parts of Greater Guwahati Region. For example, most of the areas belonging to central part of the city cover government institutional lands and commercial complexes (Ward 29 and 30). It includes Fancy Bazar locality (AT Road, SRCB Road, Chamber Road, Tokobari, Athgaon and H.B. Road) and Panbazar locality (Lakhtokia, M.M.C. Hospital, Church, PWD Head Office). Cotton College premises, Guwahati Railway Station, Guwahati High court and other educational institutions (Ward 31) are also parts of central region. All these factors contribute in low and moderate concentration of population. Moreover, a group of two wards (Wards 65 and 66) located in the South-Western fringe (beyond Deepor Beel) has also low concentration of population due to bottleneck of transport and communication networks prevails in these areas.

The distribution of population concentration in the study area looks unusual as the central parts of the city is shown low concentration and peripheral areas have high concentration. It is because of not consideration of areal extent of the Wards. Share of population would always be lesser in smaller areal size of wards, so the concentration becomes lower in such wards. Density of population may provide a real picture of population congestion of the distribution.

**3.1.3 Distribution of Population Density:** The classification of wards into five categories on the basis of their population density and the distributional pattern of population density is given below (Table-3.3, Fig-3.3).

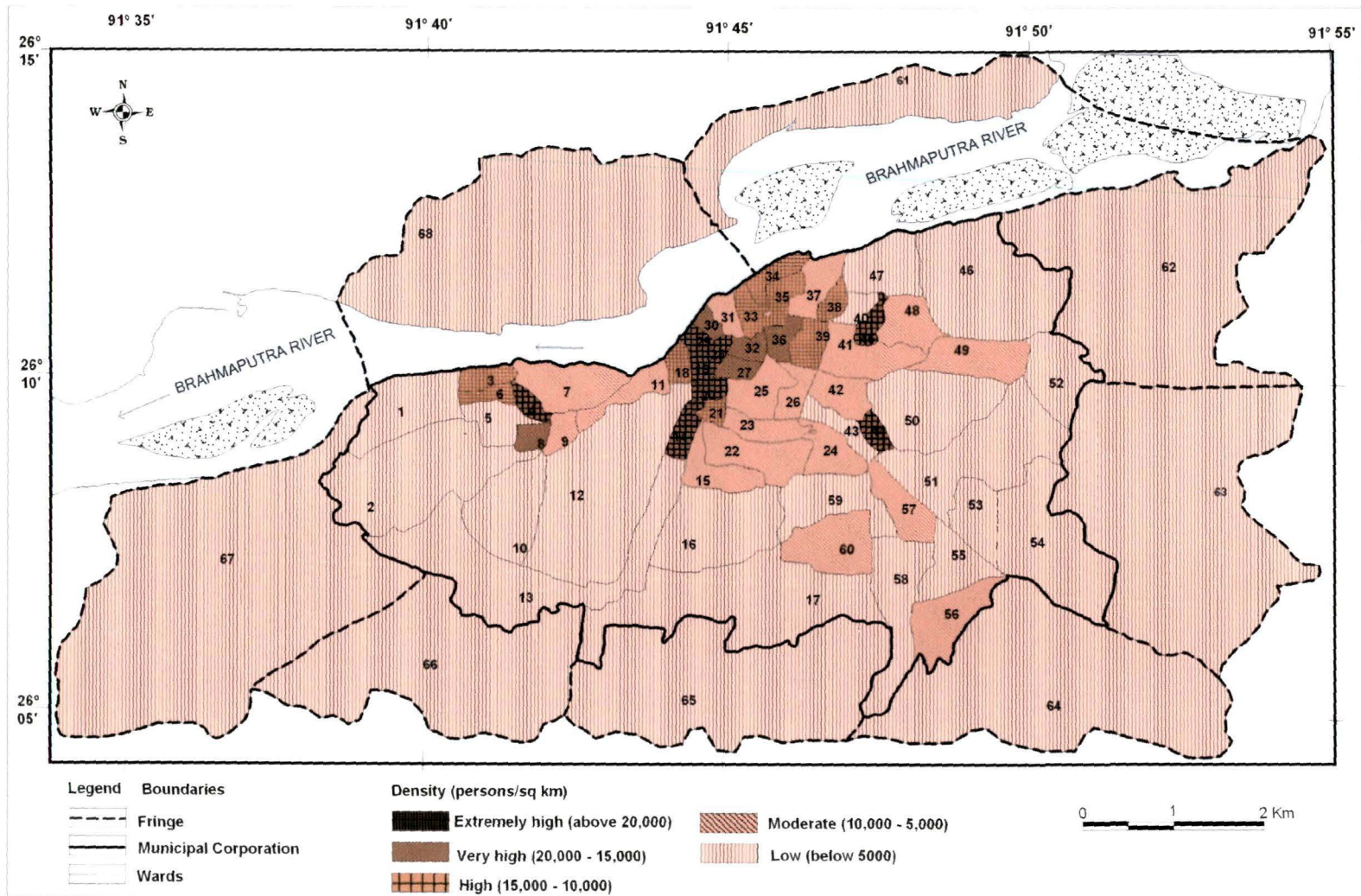


Fig-3.3: Distribution of Population Density (2001)

**Table-3.3: Population Density in Greater Guwahati Region (2001)**

Density Class (persons/sq km)	Population density	Population		Area (sq km)		No. of HH		No. of DHH		Ward code	No. of Wards
	average	total	%	total	%	total	%	total	%		
1) Extremely high (above 20,000)	23,405	1,09,668	11.71	4.71	1.01	23,547	11.50	84	1.79	4,14,19,20,28, 29,44,45	8
2) Very high (20,000-15,000)	16,781	53,513	5.71	3.19	0.68	11,632	5.68	18	0.38	8,27,30,32,36	5
3) High (15,000-10,000)	12,303	88,686	9.47	7.34	1.57	19,845	9.70	47	1.00	3,6,18,21,33, 34,35,38,39	9
4) Moderate (10,000-5,000)	7,655	2,71,087	28.94	36.96	7.91	63,503	31.02	322	6.88	7,9,11,15,22, 23,24,25,26, 31,37,41,42, 48,49,56,57,60	18
5) Low (below 5,000)	2,209	4,13,820	44.18	415.36	88.84	86,163	42.09	4,211	89.94	1,2,5,10,12,13, 16,17,40,43, 46,47,50,51,52, 53,54,55,58, 59,61,62,63,64, 65,66,67,68	28
Average /Total	8,552	9,36,774	100	467.56	100	204,690	100	4,682	100		68

**(a) The Areas of Extremely and Very High Density of Population** (above 15,000 persons/sq km): These categories include about 17.42 percent of total population dispersed in 13 wards of their smaller areal size. Most of these areas are located in and around central part of city through which main roads are passing. For example, Machkhowa, Kedar Road, B.R.P. Road, S.C. Road, A.T. Road (Ward 19); Bishnupur, Aryanagar (Ward 20); Chatribari, A.T. Road (Ward 28); Fancy Bazar, A.T. Road, M.G. Road, S.R.C.B. Road, T.R.P. Road (Ward 29); Fancy Bazar, Lakhtokia, Panbazar (Ward 30) and B. Baruah Road, Ulubari, Rehabari (Ward 32) are very close to the central part of the city. These localities are characterized by very high density of road networks. The business operating people with their associates use to reside here in spite of having all types of congestion. Such a situation contributes towards an extremely high population density.

The Pandu and Maligaon localities (Ward 4) in the Western part the city have also high concentration of population. Most of the retired employees of Indian Railways, craftsmen, small business holders, mostly from Bengali communities resides in these areas. In the Southern part, Fatasil Ambari and Dhirenpara (Ward 14) constitutes very high density of population, mostly with Bengali and Bihari communities. They prefers to reside within the environment of their own communities, which results high density of population. The localities like Sundarpur, Japorigog, Ganeshguri (Ward 44) are nearer to the Dispur Capital Complex. Most employees prefers to reside in these localities. Moreover, the Bamunimaidan Railway Colony, Jyotinagar, Lakhinagar (Ward 45) are connected with good communication networks and located in the environ of industrial area of Bamunimaidan and New Guwahati. Most of the industrial workers and employees have settle here, which contributes in extremely high density of population.

**(b) The Areas of High Population Density** (10,000 to 15,000 persons/sq km): The areas of high population density are dispersed within the close proximity of the central part of the city. Latashil, Happy Villa, Uzan Bazar, Chenikuthi, Hedayetpur, Chandmari, Pub Sarania Lachitnagar, Milanpur are closely interlinked with good road networks and preferred residential location for most people. Moreover, the Ferryghat colony, Adabari Railway colony and Bharalumukh (Wards 5, 6 and 18); Kalpahar and Mahendranagar (Ward 21) have also high concentration of population. Most of the areas of these wards are covered with Government institutional land. People has easily encroached these lands for residential purpose.

**(c) The Areas of Low Population Density** (below 5,000 persons/sq km): Nearly 90 percent area of Greater Guwahati Region accounts for this category of low population density (Table-3.3). Most of the areas of city's outskirts and fringes come under this category. Beyond the city's core, a semi-circular horse-shoe shaped hilly terrain is extending from the northern part of Happy Villa to Noonmati (Wards 34, 46 and 47) close to the bank of river Brahmaputra. As a result, most of the peripheral areas of city region including hilly terrain and *beels* fall under the category of low population density. The localities that cover the Reserved Forest like Sarania, Hengrabari, South Kalapahar, Fatasil, Gotanagar, Jalukbari and the hills of Kamakhya debottar have low population density due to the restrictions for permanent settlement. The unsuitability as well as restrictions of Government for permanent settlement covers a major areas in fringe, namely the Byrnihat foot-hills, Amchang, Garowani, Hahara, Teteliaguri, Chamata, Mata Pahar, Aprikala, Marakdola, Khanapara, Garbhanga, Rani, and Sila. These areas have very low density of population (less than 5000 persons/sq km). A sizable portion of the North and Southern fringe is covered with wetlands like Rangagara, Ghoramara, Khamrang, Borbilla and Deepor *beel*, which leads to less

population density. Most part of the plains Azara and North Guwahati (Fringes 61, 67 and 68) located in the active flood plains of river Brahmaputra. Density of population is very low in these localities due to the natural barrier and communication bottleneck.

On the whole, distribution of population density follows 'distance-decay pattern' in the Greater Guwahati Region (Douglas, 1994). It means that population density decreases exponentially in the wards located far from city centre. So the outer/peripheral areas have low to very low population density. Such density distribution leads to specific distribution of milk requirement. The areas of high population density of the city centre have higher demand for fluid milk than the peripheral areas of low population density. Concentration of DHHs may provide clues of distribution of milk supply in city region.

### **3.2 Concentration of Dairy Households**

The distribution of the supply of fresh fluid milk is more concerned with the distributional pattern of DHHs in Greater Guwahati Region. Distributional pattern of DHH may be interpreted by taking into account its three aspects: (a) proportion of milk producer households (i.e. DHHs) to the household consumers (that are total households in the locality) which would provide the crude index of producer-consumer ratio, (b) concentration of DHHs to analyse their distribution and (c) the density of DHHs which is area-associated term that may be compared with the other parameters of population distribution.

**3.2.1 Proportion of DHHs to Total Households:** Number of DHHs per 1000 total HHs is calculated to show the proportion. General distribution of DHH proportion shows a peculiar characteristics that the average value of this proportion is extremely high (198 DHHs per 1000 HHs) in the very high category of distribution but this

value is extremely low (only 2 DHHs per 1000 HH) in the very low category of DHHs proportions (Table-3.4). It shows that there is a large variation in distribution of DHHs.

Almost all the fringe areas of Greater Guwahati Region occupy about three-fourth (72.23%) share of total DHHs. Contrary to it, the central parts of city have low to very low proportion of DHHs.

**Table- 3.4: Number of DHHs per 1000 Total Households (2006)**

Proportion of DHHs per 1000 HHs	Proportion of DHHs	No. of DHH		HH		Population		Ward code	No. of Wards
	average	total	%	total	%	total	%		
1) Very high (above 35)	198	3,382	72.23	13,302	6.50	77,635	8.28	52,62,63, 64,65,66	6
2) High (35-25)	32	145	3.10	4,542	2.22	34,728	3.70	61,68	2
3) Moderate (25-15)	20	293	6.26	14,866	7.26	68,804	7.34	10,46,54,67,	4
4) Low (15-05)	8	679	14.50	86,964	42.49	3,75,257	40.06	2,6,9,11,12, 13,15,16,17, 21,22,23,24, 40,41,45,47, 49,50,51,53, 55,56,58,59,	25
5) Very low (below 05)	2	183	3.91	85,016	41.53	3,80,350	40.61	1,3,4,5,7,8, 14,18,19,20, 25,26,27,28, 29,30,31,32, 33,34,35,36, 37,38,39,42, 43,44,48,57, 60	31
Average/Total	23	4,682	100	2,04,690	100	9,36,774	100		68

**3.2.2 Concentration of DHHs:** Using concentration coefficient as formulated earlier (eqn-3.1), the all areal units (Wards/Fringes) classified into its five categories (Table-3.5). A similar pattern of distribution of concentrated milk producer population as highlighted earlier for proportion of DHHs is found in the area. It (concentration

coefficient) ranges from its average value of 9.82 (that is very very high on the scale of distribution) to 0.11 (i.e. very low). High value of concentration of milk producer population is in most of the peripheral areas except the Western fringe (Fringe 67) which covers Azara localities. The DHHs localities, namely Bonda, Birkuchi, Satgaon , Narangi located in (Ward 52) the border of the Fringe areas i.e. Panikhaity-Chandrapur (Fringe 62), which have similar topographic features and congenial environment for milk production, are also have high concentration of DHHs.

**Table- 3.5: Concentration of Dairy Households (2006)**

Category of concentration coefficient	Concentration	No. of DHH		Population		Area (sq km)		Ward code	No. of Wards
	average	total	%	total	%	total	%		
1) Very high (above 1.75)	9.82	3,323	70.97	71,145	7.59	149.29	31.93	62,63,64,65,66	5
2) High (1.75-1.25)	1.45	204	4.36	41,218	4.40	94.62	20.24	52,61,68	3
3) Moderate (1.25-0.75)	0.96	167	3.57	36,353	3.88	58.74	12.56	54,67	2
4) Low (0.75- 0.25)	0.40	696	14.87	3,15,007	33.63	103.15	22.06	2,6,9,10,11,12,13,17,21,22,23,40,45,46,47,49,50,53,55,56,58,59	22
5) Very low (below 0.25)	0.11	292	6.24	4,73,051	50.50	61.76	13.21	1,3,4,5,7,8,14,15,16,18,19,20,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,41,42,43,44,48,51,57,60	36
Average /Total	1.00	4,682	100	9,36,774	100	467.56	100		68

The causes of high concentration in these areas are: (a) juxtaposed to the nearby sand bars of Brahmaputra River, which provide extensive perennial natural grass cover and the dairy communities feel stable to operate their farm in such natural environment.

(b) the four fringe areas extending from North-Eastern parts of Greater Guwahati Region to the South-Eastern part bordering the Ri-Bhoi district of Meghalaya, and further to the South-Western part of Garbhanga Reserved Forest of Kamrup rural district, have higher concentration of DHHs (Fig-3.4, Table-3.5). The special advantages of all these fringe pockets are that they are located in the dissected hilly areas having enormous valley cuts with swamps at valley floor. It is seen that concentration of DHHs is generally on the flat tops of denuded hills that provides them easy disposal facilities of their cowshed waste. The swampy valley floor provides them winter grasses: the hilly terrain facilitates them to have green fodders during summer rainy days. The concentration of DHHs in these peripheral areas is due to the milk producer behaviour that is determined mainly by their preferences for advantageous and safe location to enjoy the economic environment. The attitude of DHHs to avoid the urban congestion and pressure, which greatly disturb the functioning of the dairy farms, is no less significant as far as the peripheral location of dairy farms is concerned. The highest concentration of DHHs is found in the South-Eastern pocket along the Meghalaya border near Burnihat and the Eastern pocket around Khanapara and Jorabat (Table-3.6). It is due to the result of their rational knowledge and economic behaviour in the context of the fodder territories (locally available green fodder in summers and dry straw of paddy crops for winter fodder) and the city market (that increases demand of fluid milk). The dissected and rolling hills with large number of small undulating valleys along with all-weather roads benefit the farms in many ways. Such topographic advantage gives them opportunity to collect fodder and fuel from the hilly tracts in both winter and summer to a considerable extent without paying any corporation tax or toll fees. It is important to

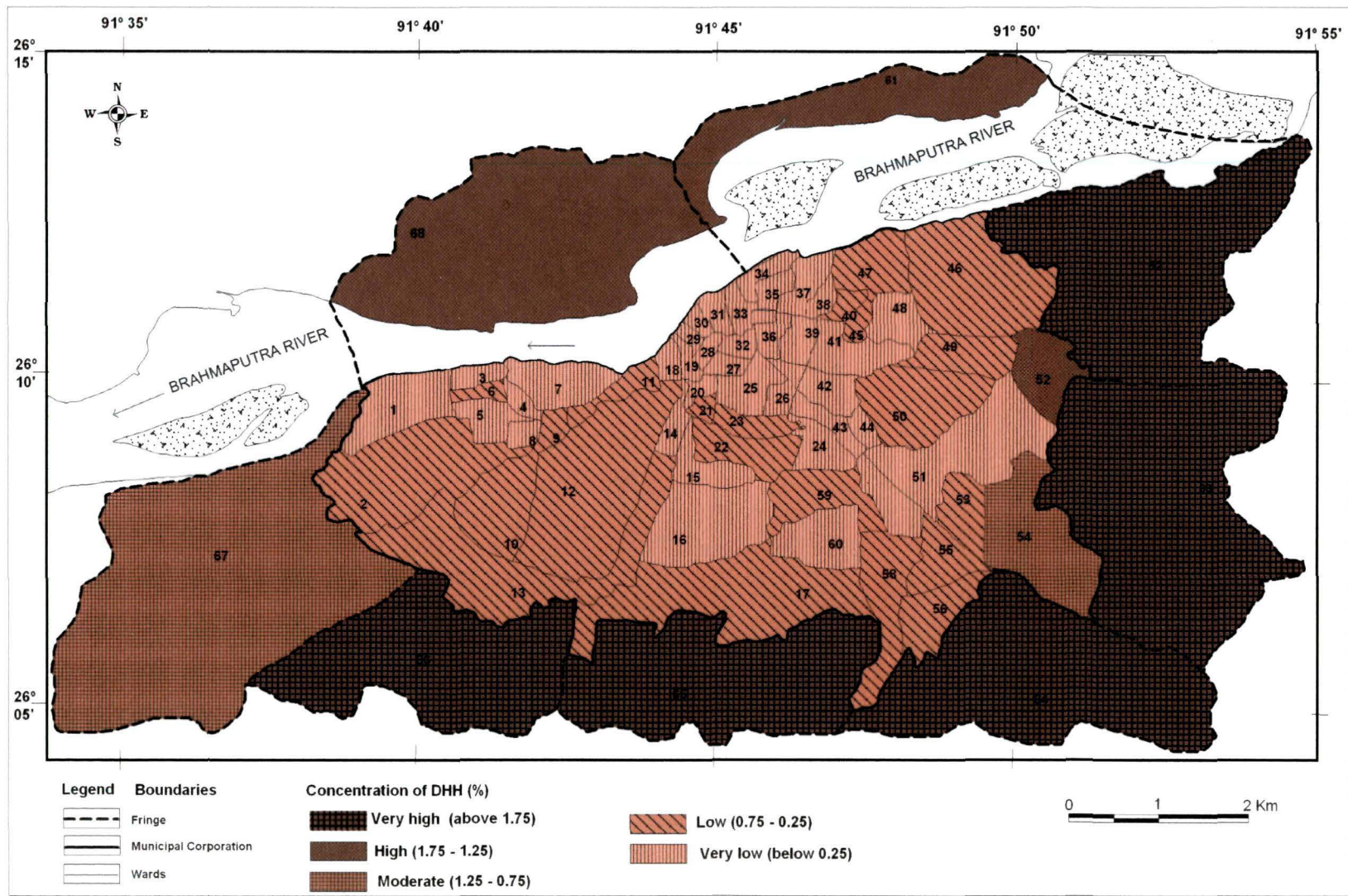


Fig-3.4: Concentration of Dairy Households in Greater Guwahati Region, 2006

**Table-3.6: Distribution of DHHs in the Fringe of Guwahati City**

Fringe code	Fringe pockets	Places of DHHs concentration	Economic and other characteristics	No. of DHH	Distance from city centre (km)	
					minimum	maximum
61	Northern Pocket covering Kuruwa	Lenga, Kuruwa Chapori	Abundance of aquatic grass, Close to Rice Growing areas	58	15 km	32 km
62	North-Eastern Pocket around Chandrapur Panikhaity Bonda Hills	Chandrapur Amchang Laharpara Rail gate Bondagaon Birkuchi Kalitakuchi	Hills/Rolling terrain, Abundance of aquatic grass, Close to Rice Growing areas	789	16 km	31 km
63	Eastern-Pocket around Amsang Jorabat Khanapara Hills Jorabat	Jansimalu Khanapara NC Amerigog 7 <sup>th</sup> to 12 <sup>th</sup> mile Jorabat	Hills/Rolling terrain, Natural grass land, Close to Rice Growing areas	959	15 km	28 km
64	South-Eastern Pocket around Meghalaya foot-hills- Burni R.F	13 <sup>th</sup> mile 14 <sup>th</sup> mile Burnihat	Hills/ Rolling terrain Natural grass land, Meghalaya beef market, Burni Cattle Market	1410	17km	26 km
65	Southern Pocket surrounding Meghalaya foot-hills Garbhanga R.F.	Barpathar Mayoli	Hills/ Rolling terrain Natural grassland & Forest	103	16 km	20 km
66	South-Western Pocket surrounding Rani R.F.	Patgaon	Forest Grassland Close to Rice Growing areas	62	15 km	21 km
67	Western pocket covering Azara, Kahikuchi, Air port	Kahikuchi Airport	Airport market Grass cover of Airport	84	18 km	25km
68	North-Western Pocket surrounding Agyathuri Hills Silapahar,	Amingaon Silamahekhaity	Forest grass Aquatic grassland IIT (G) Colony, Maligaon/Amingaon market	87	12 km	15 km

Source: Brihattar Guwahati Go-Palak Sanstha, 2005 and Self-surveyed, 2006.

note that the transportation system in the localities of milk producers is still in the lowest level of development. Majority of the farmers carries their milk from their farms to the collection centres, which are operated by either middle-man or milk co-operatives. They carry milk to the collection centres by transporting milk through bicycle or manually. *Nepalese* who constitute more than 60 percent of the total milk producers invariably prefer the hill slopes to locate their farms, which indicates some sort of spatial uniformity. Distance is one of the factors for carrying milk to collection centres that has impacts on the economy and concentration of DHHs.

### **3.2.3 Pattern of DHHs Density**

In view of density of DHHs, it is important to note that the areas of extremely high density or extremely low density of DHHs dominate their density distribution. The salient features of density pattern would be interpreted in the following manner:

**a) The areas of high and extremely high density of DHHs** (above 16 DHHs per sq km) cover nearly one-fourth areas (24.31%). About 73.19 percent DHHs are dispersed either in the East and South-Eastern fringes or in the close by wards of City Centre (Table-3.7, Fig-3.5). There may be locational factors of such distribution of high-density areas; the DHHs of peripheral areas enjoy the natural environment and cheap fodder for milch cattle, while DHHs concentrated around city centre enjoys high price of milk because of increasing milk demand. Mahendranagar, Bimalanagar, Birubari, Rupnagar, Pragatipur, and Nizarapar areas (Wards 21 and 23) cover the foothills of Narakasur hills in Southern part, and the extensive wetlands of Gopinathnagar, Rupnagar, in Northern part. These wetlands facilitate a large number of *Bihari* milk producers to perform smoothly their dairy practices. The other places (Ward 44) covering the foothills of Japorigog, the Western part of Hengrabari

Reserved Forest which are closer to Dispur capital market having unused government landholdings and the nearby affluent milk market, contribute for higher density of DHH. The entire New Guwahati and Bamunimaidan Railway colony cover the Southern extension of Hengrabari Reserved Forest (Ward 45). The milk producers exploit the un-utilised Railway land resources for their dairy operations. The Mathgharia, Oughuli and Patharkuwari villages (Ward 49) also located in the North-Eastern extension of Hengrabari Hills Reserved Forest. The nearby wetland fronts of the Damal *Beel* provide perennial green grass to the milk producer communities of this Ward. Likewise, across the River Brahmaputra, the northern fringe (Fringes 61 and 68) stretching from Panikhaity, Kuruwa, Barmajhali and Raumari Chapori to the Agyathuri Reserved Forest of the Western parts of North Guwahati have also high density of DHHs.

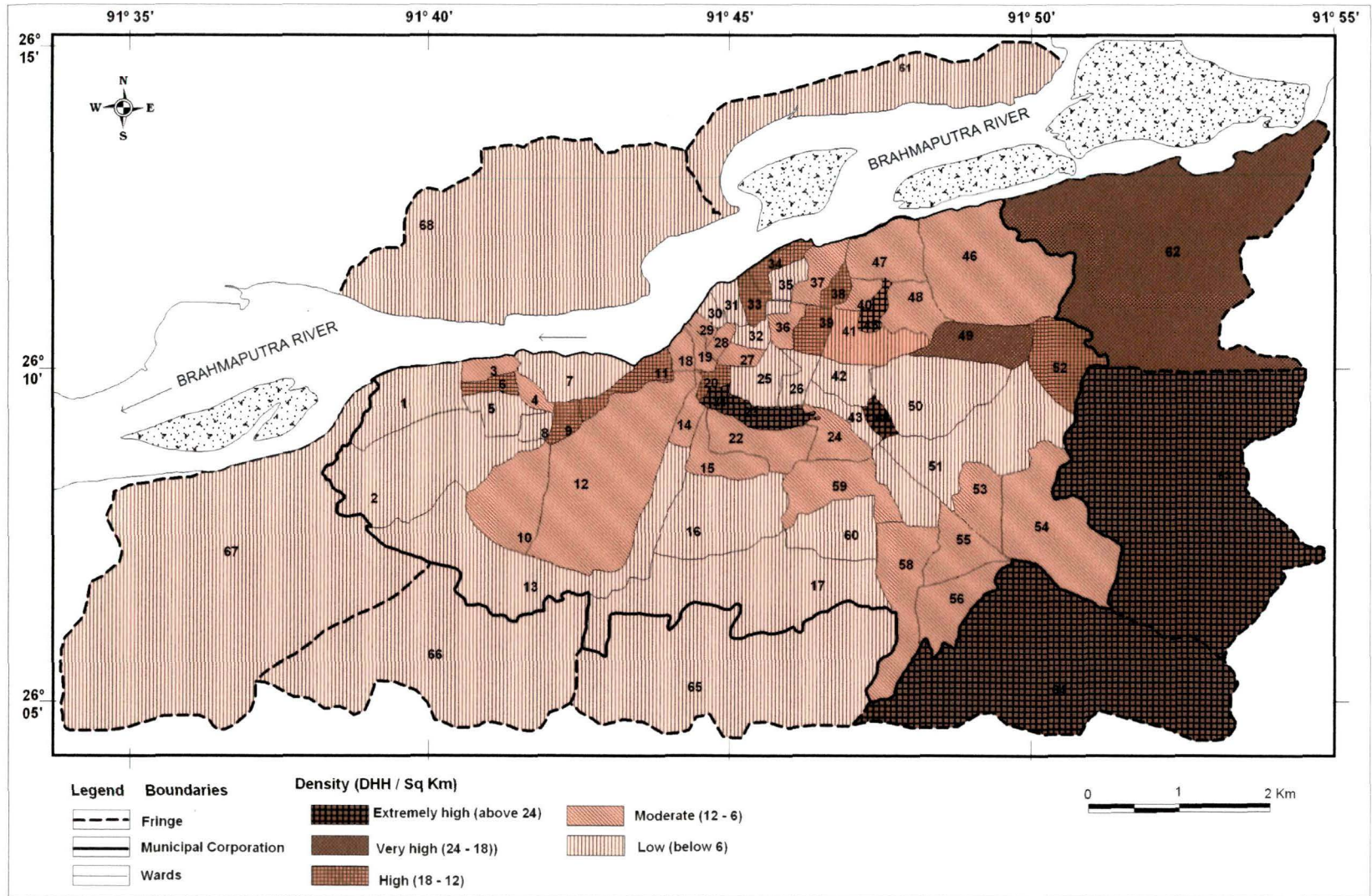
**Table- 3.7: Categories of DHHs by their Density**

Density class (DHH/sq km)	Density	Population		Area (sq km)		No. of DHH		Ward code	No. of Wards.
	average	total	%	total	%	total	%		
1) Extremely high (above 24)	36	77,322	8.25	69.03	14.76	2,431	51.92	21,44,45,63,64	5
2) Very high (24-18)	22	57,779	6.17	37.79	8.08	885	18.90	23,49,62	3
3) High (18-12)	16	47,022	5.02	6.87	1.47	111	2.37	6,9,11,20,52	5
4) Moderate (12-6)	8	3,76,475	40.19	77.24	16.52	614	13.11	3,4,10,12,14,15,18,19,22,24,27,28,29,36,37,40,41,46,47,48,52,53,54,55,56,58,59	26
5) Low (below 6)	3	3,78,176	40.37	276.62	59.16	641	13.69	1,2,5,7,8,13,16,17,25,26,30,31,32,33,34,35,38,39,42,43,50,51,57,60,61,65,66,67,68	29
Average/Total	9	9,36,774	100	467.56	100	4,682	100		68

The Eastern border lands of the study area that includes Chandrapur Hills and South Amchang Reserved Forests and also extends gradually to South-Eastern direction upto Khanapara and Marakdola Reserved Forests including same topographic features of Myllem Reserved Forest of Ri-Bhoi District of Meghalaya state, have very high density of DHHs (Fig-3.5). The milk producers get so much convenience in these fringes due to some favourable factors. These areas have enormous government unutilized landholdings. Such situation upholds less competition from city's land speculators that enhances higher densities of DHHs in these fringes as well.

**b) The areas of low density of DHHs** (below 6 DHHs per sq km) that include nearly 29 wards/fringes with a concentration of only about 13.69 percent DHHs and 40.37 percent of total population of Greater Guwahati Region, cover more than half of the area (59.16%) (Table-3.6). Such areas are dispersed in the outer parts of Municipal area of the City including the fringes of South-West adjoining the Southern peripheries of Brahmaputra River (Fig-3.5). Most of the DHHs here are of the indigenous local people rather having less interest in cattle keeping.

Density-divide in Greater Guwahati Region shows that, in spite of favourable topographic conditions in the fringe areas for cheap fodder, the density of DHHs is found to be low in some of the fringe areas. Specially, the Brahmaputra-*par* and low lying areas along National Highway 37 (Airport road), which are dominated by indigenous fishermen communities have low density of DHHs. On the other hand, fringe areas of high density with high concentration of DHHs are taking advantage of geo-environmental and socio-economic conditions: the available cheap fodder and fast supply of milk to the market. There are some advantages of cultural background for the communities living in the study area, which belong to *Nepalese* and *Biharis* for nursing and maintaining the milch cattle.



**Fig-3.5: Distribution of Density of DHHs in Greater Guwahati Region**

### 3.3 Locational Characteristics of DHHs

The existing concentration of milk producer communities in Greater Guwahati Region more or less reflects the conformity to other city's concomitant, particularly in respect to their locational dimensions. Because of spatial variations in the urban environment of the study area, the locational characteristics of milk producer communities also vary that implicitly affect the spatial pattern of milk supply. Such issues of geographical locations of milk producers can be addressed by analysing socio-economic characteristics in respect to their locations from the city centre, which is the area of maximum milk consumption.

Two main dimensions of locational characteristics of DHH are pursued here as:

- (a) to throw the light on the general distribution of DHHs in order to make comparison of the concentration of population with the DHH distribution, and
- (b) to highlight the physical distance from the city market centre as well as road accessibility of milk producer communities, that must provide the basis of locational characteristics of DHHs.

Detailed results of the analysis are given below:

**3.3.1 Distribution of DHHs *versus* Population:** If these two distributions were compared over urban space of Greater Guwahati Region, it would provide clues of concentration of DHHs (milk producers) subject to population (milk consumers). These dimensions of discussion are dealt herewith by categorising wards/fringes into five population concentration classes to visualise the strength of DHHs in each class and by establishing relationship between concentration of DHHs and population (Fig-3.2, Fig-3.4 and Table-3.8). To understand the nature of DHHs distribution, the discussion leads towards the following interesting results:

**Table-3.8: Ward-wise Distribution of Population, Area and DHHs**

Ward code	Population	% of Ward's population to Total Population	No. of DHH	Area of Ward (sq km)	Density of DHH (DHH/sq km)	Population Density (persons/sq km)	% of DHH to Total HH	Density of Roads (km/sq km)
1	18,190	1.94	9	6.08	1.48	2,994	0.25	4.86
2	13,622	1.45	18	10.34	1.74	1,317	0.68	6.23
3	10,258	1.1	5	0.89	5.6	11,492	0.22	17.36
4	12,619	1.35	7	0.61	11.48	20,694	0.26	21.21
5	7,318	0.78	4	1.62	2.46	4,509	0.24	6.92
6	9,071	0.97	11	0.64	17.15	14,145	0.58	27.2
7	19,166	2.05	6	3.26	1.84	5,874	0.15	5.56
8	9,993	1.07	3	0.64	4.66	15,507	0.14	17.72
9	7,272	0.78	12	0.79	15.17	9,196	0.76	24.37
10	8,996	0.96	30	4.60	6.53	1,958	1.58	5.41
11	12,331	1.32	21	1.53	13.73	8,059	0.78	17.68
12	33,846	3.61	79	14.07	5.61	2,406	1.06	6.12
13	16,609	1.77	48	11.98	4.01	1,386	1.35	3.46
14	21,125	2.26	8	0.94	8.47	22,357	0.17	14.18
15	13,535	1.44	13	1.86	7	7,289	0.46	14.56
16	16,854	1.8	19	6.73	2.83	2,506	0.5	11.82
17	10,924	1.17	23	13.34	1.72	819	0.9	5.26
18	7,394	0.79	4	0.68	5.92	10,938	0.28	15.82
19	15,010	1.6	5	0.54	9.3	27,915	0.18	18.2
20	11,858	1.27	8	0.51	15.84	23,472	0.32	11.29
21	6,572	0.7	14	0.45	30.92	14,514	0.94	14.29
22	15,740	1.68	28	2.93	9.56	5,374	0.84	8.99
23	11,029	1.18	29	1.39	20.89	7,946	1.11	11.41
24	15,963	1.7	18	1.79	10.07	8,933	0.47	14.08
25	18,425	1.97	9	1.96	4.59	9391	0.21	13.36
26	10,705	1.14	3	1.07	2.8	9977	0.11	17.04
27	10,725	1.14	6	0.62	9.62	17,188	0.26	17.39
28	9,832	1.05	5	0.46	10.98	21,585	0.25	7.57
29	8,465	0.9	3	0.35	8.46	23,872	0.24	13.31
30	7,564	0.81	2	0.43	4.65	17,570	0.15	9.26
31	5,616	0.6	2	0.82	2.43	6,835	0.19	12.09
32	10,245	1.09	2	0.66	3.02	15,462	0.09	15.03
33	10,531	1.12	1	0.91	1.09	11,529	0.05	10.03
34	11,512	1.23	3	0.94	3.21	12,302	0.12	12.47
35	11,968	1.28	4	1.06	3.77	11,280	0.14	13.5
36	14,986	1.6	5	0.82	6.06	18,176	0.14	12.48
37	14,546	1.55	15	1.57	9.53	9,241	0.44	9.9
38	8,123	0.87	3	0.63	4.75	12,865	0.15	12.98

39	13,257	1.42	2	1.14	1.76	11,660	0.06	14.47
40	3,420	0.37	8	0.70	11.47	4,905	0.91	13.84
41	20,360	2.17	24	2.73	8.81	7,472	0.48	13.48
42	12,181	1.3	5	1.61	3.11	7,575	0.17	15.48
43	5,400	0.58	2	1.19	1.68	4,538	0.18	14.08
44	15,117	1.61	17	0.62	27.22	24,203	0.43	21.63
45	15,642	1.67	31	0.68	45.86	23,142	0.84	15.97
46	23,455	2.5	96	10.65	9.01	2,202	1.73	3.91
47	7,799	0.83	18	3.15	5.72	2,480	0.96	8.23
48	11,622	1.24	13	2.01	6.47	5,785	0.44	8.61
49	26,314	2.81	67	2.98	22.46	8,821	1.05	9.23
50	10,933	1.17	22	6.20	3.55	1,763	0.81	8.91
51	25,989	2.77	35	8.52	4.11	3,051	0.55	9.46
52	6,490	0.69	59	3.40	17.34	1,907	3.88	5.08
53	8,608	0.92	19	2.37	8.02	3,634	0.94	11.63
54	15,347	1.64	83	8.55	9.71	1,796	2.36	5.25
55	11,785	1.26	25	2.53	9.87	4,653	0.83	14.74
56	19,683	2.1	35	3.18	11	6,184	0.76	9.79
57	16,143	1.72	6	2.05	2.92	7,863	0.15	16.06
58	22,741	2.43	35	4.91	7.13	4,632	0.64	13.42
59	18,615	1.99	27	3.74	7.21	4,973	0.58	16.48
60	20,456	2.18	16	3.43	4.67	5,967	0.31	14.92
61	14,550	1.55	58	39.38	1.47	369	2.93	0.34
62	20,436	2.18	789	33.42	23.61	611	23.08	1.34
63	21,200	2.26	959	38.23	25.09	555	27.57	1.4
64	18,791	2.01	1,410	29.05	48.54	647	46.61	0.92
65	5,758	0.61	103	24.72	4.17	233	8.94	0.45
66	4,960	0.53	62	23.87	2.6	208	8.74	0.33
67	21,006	2.24	84	50.19	1.67	419	2.15	2.67
68	20,178	2.15	87	51.84	1.68	389	3.4	2.32
Total/ Average	9,36,774	100	4,682	467.56	9.22	9,310	2.34	11.1

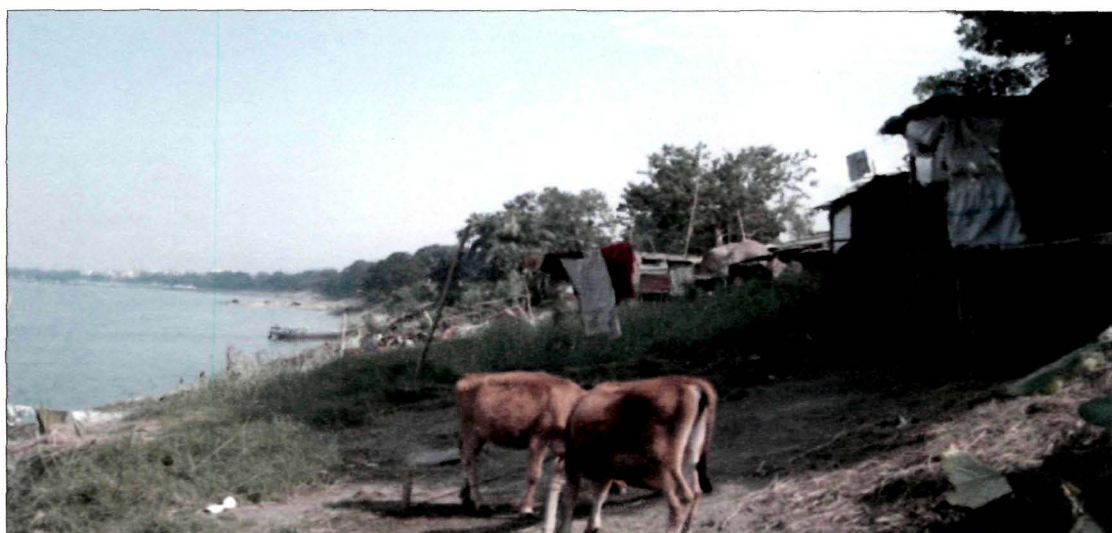
Source: Self-Surveyed and Census Hand Book (2001)

N.B.: Population data based on 2001 census and Number of DHH based on 2006 Records

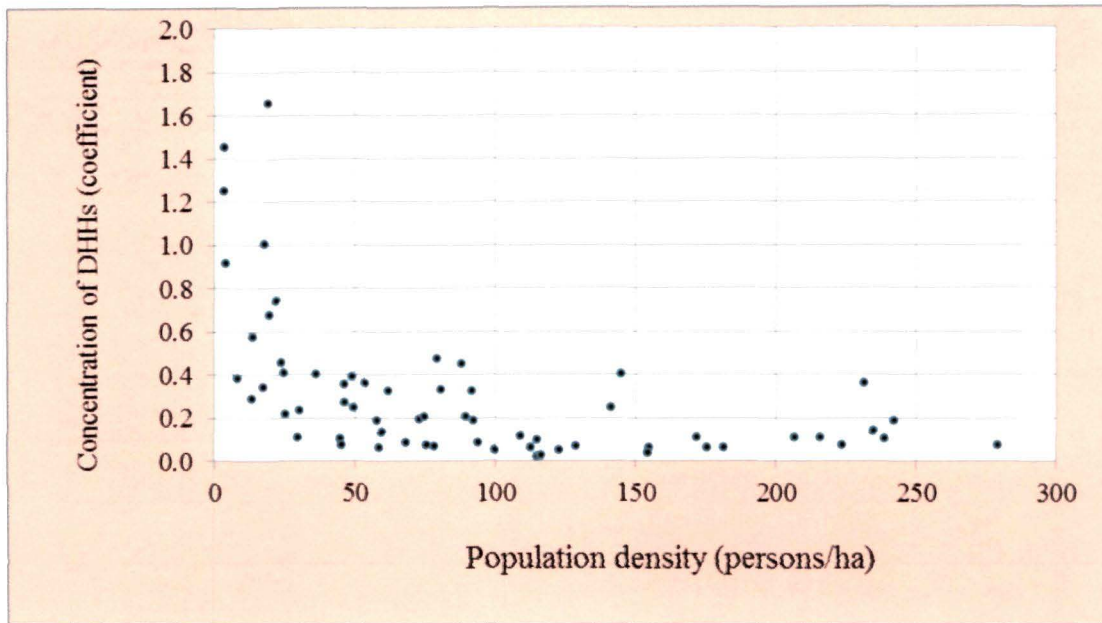
(a) In the areas of high and very high population concentration (above 1.00 coefficient), these areas account for more than three-fourth (88%) share of the DHHs of Greater Guwahati Region. Contrary to it, a mere share of DHHs (i.e. nearly one-tenth) is distributed in the moderate and low population concentration areas (below

1.00 coefficient) (Table-3.2). Such areas are generally located in the peripheral zones of the city region. It is obvious in the present analysis that the population density that is one of the important factors for DHH concentration is to be considered in the present analysis.

(b) If population density is displayed against DHHs concentration at scatter diags, it is very clear that the areas of low density of population have higher concentration of DHHs and *vice versa* (Fig-3.6). As a result, the trend of distribution is found concave in nature, which shows a negative relationship with fast degree of concentration of DHHs at very low level of population density. Since low population density prevails in the outer Ward/Fringe areas of foot-hill margins and low laying floods/swamps or *beels* with aquatic/semi-aquatic grasses are available for feeding of milch cattle, the concentration are more in these areas. Therefore, the location of dairy households appears to be influence by two factors: (i) the availability of water bodies or wetlands in the low lying areas of Wards/Fringes which provide more space and usable water for milch cattle population (Plate-3.1), and (ii) the accessibility of roads that provides facility to supply fresh milk to milk- demanding areas (Plate-3.3 and 3.7).

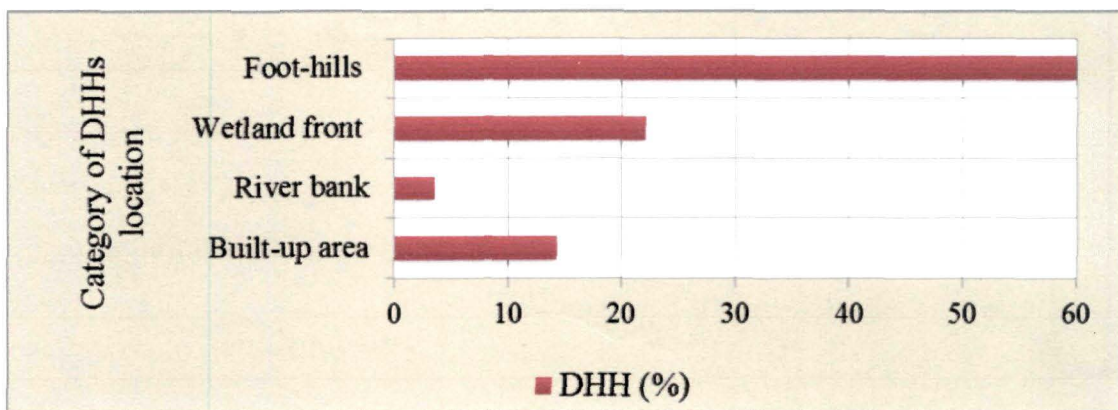


**Plate-3.1: DHHs location near Wetland**



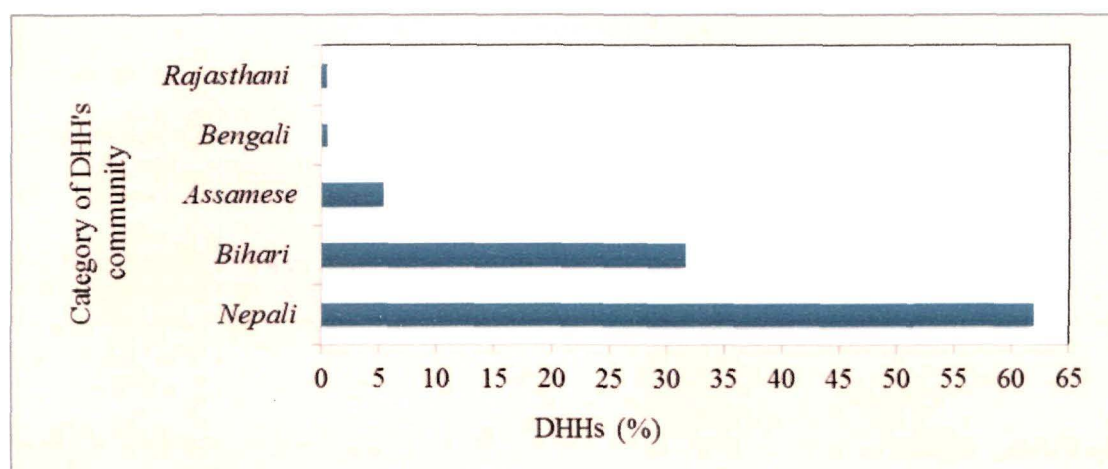
**Fig-3.6: Concentration of Dairy Household *versus* Population Density**

Considering topographic location of DHHs and their socio-economic status, it is found that DHHs are to be more concentrated in the foot-hills. More than a-half of DHHs are settled in the surrounded foot-hills (in peripheral areas of city region). Wetland fronts and river bank are also important places to settle DHHs (Fig-3.7). The reasons behind it are many but main reason is the availability of sufficient open



**Fig-3.7: Concentration of DHHs by their Topographic Location**

unutilized government land without payment of land rent. DHHs choose the location of dairy activity keeping in mind the availability of green fodder and running water. Therefore, there are locations of DHHs near the streams in foothills and close to the river banks or swamps. It is interesting to note that sex ratio and literacy rate is much higher of DHH families located in foot-hills areas. They mostly belong to *Nepali* community and their herd size is larger (Fig-3.8). They are, therefore most dependent on the income of milk production (Table-3.9).



**Fig-3.8: Concentration of DHHs by their Community**

**3.3.2 Accessibility of City Centre and Market Impact:** Classifying a total number of observations into eleven accessibility classes, namely, the areas of i) outskirts (beyond 30 km), ii) remote (27-30 km), iii) farthest (24-27 km), iv) extremely far (21-24 km), v) highly far (18-21 km), vi) very far (15-18 km), viii) farther (12-15 km), ix) far (9-2 km), x) near (6-9 km), xi) very near (3-6 km), xii) nearest (0-3 km), the following results are drawn from the present analysis. In spite of the significant variation in sex ratio and literacy rate of DHHs by market accessibility of city centre, the sex ratio and literacy rate improve as distance increases from city centre, while the dependency ratio of DHH families is calculated almost uniform everywhere (Table-3.10). It means that there is no relationship between literacy and dependency ratio. However, there is positive association of literacy rate with sex ratio. Precisely, it is

**Table- 3.9: Socio-Economic Status of DHHs by their Topographic Location (2006)**

Topographic feature of DHHs location	No. of Sample DHH		Milk Producer Communities (no. of HH)										Socio-Economic attributes			
			<i>Nepali</i>		<i>Bihari</i>		<i>Assamese</i>		<i>Bengali</i>		<i>Rajasthani</i>		Herd size	Literacy rate	Sex ratio	Dependency ratio
	total	%	total	%	total	%	total	%	total	%	total	%	average	%	females per 1000 males	
Foot-hills	222	60.00	191	86.00	26	11.70	5	2.30	0	0.00	0	0.00	15	78.70	832	1.5
Wetland front	82	22.20	22	26.80	58	70.70	2	2.40	0	0.00	0	0.00	14	68.68	732	1.5
River Bank	13	3.50	1	7.70	11	84.60	0	0.0	1	7.70	0	0.00	13	68.92	791	1.3
Built-up area	53	14.30	15	28.30	22	41.50	13	24.50	2	3.80	1	1.90	10	75.26	773	1.3
Average/Total	370	100	229	61.89	117	31.62	20	5.40	3	0.81	1	0.27	13	75.65	800	1.4

found that DHHs located in the vicinity of city centre (0-9 km) have low sex ratio (649 females per 100 of males) with low literacy rate (70%) with the dominance of *Bihari* communities. Their income share is less from milk supply and more from subsidiary activities because of availability of a variety of jobs in city market near their herds. Milk production is treated as livelihood survival in which child labour of family works are engaged in dairying. So literacy rate of DHHs living in these areas is found to be low. Secondly, the reason behind low sex-ratio is socially deprived *Bihari* communities which they do not like female-child birth because female children are considered as liability in their society in such families.

**Table-3.10: Socio-Economic Status of DHHs by Market Accessibility**

Market Accessibility classes (km)	No. of DHH	% of DHH	Sex ratio (females per 1000 males)	Dependency ratio	Literacy rate (%)	Per capita income (Rs/month)
Outskirt (beyond 30)	9	2.4	928	1.7	82.33	5,760
Remote (30-27)	15	4.1	882	1.3	75.60	4,926
Farthest (27-24)	7	1.9	879	1.4	75.29	5,149
Extremely far (24-21)	24	6.5	885	1.6	80.33	4,830
Highly far (21-18)	32	8.6	876	1.5	76.09	4,446
Very far (18-15)	68	18.4	867	1.9	76.43	4,578
Farther (15-12)	86	23.2	792	1.5	75.59	4,600
Far (12-9)	39	10.5	695	1.6	81.15	4,966
Near (9-6)	40	10.8	772	1.4	69.85	4,441
Very near (6-3)	34	9.2	649	1.5	69.76	4,594
Nearest (3-0)	16	4.3	746	1.8	74.69	3,564
Average (13.90)/Total	370	100	800	1.4	75.65	4,714

Source: Self-Surveyed during 2006

### 3.3.3 Road Accessibility and DHHs Status

Location of DHHs from vehicular road is also an important factor because distance (transport cost) is involved to supply milk and maintenance of herds of milch-cattle that requires natural environment in the city. DHHs settled at close locations from road may increase its profits by reducing transport costs. However, the DHHs who are located far from road i.e. in interior open places' get advantages of natural environment that milch cattle need to increase the quantity of milk. Classifying total number of sample DHHs by distance from vehicular road into five categories as: (i) remotely located DHHs (beyond 700 m) , (ii) distant (700-500 m), (iii) moderately accessible (500-300 m), (iv) accessible (300-100 m), and (v) the most accessible (100-0 m) and compiling the statistics related to socio-economic status of DHHs (Table-3.11, Fig-3.9) , it is found that –

**Table-3.11: Socio-Economic Status of DHHs by Accessibility from Vehicular Road (2006)**

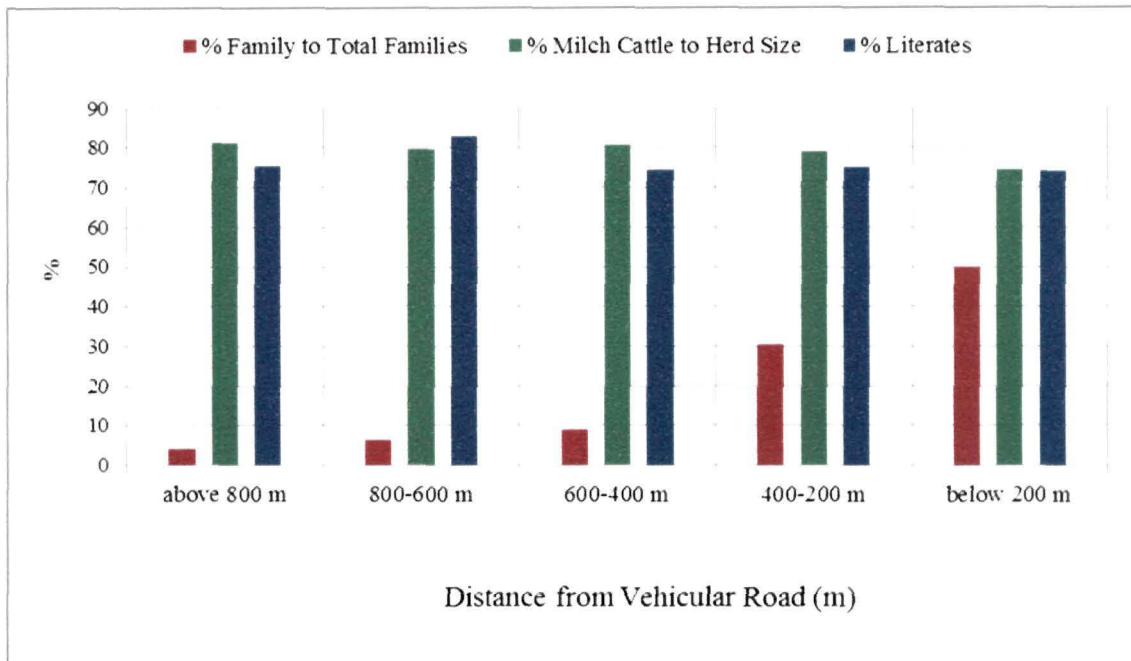
Distance from vehicular road (m)	DHH		Sex ratio	Dependency ratio	Literacy rate	Herd-size	Per capita income	HL/FL ratio	Income from milk to total income	Income from subsidiary occupation
	nos.	%			%	no. of cattle	Rs./person /month		%	%
1) Remotely located (beyond 700)	53	14	771	1.4	75.42	15	8,743	0.4009	97	3
2) Distant (700-500)	67	18	845	1.6	80.70	15	8,573	0.3582	98	2
3) Moderately accessible (500-300)	61	16	812	1.4	73.55	15	8,443	0.4208	98	2
4) Accessible (300-100)	102	28	813	1.4	74.64	15	8,398	0.2966	95	5
5) Most accessible (100-0)	87	24	730	1.4	74.73	10	9,654	0.7356	84	16
Average (392)/Total	370	100	800	1.4	75.65	14	8,719	0.4464	94	6

Abbreviations: HL-Hired labour, FL-Family labour

Firstly, the concentration of DHHs does not follow the regular pattern in its distribution in context with road accessibility. Concentration of DHHs lies either in the most accessible areas to vehicular road or in the remote areas where there is much lesser population pressure. The DHHs living nearby road-side supply milk to the markets of city centre, while the DHHs residing in interior areas of residential localities fulfill the localities' milk-demand.

Secondly, in spite of having more or less uniform per capita income from milk and subsidiary sources throughout, the DHHs residing in places of less accessible areas (beyond 700 m) from road have lower sex ratio (784 females per 1000 males) with lower dependency ratio that they have to be more dependent on family labour to operate dairying from less accessible places and expectedly having high income from milk production. Contrary to this, the high road accessible areas (between 0-300 m) have also lower sex ratio (749 females per 1000 males) but with smaller herd-size, lesser income from milk, and higher income from subsidiary sources. It indicates that most of the road-side milk producer communities could not keep large herd-size because of the public exposure of farm waste. Consequently, they have better utilized the near-by road communication facilities in opting subsidiary income and earning higher per capita income per month.

Thirdly, family size and herd-size matches in supply of milk and to make dairy activity survive. Being small family size with efficient family labour and larger herd size of high-breed milch cattle of DHHs residing close to road-side (100-500 m), it is visualized that such locations of DHHs in most accessible areas pay more to involve them into more commercial-oriented dairying by supplying more quantity of milk to the other areas/localities of larger milk-demand.



**Fig-3.9: Characteristics of DHHs by Distance from Vehicular Road**



**Plate-3.2: Concentration of DHHs near Brahmaputra River front**



**Plate-3.3: Concentration of DHHs at Machkhowa, a part of CBD**



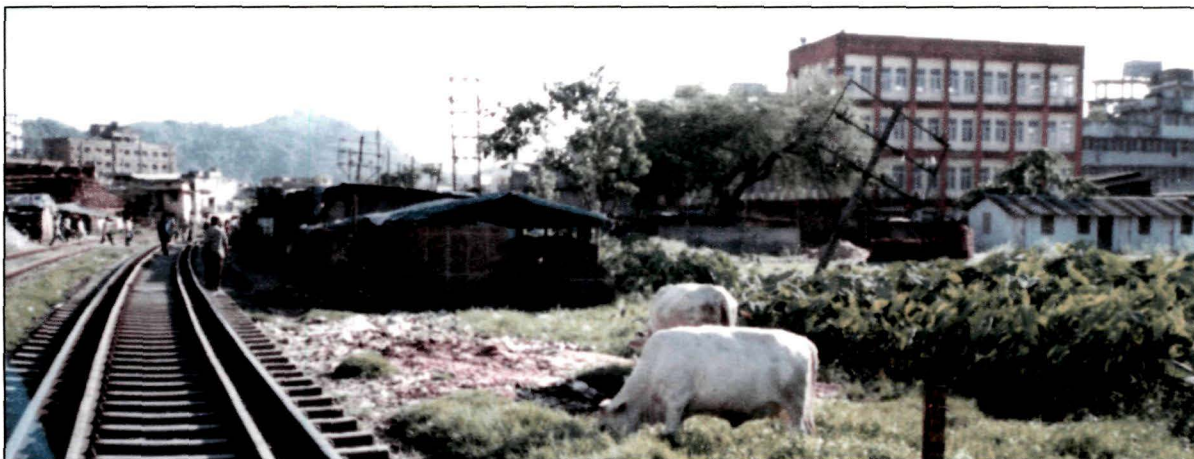
**Plate-3.4: Nepali DHHs at Foot-hills near Khanapara**



**Plate-3.5: Bihari DHHs on wetlands at Birubari**



**Plate-3.6: An eco-friendly cow-shed where cattle rest under natural shed**



**Plate-3.7: Milch cattle-sheds closer to CBD of Guwahati City**

### **3.4 Concluding Remarks**

In the forgoing analysis of concentration of milk producers in Greater Guwahati Region, some interesting conclusions can be drawn from the present analysis which are interpreted in the following manner.

i) It is universally true that the concentration of population in cities usually noted high to very high in and around the central hub of the city. Likewise, the same feature is prevalent in Greater Guwahati Region also. However, density of population is

recorded high in the wards located along the main roads. The road network contribute in the concentration of population and resultant increase in it's density.

ii) There is only 2.30 percent of share of total households engaged in dairying in the study area, which shows a significance of milk product and milk supply to the city region. However, the concentration of DHHs is found very high in the fringe areas, which are more convenient for settling the dairy communities because topographically such areas are convenient to nursing the milch cattle population and available fodder and natural grasses for grazing.

iii) If concentration coefficient of dairy households is plotted against the population density on scatter diagram, it is very clear that the areas of low density of population have higher concentration of dairy household and *vice versa*. As a result, the trend of distribution is found concave in nature, which shows inverse relationship. The DHHs are concentrated in the areas of low population density of peripheral wards/fringes in Greater Guwahati Region.

iv) Generally, the location of dairy households is more influenced by three factors:

a) The availability of water bodies or wetlands in the Wards/fringes, provide more space for shed-waste disposal and usable water for milch cattle population.

b) The hills or foot-hills are the natural choice for *Nepalese*, the dominant dairy communities of Greater Guwahati Region (Plate-3.4). It provides natural landscape for much needed easy, clean and convenient gradient of slope for milch cattle rearing practice in spite of having poor road communication facilities.

c) The density of roads in most of the river front localities (15.29 km/sq km) of Guwahati City provides facility to supply of fresh milk to 'milk-demanding areas' as well as for 'easy-home delivery' of milk.

However, the socio-economic conditions of DHHs are one of the aspects of the study, which may provide more details regarding the production of the milk in Guwahati city areas. It would be discussed separately in the next Chapter.

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## **Chapter-IV**

### **Socio-Economic Characteristics of Milk Producer Communities**

#### **4.0 Introduction**

Characterisation of phenomena is the study of structural features based on its relevant attributes. Socio-economic milieu and variations in the status of milk producer communities may be analysed by taking into account the concerned socio-economic attributes of DHHs. The results of the present discussion are portrayed in geographical point of view including location and socio-economic basis of DHH characterisation. In fact, socio-economic attributes are selected and the data of sample DHHs are classified according to the geographical basis to know about the reasons behind the variability in socio-economic status of DHHs in the Greater Guwahati Region.

Keeping this view in mind, the procedure of characterizing socio-economy of DHHs is largely dependent on 'classificatory approach'. For the same, two sets of variables namely, the base variables and dependent variables are chosen to crystallize the features and facts relating to socio-economic characteristics of DHHs in this Chapter.

#### **4.1 Procedure for Analysing Socio-Economic Characteristics**

There are three procedural steps which have been adopted for characterizing socio-economic phenomena. The first step of the procedure is concerned with the selection of socio-economic attributes while the second step of the procedure is to justify why these attributes are included in the present analysis and the third step is to provide base variables for establishing the cause-effect relationship to study the socio-economic status of DHHs.

**4.1.1 Selection of Socio-Economic Attributes:** Selection of a set of attributes (called dependent variables for statistical analysis) for a variety of phenomenal factors is main step of the analysis of socio-economic phenomena related to the DHHs. However, selection is to be the logical, relevant and applicable for the phenomenal facts. Attributes also are to be measurable in nature. Attributes related to socio-economy of DHHs are manifold. It embraces the elements in respect to demographic, social and economic phenomena of DHHs. Not all the components of these elements are, however, equally influential in the structure of milk producer communities, even then the relevant attributes are considered to serve the purpose. Considering this aspect, a number of attributes pertaining to the socio-economic status of DHHs has been included in the present study. Depending on the relevancy and availability of data collected from field, the attributes related to demography, social and economic aspects of DHHs were selected for the present purpose as given in Table-4.1.

**4.1.2 Relevance of Selected Attributes:**

**(a) Demographic Attributes:** Among the demographic attributes of DHHs, the family size plays a crucial role because it includes the persons of various age and sex that generate labour and income for the household establishment (Raghavachariar, 1980). Since labour productivity of dairy activity varies by sex in households, sex ratio is selected second demographic variable. The productivity of female labour in terms of her physical energy is always considered lesser than male worker. It differentiates between the wages rate of different workers. In fact, higher sex ratio of a family has greater degree of work force in households and vice versa. This root variable determines the socio-economic status of the family.

**Table-4.1: Attributes Representing Socio-Economic Status of DHHs**

Sl. No.	Name	Definition	Unit
A) Attributes Related to Demographic Characteristics			
1	Family size	Total member of DHH	persons
2	Sex ratio	Female per 1000 of males	‰
3	Dependency ratio	Total dependents (0-18 yrs.+ > 60 yrs.) per active population (19 yrs+59 yrs.) in the DHHs	unitless
B) Attributes Related to Social Characteristics			
4	Literacy rate	Literates (above 5 yrs.) per 100 persons of HH	%
5	Communities	Community-wise status of DHH	name
C) Attributes Related to Economic Characteristics			
6	Ratio of hired labour with family labour	(HL/FL)	unitless
7	Family labour	Family labour engaged in dairy activities per 100 of total family members	%
8	Herd size of milch cattle	Number of milch cattle under one shed of DHH	nos.
9	Total income	A total amount of income earned by all sources of DHHs	Rs.
10	Share of income from dairying	Income from dairying per 100 Rs. of total income of the DHH	%
11	Share of income from subsidiary occupations	Income from occupation other than dairying per 100 Rs. of total income of DHH	%

Even if it is not the only main element of the family, it also influences other attributes of the socio-economic state of the family. It has also been considered as ‘cause-determining’ variable in the present analysis. Dependency ratio is included as third variable reflecting age-specific and work-specific demographic characteristics of DHH. There are two bases of calculating dependency ratio: first is based on specific

age group as below 18 and above 60 year of population is considered as dependent, and between 18 and 60-year population of HH is considered active age group population. A second criterion of calculating dependency ratio is work- dependent. Total non-workers and total workers of HH also reflect the dependency ratio. An age specific criteria of dependency ratio was adopted in the present study.

**(b) Attributes Reflecting Social Status:** Literacy rate and educational status are variables showing the social relevance of the family. There are many studies, which showed that social change and economic development were directly related to education (Bathkal, 1994). In the present day, where the society is more information-based, education has a great role to play in regards of getting more information, not only about increase of HH income but also related to search of new options to diversify sources of income. Increase in income may be more elastic in the highly educated families because the family labour may choose a variety of activities and may earn more income from different associated sources than milk supply and manage their available resources. Therefore, these variables are important to consider for interpretation of socio-economic status of DHHs. Further, communities are also considered as important variable for income and social status of DHHs. Classification of socio-economic data based on community of DHHs would provide the clues of income variability to find-out its reasons. Family labour is also considered as one of the important economic variables in the present analysis because it provides the employment and income status of DHH. It is assumed here that the total labour of family is engaged only in this activity. In some cases, there are cases of disguised employment. Such arguments and issues have to be highlighted by considering these two variables (engagement of family labour and hired-family labour ratio) into account. Besides, two more variables, namely income size and herd size, are also

included as reflectants of the 'agglomeration of economies of DHH'. It has been argued in many studies that if household income increases through different sources, the total income of household increases fast but the share of income from dairy activities diminishes gradually (Kahlon et al.1975). It means, if a DHH diversifies his/her sources of income, he/she may increase income because of associated/subsidiary activities performed under the same roof of HH. Therefore, income-size matters and consequently it is included in the present analysis. Since number of milch cattle is more related to total quantity of available milk that influences the total income of DHH, it is also included in the present study.

**4.1.3 Base-Variables for Classification:** In order to interpret the salient features of socio-economic status of DHHs, a few variables within and outside the above-discussed attributes were selected to classify the concerned data. Of course, these are called 'base-variables' which provide basis of classification and crystallization of results. The cause-effect relationship is established by taking into account the base variables namely family size, literacy rate, community as demographic basis, income size as economic base, market accessibility, road accessibility and topographic location as geographic basis of the present study. In fact, these variables are considered as independent variables for the statistical analysis and inferring results relating to socio-economy of DHHs in Greater Guwahati Region.

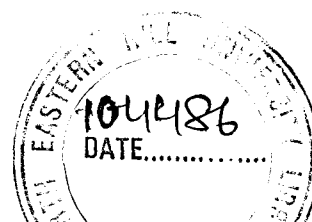
## **4.2 Results and Analysis**

In fact, classificatory approach would provide a kind of analysis for getting clues of characteristic features of DHHs. Such explanation is given under the following heads:

### **(a) DHHs Size and their Socio-Economic Status**

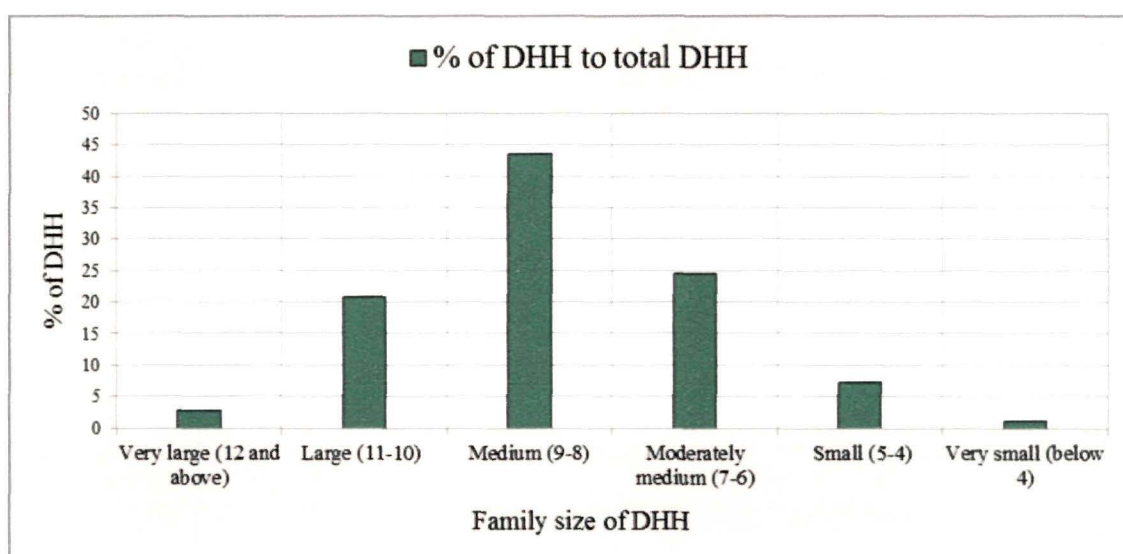
The socio-economic status of DHH in respect to their sizes is analysed by classifying the total numbers of observations into six-size classes as (i) very large DHH size (12 or more persons), (ii) large (10 and 11), (iii) medium (8 and 9), (iv) small medium (6 and 7), (v) small (4 and 5) and (vi) very small DHH size (below 4 persons). The average is counted 8 persons per DHH, which is more larger than the average HH size of total population of Greater Guwahati Region counted as 5 persons per household. In fact, larger DHH size always has a different socio-economic set-up. Such as, it has dominance of family labour and more burdens of the dependents if child population dominates in DHH size. Such facts may be elaborated in the proceeding part of the discussion.

The size distribution of DHHs is normal and the central part of it, the moderately medium and medium size of DHH (6-9 persons) accounts for about two-third strength of total DHH (252 DHHs out of total 370). The percentage share of DHH rises gradually from the category of smaller size, reaches at top in medium size and falls towards very large size of DHH (Table-4.2, Fig- 4.1). Under such distribution of DHHs in the study area, it is obvious to say that there is high concentration of DHHs in the moderately medium to medium categories of distribution. The detailed classification of socio-economic variables with size of DHH yields the following results:



**Table-4.2: Distribution of DHH by their Household Size**

HH Size (persons)	No. of DHH	% of DHH
1) Very large (12 and above)	10	2.70
2) Large (11-10)	77	20.81
3) Medium (9-8)	161	43.51
4) Small medium (7-6)	91	24.59
5) Small (5-4)	27	7.30
6) Very small (below 4)	4	1.08
Average (8.23)/Total	370	100



**Fig-4.1: Diagram showing DHH by their Family Size**

(i) The average sex ratio of DHH is 800 females per 1000 males, which is lower than the sex ratio of the population living in Greater Guwahati Region (i.e. 840 females per 1000 males). It shows that DHHs have male dominated families.

In general, sex ratio varies by size of DHH. The sex ratio was recorded 931 in the large to very large family size and 500 females per 1000 males in the small size class of below 4 persons (Table-4.3). It means, larger size of DHHs have almost equal partnership of male-females, while small size of DHHs are mainly male-dominated.

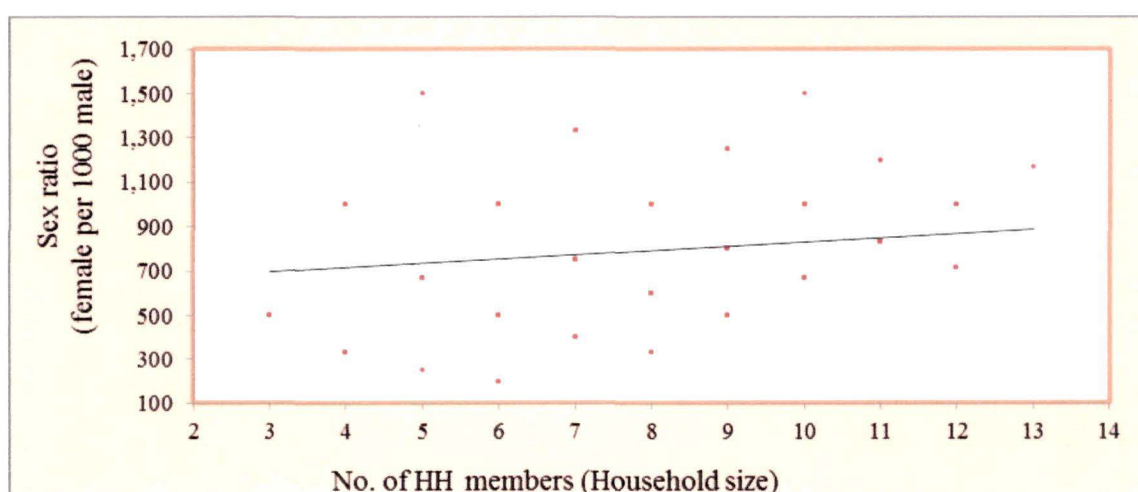
Contrary to it, it can be argued that the small families have sex-discrimination because they are less educated and literacy rate is very low (50%) (Table-4.3, Fig.-4.2).

(ii) Small-medium and medium size of DHHs (7-9 persons) have very high degree of dependents (more than 1.64 dependency ratio). Such medium DHHs have more number of children who increases dependency ratio (Fig.-4.3).

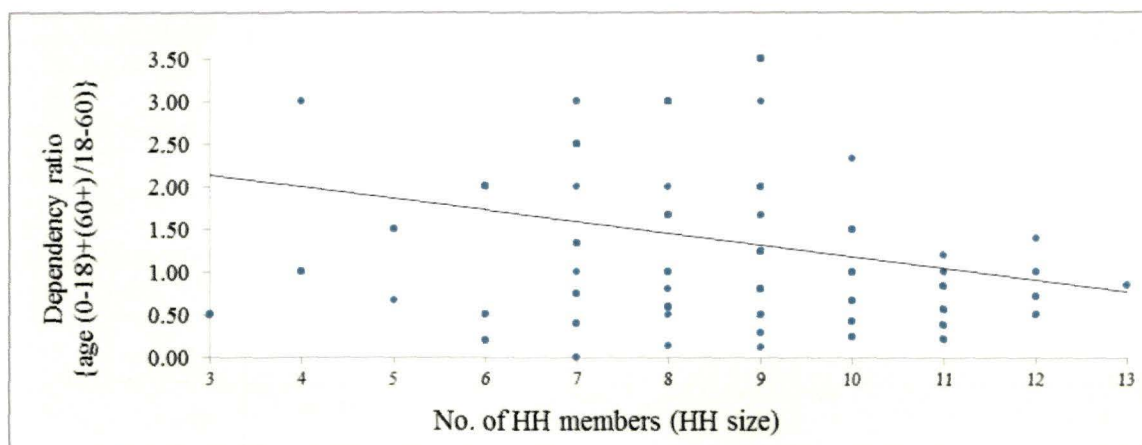
**Table-4.3: Socio-Economic Variables by DHH Size**

DHH Size (persons)	No. of DHH	Sex ratio	Literacy rate (%)	Dependency ratio	HL/FL ratio	Family labour (%)	Per capita income/month (Rs.)	No. of milch cattle per family labour
1) Very large (12 and above)	10	931	64.60	0.7890	0.1000	50.39	3,539	3
2) Large (11-10)	77	828	64.43	0.6664	0.0736	60.84	4,210	3
3) Medium (9-8)	161	791	78.47	1.6461	0.1822	55.73	4,671	3
4) Small medium (7-6)	91	819	82.45	1.8360	0.7930	41.97	4,993	4
5) Small (5-4)	27	707	75.74	1.2470	1.8148	26.30	5,834	7
6) Very small (below 4)	4	500	50.00	0.5000	2.0000	33.33	9,200	9
Average (8.23) /Total	370	800	75.65	1.4242	0.4464	50.87	4,630	4

NB: A total number of observations used in this graph are 370 but many are having the same values. So the graph looks with less number of observations.

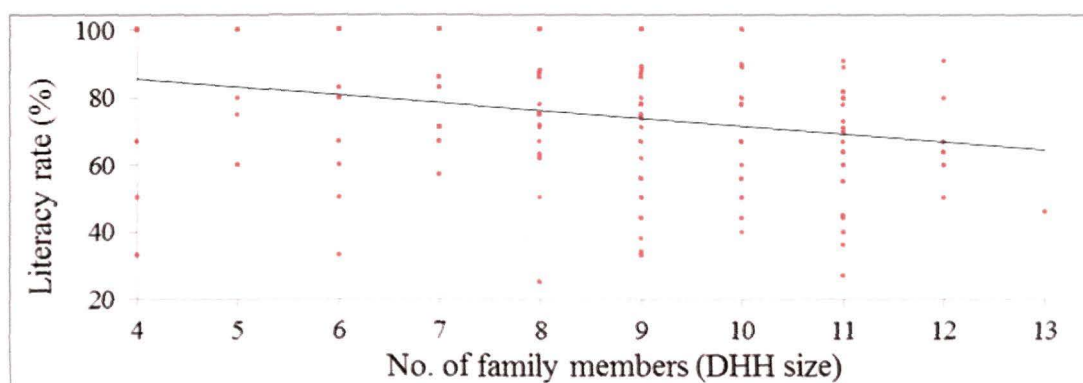


**Fig - 4.2: Family Size of DHHs versus Sex Ratio**



**Fig-4.3: Family Size of DHHs versus Dependency Ratio**

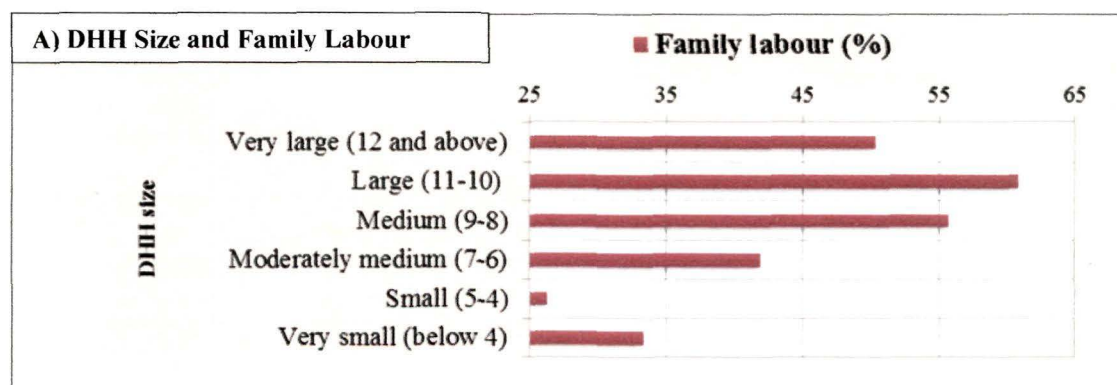
(iii) The illiteracy rate of DHHs is marginally less (75.65%) than the average literacy rate of total population (i.e. 77.40%). Literacy rate is recorded lesser (below 65%) in large and very large DHH size. Undoubtedly, literacy and education provide a strong base of social transformation from traditional to modern rational thinking. Education plays crucial role in decision-making process for the DHHs through the receipt of new information either to improve their profession or for having provision of optional occupations. So far as the case of Greater Guwahati Region is concerned where DHHs follow traditional system of socio-economic development, the literacy is very low in larger DHH size (Table-4.3, Fig-4.4). It reflects that either the numbers of infants in HH population are more or the number of adults and adolescents are fewer literates and educated.

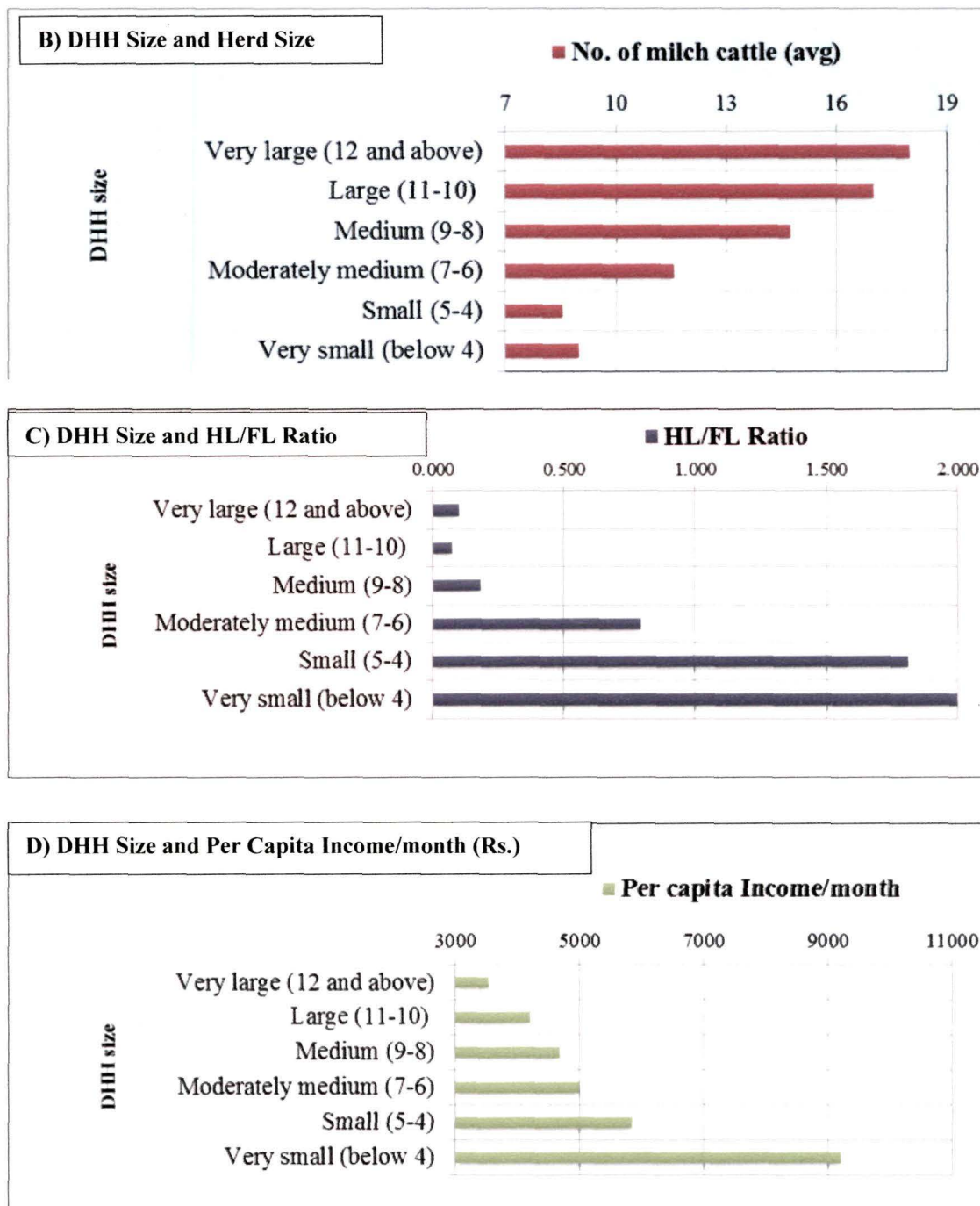


**Fig-4.4: Family Size of DHHs versus Literacy rate**

(iv) So far as variability of economic attributes of DHHs with respect to their household size is concerned, there is significant variability in the percentage share of family labour engaged in dairy activity at household level. It varies from 60.84 percent in larger families to 33.3 percent in smaller one. It implies that larger size of DHHs employ more family labour in milk production activity. Owing to availability of sufficient family labour, they employ less number of labour from outside (hired labour). So the hired-family labour ratio is calculated lower in large size of DHHs and *vice versa* (Table-4.3, Fig-4.5 C).

One observation that has been drawn from the distribution of economic attributes is more interesting to say that small size of DHHs employ less percentage share of family labour (26.3%), it means about three-fourth number of family labour engaged outside dairy works at higher wages. And some DHHs hires more labour from outside at cheaper wage rate that increases labour ratio and also increases per capita DHHs income with diversification in their occupations. In smaller household size, the occupational structure is more diversified with increase their income from non-dairy activities.





**Fig- 4.5 (A, B, C, D): Pattern of Economic Variables by DHH Size**

### 4.3 Educational Status and Socio-Economic Character of DHHs

The dairy activities in the study area are in the hands of illiterates who constitute more than half of total DHHs (190 out of 370) and the middle and high school level educated people (166 out of 370). The participation in commercial milk production activities by educated people was shown poor (14 out of 370) (Table-4.4).

Since dairy activities are labour-intensive full time vocation, it consistently exerts work-pressure on each of the family members of DHHs. The DHHs, which have either weak or partially weak educational background, they are more affected by such work environment that results high frequency of school droppings. Ultimately, such school droppers become new entrant to their parent's vocation and they learn milch cattle rearing practice with their parent's traditional knowledge base. Accordingly, this situation may results in the higher per capita income of such DHHs as well.

**Table- 4.4: Socio-Economic Variables of DHHs by their Educational Status**

Educational status	Total DHH	% DHH	Sex ratio	Dependency ratio	HL/FL ratio	Herd size	Per capita income	Family size
5) Degree	8	2.16	750.13	1.2375	1.59375	6.38	4,565	5.4
4) Senior Secondary	6	1.62	777.83	1.8067	1.05556	8.67	4,434	7.2
3) High School	12	3.24	759.67	0.9858	0.85417	10.00	5,124	6.5
2) Primary and Middle School	154	41.62	812.53	1.6892	0.60390	13.14	5,023	7.4
5) Illiterate	190	51.35	795.27	1.2330	0.22544	15.47	4,546	9.2
Average/Total	370	100	800.04	1.4242	0.44640	14.02	4,632	8.2

Alternately, the higher educated DHHs have low per capita monthly income because they are over-dependent on hired labour and giving more thrust to the subsidiary income source. Very often, for some of such DHHs, dairying becomes their occupation not by their choice but by their compulsion. Such quandary situation does not attain preferred result in the development of milk production. Furthermore, some educated DHHs rear milch cattle primarily to cater their household consumption of milk, only the additional quantities of milk are sold to the city market.

**4.3.1 Classification of Socio-Economic Attributes:** Literacy rate include the classes as i) high literacy (above 90 %), ii) moderately high literacy (80 – 90%), iii) medium literacy (70-80%), iv) moderately low literacy (60-70%), v) low literacy (50-60%), and vi) very low literacy (below 50%). The distributions of DHH in different categories of literacy rate are presented in Table- 4.5. The average literacy was counted 75.65 percent. Following are salient features of the distribution.

a) More concentration of DHH (69 percent to the total) is found to be distributed in high, moderately high and medium category of literacy class. This is indicative of the fact that the higher concentrations of literate persons characterize most of the household of the study area with either by primary or middle school background.

b) There are not much variations in sex ratio among the literacy classes. Except the medium literacy class, all remains below the average i.e. 800 females per 1000 males. It means that the literacy does not have much effect on sex ratio.

c) There is a positive relationship between literacy rate and dependency ratio. Therefore, the DHH of higher literacy class also have high ratio of dependency and *vice versa*. It means that literate DHH families have proportionately more population of dependents (either more children or more aged people). It shows that literacy do have effect on longevity or life expectancy of DHH.

d) The size of the families of DHH is marginally larger in low literacy classes. The very low literacy classes witnesses the higher family size of more than 9 persons per family (Fig- 4.7), and the high literacy class has the family size of 7 persons per family, which is lower to the average of all literacy classes. The awareness in the context of population control measures may have an effect in the down size of the family amongst high literacy class as well.

e) Engagement of family labour in dairy activities tends to be increasing from high literacy to very low literacy class. The higher literacy class constitutes 39 percent (3 persons out of a total 7) of its family labour engaged in dairy activities, which are much lower to the average of literacy classes i.e. 50 percent (4 persons out of 8 persons) to the total family members. Whereas in very low literacy class, the 60 percent (6 persons out of 9 persons) of the family members are engaged in dairy activities as well (Fig- 4.6 B). As family size increases from the class of high to low literacy, more number of family members is also engaged in dairy activities as described above also. In such category of low literacy rate, most of the family labour is engaged in dairy activities and very less number of hired labour demanded. Therefore ratio between hired and family labour becomes very low (0.32) in low literacy classes.

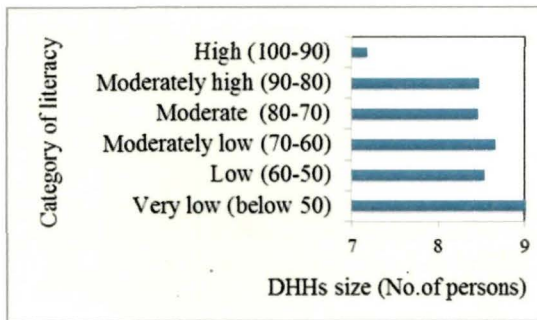
f) Comparing average income per capita per month among the DHHs, it is found that there is a slight decrease in per capita total income from Rs. 4,646 per month of the DHH falling under high literacy class of the DHHs. The decreasing rate may be nominal; however, it shows that literate households engaged in dairy activities have high income because of their diversification of the source of income. For example, the percentage share of income from milk supply is lesser (93% to total) in high literacy classes because of shifting income sources to other allied activities.

g) Fig-4.7 A and B shows that the high literacy class of DHH has largest share of milch cattle population for each of their dairy active family member i.e. 4 milch cattle per person as against the average of 3 milch cattle per person (Table-4.6). However, the low literacy class of DHH has more number of household engaged in dairy activities.

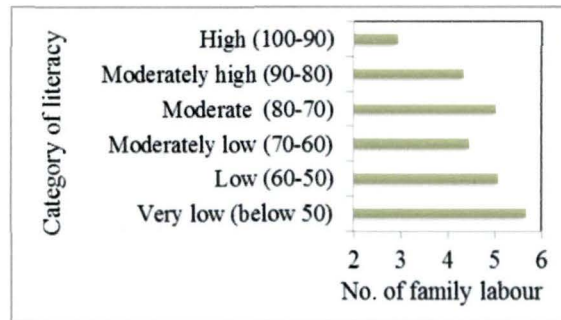
**Table- 4.5: Literacy Status and Socio-Economic Character of DHH**

Literacy class of DHH (%)	No. of DHH	% of DHH	Sex ratio	Dependency ratio	HL/FL ratio	Herd size	Per capita income /month (Rs.)
High (100-90)	96	25.95	793.18	1.7945	0.85937	12.23	4,646
Moderately high (90-80)	65	17.57	793.24	1.4306	0.28717	14.05	4,644
Moderate (80-70)	95	25.68	830.51	1.6637	0.17806	15.03	4,758
Moderately low (70-60)	47	12.70	793.21	1.0945	0.42375	13.81	4,367
Low (60-50)	28	7.57	770.82	0.8471	0.52380	15.29	4,692
Very low (below 50)	39	10.54	783.23	0.7308	0.32051	15.23	4,560
Average (75.65)/Total	370	100	800.04	1.4242	0.44640	14.02	4,632

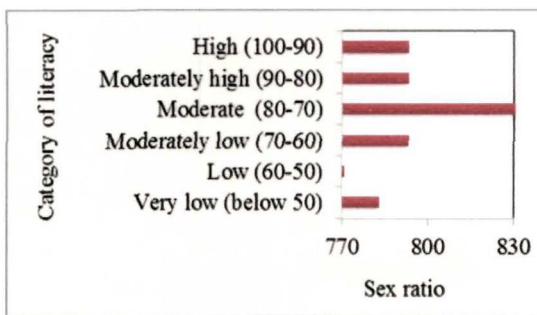
**A) Literacy rate and DHH size  
(No. of persons)**



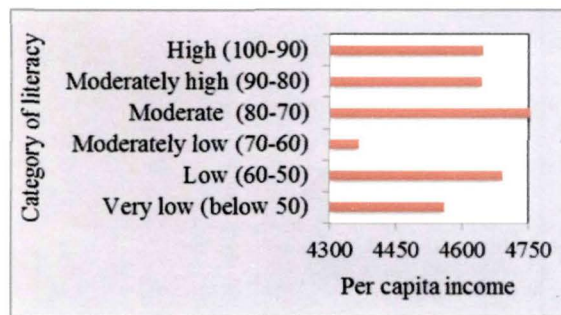
**B) Literacy rate and Family labour  
(No. of persons)**



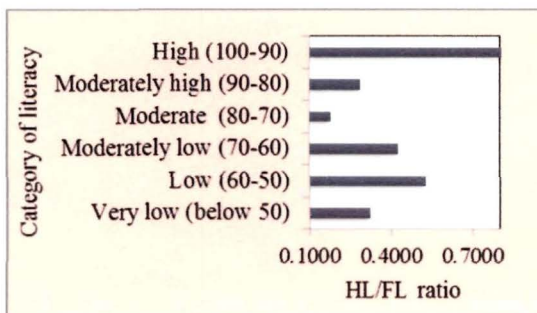
**C) Literacy rate and Sex ratio  
(No. of female per 1000 male)**



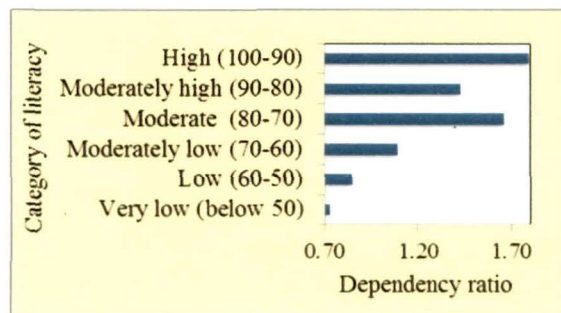
**D) Literacy rate and Per capita income  
(Rs./month/person)**



**E) Literacy rate and HL/FL ratio**



**F) Literacy rate and Dependency ratio**



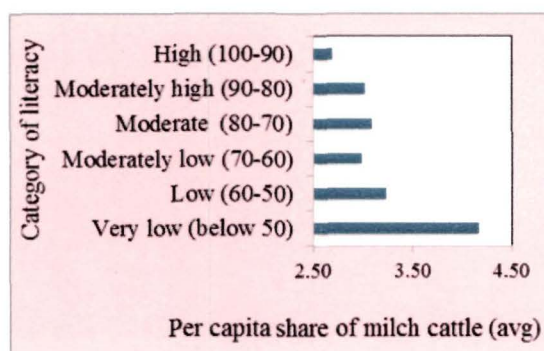
**Fig-4.6 (A, B, C, D, E, F): Socio-Economic Characteristics of DHH by their Literacy Status**

It is emerged from the present analysis that the literacy and education have positive effects on socio-economic status of DHHs with increasing sex ratio, dependency ratio and diversification of their family income.

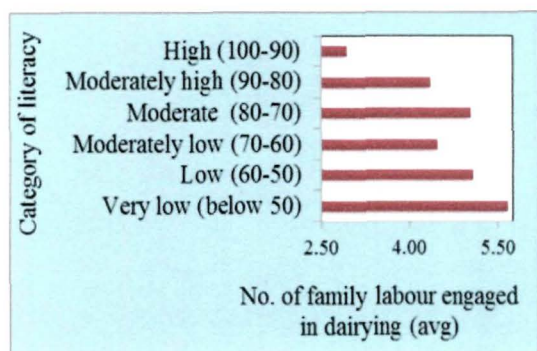
**Table-4.6: Per Capita Share of Milch Cattle of DHH by their Literacy Rate**

Category of Literacy rate (%)	No. of dairy active family members (avg)	No. of milch cattle (avg)	Per capita share of milch cattle (avg)
1) High (100-90)	3	12	4
2) Moderately high (90-80)	4	14	3
3) Moderate (80-70)	5	15	3
4) Moderately low (70-60)	4	14	3
5) Low (60-50)	5	15	3
6) Very low (below 50)	6	15	3
Average (75.65)	4	14	3

**A) Literacy rate and Per capita share of milch cattle of DHH**



**3) Literacy rate and No. of 'dairy-active' family member of DHH**



**Fig-4.7: Literacy versus (A) Per capita share of milch cattle and (B) No. of dairy active family member**

### 4.3.2 Community and Socio-Economic Status

In order to examine the characteristics of DHH against the backdrop of their community background, the DHHs have been categorized into five. These categories

include i) *Nepali*, ii) *Bihari*, iii) *Assamese*, iv) *Bengali* and v) *Rajasthani*. The distribution of DHHs against each community shows that *Nepali* and *Bihari* dominate in the dairy activity and accounts for more than 92 percent share of total DHHs (Table- 4.7).

**Table- 4.7: Distribution of DHH by their Community**

Community	DHH nos.	DHH (%)
<i>Nepali</i>	229	61.89
<i>Bihari</i>	117	31.62
<i>Assamese</i>	20	5.41
<i>Bengali</i>	2	0.54
<i>Rajasthani</i>	2	0.54
Total	370	100.00

The highest concentration of *Nepali* DHH may be dealt with the reasons that they bear a traditional character of cattle rearing practice. Moreover, they have stronger preference to settle in hills environment as well. The Greater Guwahati Region fairly fulfills their desired factors that results their highest concentration from the colonial rule. Some cultural factors also contribute in the high concentration of *Bihari* DHHs as well. The 'Yadavs' who belong to the *Bihari* community are the traditional 'gowalas' since the time immemorial and they have a share of about 32 percent concentration in the distribution of total DHHs. So far as detail characteristic features of DHHs in respect to their communities are concerned, these are given below:

(a) Community-wise distribution of social attributes of DHHs depicts a clear picture that *Bihari* DHHs have extremely low sex ratio (722 females per 1000 males) with very low literacy rate (70.15 %) and moderate dependency ratio (1.43). On the other hand, *Nepalese* have moderate values of sex ratio and dependency ratio with high literacy rate (Table-4.8). It is obvious that *Nepali* DHHs are more forward than *Bihari*

DHHs in Greater Guwahati Region. There are two main causes of socially better-off *Nepalese*: (a) they send their children to school without sex discrimination, while *Biharis* do not prefer to send the girl child to school and (b) the *Nepali* DHHs are more progressive and hardworking to arrange large herd size in comparison with *Biharis*.

(b) In the case of economic characteristics of DHHs, it is to say that *Nepali* and *Bihari* DHHs have larger herd-size, which is operated by their household labour (so the HL/FL ratio is very low even less than 0.40). They earn more than 90% income from milk supply and earn relatively high per capita income. So, the entire economy of these DHHs is largely dependent on dairy activities.

(c) It is true that *Nepali* DHHs are geographically located far from the market centre, especially in the peripheral zones of Greater Guwahati Region, while the concentration of *Bihari* DHHs is close to market city centre (Table-4.8). They may take advantage of being closer to market activity where they supply milk for commercial activity and sweet preparation shops.

**Table- 4.8: Socio-Economic Character of DHH by their Community**

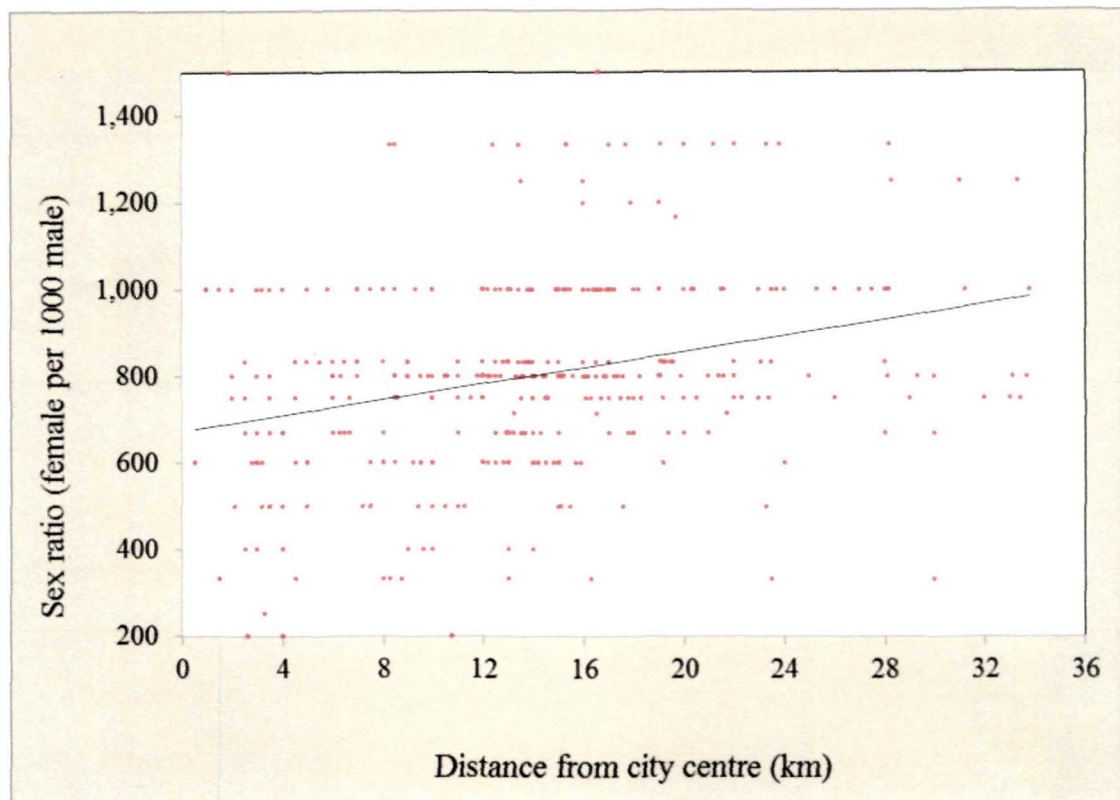
Community of DHH	Sex ratio	Dependency ratio	Literacy rate	HL/FL ratio	No. of milch cattle (avr)	Family size	Income from milk (%)	Distance from city centre (km)	Per capita income (Rs)
<i>Nepali</i>	828	1.45	78.44	0.37	15	8	97.47	16.19	4,699
<i>Bihari</i>	722	1.43	70.15	0.40	13	8	92.46	9.89	4,665
<i>Assamese</i>	922	1.19	77.95	1.47	6	7	64.40	12.18	3,564
<i>Bengali</i>	900	0.50	55.50	1.00	8	8	65.03	9.38	3,345
<i>Rajasthani</i>	800	1.80	75.00	1.33	8	8	71.23	8.00	4,348
<b>Average</b>	<b>800</b>	<b>1.42</b>	<b>75.65</b>	<b>0.45</b>	<b>14</b>	<b>8</b>	<b>93.78</b>	<b>13.90</b>	<b>4,632</b>

### 4.3.3 Market Accessibility and Socio-Economic Status

The socio-economic characteristics of DHHs have been examined taking the distance from the city centre as geographical determinant that influences the status of DHHs. A total number of DHHs was classified into twelve categories by their location as: i) outskirts (beyond 30 km), ii) remote (27 to 30 km), iii) farthest (24 to 27 km), iv) extremely far (21 to 24 km), v) highly far (18 to 21 km), vi) very far (15 to 18 km), viii) farther (12 to 15 km), ix) far (9 to 12 km), x) near (6 to 9 km), xi) very near (3 to 6 km), xii) nearest (0 i.e. city centre to 3 km). The average distance from city centre to outskirts is counted 13.90 km (Table- 4.9). The concentration of DHHs lies between 6 to 18 km from central market centre. Such DHHs have advantages of two types of scenarios prevalent in the Greater Guwahati Region, as they are closer to central city market to supply their milk and intense residential localities namely Chaymile, Dispur, Ganeshguri, Bhangagarh, Lachitnagar, Ulubari, and they take the advantage of outer fringe areas for getting green fodder at cheaper rate. Because of their advantageous location, they maximize their profit and revenue. So far as socio-economic characteristics of DHHs are concerned, it may be said that sex ratio increases as distance increases from market city centre. As stated earlier that there is concentration of *Bihari* DHHs near city centre and *Nepalese* in the far peripheral areas of Greater Guwahati Region, it is clear from the analysis that being location of *Bihari* DHHs near city centre, the sex ratio is low (Fig-4.8). However, percentage share of literates is calculated low (69.70%) in the close-by city market centre. It is contradictory to the general observations, as the literacy rate is higher in the most cases in the Central Business Areas of cities (Briney, 2010).

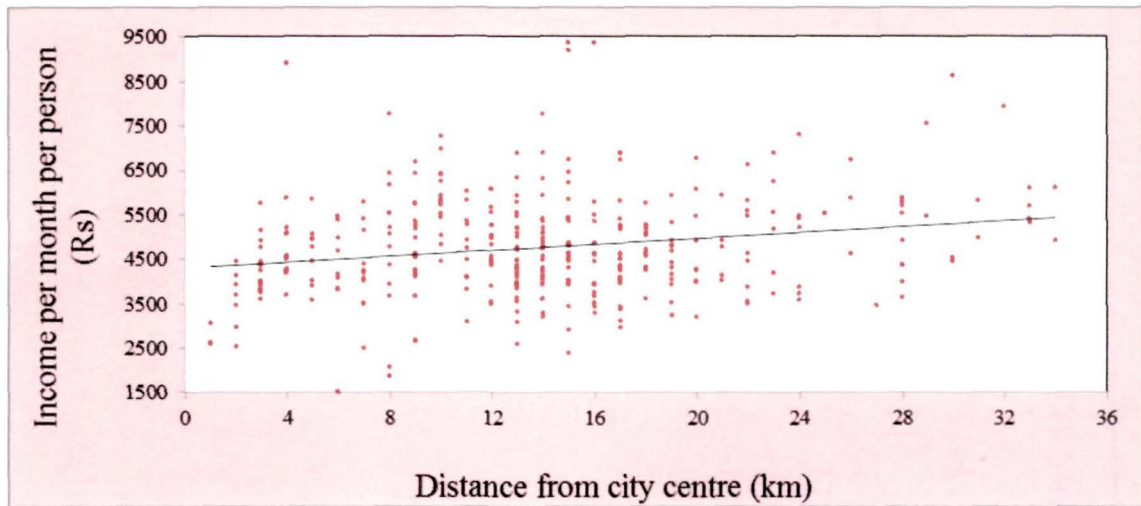
**Table-4.9: Socio-Economic Characteristics of DHHs by their Distance from City Centre**

Nearest road distance from city centre (km)	No. of DHH	DHH (%)	Sex ratio	Dependency ratio	Literacy rate (%)	HL/FL ratio	Per capita share of milch cattle (nos.)	Per capita income/month (Rs.)	Nepali DHH	Bihari DHH	Assamese DHH	Family labour in dairying (%)
1) Outskirt (beyond 30)	9	2.4	928	1.667	82.33	0.3333	4.6	5,760	8	1	0	50.67
2) Remote (30-27)	15	4.1	882	1.267	75.60	0.1556	3.4	4,926	14	1	0	60.67
3) Farthest (27-24)	7	1.9	879	1.429	75.29	0.5714	3.4	5,149	5	1	1	57.00
4) Extremely far (24-21)	24	6.5	885	1.583	80.33	0.7500	3.8	4,830	18	4	2	47.08
5) Highly far (21-18)	32	8.7	876	1.469	76.09	0.3750	3.3	4,446	24	6	2	52.91
6) Very far (18-15)	68	18.4	867	1.853	76.43	0.4510	3.4	4,578	53	12	3	50.65
7) Farther (15-12)	86	23.2	792	1.477	75.59	0.3130	3.2	4,600	60	21	4	53.93
8) Far (12-9)	39	10.5	695	1.641	81.15	0.2714	2.8	4,966	21	16	1	57.08
9) Near (9-6)	40	10.8	772	1.400	69.85	0.4542	2.7	4,441	19	17	3	53.40
10) Very near (6-3)	34	9.2	649	1.500	69.76	0.6323	3.1	4,594	7	26	0	41.21
11) Nearest (3-0)	16	4.3	746	1.813	74.69	1.1250	3.4	3,564	0	12	4	26.88
Average (13.90)/Total	370	100	800	1.573	75.65	0.4464	3.2	4,632	229	117	20	50.98



**Fig-4.8: Market Accessibility versus Sex Ratio**

It is argued here that being dominance of *Bihari* DHHs in this part who are less literates and educated diminishes the rate of overall literacy among DHHs living closer to city centre. These social characteristics of DHHs have impact on their per capita income, which is found marginally lower (Rs. 3,564 per capita per month) in the market accessible areas (Fig-4.9). It is also contradictory inference to the general statement. Generally, per capita income diminishes as distance from city centre increases. It means, locational aspects of socio-economy of DHHs distribution are implicitly controlled by the location of DHHs community which is dominated by *Biharis* towards the central parts of the city and *Nepalese* toward outer fringe areas of the study area (Table-4.9).



**Fig-4.9: Market Accessibility *versus* Income of DHHs**

#### **4.3.4 Road Accessibility and Socio-Economic Characteristics**

The characteristics of DHHs against the backdrop of the distance from nearby vehicular road are examined by classifying them into five classes as i) very far (beyond 800 m from nearby vehicular road), ii) far (500 to 800 m), iii) moderate (300 to 500 m), iv) moderately nearer (100 to 300 m) and v) closer (less than 100 m). The average distance from vehicular road to DHH sites is counted 392 m, that is slightly



**Plate-4.1: Consumer self-collection of milk from DHH site**

less than a-half-km. The concentration of DHHs in their distribution with respect to road accessibility lies in its categories of moderate to moderately nearer (100 to 500 m) because DHHs do not want to settle: (a) a very close to vehicular road, where milch cattle are not habituated in noisy environment of road-sides and (b) very far (more than 1.0 km) in remote areas due to supply of milk to the main market areas of milk consumption. However, the DHHs of remote areas maximize their profit supplying milk to the close-by localities every day. Many people from localities come in the morning and/or evening and collect milk regularly (Plate-4.1). Table -4.10 showing variation of socio-economic attributes by road accessibility clearly reveals that the nearness and remoteness both sites of DHHs have lower sex ratio, even less than 775 females per 1000 males that is lower than the average sex ratio of the study area. Most of the male dominated *Bihari* dairy communities prefer the road-side settlements for easy entrance in subsidiary sources of income. Male dominated labour of DHHs in the close-by sites has advantage to supply milk to the market areas at cheaper rates and secondly, dairy activity is time-bound generally morning and evening time's activity, so family labour becomes free during noontime. As per survey observations, their male labourers of the DHHs located near road side go for subsidiary work like vegetable or fish selling, cart or rickshaw pulling, as loading and unloading workers at the *godown* of railways, roadways, whole-sellers or are engaged as businessmen, as watchman or sometimes as *chowkidar* of landlord (Plate-4.2).



**Plate-4.2: A *Bihari Chowkider* adopts Milk Production as Subsidiary Occupation**

The remote areas have shown low sex ratio; it means the prevalence of male-dominated DHHs. The DHHs of those remote areas have moderate herd size with moderate per capita income. They rear milch cattle in natural environment having more availability of pollution free *beel* ecology. Though the impact of topographic features that would be described in the proceeding section of this Chapter, it is clear that remote locations of DHHs are near *beels*, *nalas*, and regular streams and the *Bihari* DHHs dominate their dairy activities in those remote areas (Plate-4.3).



**Plate-4.3: Traditional *Bihari* DHH on River front of Brahmaputra**

There is most striking economic feature drawn from the distribution is that the DHHs residing near vehicular roadside have male dominated small family size of which less percentage share of their work force (male dominated) is engaged in dairy activities. They hire 75 percent labour to run dairy activities and employ their family labour in non-dairy activities. Such occupational diversification increases their per capita income (Plate-4.4).



**Onion for Sale**

**Plate-4.4: Selling of vegetable items by DHHs as subsidiary income source**

**Table- 4.10: Vehicular Distance-wise Socio-Economic Character of DHHs**

Distance from vehicular road (m)	No. of DHH	No. of DHH to total (%)	Sex ratio	Dependency ratio	Literacy rate (%)	Family labour in dairying (%)	Family size (avr)	HL/FL ratio	Per capita income /month	Per capita share of milch cattle
1) Very far (beyond 800)	50	13.51	771.34	1.3480	75.42	50.70	8.14	0.4050	4,728	3.5
2) Far (800-500)	70	18.92	845.37	1.5850	80.70	51.95	8.50	0.3571	4,527	3.4
3) Moderate 500-300)	88	23.78	812.43	1.3924	73.55	53.56	8.42	0.3892	4,767	3.3
4) Moderately Nearer (300-100)	102	27.57	813.35	1.3864	74.64	55.44	8.27	0.3807	4,846	3.0
5) Closer (less than 100)	60	16.22	730.28	1.4113	74.73	38.07	7.62	0.7806	4,066	3.0
Average (392)/Total	370	100	800.04	1.4242	75.65	50.87	8.23	0.4464	4,632	3.2

#### **4.3.5 Topographic Factors and Socio-Economic Status**

Considering micro-topographic features of the study area such as (related to general land-use) i) foot-hills, ii) wetland front, iii) river bank, and the iv) built up areas, the impact of such sites on socio-economy of DHHs has been shown by classifying them based on this criterion (Table-4.11).

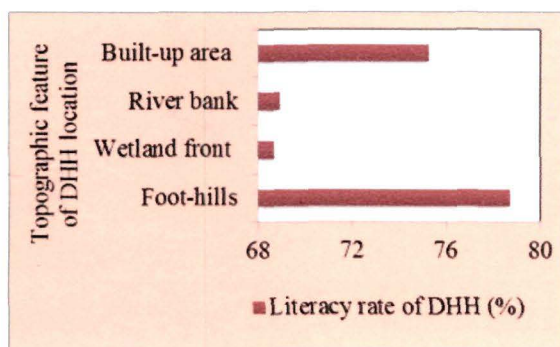
a) The distribution of DHHs is found to be more concentrated in foothills where nearly two-third of the total DHH are settled. Again, the foot-hills, wetland fronts, and river-banks have constitutes a combine share of 86 percent of DHH (317 DHH out of a total 370 DHH). Since these three topographical locales have a higher portion of government unutilized or vacant landholdings, it bears a restriction on legal possession for permanent settlement. As a result, city developers less affect these landholdings. Most of the landless and marginal DHH had encroached these government landholdings and comfortably perform their dairy practice, which results in a higher concentration of DHH in those topographic locations. Foot-hills topographic conditions are most suitable for sustaining dairy activity, where social status of DHHs is found better (high sex ratio and literacy rate) than the DHHs residing in river-banks/wetland fronts within the city. It means, the concentration of DHHs is in such areas of foot-hills, who have many advantages to maximize their profit as free grazing grounds, available fresh stream water and cheap fodder (green as well as dry) because of the localization of fringe areas nearer to rural areas, from where paddy straws are supplied during summer season and is used even in winter where green grasses are not available for grazing (due to dry winters). As a result, per capita income of DHHs living in foot-hills topographic locations has been counted moderately high (Rs.4,713 per month) (Table-4.11).

**Table-4.11: Socio-Economic Status of DHH by their Topographic location**

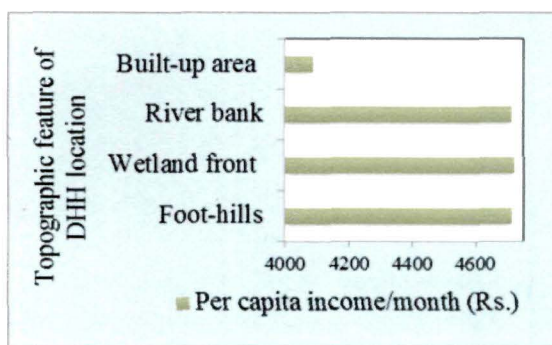
Topography	No. of DHH	DHH (%)	Sex ratio	Dependency ratio	Literacy rate (%)	Family labour in dairying (%)	HL/FL ratio	No. of milch cattle (avr)	Family size (persons)	Family labour in dairying (nos)	Per capita income /month (Rs.)
Foot-hills	222	60.00	832	1.4885	78.70	51.84	0.4350	15.14	8	5	4,713
Wetland front	82	22.16	732	1.3735	68.68	51.73	0.3678	13.67	8	5	4,722
River bank	13	3.51	791	1.2854	68.92	53.08	0.2564	12.62	9	5	4,715
Built-up areas	53	14.32	773	1.2675	75.26	44.95	0.6619	10.21	8	4	4,088
Average/Total	370	100	800	1.4242	75.65	50.87	0.4464	14.02	8	4	4,632

The DHHs of Greater Guwahati Region generally does not allow their milch cattle to open-graze. Due the fear of cattle-loss for accident or undesirable food-infection, instead, they keep their cattle under stall-fed conditions. They supply green-feeds to their cattle collected by 'cut and carry' system to avoid detrimental virus or fungus infection to their milch cattle, which are widely prevalent in hot and humid environ of Greater Guwahati Region. The DHHs who have reared local or non-descript milch cattle in the fringe is seen to have allowed for limited open grazing (Plate-4.5).

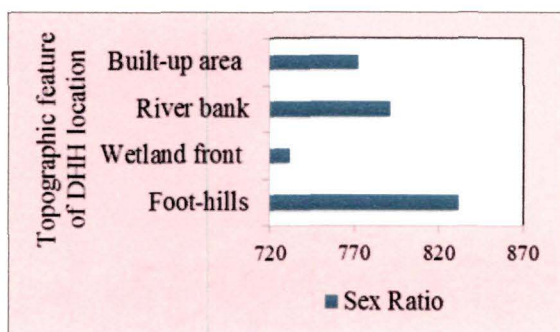
**A) Topography and Literacy rate (%)**



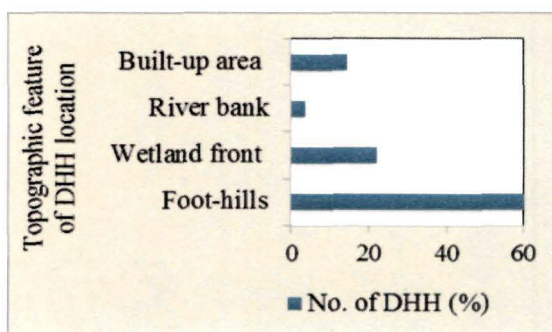
**B) Topography and Per capita income/month (Rs.)**



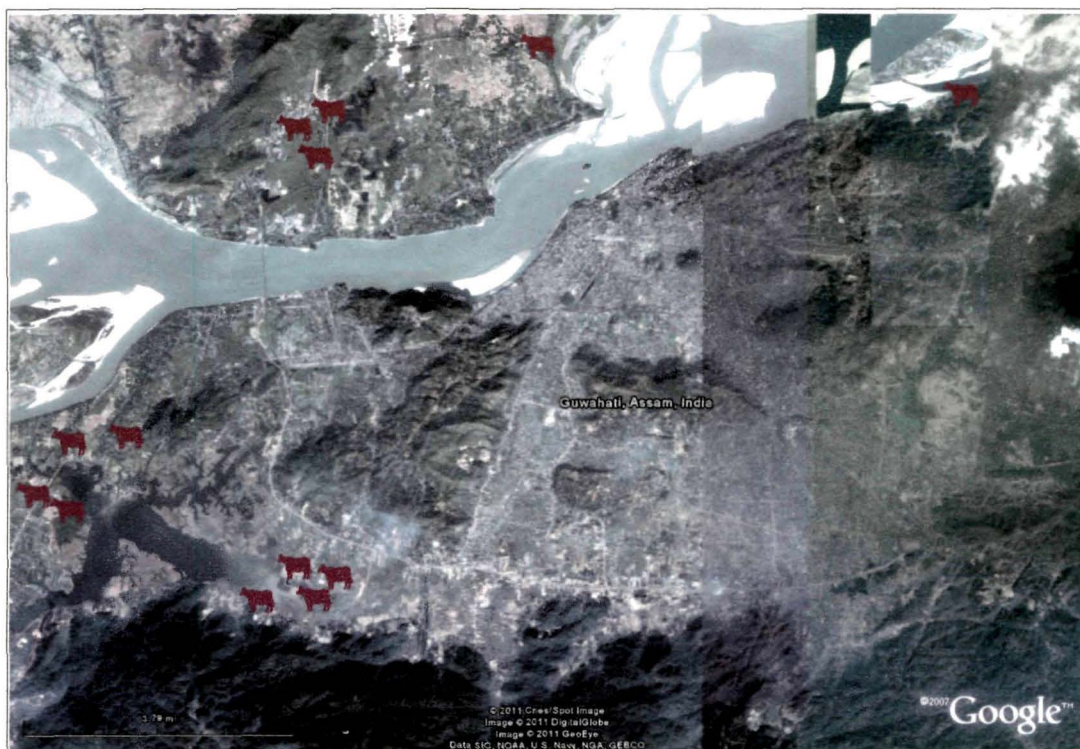
**C) Topography and Sex ratio**



**D) Topography and No. of DHHs (%)**



**Fig- 4.10 (A, B, C, D): Topography and Socio-Economic Status of DHHs**



**Plate-4.5:**  
Location of Limited Grazing Facilities in Greater Guwahati Region, 2006

#### 4.4 Concluding Remarks

In the end, it can be said that the geographical factors (market and road accessibilities, topographic locations and communities of DHHs) are more relevant to interpret the characteristic features of DHHs in Greater Guwahati Region. In fact, two main conclusions may be drawn from the present analysis.

(1) The areas of most accessible market centre of city are dominated by small size DHHs of male dominated-*Bihari* community, which are less literate and less educated. However, they diversify their source of income through adopting part-time employment of non-dairy activities like services in nearby hotels, shops and perform small business like selling of fruits and vegetables, running grocery shop and so on. They supply milk in the establishments of market city centre like hotels, medical hospitals, sweet-shops and nearby residents comparatively at higher rate to increase their milk revenues.

(2) Contrary to it, there is another scenario of socio-economic status of DHHs, which is prevalent in foot-hills areas located in outer fringe. These foot-hills areas are dominated by well-educated *Nepali* DHHs, who earns high income by managing more number of milch cattle in herd size. They maximize their income by using natural resources and cattle-food through free collection of the grasses available in those areas of grass-favourable-ecology. Cheap dry rice-straw is used during dry winters, which connects economic links of these areas with close-by rural areas. The processes and patterns of milk production of these areas would be analysed separately in the next Chapter.

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## Chapter-V

### Milk Production and its Productivity

#### 5.0 Introduction

Status of milk producer communities is determined by their income and milk production they produce for raising their income. The production of milk and related activities are manifestation of three dimensions of DHHs. First is the production and productivity of the milch cattle which is related to many factors like health, food and feeds of cattle, their seasonality (lactation period) of milk production and hygiene and hybrid that would provide a new dimension of discussion (Sharma, 1950; Singh, 1965). Secondly, it is fact that the process of milk production is labour dominated. For example –management of cowsheds, feeding practices, milking of milch cattle and even the supply of milk to the consumers are main activities of households. The third dimension of the study of productivity is related to the investment of capital for buying the milch cattle, their maintenance and management of cattle feeds and green hay if not possible in the producers' field. No doubt, these are the dimensions related to milk producer earning in connection with the DHHs income. So the analysis of milk producers' socio-economic status with respect to milk production would help in understanding the economics of milk producer communities.

Looking at the above aspects of productivity, it is appropriate that the present discussion of milk production produced by the milk producer households is to be discussed in the connection with (i) household labour involved in milk production processes (which is closely related to socio-cultural factors of households), (ii) investment of capital for milk production (that is more related to the economic aspects and income earned by the households either from the milk activities or associated

ones) and (iii) the productivity of milch cattle (that would show the status of milch cattle in accordance with their health, hygiene, and milk production and also expenditure pattern of milk producer on the maintenance of milch cattle).

## **5.1 Measurements**

Measurement of productivity is central theme to the assessment of its growth patterns (OECD, 2003). Keeping in view the above dimensions in present discussion on milk production and its factors of variability in Greater Guwahati Region, the following three productivity measurements of milk production have been used –

**(i) Labour Productivity of Milk Production-** that is calculated as total output of milk in litres produced annually at household level dividing by the number of family workers engaged in milk production activities like milking, feeding, or nursing and so on. It is formulated as total milk production by per dairy worker of households. Unit of labour produce is ltr/person/year.

**(ii) Cattle Productivity-** that is calculated as total milk produced by per milch cattle in a year. So, it is a simple division of total milk produced by milch cattle in the herd of cattle reared by the DHHs with the total number of milch cattle. Its unit is ltr/cattle/year.

**(iii) Capital Productivity-** it is an important index to measure milk productivity in terms of investment. As milk is an essential commodity and commercial activity for DHHs, there is increasing trend of investment in this activity. The measurement of capital productivity is related to three main determinants: output of milk in money term, labour wage and investment made by DHHs to maintain this activity.

The following formula is used to measure it-

$$CP = [(O - W) / \text{Investment}], \dots \dots \dots (5.1),$$

where CP = Capital Productivity annually, O = annual output of milk in Rs. that is milk production in money terms as production multiplied by milk price, and W = annual expenditure on total labour (family and hired) engaged in this activity, i.e. the total number of workers multiplied by annual average wage rate; its unit is Rupees in present case. The unit of Capital Productivity is Rs. per 1,000 rupees of investment annually.

## **5.2. Selection of Attributes and Analysis of Milk Production**

As we wish to establish the cause-effect relationship between these parameters of DHHs, that are milk production and associated attributes which influence the variability and also would give the clues for forwarding the arguments in this connection, there is a need to select attributes related to above given three dimensions of milk production. The determining factors associated with the milk productivity measures have been discussed for further analysis.

**5.2.1 Labour Productivity–Selection of Explanatory Variables:** The number of persons either from the families of DHHs or from hiring who are associated with management of milch cattle i.e. feeding practices, milking, cleaning and marketing etc. are treated here as labour. The socio-economic environment of the persons associated with dairy activities has a significant relationship with the production performance of milk (Urassa et al. 2011). The city's core to outskirts have created different milieu to the production status of milk differently amongst the persons involved. Considering importance of such aspects, the variability of labour productivity (as defined in preceding part) is studied with the following determining attributes.

(i) There are two main attributes namely, (a) Distance from the city centre (km) and (b) Distance from vehicular road (m), which are closely related to geographical location of the DHHs considered as explanatory variables for the present analysis.

(ii) For explanation of variation in socio-economic status of DHHs, a set of six explanatory variables has been considered. They are (c) Dependency ratio (unitless), (d) Share of family labour (%), (e) Literacy rate of DHHs (%), (f) Hired labour and family labour (HL/FL) ratio (unitless) and (g) Sex ratio (unitless). Such variables are most influential of variability of labour productivity, because they characterize the nature and behaviour of labour.

Out of the seven explanatory variables considered for finding out the causes of labour productivity as given in Table-5.1, it is found that four attributes namely (a) distance from the city centre (b) distance from vehicular road (c) dependency ratio and (d) share of family labour have significant relationship with labour productivity. These attributes may explain the causes of variability in the distribution of labour productivity which are elaborated in the following manner-

**Table-5.1: Name of Explanatory Variable and their Correlation with Labour Productivity**

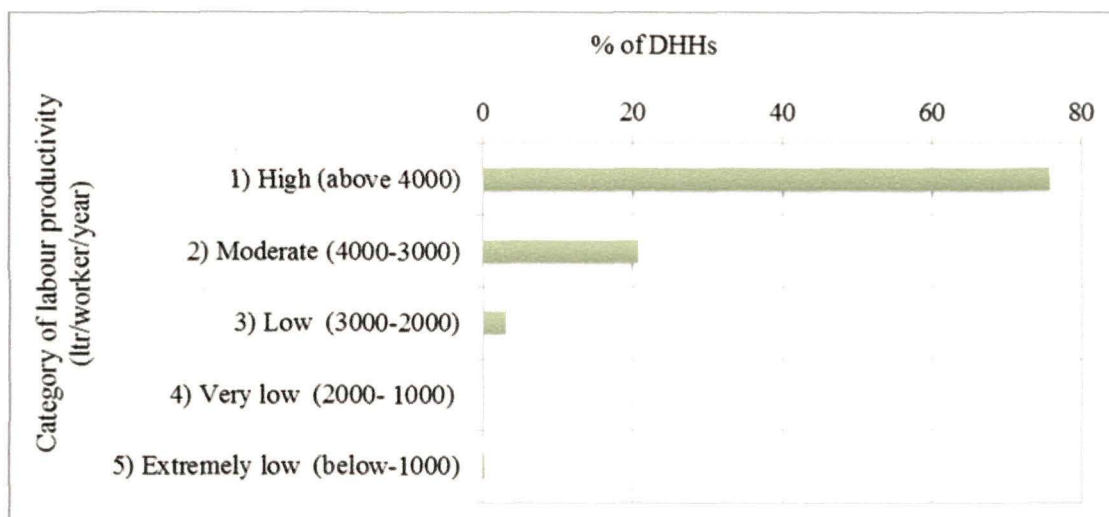
Explanatory variable	Unit	Coefficient of correlation (r)
1) Distance from the city centre	km	0.5224
2) Distance from vehicular road	m	0.3899
3) Dependency ratio	unitless	0.2332
4) Share of family labour engaged in dairy activity	%	- 0.2414
5) Literacy rate of DHHs	%	0.1957
6) Hired labour and Family labour (HL/FL) ratio	unitless	0.0589
7) Sex ratio	unitless	0.0581

**5.2.2 Labour Productivity- An Analysis:** So far as distributional pattern of labour productivity in Greater Guwahati Region is concerned, it is fact that more than three-fourth of the share of total DHHs (75.74%) is distributed in the high category of labour productivity distribution (above 4,000 ltr/worker/year) with labour productivity of 4,320 ltr of milk per worker annually. It is counted as 11.83 litre per worker per day production. The remaining 24.26 percent of DHHs have an average labour productivity of only 2,163 ltr/worker/year, which is far below the average labour productivity (i.e. 3,392 ltr/worker/year) of total DHHs in the study area (Table-5.2, Fig- 5.1).

**Table-5.2: Ward-wise Distribution of Labour Productivity of Milk (2006)**

Category of labour productivity (ltr/worker/year)	Average productivity	Area		DHH		No. of Ward	Ward code
	ltr/worker /year	sq km	%	nos.	%		
1) High (above 4,000)	4,320	242.96	51.98	280	75.74	16	7,25,35,37, 52, 53,56,57,58,59, 61,62,63,64,66,68
2) Moderate (4,000-3,000)	3,509	200.92	42.99	77	20.80	33	2,3,4,6,10,11,12, 13,14,15,16,17, 20,21,22,23,28, 29,32,36,42,43, 46,47,48,49,50, 51,54,55,60,65,67
3) Low (3,000-2,000)	2,676	20.32	4.35	11	3.05	15	1,5,18,19,24,26, 27,30,34,38,39, 40,41,44,45
4) Very low (2,000- 1,000)	1,569	2.37	0.51	1	0.15	3	8,31,33
5) Extremely low (below-1,000)	897	0.80	0.17	1	0.26	1	9
<b>Average/Total</b>	<b>3,392</b>	<b>467.37</b>	<b>100</b>	<b>370</b>	<b>100</b>	<b>68</b>	

NB: This Table is based on ward-wise distribution of labour productivity



**Fig- 5.1: Distribution of DHHs by their Labour Productivity (%)**

So far as the distribution of DHHs of different production classes across the study area is concerned, it is clear that high labour productivity of DHHs is concentrated in (a) most of the peripheral areas of Greater Guwahati Region and (b) the localities namely, Kalipur, Kharghuli, Nizarapar, Birubari, and Narakasur Hills in the closer part of central city market; Dwarandha, Sachal, Rukminigaon, Batahghuli, Mataria, and Khanapara in the Eastern part (Wards 53, 57 and 63) (Table-5.2, Fig- 5.2). The Eastern part is very close to the Dispur Capital localities, which is an affluent milk market. Such viable market acts as an incentive to the milk producers of these localities to be more productive. It is again worth to be noted here that most of the elite land property owner of these region has made temporary rehabilitation (in their vacant landholdings) of milk producers preferably from the communities of *Bihari* or *Nepali* to keep vigilant in their vacant land and to get free milk from these DHHs by allowing them to operate dairy activities. On the other hand, the localities like Machkhowa, Panbazar and Paltanbazar area (Wards 19, 30, 31) constitute few milk-habit people like *Rajasthanese* or *Biharis* who treated milk production as their secondary vocation rear milch cattle in their backyard. Their subsidiary income

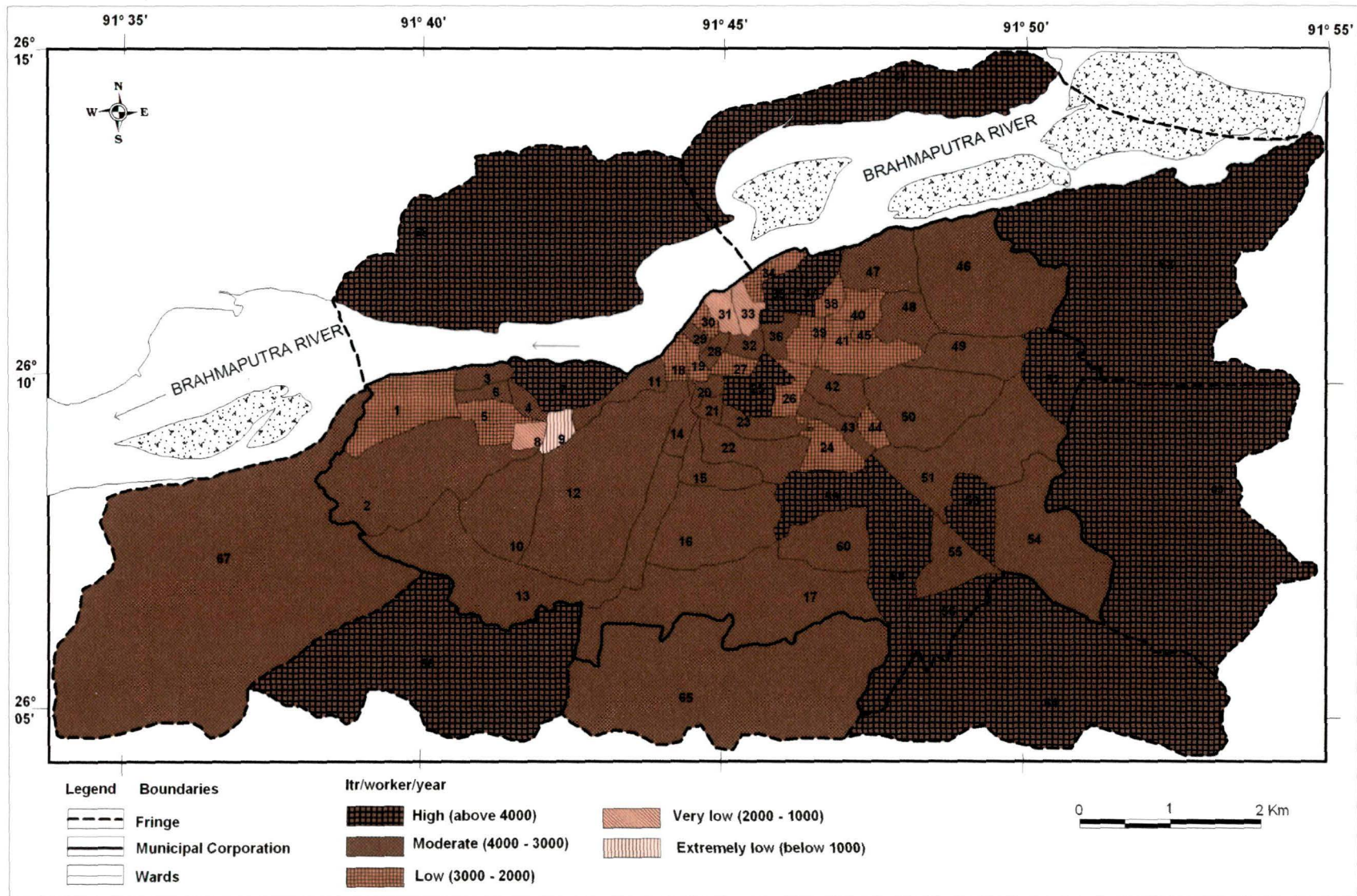


Fig-5.2: Distribution of Labour Productivity of Milk Producers in Greater Guwahati Region

involvement deterred them from the true devotion in the routine job of dairy practice, which indirectly lowers their labour productivity (Fig-5.2). Except the Western and South-Western fringe, the entire surrounding regions have retained higher labour productivity of milk. It is fact that the consistent and continuous urban pressure of the city could not affect in the stability of work-environment of milk producers in these fringe areas. Moreover, most of the areas of these fringes are closer to the rice-growing region, wherefrom the majority of DHHs have collected feedstuff both for milch cattle and for HH consumption also. However, most of the areas of Western fringe, i.e. mainly the Dharapur and Azara region have abundant wetlands where regular fish catching surpassed the needs of milk production as well as consumption for majority of the HHs. Moreover, the local indigenous inhabitants of these localities who are not traditional milk producer feel reluctant to choose such type of hard-working and full-time dairy vocation. As a result, these localities suffer from low to moderate labour productivity of milk. In such variable nature of milk producers in respect to their spatially dispersed productivity pattern, the following established facts are drawn:

(a) Diverging distance from market centre of the city is the leading cause of variability in the distribution of labour productivity. As reported earlier, that this factor has high positive relationship with labour productivity. So, it is clear that as the distance from the city centre increases, the labour productivity of milk also increases (Table-5.3, Fig-5.3A). The city's central localities always have high degree of urban pressure (Berry, 1976). It naturally affects the living cost of the all sections of people residing here including the DHHs. As a result, the DHHs have developed a tendency to engage themselves to generate additional income from subsidiary sources to meet their additional cost of living. The intensive labour activities of city's CBD easily

provide them the scope, which creates a time constraint condition for worker classes to maintain routine work for dairy activities. Such situation ultimately diminishes the productivity of milk in the areas of close vicinity of central market. However, the city's fringe generally does not provide such scope for additional or alternative remunerative avenues for DHHs. It develops a mindset for them to be more vibrant to sustain their dairy activities with more profitable manner that results higher labour productivity of labour in the outskirts areas (Table-5.2).

(b) Road accessibility also has direct impact on labour productivity of milk producers (Table-5.3, Fig-5.3 B). Herd sheds, which are far from vehicular road are more productive in the sense that DHHs of interior areas (far from vehicular roads) feel more stable in their occupancy of government land. Contrary to it, the areas of higher density of vehicular road (road accessible areas) virtually creates a higher land grabbing competition for land speculators or city developers. As a result, the DHHs operating from the nearer to vehicular road consistently have to be remain in an unstable condition for foreseeable eviction. Indirectly, this situation develops a negative impact and unstable conditions for DHHs that diminishes labour productivity and percentage share of milch cattle in herd. The city's central localities generally have higher vehicular road densities in comparison to that of the fringe areas, and accordingly, it results the labour productivity to be extremely low in the road-side residences of these areas.

(c) Literacy has positive but insignificant effect in labour productivity of milk (Fig-5.3 C). Most of the illiterate milk producers recognize their children as the asset of future. Such perceptions develop a tendency to them to give birth more kids for which percentage share of subsidiary income of low and very low DHHs increases

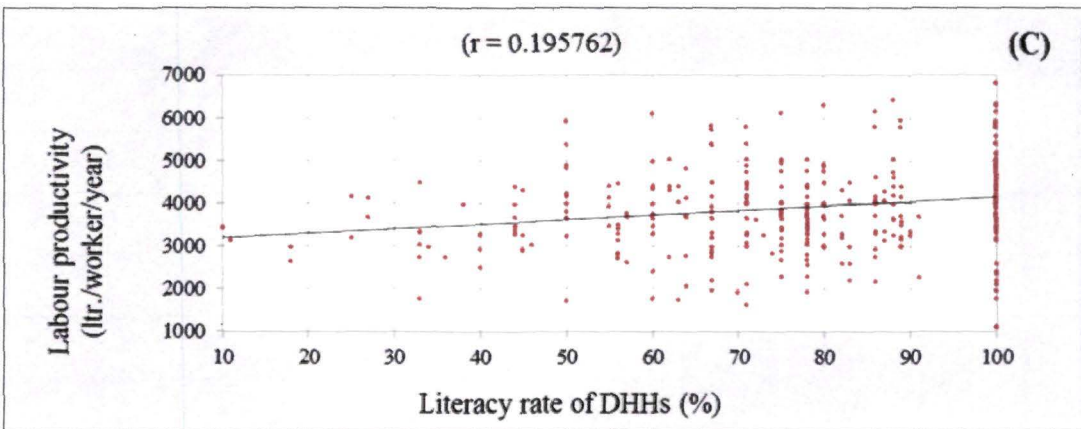
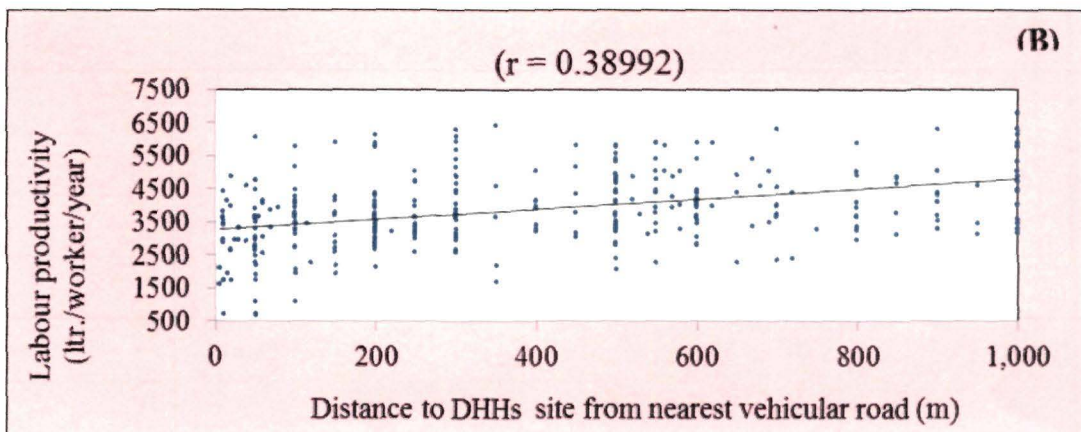
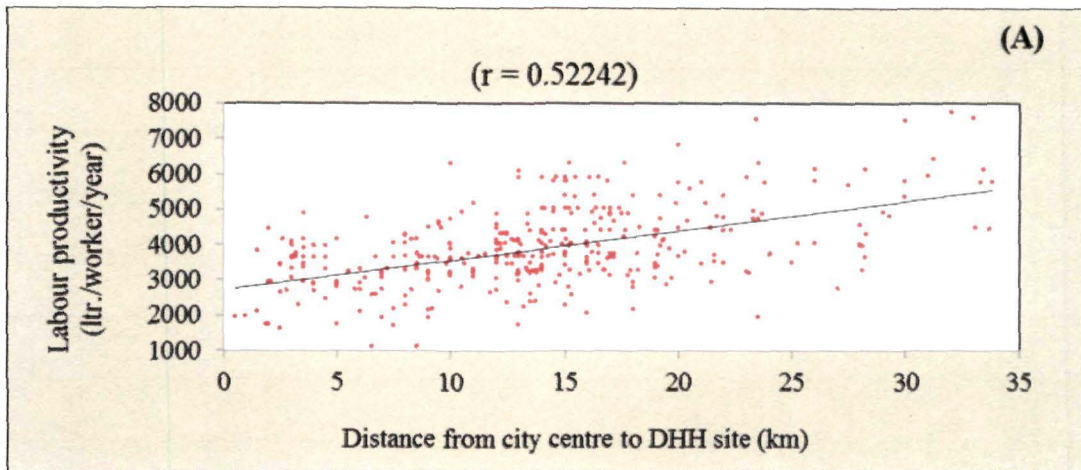


Fig-5.3 (A) Labour productivity and distance from city centre  
 (B) Labour productivity and distance from nearest vehicular road and  
 (C) Labour productivity and literacy rate.

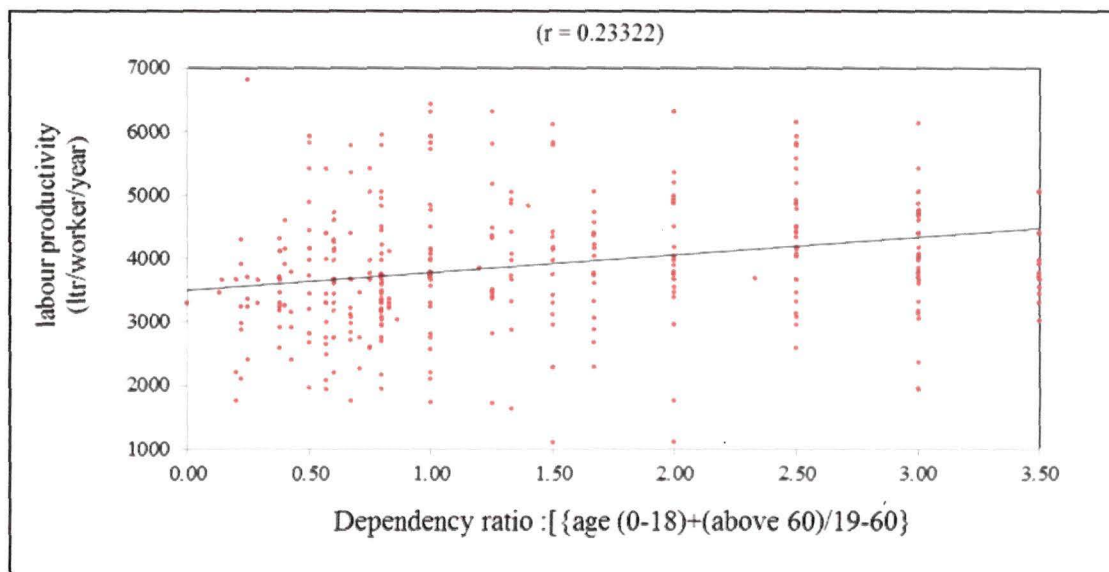
and sometimes, many low productivity DHHs have to be more dependent on other subsidiary sources of income also (Table-5.3).

**Table-5.3: Labour Productivity of Milk**

Category of Labour Productivity (ltr/worker/year)	Distance from city centre (km)	Distance from vehicular road to cattle shed (m)	Share of family persons in dairying (%)	DHH Sex ratio	Literacy rate of DHH (%)	Dependency ratio	HL/FL ratio	Family size (persons)	Cattle in milk (%)
1) High (above 5,500)	22.02	555.00	36.26	826.83	80.97	1.54	1.0463	6.4	88.31
2) Moderately high (5,500-4,500)	17.11	538.08	44.40	840.29	86.79	1.92	0.4359	7.7	82.76
3) Moderate (4,500-3,500)	13.62	390.98	51.04	785.85	75.96	1.54	0.3508	8.4	80.05
4) Moderately low (3,500-2,500)	11.67	328.24	61.87	788.87	67.94	1.08	0.2230	9.0	76.30
5) Low (below 2,500)	8.15	187.58	39.59	805.84	76.19	1.13	0.9866	7.8	60.51
Average (3,894)	13.90	392.26	50.87	800.04	75.65	1.42	0.4464	8.2	78.50

NB: This Table is based on the collected sample data of 370 DHHs. So, the classes of labour productivity in this Table are slightly different from earlier Table (Table-5.2)

(d) Dependency ratio plays positive but insignificant role in the labour productivity of milk. The DHHs who constitute more dependent especially from the younger generation virtually gets physical involvement in day-to-day dairy activities from them. On the other hand, the elderly people (dependents) act as the catalyst of dairy works, this situation ultimately enhances the labour productivity of DHHs (Table-5.3, Fig-5.4).



**Fig-5.4: Labour Productivity *versus* Dependency Ratio**

### 5.3. Cattle Productivity–Selection of Explanatory Variables

There is a variety of milch cattle from the goat to buffalo, which form the herd size in different areas. For example, camel is source of milk in desert areas, goats and cows are in temperate climate and so on. In India particularly in humid region like Brahmaputra Valley, cow is only the source of milk producers. So, cow dominance in herd is seen in almost all DHHs in the study area. Here, most of the cows are kept under stall-fed condition, by feeding green grasses, dry paddy straw and concentrates. Almost all the DHHs reared crossed-bred cows, a genetical combination of indigenous and foreign progeny namely jersey. Most of the milk producers views that

these cross-bred cows are not suited for open grazing in the existing topographic environ as well as the prevalent climatic condition of Greater Guwahati Region. Such environmental situation of the study area deserves a variety of strict routine activities for DHHs to nourish the milch cattle population to have desired level of milk productivity. Moreover, the quality and quantity of the feeds and fodders that the milch cattle regularly consume have influenced in the productivity of the milk as well. Therefore, considering these aspects, the following attributes are considered to proceed for the analysis of cattle productivity of milk in Greater Guwahati Region.

(a) Green Fodder - It provides essential natural nutritional elements like cellulose, legumes, vitamins, etc. to keep milch cattle healthy and increases production of milk (Bartlett, 2003),

(b) Distance from city centre as well as nearby vehicular road – Distance from the city centre to DHHs location is geographical attribute to determine cattle productivity of milk. Milk is a perishable item that does not allow much distance between producer and consumer. It is desirable to cover the delivery of milk within a fixed hour of time in Greater Guwahati Region, where predominance of hot and humid climate (i.e. a factor of milk spoilage/deterioration) prevails.

(c) Herd size – It constitutes the cattle in milk other than male and female calf. It is required to maintain a well-balanced herd constituting lactating and dry cows where from DHHs has to have a regular supply of milk to satisfy their consumers as well as to optimize their selling of milk produce.

(d) Concentrates – Concentrates and medicines provide the cattle population a balanced diet with essential proteins and minerals. Concentrates for cattle is desirable

to get remunerative milk from the milch cattle. Residue of oil seeds, gm and lentils are main ingredients of concentrates. For healthy cows, expenditure on medicines is equally important to consider for the present study.

To serve the purpose, the following explanatory variables are analysed and interpreted accordingly.

**Table-5.4- Explanatory Variable for Cattle Productivity**

Explanatory Variable	Units	Correlation coefficient (r)
1) Cost of green fodder	Rs.	+ 0.53428
2) Distance from the city centre	km	+ 0.16988
3) Herd size	Number	- 0.51158
4) Cost of concentrates	Rs.	- 0.41872
5) Cost of medicines	Rs.	- 0.38259
6) Distance from nearest vehicular road	m	- 0.12132
7) Cattle in milk	Number	- 0.30319

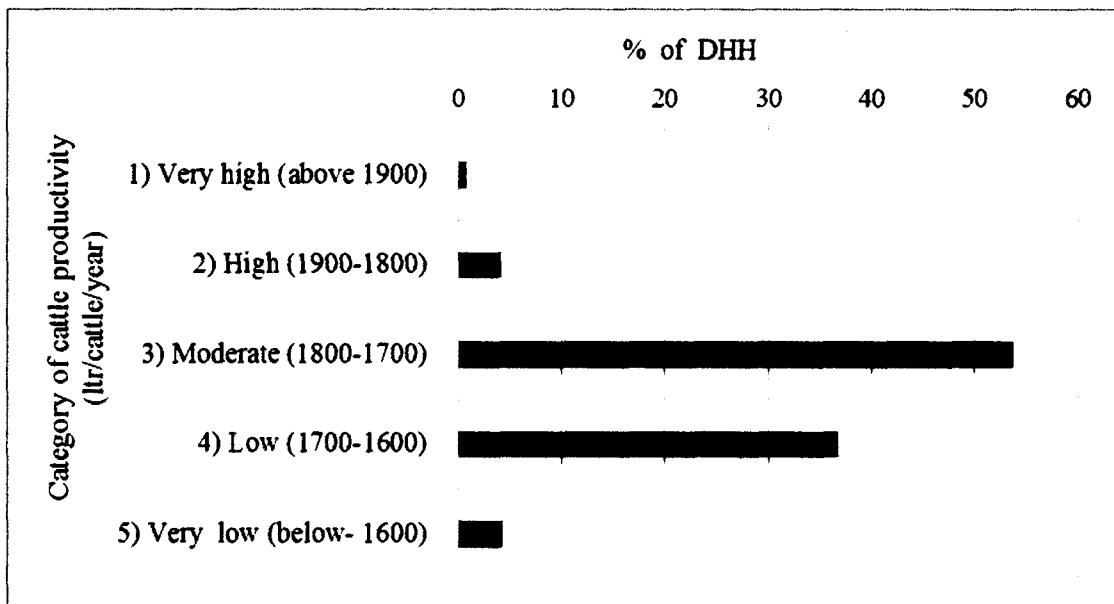
### 5.3.1 Productivity of Milch Cattle

**(a) Distributional Patterns:** As per the classification of DHHs based on milk production per milch cattle annually, it is found that the frequency distribution follows normal trend. So, the concentration of DHHs (more than a-half of total i.e. 199 out of 370 DHHs) lies around the mean value of cattle productivity (1,747 ltr/cattle/year) (Fig-5.5). However, about 5.00 percent DHHs fall under either high productivity category (above 1,800 ltr/cattle/year) or low productivity category (below 1,600 ltr/cattle/year).

**Table-5.5: Ward-wise Distribution of Cattle Productivity of Milk (2006)**

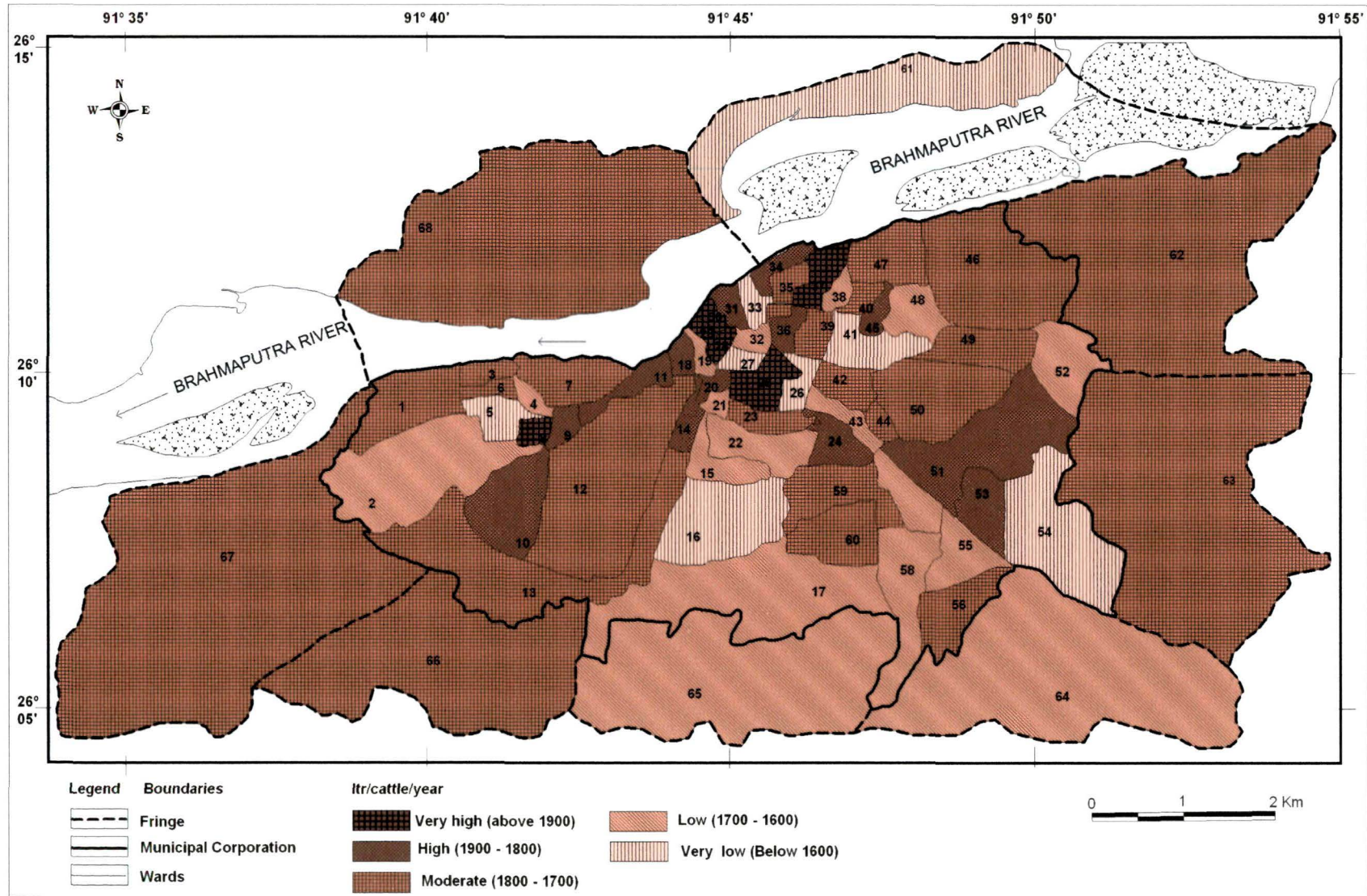
Category of cattle productivity	Area		DHH		No of Wards	Ward code
	sq km	%	nos.	%		
1) Very high (above 1,900)	5.41	1.16	3	0.85	6	8,25,28,29,30,37
2) High (1,900-1,800)	25.03	5.36	16	4.21	13	9,10,11,14,18,20, 24,31,34,6,45,51, 53
3) Moderate (1,800-1,700)	274.30	58.69	199	53.80	24	1,3,6,7,12,13,23,35, 39,40,42,44,46,47,49, 50,56,59,60,62,63,66, 67,68,
4) Low (1,700-1,600)	101.00	21.61	136	36.80	17	2,4,15,17,19,21,22, 32,8,43,48,52,55, 57,58,64,65
5) Very low (below- 1,600)	61.63	13.19	16	4.34	8	5,16,26,27,33,41, 54,61
<b>Average (1,747)/Total</b>	<b>467.37</b>	<b>100</b>	<b>370</b>	<b>100</b>	<b>68</b>	

So far as distributional pattern of cattle productivity over space is concerned, the distributional map shows that the created pattern of productivity does not seen regular (Fig-5.4). For example, in the central part of city where ward size is smaller and more demand of milk, blotted (obliterated) pattern are seen. Some wards, though these are close to central market, have low productivity, but a few like Machkhowa, Athgaon Birubari and Rupnagar have high to very high productivity in the distribution. Similarly, the peripheral areas are also having obliterated pattern. On the whole, 58.69 percent area of total Greater Guwahati Region is counted under the moderate cattle



**Fig-5.5: Distribution of Cattle Productivity of Milk (%)**

productivity class (1800-1700 ltr/cattle/year) (Table-5.5, Fig-5.5). Most of the parts of such areas are located in the periphery of Greater Guwahati Region (Fig-5.4). It is highlighted here that an average herd size is 12 cattle in Greater Guwahati Region out of which 76 percent cattle are in milk. Average production of milk per cow per day is calculated 4.787 ltr. In some areas located in the near-by areas of central city market, herd size is smaller (5 cattle) out of which 78 percent cattle are in milk and average production is 5.722 ltr/cattle/day. Most of the fringe areas have larger size of herd (13 cattle) with an average milk production of 4.661 ltr/cattle/day (Fig-5.6, Table-5.6).



**Fig-5.6: Distribution of Cattle Productivity of Milk Producers in Greater Guwahati Region**

**(b) Causes of Variability in Cattle Productivity:** As the values of explanatory variables considered for causality of cattle productivity variability in Table-5.1, the total number of DHHs are classified basing cattle productivity classes. The following conclusions may be drawn to highlight the causality of productivity variations in the study area.

(i) Increasing herd size decreases cattle productivity. This statement, which has been forwarded based on the classification (Table-5.6), reflects the facts that the larger herd size has lesser percentage share of milch cattle in it. So the per cattle production of larger herd will be lesser that diminishes cattle productivity (Fig-5.7 A).

(ii) As green fodder is used everywhere in all size of herds and in almost each and every locality of DHHs in Greater Guwahati Region, it does not have much variability in distribution (Fig-5.7 B). However, share of expenses on green fodder to total expenses on cattle maintenance become higher in high cattle productivity classes. It implies that cattle productivity of milk is increased by expanding more on green fodders, rather than making expenditure toward concentrates. Green fodder is easily available, cheap and in some areas of outer Fringes, it is freely available in the form of green grasses, only labour is involved to collect it.

(iii) DHHs spend about one-third of his/her expenditure on buying new cows to increase cattle productivity in their herds. Table-5.6 reveals that this share does not vary much and so does not have significant impact on productivity variation.

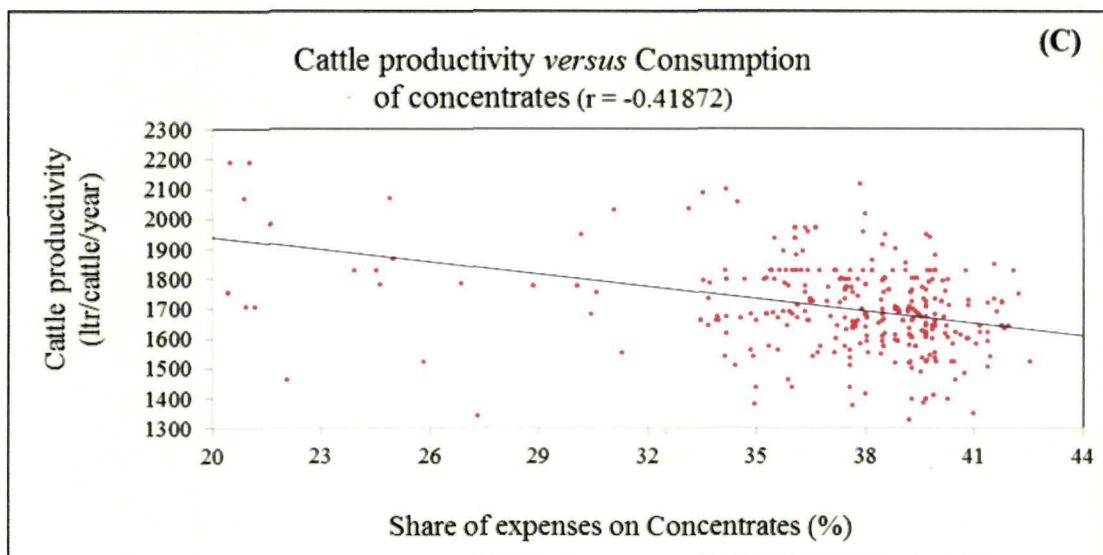
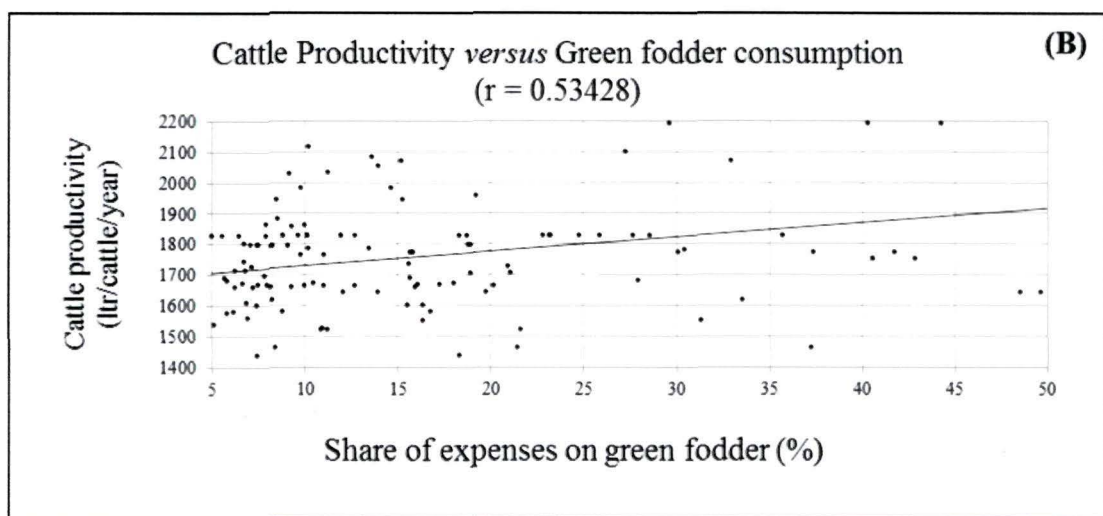
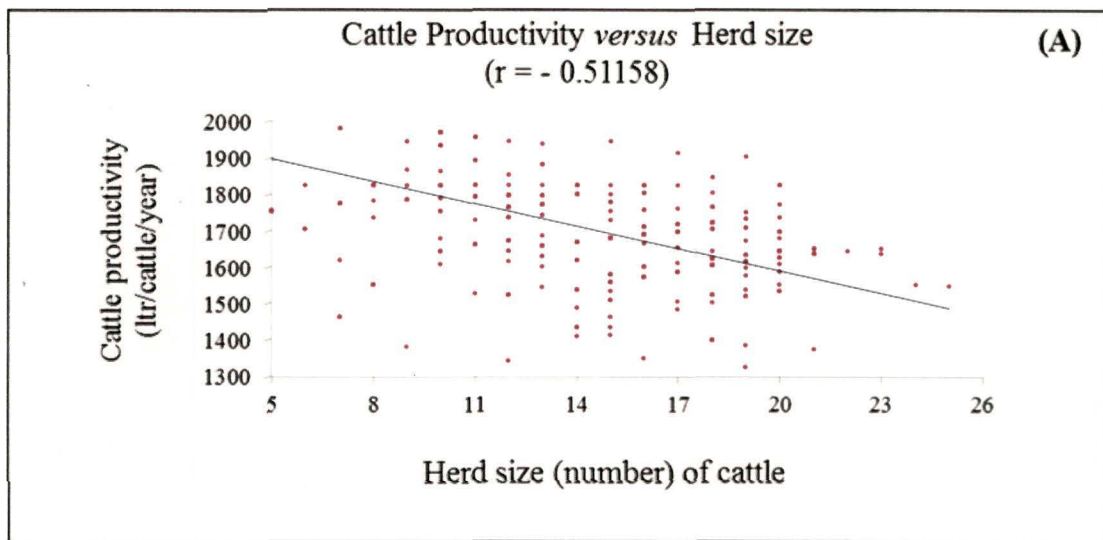
(iv) Distribution of cattle productivity shows that the expenditure towards the purchase of concentrates is shared more than one- third to total expenditure (average

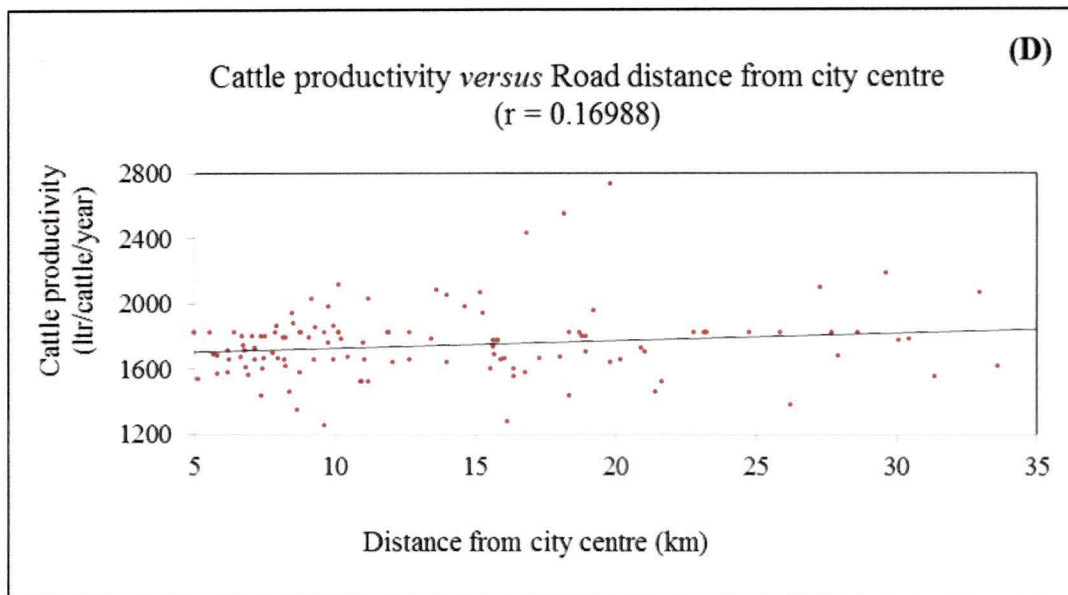
**Table-5.6: Cattle Productivity in Milk (2006)**

Category of cattle productivity	DHH		Average herd size	Cattle in milk	Total annual expenditure per DHH	Share of Annual expenditure per DHH for					Distance from-	
	nos.	%				Green fodder	Dry fodder	Concentrates	Medicines	Cattle's price	City centre	Vehicular road
ltr/cattle/year	nos.	%	nos.	%	Rs./year	%	%	%	%	%	km	m
1) Very high (above1900)	41	11.08	8.85	85.39	2,54,058	16.56	11.71	30.79	6.31	34.63	11.52	320.98
2) High (1900-1800)	40	10.81	12.35	83.40	3,54,268	11.41	13.12	36.32	6.52	32.63	10.93	318.75
3) Moderate (1800-1700)	90	24.32	13.24	80.99	3,56,761	9.85	11.23	36.47	7.12	35.32	14.46	411.28
4) Low (1700-1600)	123	33.24	15.86	78.04	4,22,896	8.34	11.71	37.97	7.52	34.46	15.36	444.11
5)Very low (below 1600)	76	20.55	15.35	68.01	4,09,009	8.04	11.93	37.45	7.52	35.07	13.62	384.44
Average (1713)/Total	370	100	14.02	78.50	3,79,671	9.88	11.81	36.60	7.18	34.53	13.90	392.26

36.0 %); the concentration of DHHs lies between the category of 32 and 42 percent expenditure of the moderate productivity with its low degree of variability (Fig-5.7 C). Increasing share of expenditure on concentrates the cattle productivity does not increase. It means productivity is more related to fodder expenditure rather than concentrates.

(v) Market accessibility (distance from market centre) (Fig-5.7 D) and road accessibility (distance from vehicular road) are main geographical factors (i.e. related to location of DHHs) do not have much impact on the distribution of cattle productivity. The degree of average market accessibility is less than a-half km. However, it may be concluded that the most in accessible areas from city centre and road as well have low cattle productivity. There may be economic factor behind it, which would be studied in the upcoming part of this Chapter. In addition, it is to be said that the cattle productivity of milk is higher (more than 1900 ltr/cattle/year) is nearer to the city centre. Noticeably, two factors, in this regard, make cattle to be more productive: (i) small herd with higher number of cattle in milk are preferred by DHHs in the vicinity of city centre due to the scarcity of waste disposal facilities. As a result, the cattle of smaller herd have been facilitating with higher share of fodders, family care, and nourishment compared to the larger herds located in the city's outskirts and (ii) the advantage of the DHHs of the central part of the city enjoys that they are getting supply of consumable waste from near-by milk consumers' household, hotels and restaurants, vegetable markets,





**Fig-5.7: Cattle Productivity and (A) Herd size, (B) Consumption of green fodder, (C) Consumption of concentrates, (D) Road distance from city centre**

virtually with no cost. Most of the milk producers supply maximum quantity of their milk produce to nearby hotels, fruit processors, whole sale grocery vendors who produce consumable waste for cattle. Such situation develops a supply chain between milk producers and consumable waste producers as to get assured and regular milk supply of milk. As a result, this situation reduces the expenses of concentrates (an average 30% expenditure of the total) to the DHHs of this central part of city region. Moreover, the river Brahmaputra traverses the more parts of the closer areas of the city centre, which facilitates an easy and perennial network of green grass supply to the milch cattle population of this area.

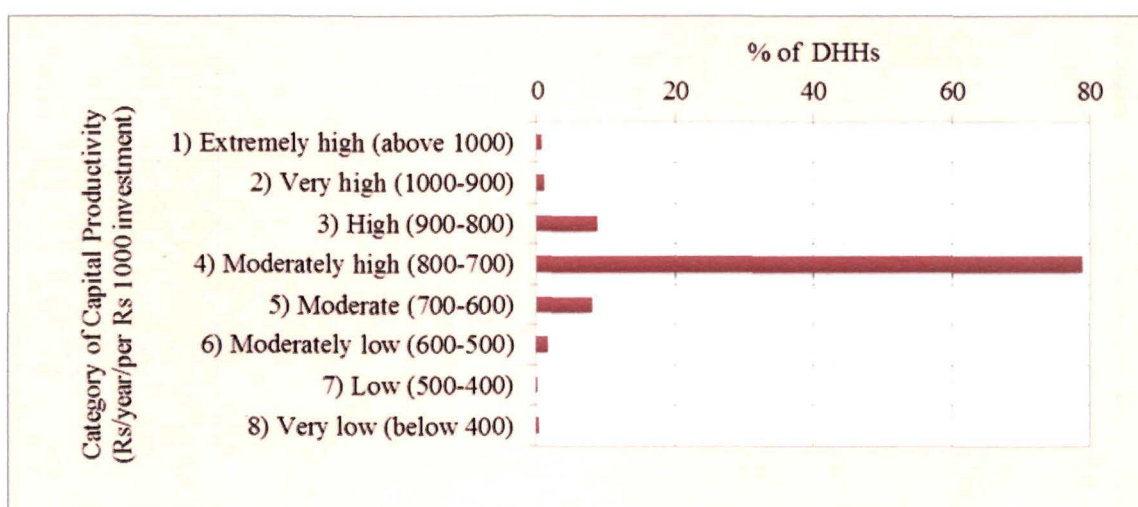
#### **5.4 Pattern of Capital Productivity of Milk Producers**

In fact, capital productivity is closely related to economic factors like cattle in milk, expenditure on foddors, milk selling price, distance from the central market, expenditure on hired labour and medicines made for regulating milk production activities, so the following attributes are considered for the purpose (Table-5.7).

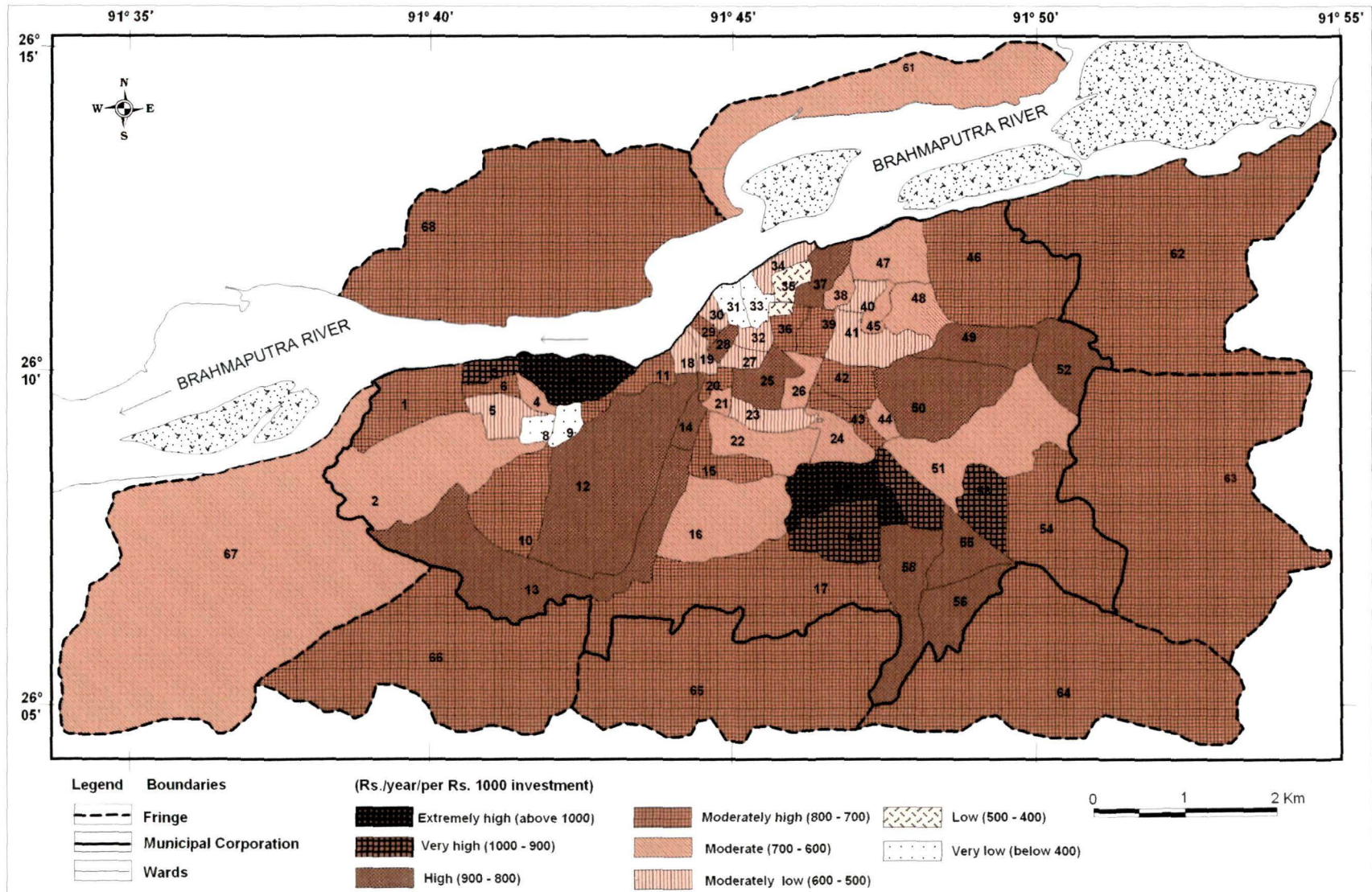
**Table- 5.7: Explanatory Variable for Capital Productivity of Milk**

Explanatory variable	Unit	Correlation coefficient (r)
1) Share of cattle in milk in total herd-size	number	0.8528
2) Cost of concentrates	Rs.	0.2195
3) Milk selling prices	Rs.	0.1866
4) Distance from the city centre	km	0.1755
5) Cost of dry fodder	Rs.	0.1600
6) Distance from nearest vehicular road	m	0.1376
7) Cost of medicines	Rs.	0.0631

**(a) Distributional pattern of Capital Productivity:** The distribution of capital productivity of milk producers follow normal curve and most of its distribution lies in between moderate and high categories (i.e. Rs.600-900/year/per Rs. 1000 investment) of distribution (Table-5.9, Figs-5.8 and 5.9). The average capital productivity for the entire study area is counted Rs.706/year/per Rs.1000 investment. It is lower than the other parts of the country. For example, capital productivity values (average) in Delhi, Mumbai, Hyderabad are recorded more than Rs.1000/year/per Rs. 1000 investment (Varadrajan, 1997)



**Fig-5.8: Distribution of Capital Productivity of Milk Producers (%)**



**Fig-5.9: Distribution of Capital Productivity of Milk Producers in Greater Guwahati Region**

**Table- 5.8: Capital Productivity of Milk**

Category of Capital Productivity Rs./year/per Rs.1,000 investment	Area		DHH		No. of Wards	Ward code
	sq km	%	nos.	%		
1) Extremely high (Above 1,000)	7.00	1.50	2.69	0.73	2	23,40
2) Very high (1,000-900)	9.23	1.97	4.27	1.15	5	29,32,36,39,44
3) High (900-800)	53.73	11.50	32.64	8.82	11	8,12,17,19,30, 31,35,49,55,62,63,
4) Moderately high (800-700)	253.68	54.28	291.92	78.90	20	5,10,13,18,21,22,25, 38,42,45,46,47,50,53, 56,59,64,65,67,68
5) Moderate (700-600)	129.18	27.64	29.63	8.01	15	2,3,7,14,15,16,20,27, 34,43,48,52,58,60,61
6) Moderately low (600-500)	9.78	2.09	6.56	1.77	9	1,11,26,28,33,51,54, 57,66
7) Low (500-400)	1.60	0.34	0.79	0.21	2	4,6
8) Very low (Below 400)	3.17	0.68	1.50	0.41	4	9,24,37,41
Average (706) / Total	467.37	100	370	100	68	

**(b) Causes of Spatial Variability of Capital Productivity:**

(i) As per the classification of DHHs on the basis of their capital productivity, it is found that about 96 percent of DHHs who have a capital productivity ranging between moderate and moderately high (Rs. 600-800/year/per Rs.1000 investment) are mostly situated in peripheral localities that include all the Fringe areas of Greater Guwahati Region (Table-5.9). Only a few localities like Machkhowa (Ward 29), Japorigog, Rajgarh, Bhangagarh and Birubari areas (Wards 39, 44, 40 and 23) have higher capital productivity i.e. Rs. 985/year/per Rs.1000 investment. In spite of the lesser or medium return from capital investment, most of the DHHs of the study area prefer to live in peripheral localities of the city due to some other advantages. The

living as well as the cattle maintenance cost is apparently less in those areas due the existence of natural grass cover in fringe localities. Moreover, the milch cattle of these peripheral localities are comparatively in safer location because of the dry and clean environment of hills topography. On the other hand, the plains and wetlands of the city areas are very frequently inundated by storm water; such situation has a spread effects for foot and mouth disease of milch cattle population. Again, the grass cover of such areas contains more germs or viruses, which affects milch cattle. As a result, as the distance from city centre increases the capital productivity also increases (Fig-5.10 A)

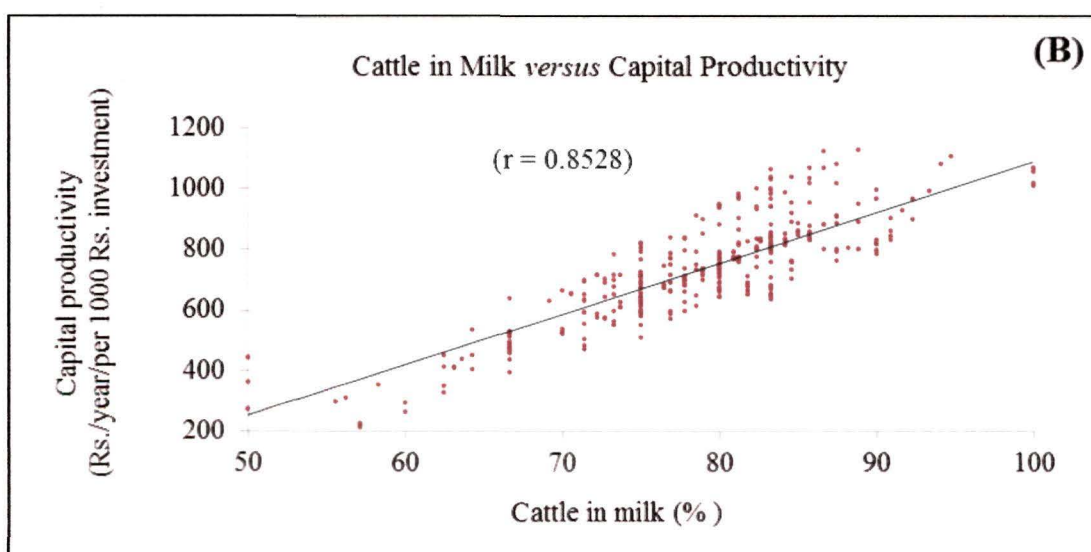
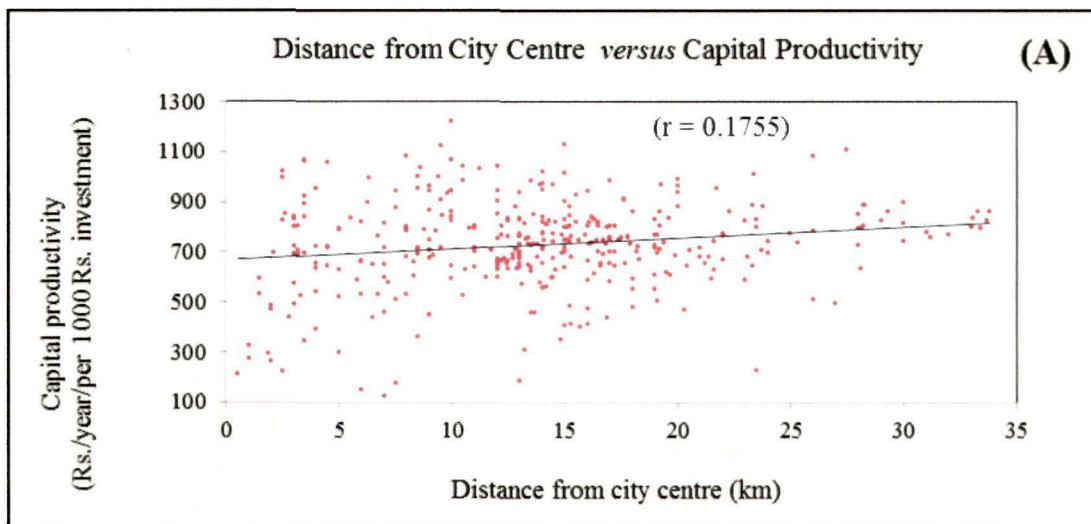
**Table-5.9: Annual Investment on Cattle Feeds and Health Care**

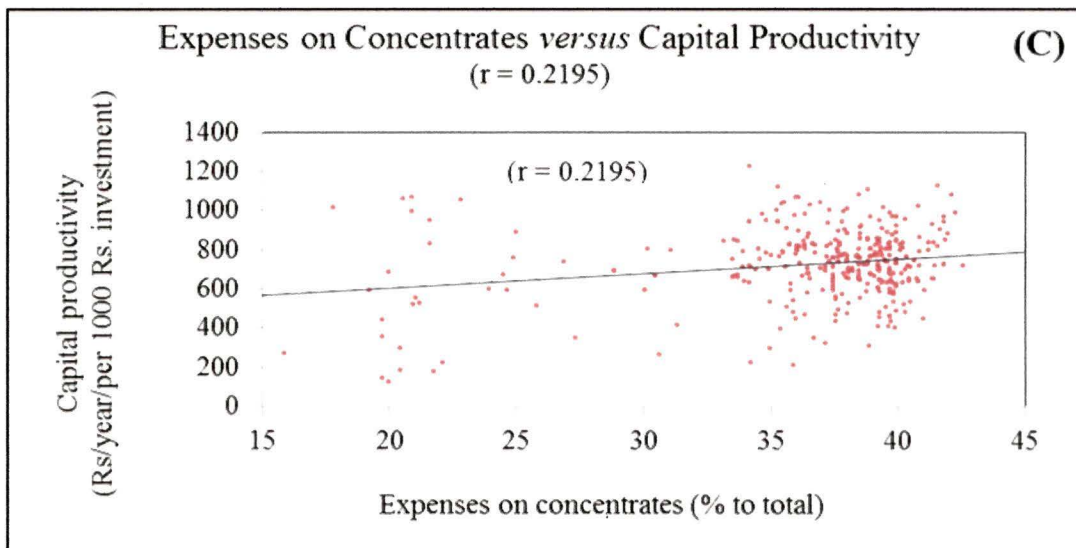
Cost Items	Total Annual Cost per DHHs (Rs.)	
	total	% of total cost
1) Green Fodders	33,932	8.94
2) Dry Fodders	45,050	11.87
3) Concentrates	1,43,492	37.79
4) Cattles' Health Care	27,791	7.32
5) Cost of Cattle	1,29,407	34.08
<b>Total</b>	<b>3,79,671</b>	<b>100</b>

(ii) The capital productivity has a strong association with the numbers of cattle in milk (Fig-5.10 B). Some DHHs replaced their dry milch cattle with new cattle in milk. Such situation prevails where DHHs have to maintain cows in smaller sheds. Due to the scarcity of open landholdings in the central part of city, DHHs of this region have

to maintain higher number of cattle in milk. As a result, in comparison to periphery, the DHHs of central region has gain higher amount of capital productivity

(iii) In fact, variations in capital productivity of milk producers are occurring because of the different nature of distribution of expenditure pattern. On the whole, a total annual cost of per DHHs is calculated about Rs. 3.8 lakh annually of which more than two-third cost is made towards buying the concentrates and cost of cattle (Table-5.8).





**Fig- 5.10: Correlation between Capital Productivity and (A) Distance from City Centre (B) Cattle in Milk and (C) Expenses on Concentrates**

If such expenses are calculated by each category of capital productivity, it is clear that fodder has less variability in the distribution, however the share of expenses on concentrates vary from low (25.08%) is extremely low capital productivity (below Rs.300/year/per Rs.1,000 investment) to 38 percent in moderately high capital productivity. It shows higher expenditure on concentrates increases capital productivity significantly (Fig-5.10 C).

There is also significant variation in capital productivity subject to market accessibility (Table-5.10). High capital productivity is marked in the far areas from the city market and *vice versa*. There are many causes of insignificant relationship of capital productivity with market accessibility but main cause is the locational advantage of DHHs living in the far areas. Those who spent less for the maintenance of cowsheds, they are more dependent on cheap green grass than concentrates. Because of reduction in the expenditure in these areas, the capital productivity becomes higher.

**Table-5.10: Annual Expenditure for Major Cost Items for Milch Cattle (2006)**

Category of capital productivity	DHH		Milk selling prices	Cattle in milk	Total cost for fodders and others		Share of annual expenses per DHH for -					Distance from -	
	nos.	%			Rs./ltr	%	Rs./year	%	Green fodder	Dry fodder	Concentrates	Medicines	Milch cattle
Rs./year/per Rs.1,000 investment	nos.	%	Rs./ltr	%	Rs./year	%	%	%	%	%	%	km	m
1) Extremely high (Above 1000)	20	5.41	21.40	90.01	3,66,822	12.03	10.87	13.65	34.23	7.00	34.05	11.66	289.50
2) Very high (900-1000)	33	8.92	21.03	84.63	3,93,238	12.90	9.65	12.10	37.07	7.13	34.05	12.61	406.52
3) High (800-900)	73	19.73	19.29	84.50	4,10,344	13.46	9.67	11.76	37.57	7.29	33.72	16.26	471.16
4) Moderately high (700-800)	102	27.57	19.22	79.78	4,20,558	13.79	8.88	11.70	37.95	7.40	34.08	15.64	423.14
5) Moderate (600-700)	73	19.73	19.26	76.93	3,67,944	12.07	9.82	11.83	36.85	7.03	34.47	13.44	386.51
6) Moderately low (500-600)	32	8.65	19.44	72.35	3,02,288	9.91	10.78	11.17	34.80	6.91	36.35	11.63	329.84
7) Low (400-500)	20	5.41	19.20	65.16	3,79,103	12.43	8.96	11.57	37.38	7.24	34.84	12.20	368.50
8) Very low (below-400)	17	4.59	19.67	55.01	2,04,333	6.7	15.36	11.47	28.73	6.58	37.79	6.93	155.76
Average (729)/Total	370	100	19.56	75.96	3,79,671	100	9.88	11.81	36.60	7.18	34.53	13.90	392.26

## 5.5 Concluding Remarks

There is more than two-third DHHs under the categories of high labour productivity (4000 ltr/cattle/year), most of them settled in the outer peripheral areas dominated by *Nepali* community. Literacy has positive impact on productivity with engagement of higher percentage share of family labour. On the other hand, cattle productivity in milk producer communities declines as herd size increases and increases as percentage share of milch cattle in herd increases. That is obvious reason of decrease in the expenditure on concentrates and less expensive available natural grass-fodder in the outer areas of Greater Guwahati Region.

(i) In the distribution of labour productivity of dairy households, it is found that labour productivity is predominantly high in the peripheral localities as well as the in the places away from the vehicular road. In this context, the role of increasing pressure of settlement due to the rapid urbanization in the central parts of Greater Guwahati Region cannot be denied. Moreover, the expenditure on maintenance and living costs of sheds is lesser in the peripheral localities. Alternately, the business establishment of the core areas of Greater Guwahati Region provides easy 'off farm' (non-dairy activities) employment or self-employment opportunities for the family labourers of milk producers to meet their additional and higher living cost. This situation virtually contributes in declining trends of the labour productivity in the central localities in the study area.

(ii) In the context of the distribution of the cattle productivity, a reverse situation of the distribution of labour productivity is found to be prevails in the study area. It is due to the acute scarcity of suitable landholdings for the construction of cattle sheds in

central localities of Greater Guwahati Region, most milk producers rear smaller herds of milch cattle. Naturally, such smaller herds enjoy the higher shares of feeds intake with better care. Consequently, it results higher cattle productivity of milk.

(iii) Undoubtedly, capital productivity of milk producers is influenced by high revenue earning from milk (due to high prices) and low expenditure pattern of DHH. In average capital productivity of Rs. 700 per unit of Rs. 1,000 investment is recorded with its significant variation. Moderate capital productivity was mapped in the peripheral areas of fringe ecology because of less investment on dairy activity. Main factor of high capital productivity in Greater Guwahati Region is high percentage share of milch cattle in herd size, which contributes to productivity by increasing milk production.

On the whole, the peripheral fringe areas have high concentration of dairy activities because high labour as well as capital productivities which concentrate family labour in this activity. Profitability is another important dimension of discussion that would be discussed separately in the next Chapter.

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## **Chapter-VI**

### **Milk Profitability and Socio-Economic Status of Dairy Households**

#### **6.0 Introduction**

There are numerous studies in India as well as in other countries on the analysis of profitability of the households engaged in dairy activities (Islam et al. 2008, Priekulis et al. 2009, Resende et al. 2010, Uddin et al. 2010, Sharma et al. 2011). From these studies, it is clear that costs of cattle feed and price of the milk supply are two important determinants of milk profitability. As in the modern social setup, profit is major economic factor to perform any activity that has direct link with the social transformation and economic change. It is also true in case of DHHs living in Greater Guwahati Region. In fact, profit from milk sale is a major determinant for assessment of socio-economic status of DHHs. In the changing scenario of socio-economic milieu of DHHs in Greater Guwahati Region, it is clear that the intensification and extension of dairy activities are closely related to the profit earned by the households from dairy activities. However, it links a chain of many factors like investment pattern in dairy activities, supply of milk, engagement of labour and cost of feeds, which expand the size of DHH economy.

Milk profitability can be estimated using the concept of return either from the milk or from the cattle. There are many ways of assessing the return from milch cattle as it is related to an amount obtained from selling cull cows, male calves and selling of dung (Garcia et al. 2010). The data on these items are not available in ready-made form and, on the other hand, such type of cattle return may not constitute significant earnings to the DHHs in this area. So, these aspects of return are not dealt here detail. The main part of profit of DHHs is counted by taking in account the earnings from the

milk supply, where price of milk, cost of feeds purchase for dairy cows, veterinary services, medicines and other expenses under the shed of herds are significant factors. Accordingly, all the above attributes determine the profit of DHHs.

Keeping these views in mind, the socio-economic status of DHHs is analysed with respect to considering milk profit as an important determinant. It would explain the causality of the variation in the socio-economic structure of DHHs. In this Chapter, two main aspects of the socio-economy of DHHs would be dealt with as (a) the cost and return analysis of milk supply and (b) the variation in socio-economy in connection with the variability in the profit from milk produce of DHHs. Before starting the analytical part, milk profitability is to be defined.

### **6.1 Profitability Measurement**

In general, profitability of any economic activity is the function of its two attributes: revenue received and expenditure incurred in money term in the operation of dairy activity at household level. As a result, calculation of milk output is directly related to milk production prices. Both these attributes vary over space in the landscape of Greater Guwahati Region, which shall be discussed later. The second factor of milk profitability is the cost involved in investment and labour. However, it is concluded in the previous Chapter that most of the family labour is engaged in dairy activities and this activity is considered not only for the source of household earnings but also the employment of family workers. In the measurement of profitability, costs on medicines, fodder and forage have been considered as investment on cattle. Further, engagement of labour (family as well as hired) and their wage rates are considered for calculation of total profit of a DHH. It is to be noted here that the workers (family plus hired) engagement is taking into account for calculation of investment on labour. Milk profitability is calculated here with respect

to total investment including labour cost involved in dairy activities as well as per milch cattle. After calculating total milk profitability, its two determinants, investments and size of milch cattle in the herd, are considered to make the analysis of milk profitability in respect to socio-economic factors of DHH. The following formula is used for the calculation of total milk profit (i.e. total revenue from milk) as well as profitability as:

$$TP = [O - (W + I)] \dots \dots \dots (6.1)$$

$$\text{and } TP/I = [O - (W+I)] / I, \text{ and } \dots \dots \dots (6.2)$$

$$TP/C = [O - (W+I)]/C, \dots \dots \dots (6.3)$$

where TP = Total profit of DHH from milk, O = Total revenue from the milk including household consumption of milk in terms of money so the revenue is multiplier factor of milk production (in ltr) and its price (Rs./ltr), W = Labour Cost (family and hired labour) that is multiplier factor of total number of workers engaged in dairy activities and wage rate, I = Investment, i.e. annual cost of medicines, fodders and cattle purchase and C = Number of milch cattle in the herd of DHHs, TP/I = Profitability per unit of investment and TP/C = Profitability per milch cattle.

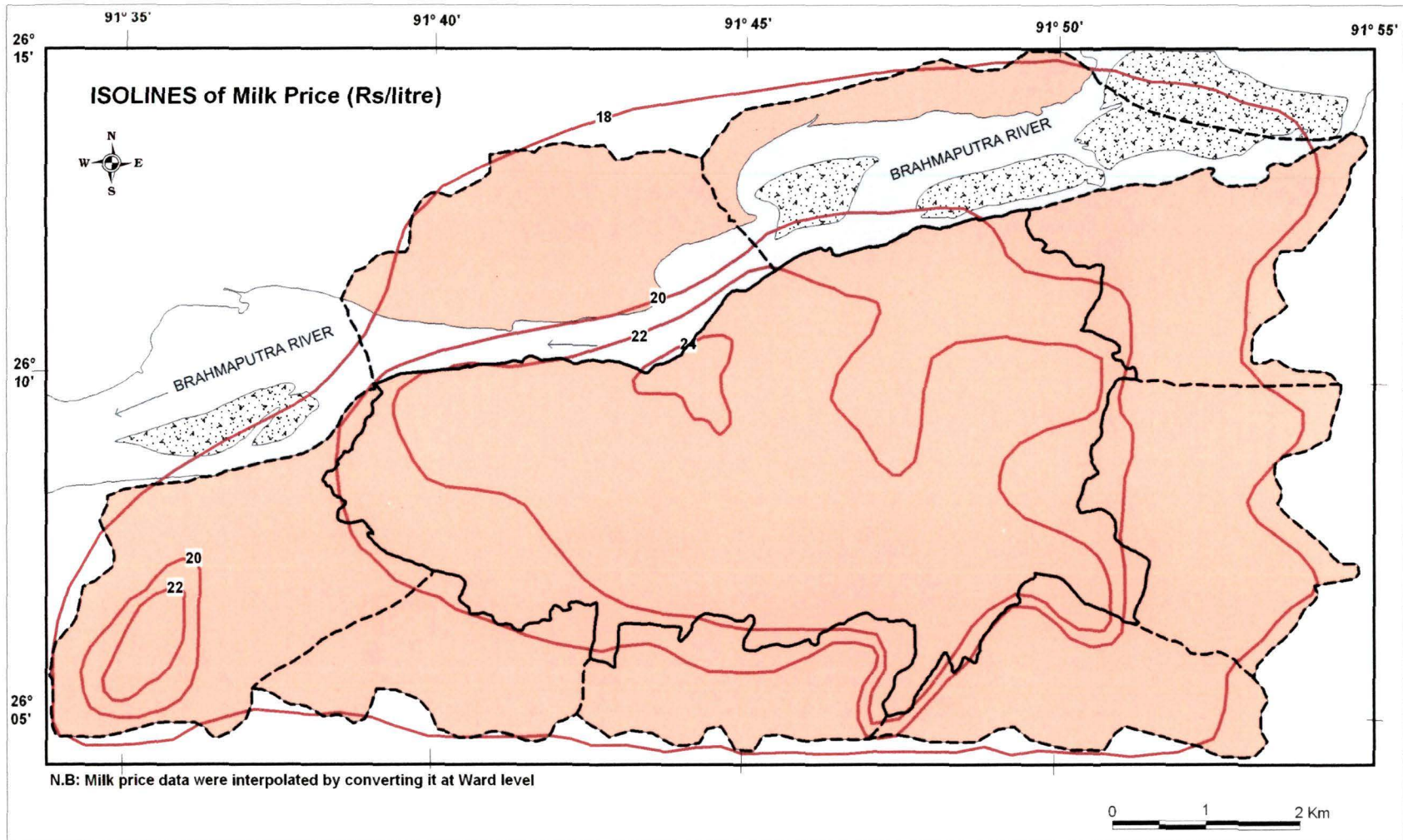
## 6.2 Cost and Return Analysis

**6.2.1 Distribution of Milk Price:** The costs and returns of milk supply of DHHs analysed in this study area are expressed in terms of profit in rupees per unit of investment as well as at per unit of cattle in milk. No doubt, the total revenue of milk is a multiplier factor of milk production with its price. Both factors vary over space and even by time also. However, milk price is more important factor than production. It directly controls the profit of DHHs. In fact, price of milk does not vary much seasonally; there is a significant variation in the actual prices of milk instead of prices

controlled by the Government of Assam and dairy associations of Greater Guwahati Region. During the survey period conducted in 2006, the agreed milk price between producers and consumers was negotiated at Rs. 18.00 per ltr for the whole city region. In spite of a uniform implementation of pricing policies, there is a variation in the actual price from locality to locality. It varies from Rs.24.00 per litre (in the core areas of the city) to Rs. 18.00 per litre (in the outskirts) (Fig- 6.1).

How and why location of DHHs and their distance from city centre as well as the nearest vehicular road are being the main factors which influence the actual price of milk in the Greater Guwahati Region? The answers to such questions are forwarded here to interpret the salient features of the distribution of milk price. In case of variation in milk price, a general inference drawn from Fig- 6.1 is that, as the distance increases from the city centre towards outskirts, the milk price decreases. However, such trend is not uniformly observable in all directions of the study area. In spite of having a lesser distance from city's core to Northern part, a sharp fall of milk price i.e. Rs. 18.00 per litre is witnessed in North Guwahati due to the existence of surface barrier of River Brahmaputra.

In the South-Western part of the study area namely, the Azara locality which is closer to the Airport has developed a knot of increased milk price i.e. Rs. 22.00 per litre within the domain of general trend as stated above. Whereas, in the Southern and South-Eastern parts, a sharp fall of milk prices is observed. The higher price of milk prevails in all the densely populated built-up areas here and the same milk prices immediately fall in the part of foothills of the Garbhanga Reserved Forest of Kamrup Rural District of Assam and adjoining Ri-Bhoi District of Meghalaya.



**Fig-6.1: Spatial Distribution of Milk Prices (2006)**

In the North-Eastern and Eastern parts, the general trend of decreasing milk prices in accordance with the increasing distance from city's core is seen to be continuing upto Chandrapur and Patarkuchi localities as well. Apart from the distance from the city centre towards outskirts, the topography, local market demand, population and road densities are the determining factors for milk prices in Greater Guwahati Region.

The Iso-price lines generally follow the road pattern (Fig-6.1). Increasing prices increases the revenue and consequently profit is gained more. The spatial distribution of milk price over the study area shows an irregular and uneven distribution of milk price in the study area. However, the areal extents of such difference of milk prices are found more prominent within the Municipal Corporation area of Guwahati city. It is observed that the difference of milk prices buffers a wide area in the Eastern part ranging milk price from Rs.18.00 to Rs. 20.00 per litre, which is lesser in comparison to the other parts of the city. This is because of the competition on milk prices amongst milk marketers/producers that arose from the paucity of road networks, consumer preference, community cross-section as well as the more topographic difference in the location of milk producer communities prevalent in these localities. The higher prices of milk are marked in the areas of high 'local market demand' also. The prices of milk within the Airport localities in Western fringe which is Rs. 22.00 per litre is found to be exceptionally high amongst all fringe localities due to high concentration of affluent milk consumers here. The city's central parts have the highest milk price i.e. Rs.24 per litre due to the higher transport costs for milk as well as the high demand for fresh fluid milk. As a whole, the all fringe localities, which are the main milk producing areas for the city's milk consumer, have the milk price of Rs.18 per litre.

**6.2.2 Distribution of Milk Profit per unit of Investment:** As stated earlier that increasing investment in milk production decreases the profitability of milk activities, it is the question of testing validity of this statement in present case. If Iso-profit lines for per unit of investment are drawn on the map for showing high profitability areas, it is found that the localities of high profitability (Rs.400 and above per unit of Rs.1000 investment) are located in three parts of the city: (i) along the main road side areas specially in the Fancy bazar, Panbazar and Uzanbazar localities (Wards 30, 31, 34), (ii) the closer areas to the city centre as surrounded by Uzanbazar, Ulubari, Paltanbazar, Athgaon and Bharalumukh and (iii) the Azara locality near airport (Western fringe) (Figs- 6.2 and 6.3). The reasons behind for the high to very high profitability of milk activities in such areas are due to less investment cost. Generally, the cattle feed costs for DHHs belonging to the area between Uzanbazar and Bharalumukh are comparatively lesser because of its convenient locational advantages. These areas are closer to the whole-sale dealer of concentrates and green vegetables (green vegetable market produces consumable waste for cows). The carrying costs of such articles are minimum here for the DHHs to collect their required cattle's feeds. As a result, they have less investment cost for their milch cattle. Further, the areas situated South-Central parts of the city (along the main road) have high profitability because of higher prices of milk. Such areas are close to posh residential colonies like Zoo-Road, Dispur Capital Complex, Rukminigaon, Barmataria and Chaymile in Greater Guwahati Region.

The DHHs living in Azara area earn high profit from milk activities because of two main reasons: the higher price of milk supply which increases their revenue

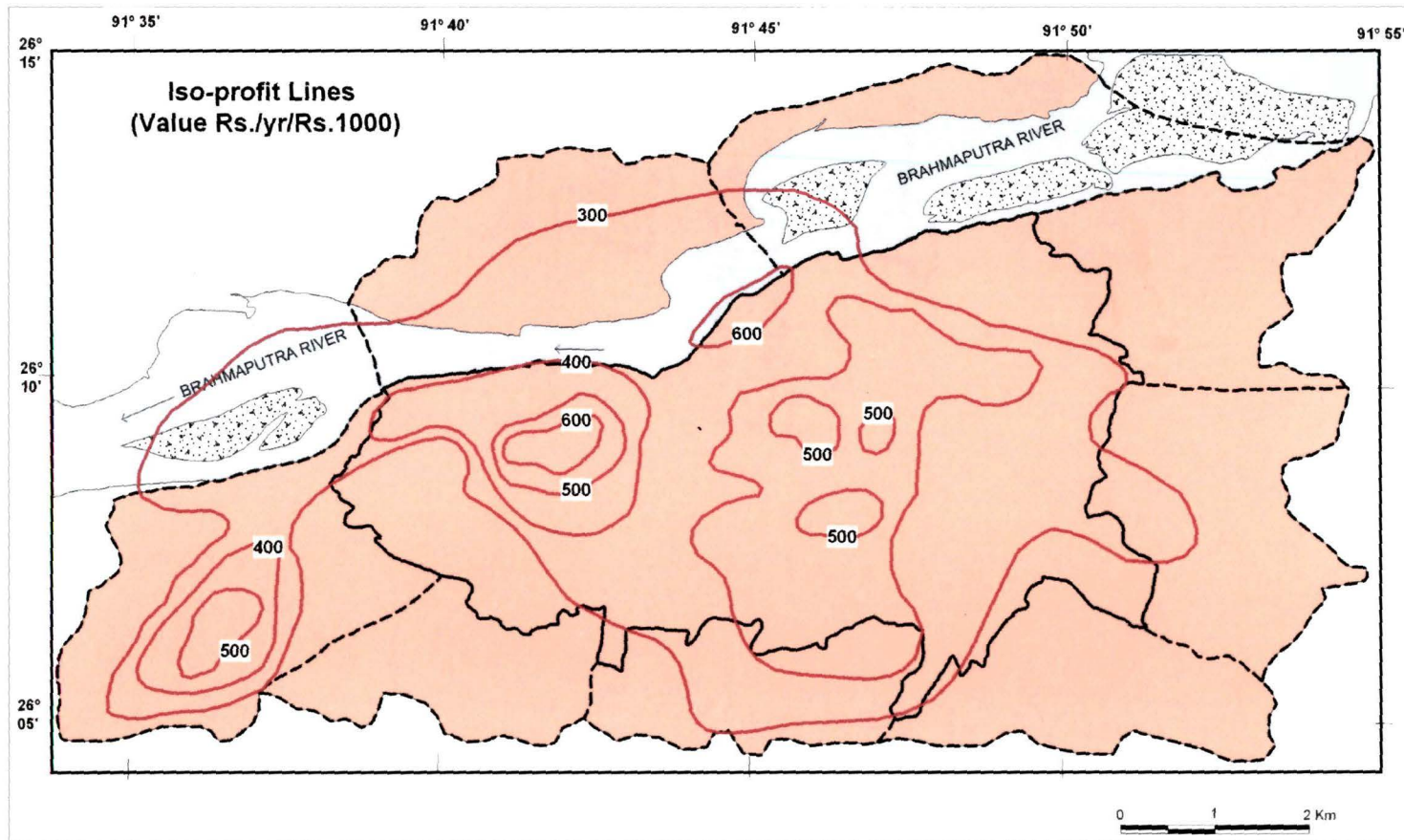
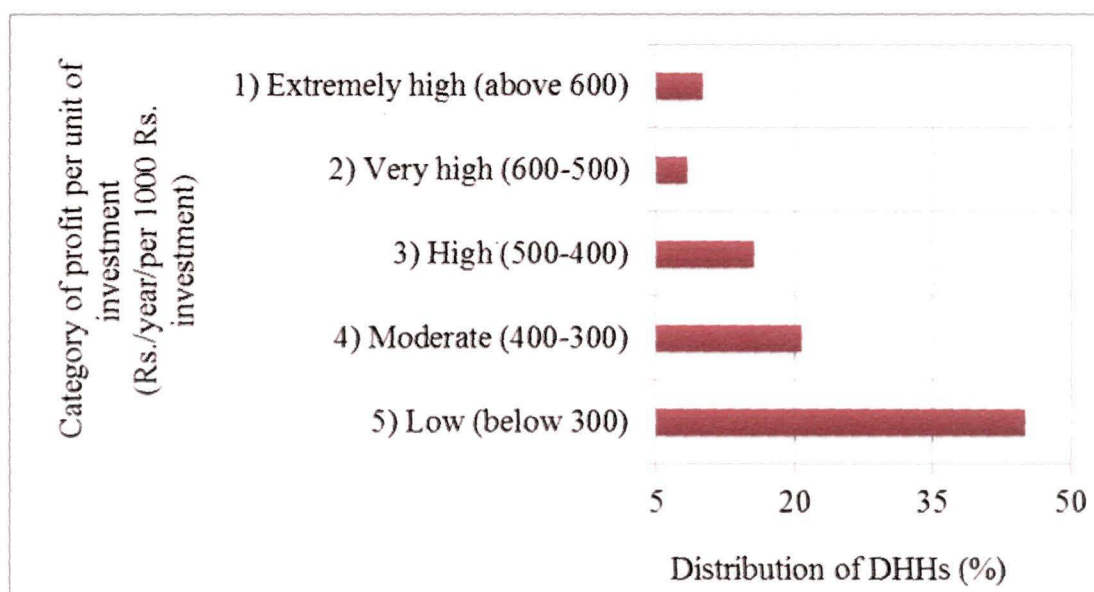


Fig-6.2: Iso-profit lines drawn based on per unit of Investment

from milk sale and forages which are locally available that reduce the investment costs on other side. On account of these two cost-factors and location of Azara area near Guwahati Airport, the DHHs are getting high profit from dairy activities. It is evident that, as Airport Authority of India intensifies its activity in the close by areas of Guwahati Airport, the in-migration of people takes place in Azara area, population density increases and consequently, the more demand of milk is created that increases milk price. Simultaneously, the concentration of DHHs increases in this area to supply of milk in this locality.

Contrary to it, the DHHs of the outskirts location namely, Hatisila Pahar, Ghugua, Panikhaity, Natun Bazar, Laharpara have less milk profitability from milk activities per unit of investment (below 300 Rupees per Rs.1,000 investment). The situation of dairy activities is different in these areas, where natural fodder and



**Fig- 6.3: Distribution of DHHs by their Profit per unit of Investment**

forages are available at cheaper rates. However, the DHHs of these localities supply milk at lower price (Rs. 18 per litre), which reduces their profitability.

In the distribution of profit per unit of investment, nearly a half of the total DHHs fall under the category low profit (i.e. below Rs.300 per unit of investment). It is found that such DHHs of low profitability engage higher number of labour (i.e. above the average of 5 persons/per DHH), invest much and get less production of milk and also sale it at lower price. Opposite situation prevails for the DHHs in the category of extremely high (though their numbers in the study area is less) that have profit more than Rs. 600 per unit of investment and they have lesser labour employment, lower investment costs, fairly high milk production and much higher selling price of milk (Table-6.1). These two opposite trends of profit per unit of investment in the study area are the indicative of inherent problem prevalent in milch cattle herd management.

**Table- 6.1: Pattern of Profit per unit of Investment (2006)**

Category of Profit per unit of investment	DHHs		Annual production	Average milk price	Total investment cost	Labour employed	
	Rs./year/per 1,000 investment	nos					%
1) Extremely High (above 600)		37	10.00	23,787	20.27	1,72,439	4.41
2) Very High (600-500)		31	8.38	25,672	19.55	2,64,448	5.10
3) High (500-400)		58	15.68	24,403	20.17	2,52,884	4.83
4) Moderate (400-300)		77	20.81	23,906	19.40	2,69,499	5.00
5) Low (below 300)		167	45.14	21,633	19.27	2,72,241	5.13
Average (335.33)/Total		370	100.00	23,011	19.56	2,58,891	5.00

### **6.3 Analysis of Socio-economic Status of DHHs with respect to Milk Profitability**

The economy of DHHs is, no doubt, directly related to the activity of milk and its profitability. One has to compare profitability of milk by the socio-economic status of DHHs. Calculating total profitability (eqn. 6.1) and profits per unit of investment as well as per milch cattle (eqn. 6.2 and 6.3), the distribution of these attributes of milk profit have been compared with the socio-economic attributes of the DHHs. For this purpose, two base-variables, namely, milk profitability per unit of investment and profit per milch cattle are considered for finding out the causes of the variability in the socio-economic status of DHHs. Five dependent variables relating to the socio-economic status of DHHs namely family size, literacy rate, total income including income from subsidiary sources, labour engaged in dairy activities and hired - family labour ratio are considered for analysing the causes of milk profitability.

Justification of the choice of these attributes is with the assumption that larger family size may supply more labour to the milk activities which increases the profitability. Likewise, literacy rate may be positively related to profitability per unit of investment, because literates and educated DHHs may conceive in reduction of their investment for raising the milk profitability. Likewise, total income may be one of the important factors which expand the herd size. Because of DHHs having higher income to invest more in dairy activities, they may increase their return from milk activities.

Secondly, the another set of five variables, namely, herd size, investment on green fodder, dry fodder, concentrates and medicines are taken into account for analysing the causes of the variation of profitability per milch cattle. The priority of the factors should be understood while considering these factors as explanatory variables. Further, it is a fact that these variables are closely related to milch cattle

health and their milk production. It is assumed that larger herd size may increase profitability because of agglomeration economies. Increasing cost of medicines may increase the milk productivity of milch cattle. Likewise, the investment cost on fodders and concentrates may also show the positive relationship which can be tested in the present discussion. To serve the purpose for establishing cause-effect relationship of milk profitability in respect to the socio-economic status of DHHs, the following results are drawn.

### **6.3.1 Socio-economic Characteristics of DHHs and Milk Profitability per unit of**

**Investment:** As interpreted in the earlier part of this Chapter about the distribution of profit per unit of investment, it was clear that the patterns of distribution of profitability found obliterated in the areas of central part of Greater Guwahati Region. It is obvious from the Table-6.2 that two general inferences about the socio-economic characteristics of DHHs are drawn as given below:

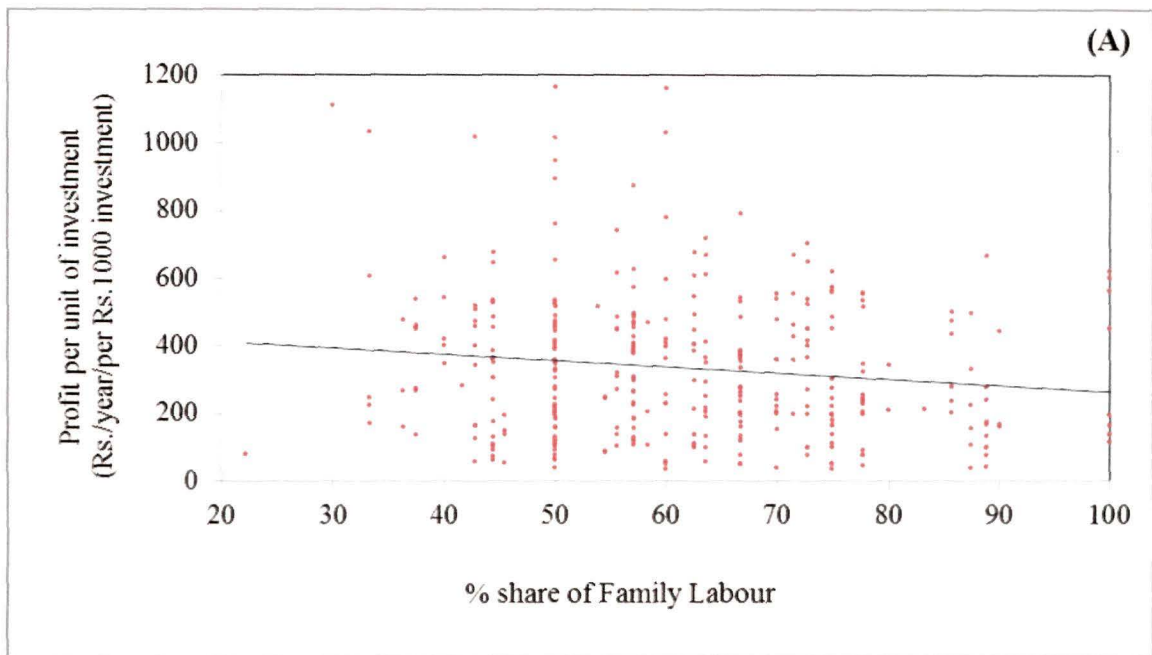
(i) Increasing family size increases the labour employment in dairy activities (they are positively related), but it has negative relationship with profitability of milk activities. There is a clear clue that higher engagement of the percentage of family labour to dairy activities increases the investment cost and, consequently, diminishes the profitability of milk activities. Hired - family labour ratio diminishes from 0.9140 to 0.3957 while profit decreases from Rs. 600.00 per 1,000 rupees of investment to Rs. 300.00 per 1,000 rupees of investment (Table-6.2). It means there is a negative relationship of family labour with profitability per unit of investment (Fig-6.4 A). This relationship shows peculiar characteristics of socio-economic study of DHHs. It is a general argument that increasing share of family labour for the milk production increases the productivity, but this is not the case in the study area. It implies that there is disguised unemployment in DHHs that refers to a scenario of their poor socio-

economic status. The employed family labour does not seem productive in the activity. Owing to low literacy rate and sex ratio in the *Bihari* communities of DHHs, they do not think for the diversification of the activities of increasing the milk supply for higher profit.

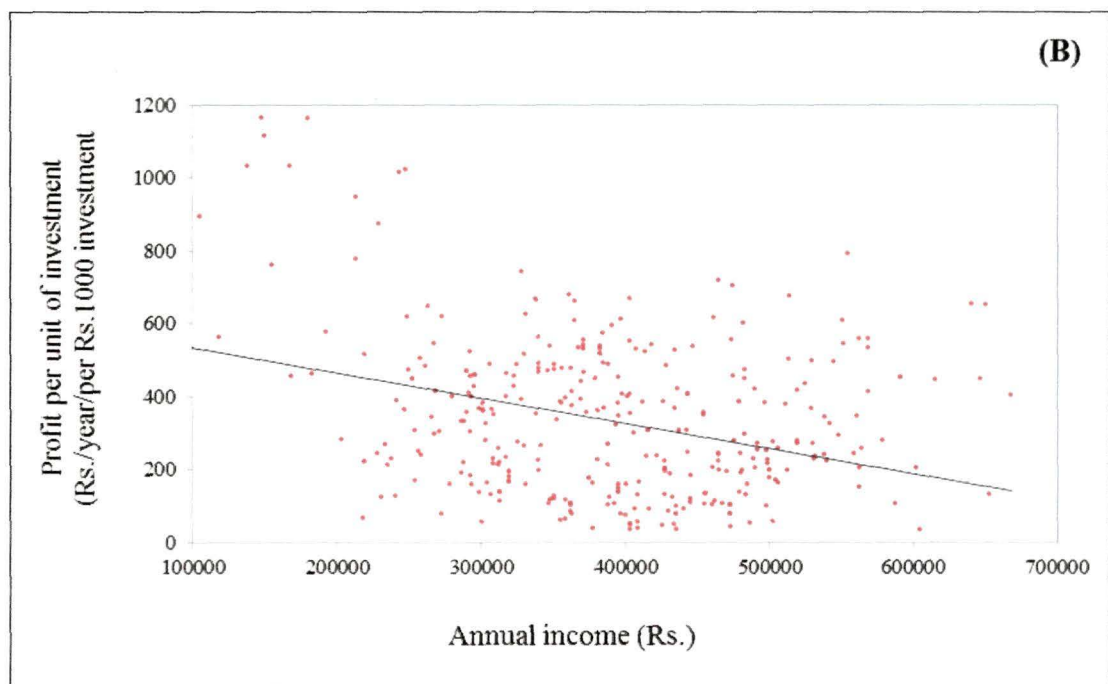
(ii) Profitability among DHHs also varies with their annual income. It is surprising to note that at higher income of DHHs have low profitability and *vice versa* (Fig-6.4B). The reason behind the negative relationship is to be the various sources of income of DHHs. It was discussed earlier in Chapter-III, that the high income DHHs has the larger share of income from the sources other than dairy activity. This fact provides a base of transformation of economy and occupational shift of DHHs.

**Table-6.2: Annual Profit per unit of Investment (2006)**

Profit per unit of investment	DHHs		Average-				
			Family size	Literacy rate	Annual Income (milk + subsidiary source)	Labour per DHHs (HL+FL)	HL/FL ratio
Rs./year/ per Rs. 1,000 investment	nos.	%	persons	%	Rs./DHH/year	persons	unitless
1) Extremely high (above 600)	37	10.00	7.8	72.19	3,19,325	4.41	0.9414
2) Very high (600-500)	31	8.38	8.2	72.74	3,84,514	5.00	0.4409
3) High (500-400)	58	15.68	8.2	77.95	3,83,857	5.00	0.4856
4) Moderate (400-300)	77	20.81	8.4	77.60	3,92,056	5.00	0.2911
5) Low (below 300)	167	45.14	8.2	75.25	4,02,197	5.00	0.3957
Average (335)/ Total	370	100	8.2	75.65	3,87,443	5.00	0.4464



(A) - Profit *versus* DHHs labour ( $r = - 0.1149$ )



(B) -Profit *versus* Annual income ( $r = - 0.3024$ )

**Fig-6.4: Decreasing trends of Profit per unit of Investment with (A) share of family labour and (B) annual income**

Historically, the families of milk producers specially *Biharis* migrated from outside with their indigenous culture with poor socio-economic status. After settling in

Greater Guwahati Region, they have option of performing occupation other than dairying. In spite of dairy as primary activity of family and main source of income for the survival of livelihood, they have shifted gradually their occupations and consequently household income gets increased with low production of milk and low profitability from dairy activity. For example, it is observed during field visit that many DHHs living in the adjoining part and central city region partly engaged in business like vegetables or fruits seller, *paan* shop, grocery shop etc. Their children assist them in dairy activities in many ways e.g. during the holiday time, children of DHHs remain busy in the collection of green grasses from the nearby sources as well. Sometimes they deliver their milk produce at the consumer households also.

**6.3.2 Distribution of Profit per Milch Cattle:** In the earlier part of this Chapter, it is found that the areas of high profitability are generally located in the central part of Greater Guwahati Region specially along the road side and near the city centre. The central parts of the city region extending from Uzanbazar to Kalipur (closing to Brahmaputra River front) have higher profit per milch cattle. On the other hand, the residential colonies of Guwahati Refinery, Indian Oil Corporation that belong to the North-Eastern part, the Dispur Capital Region comprising Rukminigaon, Chaymile and Beltola areas in the South-Eastern part have shown higher profit per milch cattle (above Rs.10,000/cattle/year) (Figs-6.5 and 6.6). Moreover, in the Western region,

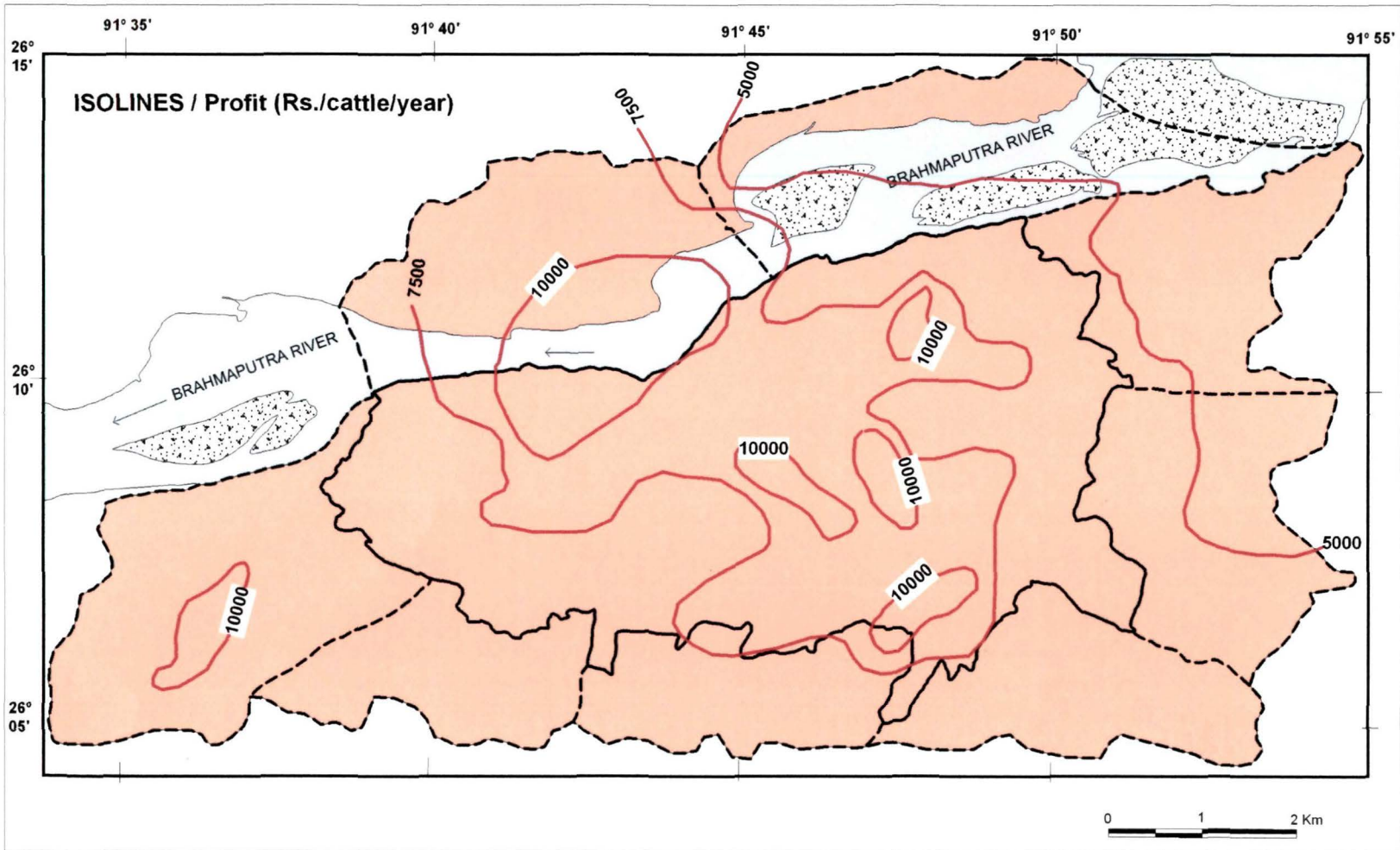
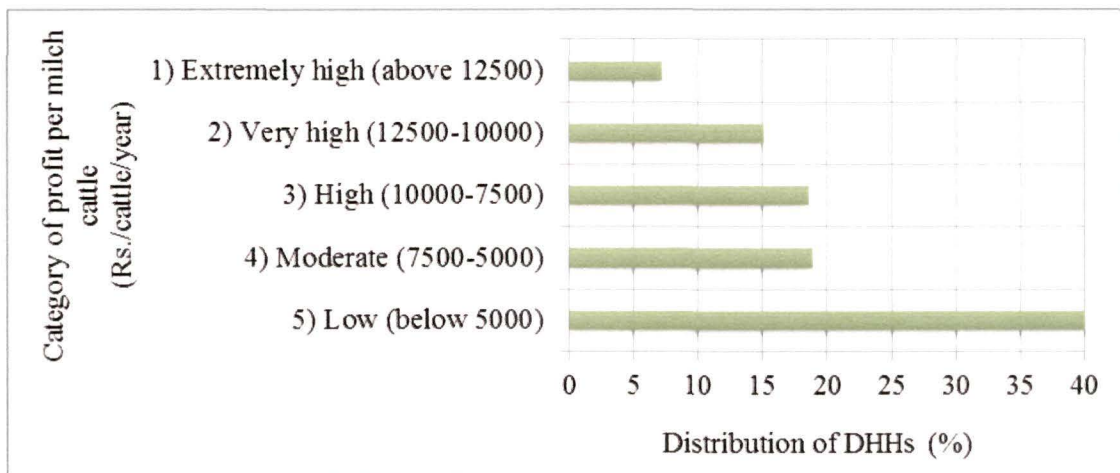


Fig-6.5: Spatial Distribution of Profit per Milch Cattle



**Fig-6.6: Distribution of DHHs by their Profit per milch Cattle**

the Azara localities surrounding the residential colonies of Indian Air Force station has higher profit per milch cattle as well.

If the reason for such distribution is given, it is to say that profitability per unit of milch cattle varies either with respect to annual investment on cattle or socio-economic status of the DHHs. The results on the relationship of profit per milch cattle with other socio-economic factors are given in the latter part of this Chapter.

The distributional pattern of profit per milch cattle shows that the areas of the central part of the city which include either low lying areas or river banks' have high profit (Rs. 10,000/cattle/year). In fact, the fringe areas have low profitability in spite of having cheap fodders and other natural resource base. It shows that the pattern of profit per milch cattle is similar to the distribution of profit per unit of investment.

So, it emerges from the analysis that investment increases as number of cattle in the herd increases. However, the details of this analysis are given considering two aspects of relationship of profit per milch cattle with herd size as well as the socio-economic status of DHHs.

(i) It is clear from the Table-6.3 that the increasing percentage share of expenditure on cattle decreases profitability. It may be because of higher share of costs on

concentrates (the average share of this cost is about 57%) that increases the total investment of establishment of herds. Further, it is interesting to note that the share of investment shift from green fodder to dry fodder and then to medicine costs on milch cattle increases as profit per milch cattle decreases in Greater Guwahati Region. It is obvious to say that those DHHs who use higher share of investment on green fodders get more profitability per milch cattle. Contrary to it, those who are investing more money on concentrates and medicines have less profit.

**Table- 6.3: Herd-size and Annual Investment by Profit per Milch Cattle (2006)**

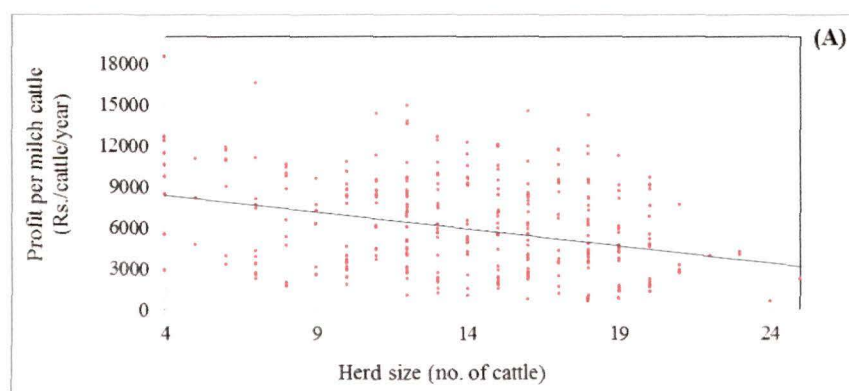
Category of profit per milch cattle	DHHs		Herd size nos.	Annual Investment in -				
	nos.	%		Green fodders Rs.	Dry fodders Rs.	Concentrates Rs.	Medicines Rs.	Total
1) Extremely high (above 12,500)	27	7.30	10.9	30,743 (15.83)	36,272 (18.68)	1,06,626 (54.91)	20,534 (10.58)	1,94,175 (100)
2) Very high (12,500-10,000)	56	15.14	12.9	33,529 (14.55)	44,248 (19.20)	1,27,571 (55.35)	25,129 (10.90)	2,30,476 (100)
3) High (10,000-7,500)	69	18.65	13.6	34,997 (14.13)	44,278 (17.87)	1,41,994 (57.32)	26,465 (10.68)	2,47,734 (100)
4) Moderate (7,500-5,000)	70	18.92	14.8	33,018 (12.60)	46,570 (17.77)	1,52,873 (58.34)	29,558 (11.28)	2,62,019 (100)
5) Low (below 5,000)	148	40.00	14.8	34,234 (13.04)	46,354 (17.65)	1,52,097 (57.92)	29,903 (11.39)	2,62,588 (100)
Average (6,820)/Total	370	100	14.0	33,785 (13.52)	44,953 (17.99)	1,43,330 (57.36)	27,791 (11.12)	2,49,858 (100)

N.B.: Figures in parentheses indicate percentage

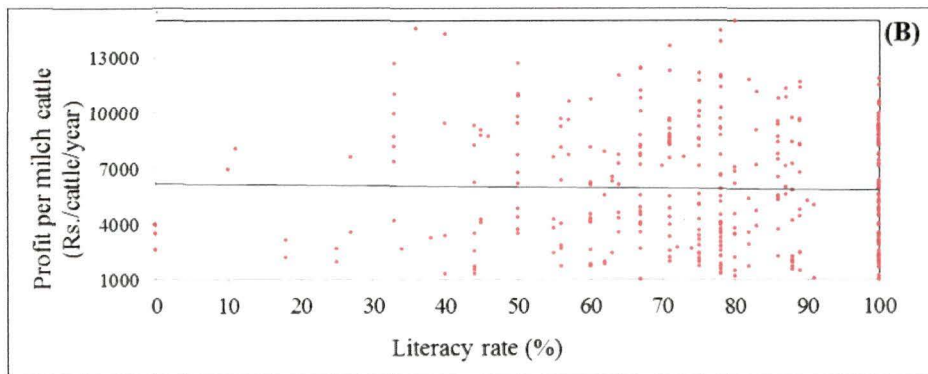
The second attribute, i.e. herd-size, may have perhaps a positive relationship with profit per milch cattle. It is also concluded from some studies in the other parts of the country that profit per milch cattle increases as herd-size increases (Verma et

al.1978). In the present case, it is not true. There is a negative relationship and in extremely high profitable areas (above Rs.12,500/cattle/year), the herd-size counted 11 cattle, while in the category of low profitability areas (below Rs.5,000/cattle/year) the herd-size is 15 cattle per herd. It may be because of two reasons (a) larger herd-size constitute higher share of non-milch cattle as mentioned in the previous Chapter (Chapter-V, Table-5.6) and (b) dis-economies of larger herd-size prevail because DHHs of larger herd-size may not be able to manage expenditure on cattle. Large herd-size increases the expenditure; as a result profitability diminishes in such large herd-sizes.

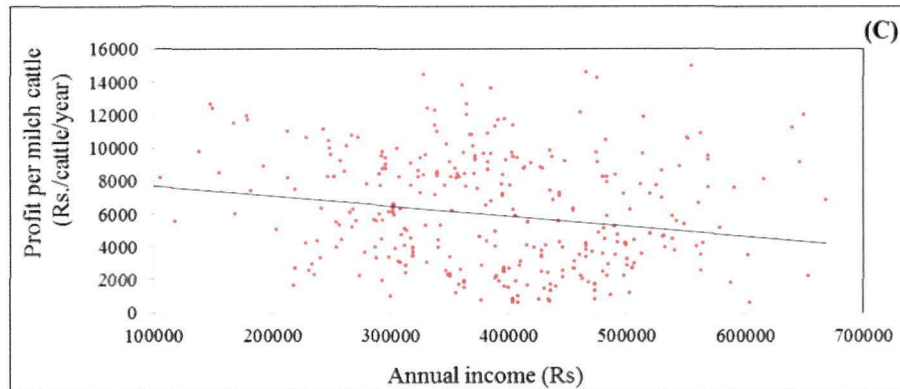
(ii) Profit per milch cattle in respect to socio-economic variables like herd size, literacy rate, and annual income have shown negative associations (Fig- 6.7 A, B, C). It is noted that most of the smaller size DHHs are the constituent of higher number of working adults which contribute to have their lower literacy rate as well as sex ratio because of conservative view of thinking. Some of the members of DHHs have been involved in alternate income avenues for their family worker also for their sustenance whereby they accumulate more annual income. It is a fact that, the small families of DHHs reared smaller herd size with better care and nursing and this situation is more prominent in the central part as well as some other thickly populated areas dominated by affluent milk consumers; as a result their profitability is higher.



**(A)-Profit per Milch Cattle *versus* Herd Size (r = - 0.3021)**



**(B)- Profit per milch cattle *versus* literacy rate ( $r = - 0.0230$ )**



**(C)- Profit per milch cattle *versus* annual income ( $r = - 0.1798$ )**

**Fig-6.7: Decreasing Trend of Profit per Milch Cattle as DHH's Herd-size, Literacy rate and Income increases**

From the above discussion, it can be concluded that most of DHHs of these areas have developed cordial relation with affluent milk-habit consumers and makes delivery of milk at their doorstep at higher price per litre which indirectly contributes in the gaining of higher profit per milch cattle (Table-6.4). No doubt, the percentage of DHHs is high in high and moderate categories of profit per milch cattle (Rs.5, 000 - 10,000/cattle/year). It means, there is a high concentration of DHHs in these categories.

**Table-6.4: Socio-Economic Pattern of DHHs by their Profit per Milch Cattle**

Category of Profit per milch cattle	DHHs		Family size	Literacy rate	Sex ratio	Dependency ratio	Total income
	nos.	%	persons	%	unitless	unitless	Rs.
1) Extremely high (above 12,500)	27	7.30	7.89	70.70	779.63	1.27	3,38,601
2) Very high (12,500-10,000)	56	15.14	8.11	77.25	757.13	1.49	3,78,728
3) High (10,000-7,500)	69	18.65	8.30	74.38	826.74	1.49	3,87,143
4) Moderate (7,500-5,000)	70	18.92	8.30	78.30	841.60	1.41	3,81,972
5) Low (below 5,000)	148	40.00	8.26	75.28	787.91	1.40	4,02,378
Average (6,820)/Total	370	100	8.23	75.65	800.04	1.42	3,87,443

#### 6.4 Concluding Remarks

In this Chapter, two main aspects of socio-economic status of DHHs with respect to profitability of milk producers have been analysed. They are related to socio-economic relations of DHHs with their investment on the maintenance of herd and their source of income. In general, it is concluded in this Chapter that the areas located near the city centre and road-side have higher milk prices than the fixed rate by the Government of Assam. Such areas of high milk price also have high profitability of milk per unit of investment as well as per milch cattle. The reason of high profitability is obvious that is high milk price. However, there are some specific

conclusions drawn from the present analysis, which have been generalised, in the following paragraph.

(1) The profitability of milk does not have relation with the household income. The other source of income increases the total income of the household. It does not influence the dairy activities.

(2) There is a disguised employment problem in the DHHs, those who have large family size, low literacy rate, low sex ratio results in consequent low profitability.

(3) The concentration of DHHs is more in low profitability classes. The low profitability areas are most dispersed in the peripheral areas with much higher investment on herd-size in spite of free access to green grasses and cheap dry fodder.

(4) Among the profitability distribution of DHHs, it is found that profitability per per milch cattle is higher in the cases those who spent more share of expenditure on green fodder and tends to decrease investment share from green fodder to concentrates and then to medicines. It shows per unit of costs on different items of expenditure vary. Per unit of fodder is cheaper than concentrates and concentrates are cheaper than medicines that affect the variability of investment and also the profitability pattern in the Greater Guwahati Region.

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## **Chapter-VII**

### **Findings and Conclusion**

#### **7.0 Introduction**

In the last four Chapters from Chapter-III through Chapter-VI, detailed analyses of the socio-economic status of DHHs has been persuaded with the finding that there is a dominance of only two communities of DHHs, viz. *Nepalese* and *Biharis*; the former being located in the outer peripheries and later generally located in the central areas of the city region, and a mixed category located in the central ring of the city region. This analysis has been persuaded by considering locational aspects, socio-economic status, production and profitability aspects of milk producers. Many results are drawn as given in the last part of each Chapter. In the preceding analysis, the variables related socio-economic aspects of DHHs and base variables for the classification of DHHs were interpreted separately to take them according to their needs for the characterization of the socio-economic status of DHHs. However, there is need to keep all the attributes together and to visualize the overall picture of socio-economic characteristics of DHHs. This procedure is more related to 'generalization of facts' considering the totality concept of geography.

The present Chapter would be devoted towards two main aspects of the discussion viz. (i) synthesization of results based on the total picture emerged from the attributes related to milk producers and (ii) the generalization of the findings as given in the earlier Chapter with the conclusion of the thesis as a whole.

#### **7.1 Synthesis of Results**

Most of the main attributes (14 in number) in the present study, related to the socio-economic status of milk producers are considered for the synthesization of

results, highlighting locational, social and economic characteristics of milk producers of Greater Guwahati Region (Table-7.1).

**Table-7.1: Distributional Characteristics of Attributes**

Attributes		Unit	min	max	mean	STDEV	C.V.%
<b>Locational</b>							
X1	Road accessibility	distance from nearest vehicular road (m)	5	1,000	392.26	289.68	73.85
X2	Market accessibility	distance from city centre (km)	1	34	13.90	7.10	51.08
<b>Socio-Economic</b>							
X3	DHHs size	persons	3	13	8.23	1.93	23.45
X4	Sex ratio	no. of females per 1000 males	200	1,500	800.04	225.50	28.19
X5	Literacy rate	%	0	100	75.65	21.26	28.10
X6	Dependency Ratio	unitless	0	4	1.42	0.95	66.70
X7	Per capita income	Rs./year/person	12,410	1,06,434	52,240.91	13,923.44	26.65
X8	Share of family labour in dairying	%	10	100	50.87	21.72	42.68
X9	Share of milch cattle to total	%	70	100	84.84	5.43	6.40
X10	Expenditure on concentrates	Rs./year	8,000	245700	1,43,329.70	49,401.79	34.47
<b>Productivity Related</b>							
X11	Cattle productivity	ltr/cattle/year	1,256	2,738	1,713.19	172.98	10.10
X12	Labour productivity	ltr/labour/year	669	7,738	3,894.21	1,133.73	29.11
X13	Profitability per milch cattle	Rs./cattle/year	612	23,750	5,907.06	3,585.85	60.70
X14	Capital productivity of milk	(total output/total investment)	127	1,224	729.07	177.28	24.32

The 'Principal Component' tool is used to crystallize the forces of attributes into a few common factors, which much provide the common characteristics of attributes for explaining the commonality of the given data. This method is based on correlation matrix generated through the given attributes. The factors are crystallized in the form

of Factor Loadings and their Eigen values. The number of factors of common characteristics were drawn by using this tool. The results of factor analysis method are drawn in three stages: at the initial stage of the distributional variability of selected attributes, at the middle stage of symmetric matrix of attributes correlation and the final stage of the contribution of attributes to each and every component and their spatial distribution in the Greater Guwahati Region.

**7.1.1 Distribution of Attributes:** Calculating mean, standard deviation, coefficient of variation of each and every attribute related to socio-economic study of milk producers, the comparisons are given in the following manner:

(a) The spatial variability of 3 attributes, namely, the road accessibility, dependency ratio and milk profitability from milch cattle are main attributes, which have more diversified feature in Greater Guwahati Region. Say for example, the distance from nearest road to cattle shed varies from 5 m to 1,000 m with an average of 392 m. In the attribute namely dependency ratio varies from 0 to 4 with its great variation of 66.7 percent; in some localities there is no dependents on workforce in DHHs when family size is the smallest i.e. only 2 persons. On the other hand, in some large family, size of dependents is more because of more number of children and aged person. Likewise, profitability per milch cattle varies significantly from Rs. 612/cattle/year upto Rs. 23,750/cattle/year with its mean of Rs. 5,907/cattle/year.

The lowest variability in the spatial distribution has been observed in the share of milch cattle to total herd size. Percentage share of milch cattle is recorded 70 percent in lower side on the spatial scale and 100 percent in upper side within the average percentage of 84.8. A moderate degree of spatial variability (from 25% to 30%) is recorded for the attributes of sex ratio, literacy rate, per capita income and labour productivity of milk.

In such situation of high degree of variability in such cases and very low degree on the other side is question of weak to very weak correlation, which is analysed in the concluding part of this discussion.

**7.1.2 Correlation Coefficient among Attributes:** A symmetric correlation matrix of each and every attribute was made to understand the association among attributes of socio-economic studies. It is clear from Table-7.2 that-

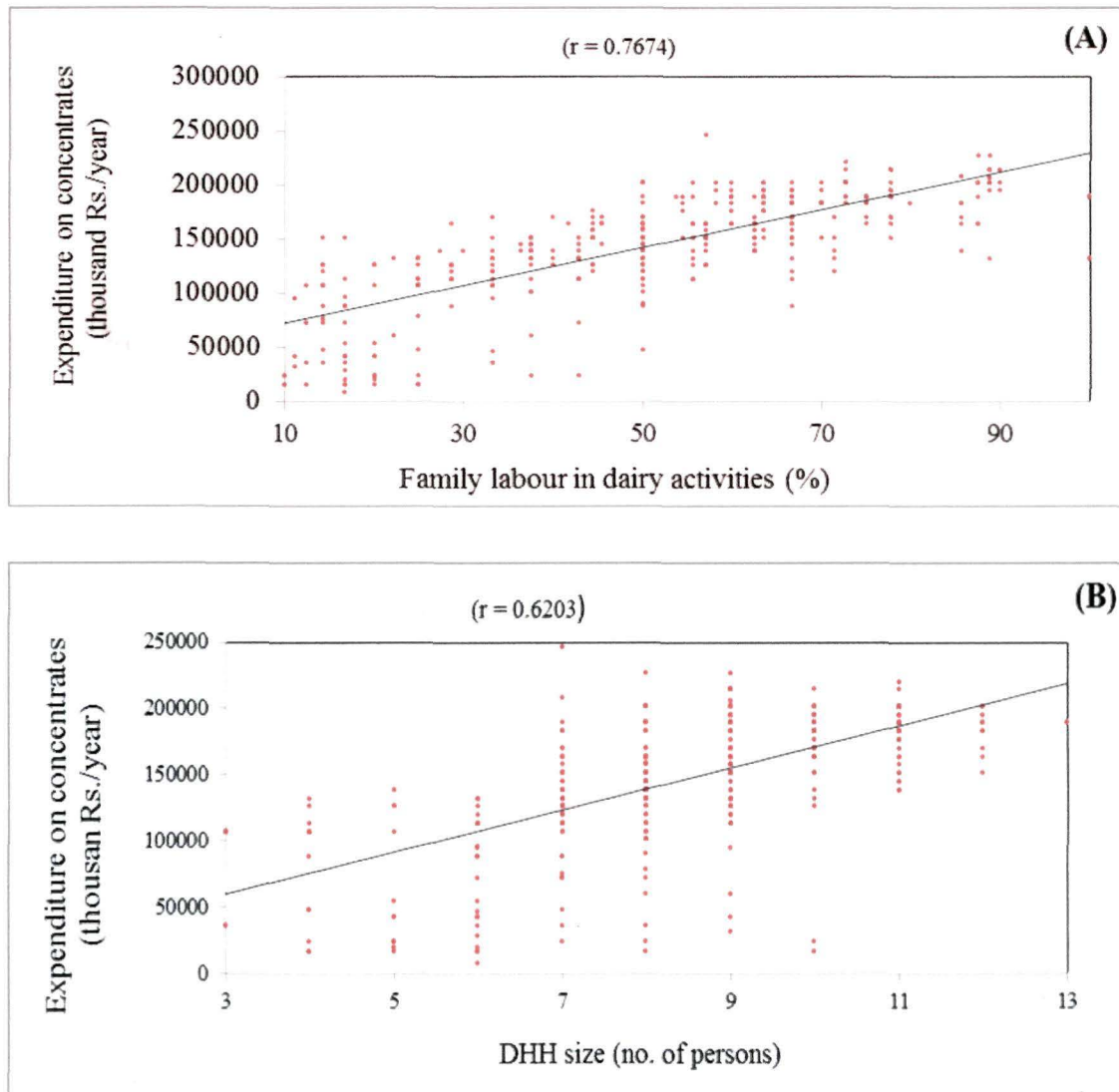
(i) The amount of expenditure on concentrates (X10) is most significantly and positively related to share of family labour (X8) ( $r = 0.7674$ ) as well as the size of DHH (X3) ( $r = 0.6203$ ) (Fig-7.1 A and B, Table-7.2). Such highly positive correlations show that the DHHs having larger size involve their higher percentage share of family labour in dairy activities. DHHs expenditure on concentrates is also found higher. It shows that size and labour have a high positive relation which is a fact drawn from the analysis forwarded earlier also.

(ii) Profitability of milk producers (X13) has high positive correlation co-efficient with share of milch cattle in herd-size (X9) ( $r = 0.6465$ ). It is a fact that more number of cattle in the herd produces more milk at lesser investment; so, profitability of milk producers is higher with large herd size. It reflects the economies of increasing the number of milch cattle in the herd.

**Table-7.2: Correlation Matrix among Attributes**

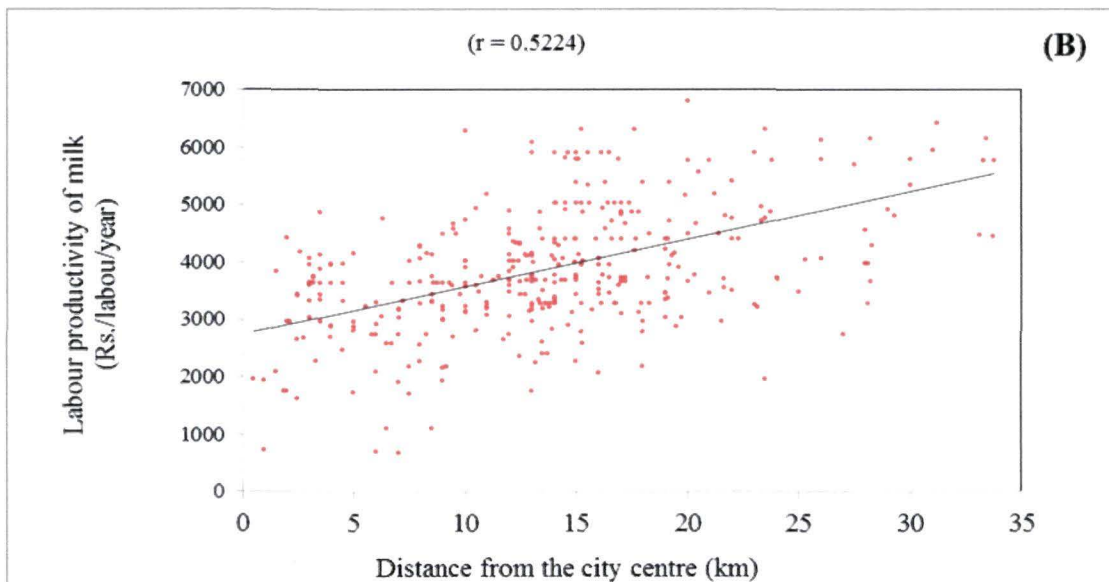
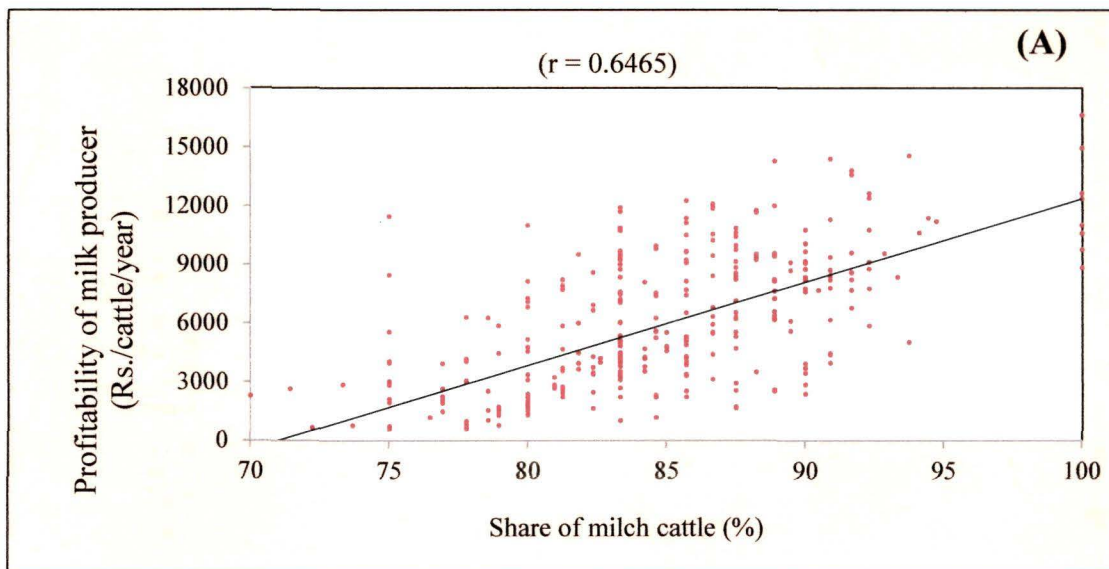
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14
X1	1	0.4802	0.0856	0.0600	0.0595	0.0142	0.1900	0.1001	0.038	0.2891	-0.1213	0.3899	-0.2039	0.1376
X2	0.4802	1	0.0973	0.2891	0.0871	-0.0074	0.2401	0.1484	0.0112	<b>0.4057</b>	-0.1699	<b>0.5224</b>	-0.2454	0.1756
X3	0.0856	0.0973	1	0.1651	-0.2104	-0.2757	<b>-0.4439</b>	<b>0.4426</b>	-0.2156	<b>0.6203</b>	<b>-0.4538</b>	-0.2575	-0.0966	0.0648
X4	0.0600	0.2891	0.1651	1	0.0439	0.0819	-0.1069	0.0332	-0.0228	0.1566	-0.1903	0.0258	-0.0512	-0.1497
X5	0.0595	0.0871	-0.2104	0.0439	1	0.3577	-0.0259	-0.2445	0.0063	-0.1606	0.0065	0.1958	-0.0231	-0.0647
X6	0.0142	-0.0074	-0.2757	0.0819	0.3577	1	0.0470	-0.2354	0.0162	-0.1725	0.0539	0.2332	0.0174	0.0245
X7	0.1900	0.2401	-0.4439	-0.1069	-0.0259	0.047	1	0.2290	0.3613	0.2582	0.0961	<b>0.4919</b>	0.161	<b>0.3525</b>
X8	0.1001	0.1484	0.4426	0.0332	-0.2445	-0.2354	0.229	1	-0.2776	<b>0.7674</b>	-0.3333	-0.1735	-0.1746	<b>0.3325</b>
X9	0.0380	0.0112	-0.2156	-0.0228	0.0063	0.0162	0.3613	-0.2776	1	-0.2156	0.3334	0.1395	<b>0.6465</b>	-0.0612
X10	0.2891	0.4057	0.6203	0.1566	-0.1606	-0.1725	0.2582	0.7674	-0.2156	1	<b>-0.4799</b>	0.1763	-0.3027	0.3059
X11	-0.1213	-0.1699	-0.4538	-0.1903	0.0065	0.0539	0.0961	-0.3333	0.3334	-0.4799	1	0.2856	0.1189	<b>0.4660</b>
X12	0.3899	0.5224	-0.2575	0.0258	0.1958	0.2332	0.4919	-0.1735	0.1395	0.1763	0.2856	1	-0.2312	<b>0.5451</b>
X13	-0.2039	-0.2454	-0.0966	-0.0512	-0.0231	0.0174	0.161	-0.1746	0.6465	-0.3027	0.1189	-0.2312	1	-0.0782
X14	0.1376	0.1756	0.0648	-0.1497	-0.0647	0.0245	0.3525	0.3325	-0.0612	0.3059	0.4660	0.5451	-0.0782	1

N.B.: Names of attributes are given in Table-7.1



**Fig-7.1: Expenditure on Concentrates with (A) share of Family labour and (B) DHH size**

(iii) Increasing distance from the market centre (X2) significantly and positively related with increasing labour productivity of milk (X12). It can be generalized resultantly that labour productivity is more related to the locational factor of market. In fact, it is visualized that in the central part of the city (closer to market) labour productivity of DHHs was found low in the earlier conclusion also and high in the peripheral areas which are far from the city centre (Fig-7.2 A and B).



**Fig-7.2: (A) Profitability versus Share of milch cattle and (B) Labour productivity versus distance from the city centre**

**7.1.3 Principal Components and their Nature:** After extracting the Factor Loadings as well as Eigen values of each and every Principal Component from the process of factor analysis, it is found that first factor component has more than two-third variability of the total. Since Eigen value of first component is very high (3.74) and includes nearly 25 percent variability, it has the strongest component, while second component includes nearly 20 percent variability and subsequently third and fourth

components account for 12.4 percent and 10.6 percent variability respectively (Table-7.3). It implies that these first four components are stronger and would make a good combination of attributes on the basis of the strength of their correlation. The nature of these components' combinations has been highlighted in the following manner that emerge from the Table -7.3.

**Table-7.3: Factor Loadings (Varimax Rotation method) and Eigen values**

Attributes		Principal Components			
		I	II	III	IV
X1	Road accessibility	-0.0899	<b>0.6700</b>	0.0579	0.0337
X2	Market accessibility	-0.1248	<b>0.8375</b>	0.0946	0.0380
X3	DHHs size	<b>-0.3528</b>	0.0953	<b>0.6792</b>	0.1697
X4	Sex ratio	-0.2192	<b>0.5071</b>	0.0366	-0.1072
X5	Literacy rate	-0.1194	0.1817	<b>-0.6456</b>	0.1459
X6	Dependency Ratio	-0.0642	0.1089	<b>-0.6513</b>	0.1343
X7	Per capita income	0.0485	0.2284	-0.0152	-0.3188
X8	Share of family labour in dairying	-0.3075	-0.0132	<b>0.6907</b>	0.2340
X9	Share of cattle in milk to total	0.2127	0.1210	-0.0922	<b>-0.8809</b>
X10	Expenditure on concentrates	<b>-0.4130</b>	0.3649	<b>0.6356</b>	0.2409
X11	Cattle productivity	<b>0.9623</b>	-0.0376	-0.1317	-0.1126
X12	Labour productivity	<b>0.3561</b>	<b>0.6953</b>	-0.1952	0.1048
X13	Profitability from milch Cattle	0.0091	-0.2567	-0.0404	<b>-0.8367</b>
X14	Capital productivity of milk	<b>0.5705</b>	0.2424	0.3409	0.2417
Eigen values		3.7406	2.8629	1.8646	1.5938
% of total variance		24.94	19.09	12.43	10.63
Cumulative % of variance		24.94	44.02	56.45	67.08

**(a) Productivity Dominated Component:** First component of the factor analysis is dominated by cattle, labour and capital productivity including expenditure on concentrates and milk producers household size. These five attributes have strong relationship. In fact, productivity attributes whether it is per cattle or per worker or even in per unit of investment of capital is positively related themselves because, in the general observation, productivity is more related to milk prices rather than

production factors. In addition, the attribute of household size of milk producer also have strong association with this Productivity Component. Such a strong relationship, the inclusion of these productivity attributes to Principal Component first, does not provide the clue of the prioritisation of production factors. But, it shows clearly that attributes related to milk productivity are dominating factors for influencing the socio-economic status of DHHs.

**(b) Location Specific and Labour Productivity Dominated Nexus:** The second component accounts for the accessibility attributes, which are namely the road as well as market accessibilities. It shows that geographical factors are much important to influence the socio-economic status of DHHs. However, these factors are included in second priority of the relationship. One important salient feature of this Principal Component is that labour productivity dominates more in this component. In fact, distance from the city centre and distance from nearest vehicular road are directly related to labour productivity. Sex ratio, though it is not strong but it has significant place, is directly related to market accessibility class in the Greater Guwahati Region.

**(c) Literacy Rate - Family Labour - Family Size Dominated Relationship:** This third Principal Component is the amalgam of social attributes like literacy, DHHs size, and dependency ratio, and strongly related with family labour. It can be said that in such scenario of poor status of milk producers in this area, the combination of social factors are placed in the third priority with the variation of 12.4 percent.

**(d) Profitability-Cattle share nexus Component:** Despite of its weak relationship with most attributes included in the present analysis, the share of milch cattle and profitability per milch cattle are behaving negatively in these components. However, they have stronger correlation coefficient; that is why they dominate in these components.

In general, it is found from Table-7.3 that productivity related economic attributes, which characterise the whole gamut of the development of milk producers, are in the first priority in this area while locational factors play the role at second place. In addition, social aspects are included in the third priority. In addition, one specific feature of the analysis highlighted here is that per capita income is the main attribute of the raising the socio-economic status not only of milk producers but also the other section of the society.

It seems per capita income does not account for much contribution to any Principal Component analysed in the present analysis. It is surprising fact and the association of income, which was studied earlier as an important economic attribute of the socio-economy of DHHs, fails to add strength to any one of these components. The spatial distribution of these components may provide more details of their pattern over space.

## **7.2 Patterns of Principal Components**

In the proceeding part of this Chapter, attributes related to socio-economic status of milk producers were crystallized into four Principal Components and their nature was discussed to show the multi related aspects of socio-economy of milk producers. In spite of inferences of interesting results from the present analysis, the spatial pattern of these Principal Components are of much use to highlight the spatial mosaic and pockets of these components in the Greater Guwahati Region. Processed data showing spatial distribution of Principal Components, as given in the end of this Thesis (Appendix-V), have been arranged in its spatial form to show the salient features of spatial processes of these components. The identification of spatial patterns were made by classifying Z-scores into six categories as: very high + (above 1.0), moderately high + (0.5 – 1.0), high + (0.0 – 0.5), low – (0.0 – 0.5), moderately

low – (0.5–1.0) and very low – (above 1.00). The main spatial features of these Principal Components are as given below-

**(A) Spatial Patterns of Productivity Dominated Component (PC-I)**

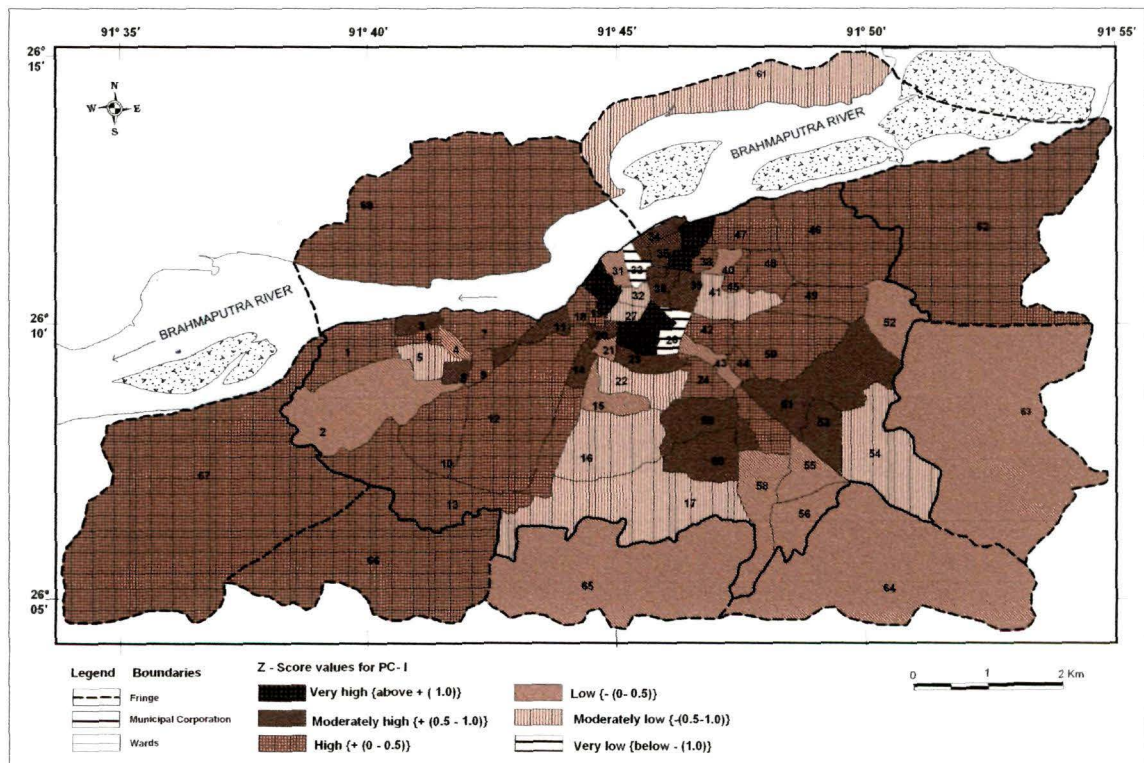
Map of the spatial pattern of this Principal Component shows diverse nature of its distribution; it does not follow smooth pattern. The areas of central part of Greater Guwahati Region (some localities of Birubari, Ulubari, Chatribari, Tokobari, Panbazar, Machkhowa and Kharghuli and along the main roads extending upto a 6 km away from the city centre) have very high value of Z-score showing that the socio-economic activities of DHHs of these areas are highly dependent on their milk productivity activities. It is a fact that milk productivity activities in these localities are of course diversified in nature with the dominance of subsidiary activities as dairying.

On the other hand, the areas of very close to the central market namely the Jorpukhuri, Latasil, Ambari, Lachitnagar, Rupnagar (Wards 26 and 33) have very low Z-score value on the map. It may be because of (i) the less number of DHHs settled in these wards and (ii) the highest congested areas which are more oriented to commercial activities and partly residential areas having less consumption of milk. Therefore, the patterns are so obliterated in the central part of Greater Guwahati Region to be diversified socio-economic characteristics of DHHs in these areas.

Furthermore, the areas of moderate values of Z-score of productivity-dominated component  $\{\pm (0.0-0.5)\}$  are located in the most middle parts of Greater Guwahati Region including outer fringes located along the Brahmaputra River. It confirms that the socio-economic conditions of DHHs have moderate influence of their milk productivity factors (Table-7.4, Fig-7.3).

**Table-7.4: Z-score values for Principal Component-I**

Category of Z - Score	Z- Score value	PC-I	No. of Wards	Ward code
1) Very high	+(1.0 <)	2.04666	5	25,28,29,30,37
2) Moderately high	+(1.0 - 0.5)	0.59521	14	3,8,11,14,20,23,34,35,36,39,51,53,59,60
3) High	+(0.5 - 0.0)	0.20047	24	1,6,7,9,10,12,13,18,19,24,38,42,44,45,46,47,48,49,50,57,62,66,67,68
4) Low	-(0.0 - 0.5)	-0.24876	14	2,4,15,21,31,40,43,52,55,56,58,63,64,65
5) Moderately low	-(0.5 - 1.0)	-0.69080	9	5,16,17,22,27,32,41,54,61
6) Very low	-(1.0 <)	-1.23707	2	26,33
Average /Total		0.15815	68	



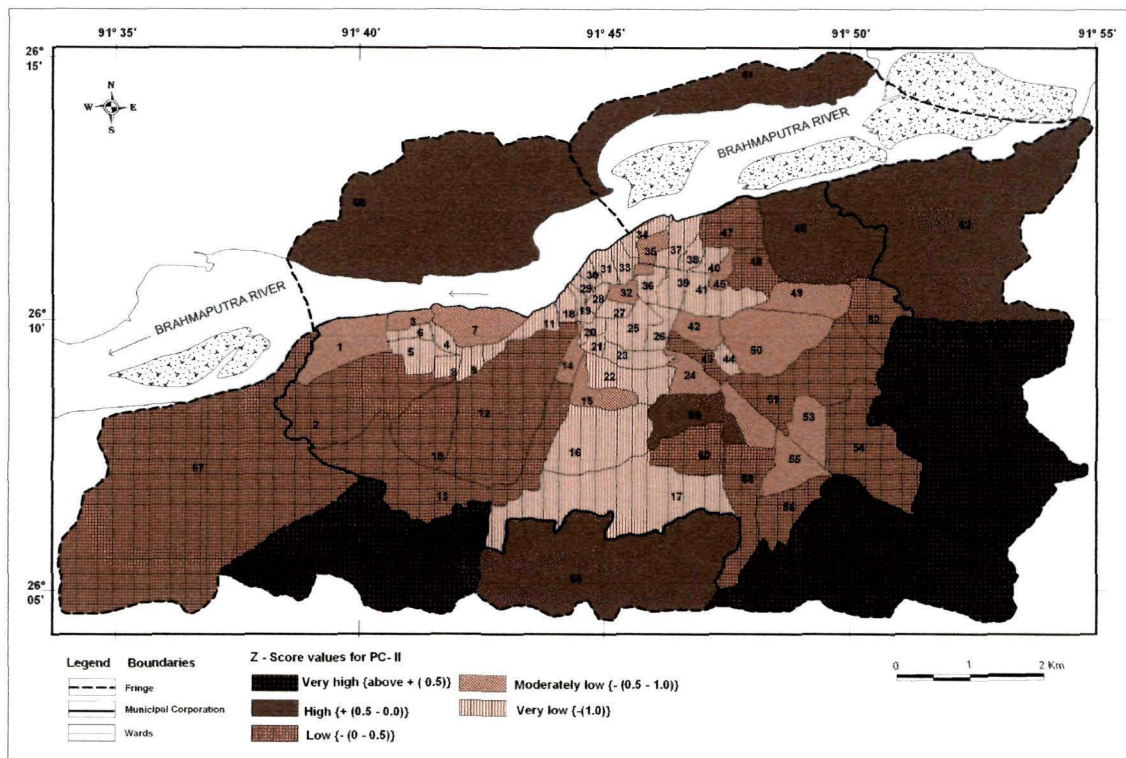
**Fig-7.3: Spatial Pattern of First Principal Component**

### (B) Spatial Patterns of Location Specific Component (PC-II)

It is already discussed that this Principal Component includes the geographical attributes of road and market accessibilities. Very high Z-scores are found in the peripheral areas of Greater Guwahati Region specially the fringes of North and North-East of hilly terrain and the Brahmaputra-par lowlying areas of fringe 61 and 68. It is clear from the map that these areas are producing more milk and supplying to the central part of the city, so that the socio-economic conditions of DHHs of these areas area more influenced by location specific factors (market as well as road accessibility) (Table-7.5, Fig-7.4).

**Table-7.5: Z-score values for Principal Component-II**

Category of Z - Score	Z- Score value	PC-II	No. of Wards	Ward code
1) Very high	+(0.5 <)	0.86142	3	63,64,66,
2) High	+(0.5 - 0.0)	0.28279	6	46,59,61,62, 65,68,
3) Low	-(0.0 - 0.5)	-0.27914	14	2,10,12,13,43 ,47,48,51,52, 54,56,58,60,67,
4) Moderately low	-(0.5 -1.0)	-0.74559	15	1,3,7,14,15,24, 32,35,42,45,49, 50,53,55,57,
5) Very low	-(1.0 <)	-1.34511	30	4,5,6,8,9,11,16, 17,18,19,20,21, 22,23,25,26,27, 28,29,30,31,33, 34,36,37,38,39, 40,41,44,
Average/Total		-0.75241	68	



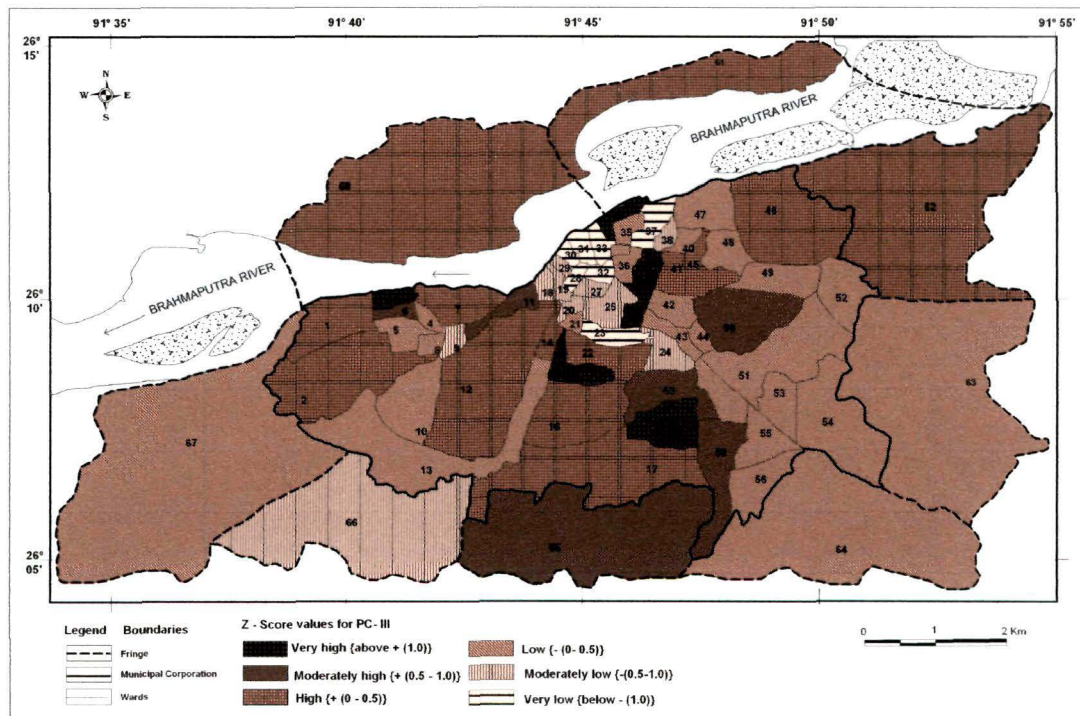
**Fig-7.4: Spatial Pattern of Second Principal Component**

**(C) Spatial Patterns of the Component related to Literacy Rate-Family Size-Family Labour Dominated Relationship (PC-III)**

The high Z-scores of this Component are shown only in a few patches along with the road and the South located Garbhanga Reserved Forest areas where the socio-economic conditions of DHHs are controlled by the status of their literacy, family size and available family labour. So, the economic factors do not influence the characteristic features of DHHs located in these areas. However, the areas located in and around city centre have very low Z-score value of this Component (- below 1.0). It is clear with the comparison of the First Principal Component with this Third one that the DHHs located in the areas of central part of city do not have significant influence of the social factors (Table- 7.6, Fig-7.5).

**Table-7.6: Z-score values for Principal Component-III**

Category of Z - Score	Z- Score value	PC-III	No. of Wards	Ward code
1) Very high	+(1.0 <)	1.66663	6	3,15,26,34,39,60
2) Moderately high	+(1.0 - 0.5)	0.67044	6	6,11,50,58,59,65
3) High	+(0.5 - 0.0)	0.21096	14	1,2,7,12,14,16,17,22,41,45,46,61,62,68
4) Low	-(0.0 - 0.5)	-0.21132	25	4,5,8,10,13,21,35,36,40,42,43,44,47,48,49,51,52,53,54,55,56,57,63,64,67
5) Moderately low	-(0.5 -1.0)	-0.67425	10	9,18,19,20,24,25,27,29,38,,66
6) Very low	-(1.0 <)	-1.37872	7	23,28,30,31,32,33,37
Average/Total		-0.06913	68	



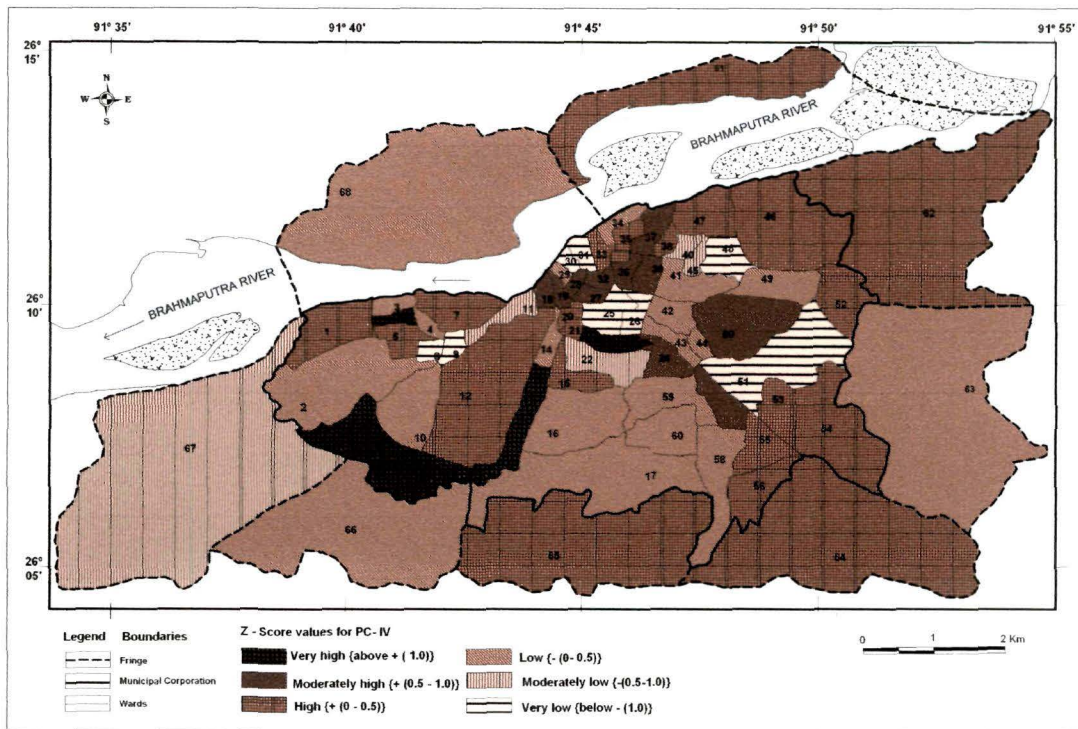
**Fig-7.5: Spatial Pattern of Third Principal Component**

**(D) Spatial Patterns of Profitability-Cattle Share nexus Component (PC-IV)**

In spite of its less effect on the socio-economy of the DHHs on the whole in Greater Guwahati Region as it accounts for less significant share of variation and low value of its Eigen Vector, the spatial pattern of this component are diversified in nature. For example, the areas of the foot-hills located in the city following main roads (namely Narakasur, Fatasil, Gorchuk, Boragaon, Tetelia etc.) are having high Z-score value that shows the impact of profitability on the socio-economic conditions of DHHs in these areas (Table-7.7, Fig-7.6).

**Table-7.7: Z-score values for Principal Component-IV**

Category of Z - Score	Z- Score value	PC-IV	No. of Wards	Ward code
1) Very high	+(1.0 <)	1.14911	3	6,13,23
2) Moderately high	+(1.0 - 0.5)	0.73552	11	18,19,24,27,28,32,36,37,39,50,57
3) High	+(0.5 - 0.0)	0.23999	21	1,5,7,12,15,20,21,33,35,38,46,47,52,53,54,55,56,61,62,64,65
4) Low	-(0.0 - 0.5)	-0.20193	20	2,3,4,10,14,16,17,29,34,41,42,43,44,49,58,59,60,63,66,68
5) Moderately low	-(0.5 - 1.0)	-0.83407	5	11,22,40,45,67
6) Very low	-(1.0 <)	-1.60467	8	8,9,25,26,30,31,48,51
Average/Total		-0.06571	68	



**Fig-7.6: Spatial Pattern of Fourth Principal Component**

On the whole, the patterns of all these four Components are so diversified that the generalization are difficult to explain. However, the relationship of Principal Component-I and Principal Component-II which account for nearly half of the variability (44.50%) of total inclusion of attributes strength in the present study, shows some interesting features that these both Components are negatively related ( $r = -1.68823$ ). It confirms the fact that these components are complementary to each other, so they do not have their dominance together. The areas of productivity dominance factors do not have impact on location specific factors in the study area (Fig- 7.7). Comparing spatial patterns of these two Components, it is found that the socio-economic status of DHHs in the areas located closed to the city centre are influenced by their productivity factors, while the peripheral areas of Greater Guwahati Region is more influenced by location-specific factors that are market and road accessibility.

ratio and literacy rate are found very low in the DHHs of *Bihari* communities. However, milk producers belonging to the *Nepali* communities have high literacy rate with high income from dairy activities. Dairy is the only activity for their income, which increases labour productivity also.

(iii) So far as locational aspects of these two communities are concerned, milk producers belong to *Biharis* are more concentrated in central part of the study areas because they have a cultural background to stay attached with the business communities like *Rajasthanese* who are living in the CBD and have been performing low profile jobs related to their business. Moreover, being the minority community, both the communities have a feeling to settle or reside within the peripheries with their own communities to share their work culture. Such attitude ultimately develops some dairy pockets dominated by each of both communities in the study area. On the other hand, the *Nepalese* are culturally hill people who prefer to settle in calm and quiet natural environment. Accordingly, both the hardworking communities perceived their preferred location in the environ of Greater Guwahati Region wherefrom they have been consistently supplying the much needed fresh fluid milk to the city consumers of Greater Guwahati Region as well.

(iv) The Rivers Brahmaputra and Bharalu- the prominent wetlands fronts like Borsola and Sarusola *Beel* - with several others that are spreading in the central parts as well as in the Northern peripheries of the study area, provide immense scope to operate milk-producing activities specially for the *Bihari* milk producers. It is because these wetlands are the natural absorber of cowshed waste, perennial source of green grass cover as well as the fish for regular catching, which are the utmost need for them. Alternately, the denuded hills provide the *Nepalese* a gradient gentle slope to have natural outlet for the disposal of their cattle shed-waste. The hills with frequent valley

cuts are the most viable source of natural grass cover and the *Nepalese* are recognized as the sole proprietor of that grass domain. Such facility naturally fuels their cultural instinct to rear milch cattle in the surrounding hill topography of Greater Guwahati Region. Ultimately the magnet of milk market in the city region and the urban pressure, both the opposite interacting agent on milk producers temporarily compensates over the space wherefrom milk producers of Greater Guwahati Region sustain their economic opportunity with their best possible effort.

In the end, it is to be concluded that the concentration of milk producers set up with two dominating communities namely the *Biharis and Nepalese*, one living in the low lying areas of the North and South-Western parts and the another concentrated in the transitional ecological conditions between the plains and foot-hills on the Eastern and Southern fringe of the Greater Guwahati Region are obviously seen in the spatial distribution of the milk producer communities. In the context of the socio-economic status of the *Bihari* community, it is found that they are much poor than the *Nepalese* despite of their residences close to the city centre. At lower percentage share of expenditure on concentrates and medicines, *Nepalese* milk producers living in the foot-hill topography have high labour as well as cattle productivity and moderate profitability from dairy activities. They have higher sex ratio, high literacy rate and high productivity from dairy activities. They also are supplying milk to the city centre for increasing need of fresh fluid milk in the city.

## Appendix-I

### QUESTIONNAIRE cum SURVEY SCHEDULE

#### Socio-Economic Study of Milk Producer Communities in Greater Guwahati Region

Schedule No.

Date of Survey: 00 / 00 / 2006

Name of Surveyor: *Jogesh Chandra Deka*, Signature of Surveyor: .....

Address: ..... Location of DHH and Total No. of DHH in the Locality: .....

1. Ward/Fringe no. with locality of DHH: ..... (W denotes Ward No. and F denotes Fringe)

2. Distance of DHH from the City Centre (km): .....(City Centre: DC Office, Guwahati)

3. Distance of DHH from Nearest Vehicular Road (m):.....m

#### Social and Demographic Structure of the Household -

4. Name of the Head of Household: ..... (Title first)

5. Religion: ..... (Hindu - 1, Muslim - 2, Jain - 3, Sikh - 4, Christian - 4, Others - 6)

6. Caste: ..... (General - 1, SC - 2, ST - 3, OBC - 4, Others - 5)

7. Community / Clan: .....(Nepali – 1, Bihari - 2, Assamese -3, Bengali -4, Rajasthani -5, Punjabi - 6, Others - 7)

8. Topographic Feature of the locality of HH:.....(Foot-hills - 1, Built-up areas - 2, Wetland front - 3, River bank - 4)

#### 9. Socio-Demographic Information:

Family Members	Relation with DHH head	* Sex	Age (yrs)	** Educational Status	*** income of DHH from subsidiary occupation (daily/monthly)	Income of DHH from Milk (daily/monthly)	Expenditure of DHH (herd/daily/monthly)	Balance of income (daily/monthly)
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								

\* Sex: M denotes Male, F denotes Female,

\*\* Educational Status: Illiterate -1, Primary - 2, Middle School - 3, High School - 4, Higher secondary - 5, Graduate - 6, Post-Graduate -7, Technical qualification - 8, others - 9

\*\*\* Sources of subsidiary Income : Agriculture - 1, Business - 2, Private Service - 3, Government Service - 4, Govt. Pensioner - 5, No other sources of Income – 6

Special Note if any:

.....  
 .....

**10. Additional Occupation of HH other than Milk Production –**

Members of Household	Agriculture	Business	Private Service	Government Service	Others
Household Head					
Wife / Husband					
Sons/ Daughters					
Brothers / Sisters					
Grandsons / Grand daughters					

**11. Production and Consumption pattern of the Household –**

Types of Milch Cattle	No. of Milch Cattle	Cattle in Milk	* Breed of Milch Cattle	Daily Milk Production (ltr)	Lactation Period (months)	Sale prices of Milk (Rs. per ltr)	Household Milk Consumption (day/ltr)	Qty. of Surplus Milk (day/ltr)
1.Cow								
2.Buffalo								
3.Goat								

\* **Breed:** local (1), Crossed (2), others (3)

**12. Supply / Marketing of Milk from the Household –**

Mode of Consumption of Milk	Quantity of Milk Sold (ltrs/daily)	* Producer's Milk Delivery System	** Means of Carrying Milk	Place / Ward No. of Milk Supply	Distance between Milk Producing Unit & Places of Milk Delivery (km)
Primary Consumer					
Milk Cooperative					
Middleman					
Sweet meat Shop					
Others					

\* **Delivery System** denotes consumer / middlemen self-collection from farm (1), middlemen's site delivery (2), consumer's home delivery (3), consumer self-collection and home delivery (4)

\*\* **Means of carrying milk** denotes - No Carrying required (1), by bicycle (2), by motor vehicle (3), both by manually & vehicle (4)



**Appendix-II****Ward-wise Household Size (Census 2001)**

Ward code	Total population	Total HH	HH size
1	18,190	3,555	5.17
2	13,622	2,655	5.13
3	10,258	2,226	4.60
4	12,619	2,730	4.62
5	7,318	1,697	4.31
6	9,071	1,895	4.78
7	19,166	4,020	4.76
8	9,993	2,124	4.70
9	7,272	1,580	4.60
10	8,996	1,901	4.73
11	12,331	2,696	4.57
12	33,846	7,450	4.54
13	16,609	3,558	4.66
14	21,125	4,620	4.57
15	13,535	2,850	4.74
16	16,854	3,779	4.45
17	10,924	2,562	4.26
18	7,394	1,453	5.08
19	1,501	2,828	5.30
20	11,858	2,492	4.75
21	6,572	1,488	4.41
22	15,740	3,352	4.69
23	11,029	2,609	4.22
24	15,963	3,793	4.20
25	18,425	4,377	4.20
26	10,705	2,653	4.03
27	10,725	2,314	4.63
28	9,832	1,975	4.97
29	8,465	1,275	6.63
30	7,564	1,350	5.60
31	5,616	1,040	5.40
32	10,245	2,296	4.46
33	10,531	2,217	4.75
34	11,512	2,481	4.64
35	11,968	2,916	4.10
36	14,986	3,548	4.22
37	14,546	3,436	4.23
38	8,123	1,946	4.17
39	13,257	3,223	4.11

40	3,420	883	3.87
41	20,360	4,987	4.08
42	12,181	3,013	4.04
43	5,400	1,134	4.76
44	15,117	3,955	3.82
45	15,642	3,672	4.25
46	23,455	5,535	4.23
47	7,799	1,877	4.15
48	11,622	2,952	3.93
49	26,314	6,373	4.12
50	10,933	2,732	4.00
51	25,989	6,396	4.06
52	6,490	1,520	4.26
53	8,608	2,025	4.25
54	15,347	3,518	4.36
55	11,785	2,999	3.92
56	19,683	4,602	4.27
57	16,143	3,977	4.05
58	22,741	5,507	4.12
59	18,615	4,644	4.00
60	20,456	5,193	3.93
61	14,550	1,980	7.34
62	20,436	3,418	5.97
63	21,200	3,478	6.09
64	18,791	3,025	6.21
65	5,758	1,152	4.99
66	4,960	709	6.99
67	21,006	3,912	5.36
68	20,178	2,562	7.87
Total /average	9,36,774	2,04,690	4.57

### Appendix-III

Ward/Fringe-wise Distribution Population and Dairy Household (2001, 2006)

Ward code	Population (2001)	No. of DHH (2006)	Area (in ha)	% to total population	Density of DHH (DHH/sq km)	Population density (persons/ha)	% of DHH to total HH	Density of roads (km/sq km)
1	18,190	9	607.5	1.94	1.48	29.94	0.25	4.86
2	13,622	18	1034	1.45	1.74	13.17	0.68	6.23
3	10,258	5	89.26	1.10	5.60	114.92	0.22	17.36
4	12,619	7	60.98	1.35	11.48	206.94	0.26	21.21
5	7,318	4	162.3	0.78	2.46	45.09	0.24	6.92
6	9,071	11	64.13	0.97	17.15	141.45	0.58	27.20
7	19,166	6	326.3	2.05	1.84	58.74	0.15	5.56
8	9,993	3	64.44	1.07	4.66	155.07	0.14	17.72
9	7,272	12	79.08	0.78	15.17	91.96	0.76	24.37
10	8,996	30	459.5	0.96	6.53	19.58	1.58	5.41
11	12,331	21	153	1.32	13.73	80.59	0.78	17.68
12	33,846	79	1407	3.61	5.61	24.06	1.06	6.12
13	16,609	48	1198	1.77	4.01	13.86	1.35	3.46
14	21,125	8	94.49	2.26	8.47	223.57	0.17	14.18
15	13,535	13	185.7	1.44	7.00	72.89	0.46	14.56
16	16,854	19	672.5	1.80	2.83	25.06	0.50	11.82
17	10,924	23	1334	1.17	1.72	8.19	0.90	5.26
18	7,394	4	67.6	0.79	5.92	109.38	0.28	15.82
19	15,010	5	53.77	1.60	9.30	279.15	0.18	18.20
20	11,858	8	50.52	1.27	15.84	234.72	0.32	11.29
21	6,572	14	45.28	0.70	30.92	145.14	0.94	14.29
22	15,740	28	292.9	1.68	9.56	53.74	0.84	8.99
23	11,029	29	138.8	1.18	20.89	79.46	1.11	11.41
24	15,963	18	178.7	1.70	10.07	89.33	0.47	14.08
25	18,425	9	196.2	1.97	4.59	93.91	0.21	13.36
26	10,705	3	107.3	1.14	2.80	99.77	0.11	17.04
27	10,725	6	62.4	1.14	9.62	171.88	0.26	17.39
28	9,832	5	45.55	1.05	10.98	215.85	0.25	7.57
29	8,465	3	35.46	0.90	8.46	238.72	0.24	13.31
30	7,564	2	43.05	0.81	4.65	175.70	0.15	9.26
31	5,616	2	82.17	0.60	2.43	68.35	0.19	12.09
32	10,245	2	66.26	1.09	3.02	154.62	0.09	15.03
33	10,531	1	91.34	1.12	1.09	115.29	0.05	10.03
34	11,512	3	93.58	1.23	3.21	123.02	0.12	12.47
35	11,968	4	106.1	1.28	3.77	112.80	0.14	13.50
36	14,986	5	82.45	1.60	6.06	181.76	0.14	12.48
37	14,546	15	157.4	1.55	9.53	92.41	0.44	9.90

38	8,123	3	63.14	0.87	4.75	128.65	0.15	12.98
39	13,257	2	113.7	1.42	1.76	116.60	0.06	14.47
40	3,420	8	69.73	0.37	11.47	49.05	0.91	13.84
41	20,360	24	272.5	2.17	8.81	74.72	0.48	13.48
42	12,181	5	160.8	1.30	3.11	75.75	0.17	15.48
43	5,400	2	119	0.58	1.68	45.38	0.18	14.08
44	15,117	17	62.46	1.61	27.22	242.03	0.43	21.63
45	15,642	31	67.59	1.67	45.86	231.42	0.84	15.97
46	23,455	96	1065	2.50	9.01	22.02	1.73	3.91
47	7,799	18	314.5	0.83	5.72	24.80	0.96	8.23
48	11,622	13	200.9	1.24	6.47	57.85	0.44	8.61
49	26,314	67	298.3	2.81	22.46	88.21	1.05	9.23
50	10,933	22	620.2	1.17	3.55	17.63	0.81	8.91
51	25,989	35	851.8	2.77	4.11	30.51	0.55	9.46
52	6,490	59	340.3	0.69	17.34	19.07	3.88	5.08
53	8,608	19	236.9	0.92	8.02	36.34	0.94	11.63
54	15,347	83	854.7	1.64	9.71	17.96	2.36	5.25
55	11,785	25	253.3	1.26	9.87	46.53	0.83	14.74
56	19,683	35	318.3	2.10	11.00	61.84	0.76	9.79
57	16,143	6	205.3	1.72	2.92	78.63	0.15	16.06
58	22,741	35	491	2.43	7.13	46.32	0.64	13.42
59	18,615	27	374.3	1.99	7.21	49.73	0.58	16.48
60	20,456	16	342.8	2.18	4.67	59.67	0.31	14.92
61	14,550	58	3938	1.55	1.47	3.69	2.93	0.34
62	20,436	789	3342	2.18	23.61	6.11	23.08	1.34
63	21,200	959	3823	2.26	25.09	5.55	27.57	1.40
64	18,791	1,410	2905	2.01	48.54	6.47	46.61	0.92
65	5,758	103	2472	0.61	4.17	2.33	8.94	0.45
66	4,960	62	2387	0.53	2.60	2.08	8.74	0.33
67	21,006	84	5019	2.24	1.67	4.19	2.15	2.67
68	20,178	87	5184	2.15	1.68	3.89	3.40	2.32
<b>Total /average</b>	<b>9,36,774</b>	<b>4,682</b>	<b>4,67,55.53</b>	<b>99.99</b>	<b>9.22</b>	<b>85.52</b>	<b>2.34</b>	<b>11.10</b>

## Appendix-IV

### Sex ratio of Overall Population in Greater Guwahati Region (2001)

Ward code	Total population	Total male	Total female	Sex ratio {1000*(F/M)}
1	18,190	10,039	8,151	812
2	13,622	7,579	6,043	797
3	10,258	5,493	4,765	867
4	12,619	6,631	5,988	903
5	7,318	3,993	3,325	833
6	9,071	4,689	4,382	935
7	19,166	10,092	9,074	899
8	9,993	5,148	4,845	941
9	7,272	3,694	3,578	969
10	8,996	4,710	4,286	910
11	12,331	6,706	5,625	839
12	33,846	18,088	15,758	871
13	16,609	8,844	7,765	878
14	21,125	11,372	9,753	858
15	13,535	7,105	6,430	905
16	16,854	8,984	7,870	876
17	10,924	5,901	5,023	851
18	7,394	4,050	3,344	826
19	15,010	8,374	6,636	792
20	11,858	6,648	5,210	784
21	6,572	3,577	2,995	837
22	15,740	8,240	7,500	910
23	11,029	6,009	5,020	835
24	15,963	8,831	7,132	808
25	18,425	10,032	8,393	837
26	10,705	5,917	4,788	809
27	10,725	5,739	4,986	869
28	9,832	5,603	4,229	755
29	8,465	5,136	3,329	648
30	7,564	4,160	3,404	818
31	5,616	3,424	2,192	640
32	10,245	5,697	4,548	798
33	10,531	5,679	4,852	854
34	11,512	6,033	5,479	908
35	11,968	6,428	5,540	862
36	14,986	8,387	6,599	787
37	14,546	7,911	6,635	839
38	8,123	4,433	3,690	832
39	13,257	7,148	6,109	855

40	3,420	1,847	1,573	852
41	20,360	10,892	9,468	869
42	12,181	6,741	5,440	807
43	5,400	2,789	2,611	936
44	15,117	8,397	6,720	800
45	15,642	8,736	6,906	791
46	23,455	12,853	10,602	825
47	7,799	4,238	3,561	840
48	11,622	6,399	5,223	816
49	26,314	14,353	11,961	833
50	10,933	5,877	5,056	860
51	25,989	14,239	11,750	825
52	6,490	3,494	2,996	857
53	8,608	4,672	3,936	842
54	15,347	8,268	7,079	856
55	11,785	6,499	5,286	813
56	19,683	10,823	8,860	819
57	16,143	8,590	7,553	879
58	22,741	12,542	10,199	813
59	18,615	10,194	8,421	826
60	20,456	11,321	9,135	807
61	14,550	7,602	6,948	914
62	20,436	10,872	9,564	880
63	21,200	10,876	10,324	949
64	18,791	9,518	9,273	974
65	5,758	3,000	2,758	919
66	4,960	2,564	2,396	934
67	21,006	11,444	9,562	836
68	20,178	10,704	9,474	885
Total /Average	9,36,774	5,06,868	4,29,906	849

## Appendix-V

### Spatial Distribution of Principal Component

Sl.no.	Ward code	Dairy cluster	PC-1	PC-2	PC-3	PC-4
1	1	Sadilapur	-0.62964	-0.50984	0.54692	0.91362
2	1	Garigaon	1.07315	-0.56681	-0.05958	1.27114
3	1	Khanamukh	0.31952	-0.79821	-0.07982	-1.11454
4	2	GU Campus	0.29829	-0.47052	0.45909	0.52759
5	2	APRO	-1.02435	-0.35847	0.24194	-0.61529
6	3	Ferryghat	0.24909	-0.47600	1.68028	0.07131
7	3	New Colony	0.96186	-0.94616	1.77327	-0.19948
8	4	Rest Camp	-0.45360	-1.17851	-0.38474	-0.14429
9	5	Boripara	-0.70654	-1.33741	-1.98414	0.48904
<b>10</b>	<b>5</b>	<b>Ananda Nagar</b>	<b>-2.15212</b>	-1.02654	0.78378	-0.77761
11	5	Katiya Dolong	0.07406	-0.75901	1.08294	0.60000
12	6	Adabari	0.77190	-1.16680	0.39450	1.04322
13	6	BBC Colony	-0.49000	-0.84729	1.08151	1.12800
14	7	Nilachal	0.66837	-0.89642	0.92106	-0.49104
15	7	Kamakhya	-0.11712	-0.42399	-0.35241	0.63788
<b>16</b>	<b>8</b>	<b>West Maligaon</b>	1.03193	-1.23992	0.02325	<b>-3.12640</b>
17	8	WestGotanagar	0.28794	-1.78989	-0.12400	-0.16297
<b>18</b>	<b>9</b>	<b>East Gotanagar</b>	1.34733	-1.44280	-0.00160	<b>-2.54917</b>
<b>19</b>	<b>9</b>	<b>East Maligaon</b>	-0.61930	<b>-2.14520</b>	-1.87879	0.26383
20	10	Gotanagar	0.37800	-0.26534	0.15091	-0.97018
21	10	Gosala	-0.95750	-0.47677	0.41330	-0.66471
22	10	Nambari	-0.94326	-0.50721	0.17202	-0.38695
23	10	Tetelia Gaon	1.51317	-1.09565	0.58687	-0.11640
24	10	Pachim Boragaon	1.91634	-0.03865	-1.37242	0.76342
<b>25</b>	<b>11</b>	<b>Bhutnath</b>	<b>3.20398</b>	-0.60118	0.65928	-0.37823
26	11	Kalipur	-0.59369	-1.33562	1.02318	-0.64618
27	11	Durgasarobar	0.66029	-1.32756	0.27090	-1.10652
28	11	Santipur hillside	0.00432	-0.87542	0.32599	-1.85064
29	12	Fatasil N.C.	0.13154	-1.27712	0.57446	1.42776
30	12	Kalikhola	-0.19399	-0.37805	1.25678	0.48422
31	12	Dhirenpara N.C.	0.86464	0.20998	0.21096	-1.28873
32	12	Ganeshpara	0.81125	0.54057	0.12639	-0.09451
33	12	Manpara	-0.52264	-0.42130	1.03601	0.80119
34	12	Datalpara	0.14365	-0.77579	0.99690	0.07507
35	12	Katahbari	0.17808	-0.26756	0.37752	0.30628
36	12	Kalapani	-0.19078	-0.32997	-0.59715	0.85983
37	12	Gokhaigaon	0.69236	-0.67367	-0.51377	0.46054

38	12	Dawpara	0.62940	0.13712	-0.51814	0.23687
39	12	Gotanagar N.C.	2.10812	0.36570	-0.06726	-2.20429
40	12	Madhabdevnagar	-0.38921	-0.79138	-2.11666	0.29985
41	13	Garchuk	-0.19552	-0.47440	-0.13650	0.30170
42	13	Pub Boragaon	0.08982	-0.07434	0.42510	1.36995
43	13	Pachim Boragaon	-0.26910	-0.66832	-1.61429	2.31643
44	13	Deepar Beel	0.37207	-0.51038	0.94628	1.10259
45	13	Tetelia	0.05356	-0.61812	0.05951	-0.05991
46	14	Fatasil	1.24031	-1.03257	1.69128	0.00070
47	14	Dhirenpara	-0.17946	-0.70644	-0.75071	-0.12047
48	15	Barkhapara	-0.06714	-0.94794	1.67054	0.87777
49	15	Lutuma	-1.34688	-0.81972	0.99830	-1.26684
50	15	Odalbakra	-0.29461	-1.19026	1.04759	0.82336
51	15	Lalganesh	0.57829	-0.62065	0.81166	0.30807
52	15	Mora Bharalu	-0.37024	-1.35557	0.76971	1.28745
53	16	Saukuchi	-1.22913	-1.59990	0.66184	-0.89328
54	16	Sonaighuli	-0.17967	-0.42516	0.37495	1.60084
55	16	Dakchingaon	-0.69585	-0.78938	-0.78938	0.04475
56	16	Bhetapara	-0.50425	-1.20686	0.14625	-0.91567
57	17	Sarusajai	-0.21510	-1.78847	-1.11424	1.97563
58	17	Barsajai	-1.50046	-0.57849	0.51913	-1.18456
59	17	Betkuchi	0.24889	-1.01550	1.01696	0.06922
60	17	Lakhra	-1.30866	-1.11398	-0.42175	-0.98229
61	18	Bharalumukh	-0.86041	-1.82908	-0.88878	0.07139
62	18	Santipur	1.67264	-1.10128	-0.83941	1.03902
63	18	Kumarpara	0.68216	-1.67790	0.18555	0.49809
64	19	Mashkhowa	0.00934	-0.93189	-0.91885	-0.76168
65	19	Kumarpara	1.17401	-1.95244	0.09268	1.79681
66	19	Athgaon	-1.16688	-1.70030	-0.73897	0.54187
67	20	Bishnupur	0.59060	-1.17043	-0.17328	-0.82798
68	20	Aryanagar	0.08153	-1.08582	0.27756	1.05229
69	20	Bishnupur	-0.08092	-2.48688	-1.45463	-0.46915
70	20	Bimalanagar	1.85820	-1.14594	-0.77509	0.27972
71	21	Sankarpur	-0.63870	-1.30703	1.39732	-0.89963
72	21	Mahendranagar	-0.69920	-1.22807	-1.43962	0.86543
73	21	Gopinathnagar	0.01334	-0.73329	-0.18008	1.47768
74	22	Lutuma Area	-1.16155	-1.34019	1.89951	-1.83865
75	22	Binovanagar	0.14077	-0.91539	-1.28390	-0.12873
<b>76</b>	<b>23</b>	<b>Birubari</b>	0.73561	-1.95116	-1.30589	<b>2.03712</b>
77	23	Rupnagar	0.27857	-1.39672	-1.91851	0.67401
78	24	Indrapur	-1.79415	-1.25696	-0.19458	-0.85922
<b>79</b>	<b>24</b>	<b>Natun Nagar</b>	<b>2.58017</b>	-0.92818	-0.67017	1.66935
80	24	Kahilipara	0.40512	-0.46642	-0.79947	1.22676
<b>81</b>	<b>25</b>	<b>Gopinathnagar</b>	-1.09289	-1.35498	<b>-2.06876</b>	-0.04514
<b>82</b>	<b>25</b>	<b>Jonakpur</b>	<b>5.13768</b>	-1.31529	-0.42460	-1.26920

<b>83</b>	<b>25</b>	<b>Agri office</b>	<b>3.92005</b>	-1.18996	0.13241	<b>-2.24094</b>
84	26	Rup Nagar	-1.48156	-1.17190	1.00499	-0.78962
<b>85</b>	<b>26</b>	<b>Sreemantapur</b>	-0.63064	-1.00792	1.85431	<b>-2.31240</b>
86	27	Beelpar	-1.36696	-0.92179	-1.07035	0.17055
87	27	Baninagar	-0.48513	-1.52153	-0.61722	0.89404
<b>88</b>	<b>28</b>	<b>Krishnanagar</b>	<b>2.09759</b>	-1.66386	-1.26841	0.68858
<b>89</b>	<b>28</b>	<b>Tokobari Satra</b>	<b>2.00099</b>	-1.63772	-1.31984	1.04006
<b>90</b>	<b>29</b>	<b>Kalimandir</b>	<b>4.26027</b>	-0.92999	-0.61446	-1.30753
91	29	Kedar road	0.11670	-1.35675	-1.14364	0.34230
<b>92</b>	<b>30</b>	<b>Rly.INo Gate</b>	1.45581	-2.30747	-1.17938	<b>-2.80685</b>
<b>93</b>	<b>31</b>	<b>Panbazar</b>	-1.93300	-1.90231	<b>-2.10273</b>	-0.10421
<b>94</b>	<b>31</b>	<b>ASEB HQ.</b>	1.37332	-1.64370	-0.90131	<b>-3.85420</b>
95	32	Solapara	-0.52984	-0.80030	-1.24575	0.84612
96	33	Latasil	-1.41803	-1.18554	-1.70185	0.33224
<b>97</b>	<b>34</b>	<b>Satpukhuri</b>	1.21818	-1.28137	<b>2.10294</b>	0.45486
98	34	Uzanbazar	0.09250	-1.81550	0.04030	-0.93869
99	35	Kharghuli	0.61119	-0.65619	-0.47864	0.38263
100	36	Silphukuri	0.33484	-0.95596	-0.96157	1.09383
101	36	Silpukhuri	0.76755	-1.13402	0.89575	0.52029
102	37	Kharghul	1.88479	-1.29485	-1.11573	0.91986
<b>103</b>	<b>38</b>	<b>Milanpur</b>	<b>2.02001</b>	-1.84222	-0.57896	0.27003
104	38	Chandmari	-1.87024	-1.55325	-0.42127	0.11599
<b>105</b>	<b>39</b>	<b>Rajgarh</b>	0.58782	-1.09679	<b>2.18132</b>	0.75326
106	40	Krishnanagar	-0.42884	-1.22066	-0.12533	-1.23642
107	40	Milanpur,	0.43438	-0.76722	0.03628	-0.41620
108	40	Bamunimaidan	-0.53943	-1.78504	-0.41689	-0.88641
109	41	Japorigog	0.21080	-0.51287	0.99624	0.81092
110	41	Narikal basti	-0.16050	-1.21050	0.46481	-0.92405
<b>111</b>	<b>41</b>	<b>Geetanagar</b>	<b>-2.16877</b>	-1.60122	-0.92516	-1.23985
112	42	Rajgarh	-0.67097	-1.27296	-0.36698	-0.08846
<b>113</b>	<b>42</b>	<b>Tarun Nagar</b>	<b>2.12356</b>	-0.31277	-0.06452	-0.08079
114	42	Ambikagiri	-1.18430	-0.67076	-0.70105	0.12419
115	43	Srinagar	0.06373	-0.41113	0.51263	1.12174
116	43	Bhangagarh	-0.54654	-0.53770	-0.87218	-1.42683
117	44	Sundarpur	0.38235	-1.07105	-0.07435	0.65610
118	44	Kalyanpur	0.04842	-1.32494	-0.69156	-0.54510
119	44	Arun Nagar	0.51788	-2.16004	-0.24394	-1.23062
120	45	New Ghyy	0.39766	-0.94646	0.32495	-0.61814
121	46	Kenduguri	-0.03084	0.54237	-1.21041	-1.16224
122	46	Mothgharia	0.24375	0.41390	1.15991	0.30056
123	46	Salbari	0.06058	-0.27618	0.57455	0.73883
124	46	Sunsali grant	-0.07894	0.25203	0.39947	0.97448
125	47	Ganesh Nagar	0.50997	-0.49346	-0.18796	-1.11892
126	47	Jyoti Nagar	-1.74652	-1.02352	-0.00485	-0.23713
127	47	Chunsali Hills	0.07401	0.30402	-0.09925	1.12459

128	47	Ramcha Hills	1.38404	-0.10307	-1.46073	0.53071
129	48	Lalmati	-0.21502	-0.18044	-0.04139	-1.63268
130	48	Shankar Nagar	-0.47320	-0.05143	-0.56629	-1.34137
131	49	Mathgharia	2.03507	-1.39178	0.60920	-0.36058
132	49	Kusal Nagar	0.61795	-0.98179	-0.10038	0.51280
133	49	Chaliha Nagar	-0.27797	-0.62289	0.01395	0.68951
134	49	Oughuli	-0.47036	-0.78231	0.44334	1.28062
135	49	Pathar Kuwari	0.43373	-0.49887	-0.49422	-0.13927
136	49	Kamala Bagan	0.32116	0.43933	-0.99664	-1.14039
137	49	Forest Gate	-0.58231	0.09860	-0.35055	-1.89474
138	50	1No.Hengrabari	0.48523	-0.92122	0.24125	-0.17168
139	50	Lichu Bagan	-0.42068	-0.53286	0.93060	1.50138
140	51	Hengrabari	0.53517	-0.42252	-0.13545	-1.04085
141	52	Narengi	-0.77988	-0.72527	0.59486	1.96578
142	52	Birkuchi Gaon	-0.90964	-0.31109	-0.00062	-1.03921
143	52	Bondagaon	-0.00586	-0.06372	-0.55569	0.45658
144	52	Kalitakuchi	0.60884	0.03928	-0.25485	0.07588
145	52	Satgaon	0.34405	0.12548	-0.82911	0.48323
146	53	Sasal	0.58532	-0.81891	-0.54967	0.83494
147	53	Dwarandha	0.61790	-0.53238	-0.09717	-0.14819
148	54	Batahghuli	-0.83270	-0.03159	0.03583	-0.70408
149	54	Bagharbari	-0.14283	-0.04279	-0.08361	1.41402
150	54	Bagharbari	-0.89072	-0.17921	0.42122	-1.23202
151	54	Khanapara	0.11450	0.31449	-0.15600	1.32459
152	54	Amrigog	-0.77358	-0.09470	-0.59472	1.56627
153	55	Khanapara	-0.26188	-0.40196	-0.80985	0.94883
154	55	Maidam	0.70234	-0.60994	0.25156	0.26133
155	55	Ganesh Mandir	-1.09482	-0.50246	-0.40579	-0.47988
156	56	Koinadhara	-0.67795	-0.08545	-1.39965	-0.32669
157	56	Latakata	-0.83035	-0.37030	0.12493	0.97669
158	56	Bakrapara	-0.27279	-0.26243	-0.47725	0.89685
159	56	Maidam	1.18229	0.63414	-0.05408	-0.70793
160	57	Rukminigaon	0.15112	-0.85054	-0.19547	0.96221
161	58	Jatiya	0.25923	-1.09897	-0.00864	-0.06999
162	58	Dakhingaon	0.00442	0.62654	1.10751	-2.00261
163	58	Beltola	0.54309	0.04436	1.27054	0.09062
164	58	Natun Bazar	-0.88861	-0.95142	1.12606	1.62236
165	58	Barpathar	-0.91698	-0.49015	-0.89549	-0.83931
166	59	Dakhingaon	0.06414	0.48825	-0.24517	0.41204
<b>167</b>	<b>59</b>	<b>Hatigaon</b>	0.94045	-0.02090	<b>2.09663</b>	-0.99412
<b>168</b>	<b>60</b>	<b>Sijubari</b>	0.60305	0.10221	<b>2.42294</b>	-0.16213
<b>169</b>	<b>60</b>	<b>Barsajai</b>	0.50558	-0.54561	<b>2.63881</b>	-0.38006
170	61	Majgaon	-0.30261	-0.39725	1.45205	0.91217
171	61	Abhayapur	-0.48364	-0.05521	0.77173	0.86694
172	61	Madhupur	-0.91121	<b>2.09655</b>	-0.78369	0.96075

173	61	Raumari	-1.36430	-0.15628	-1.09110	-1.26083
174	62	Ramsing	1.80919	0.48765	0.38962	-1.20126
175	62	Ramsing	0.23628	0.46718	0.99311	0.73777
176	62	Ramsing	0.58047	0.65161	1.30068	0.45287
177	62	Ramsing Chapori	-0.34660	0.51707	1.12153	0.98945
178	62	Khandakoa	0.35698	0.59323	0.99965	0.75070
179	62	Khandakoa	-2.06966	0.40861	1.05673	-1.19835
180	62	Kharghuligaon	0.10629	0.28662	0.84341	0.59137
181	62	Kharghuligaon	-0.30186	0.28457	0.66185	1.36741
182	62	Dhpguri	0.18114	0.34185	1.07326	0.52233
183	62	Turibari	-1.79568	-0.02274	0.66725	-0.83755
184	62	Rajabari	1.58747	2.01448	0.64505	-0.73626
185	62	Hahchora	-0.32622	0.43356	0.75833	0.82990
186	62	Bonda	-1.36082	0.79184	0.60685	-1.24712
187	62	Bonda	0.15185	1.38219	0.86006	0.38152
188	62	Bonda	0.52153	0.53654	1.60467	0.14315
189	62	Bonda	0.04926	0.47648	0.98594	0.43681
190	62	Amgaon	-0.17151	1.10319	-0.84577	1.38411
191	62	Amgaon	-0.23554	0.75572	-0.59890	1.15816
192	62	Turibari	-0.71550	-0.19388	-0.00486	-0.80710
193	62	Diyachorbasti	-0.44692	-0.23641	0.43057	1.38491
194	62	Bungaon	-1.98953	-0.45325	0.10846	-0.75415
195	62	Bungaon	-0.62160	0.21139	0.00200	1.48739
196	62	Panikhaity	-0.56293	-0.06131	0.47782	1.23260
197	62	Panikhaity	-0.83450	-0.07619	0.15597	1.38722
198	62	Panikhaity	-0.58011	0.32168	0.48940	1.18000
199	62	Tamulbari	0.28552	1.38940	1.19761	-0.23268
200	62	Tamulbari	-1.95574	0.25136	-1.26748	0.00661
201	62	Khangkarbasti	0.12342	0.51671	-0.05852	1.14289
202	62	Hatisila	-0.02048	0.08896	0.45781	0.67798
203	62	Hatisila	0.22512	-0.51272	-0.66177	1.71355
204	62	Hatisila	-0.54029	-0.04225	0.35635	1.23402
205	62	Raumari	-0.76963	0.36390	-0.81718	-0.19920
206	62	Laharpara	-0.48156	-0.00690	-0.40987	1.79190
207	62	Dumpara	-0.54376	-0.13159	0.33823	1.43115
208	62	Hajobari	1.02570	1.60048	0.13343	-1.16274
209	62	Thakurkuchi	-0.88024	-0.29524	0.16369	-0.93528
210	62	Tatimara	0.14606	-0.22676	-1.07837	-0.79090
211	62	Chandrapur	0.19217	0.65809	-0.73387	-1.23848
212	62	Chandrapur	0.39445	0.99414	-0.59864	0.39468
213	62	Chandrapur	0.23018	2.03798	-0.46846	-0.24499
214	62	Chandrapur	1.40035	1.42912	0.13889	-0.91199
215	62	Singimari	1.28974	1.02428	-0.39026	-0.52472
216	62	Taltala	0.32619	0.82269	-0.70307	0.44542
217	62	Taltala	1.99748	0.04146	0.31170	-0.68462

218	62	Bengnabari	1.66841	1.08377	-0.37490	-0.77144
219	62	Bengnabari	1.94911	1.01218	0.41278	-1.03628
220	62	Dumduma	1.54922	-0.20068	-0.45504	-0.75210
221	63	Amsing	-1.48176	0.10725	0.56799	-1.25281
222	63	Amsing	-1.94999	0.69690	1.06925	-1.35427
223	63	Amsing	1.39249	1.87869	1.67560	-1.44419
224	63	Amsing	-0.90540	0.72571	0.84145	-1.77875
225	63	Amsing	0.22301	1.16392	0.57451	0.67922
226	63	Amsing	-0.38423	1.02783	0.76829	1.08180
<b>227</b>	<b>63</b>	<b>Amsang</b>	0.25423	<b>2.07969</b>	-0.02469	-1.36292
228	63	Haldibari	-0.08165	1.76741	-0.48820	0.88919
229	63	Bamankhat	0.65853	1.00058	-0.28190	0.80488
230	63	Ghugua	-0.47643	0.38767	0.44585	1.30062
231	63	Belguri	-0.48024	-0.08922	0.86836	1.02558
232	63	Belguri	-0.87323	0.92936	-1.40815	-1.12146
233	63	Nautunbasti	0.72236	0.25378	-0.11306	0.63364
234	63	Nautunbasti	-0.27641	1.11037	-1.11505	1.29569
235	63	Nautunbasti	-0.11460	0.74597	-0.71523	1.19122
236	63	Nautunbasti	-1.13338	1.52420	-0.67173	-1.03730
237	63	Nautunbasti	1.66678	1.74824	-0.05297	-1.52566
238	63	Nautunbasti	-0.89015	0.24215	-1.34823	-0.39008
239	63	Nautunbasti	1.46971	1.21198	-1.35441	0.27345
240	63	Namile	1.38003	0.51850	-0.79867	-0.20896
241	63	Namile	0.98785	1.34581	-1.30830	-0.79581
242	64	Namile	1.19244	1.17679	-1.25133	-0.38554
243	64	Namile	-1.01686	1.08280	1.62256	-1.39207
244	64	Namile	0.27584	0.84150	1.65785	0.18878
245	64	Namile	0.79881	0.99848	1.24130	-0.25671
246	64	Namile	-0.17429	0.68478	1.44751	0.81191
247	64	Bardhua	-2.61193	0.03901	0.03527	-1.05420
248	64	Bardhua	0.14410	1.60888	1.33440	0.31265
249	64	Bardhua	-0.29288	0.93554	1.38280	0.70742
250	64	Bardhua	0.37106	0.79460	1.07287	0.71217
251	64	Bardhua	1.03265	1.19510	0.87694	0.16567
252	64	Hatimara	0.32897	0.50899	1.64689	0.17671
253	64	Hatimara	0.26882	0.44682	1.63266	0.14672
254	64	Hatimara	-0.23452	0.31744	1.40606	0.90724
<b>255</b>	<b>64</b>	<b>Jorbil</b>	0.93722	0.44012	<b>2.29374</b>	-0.77756
<b>256</b>	<b>64</b>	<b>Jorbil</b>	0.82541	0.71610	<b>2.02080</b>	-0.70907
257	64	Jorbil	-1.01861	0.22297	1.76973	-1.39078
258	64	Chhotakling	-0.51718	0.63318	0.31378	1.32555
259	64	Chhotakling,	-0.90740	0.69221	-0.11068	-0.79141
260	64	Gyarahmile,	-2.06027	-0.17792	0.24715	-0.62367
261	64	Gyarahmile	-0.42768	0.04403	0.66434	1.44253
262	64	Gyarahmile	-1.78987	-0.53648	0.95613	-0.84473

263	64	Gyarahmile,	-0.65145	0.23841	1.36498	-1.28768
264	64	Gyarahmile,	-1.17527	0.21203	1.12245	-1.18927
265	64	Patarkuchi	-0.39620	0.18451	1.17381	0.82891
266	64	Kumarkuchi	0.12687	2.81652	0.62799	-0.01147
267	64	Uparkholi	0.81595	-0.01805	1.24113	-0.10780
268	64	Uparkholi	-1.44111	0.43133	0.08034	-1.03424
269	64	Uparkholi,	-0.77936	0.83849	-0.33675	-0.78368
270	64	Uparkholi,	-0.31419	0.02187	0.90928	0.96104
271	64	Uparkholi	-0.51875	0.80844	0.57110	0.91344
272	64	Uparkholi	0.15837	0.58318	-0.04797	1.12938
273	64	Uparkholi,	-0.38258	0.41106	-0.25939	-0.07683
274	64	Uparkholia	-0.27949	-0.25669	1.41114	0.84275
275	64	Uparkholi	-0.28487	0.29141	-0.38004	1.00374
276	64	Uparkholi,	-0.26368	0.72193	-1.23135	1.55171
277	64	Athmile	-1.95094	0.59553	-1.13636	-0.14074
278	64	Athmile	-0.37616	0.34941	1.23308	0.83336
279	64	Athmile,	-1.56503	0.88252	-0.47577	-0.39587
280	64	Athmile	-0.28419	1.16902	-1.21891	1.49074
281	64	Athmile,	0.71129	1.63222	-0.07717	0.03724
282	64	Athmile	-0.29224	0.61524	-0.78332	1.27332
283	64	Athmile	-0.34695	0.13182	1.25444	0.62185
284	64	Maighul	-0.16901	0.97536	1.42901	0.37703
285	64	Maighuli,	0.19307	1.27342	1.24326	-0.06652
286	64	Maighuli	0.19357	2.26158	0.14552	0.47629
287	64	Maighuli,	-0.16427	1.73728	1.46507	0.03757
288	64	Maighuli,	-0.03227	3.11874	0.33400	-0.13138
289	64	Nongthimai,	-0.31375	1.82494	1.24157	0.12576
290	64	Nongthimai	0.22843	1.08612	-1.18070	0.83055
291	64	Nongthimai,	-1.62698	0.89397	-1.46967	-0.29983
292	64	Nongthimai	-1.20451	0.99545	-0.91577	-0.44189
293	64	Nongthimai	-0.92616	0.66541	-1.54960	0.07069
294	64	Nongthimai	-0.69213	0.95282	-1.17474	-1.19578
295	64	Umtringa,	-0.90573	0.08832	-0.57583	-0.33939
<b>296</b>	<b>64</b>	<b>Umtringa</b>	<b>-2.10010</b>	-0.35417	-2.11728	0.05398
297	64	Umtringa	-0.22346	0.72205	-0.44210	0.97083
298	64	Umtringa	-2.65818	-0.08064	0.01874	-0.94154
299	64	Umtringa,	0.13436	0.73955	-1.36877	0.43787
300	64	Mausmai	-0.12386	0.07201	-0.31438	1.14641
301	64	Mausmai	-0.96368	1.31513	-0.42304	-0.84949
302	64	Mausmai,	-0.02132	1.47020	-1.52691	-0.70800
303	64	Mausmai,	-0.56100	0.46847	0.37699	1.16181
<b>304</b>	<b>64</b>	<b>Mausmai,</b>	-0.58174	0.63860	<b>0.20315</b>	1.01545
305	64	Jorabat,	-0.24745	1.61478	0.03253	0.24790
306	64	Jorabat	-0.33497	1.92716	-0.13190	0.82092
307	64	Jorabat,	-0.03977	1.34384	-1.30603	0.09569

308	64	Barahmile,	0.06129	0.43015	-0.16960	1.01441
309	64	Barahmile,	0.24668	0.61884	-1.15150	0.85631
310	64	Barahmile,	-0.14366	1.54321	-1.19804	-1.17301
311	64	Barahmile	0.24238	0.71132	-1.14908	0.84376
312	64	Ambher,	0.00000	1.08208	-1.67189	1.06785
313	64	Ambhea	-1.50074	1.27946	-0.91801	-0.58583
314	64	Tamulkuchi	-0.30635	0.31343	-0.07268	0.72426
315	64	Tamulkuchi,	1.47368	1.10528	-1.35957	0.28887
316	64	Tamulkuchi	-0.30024	0.83883	-0.25843	-0.37095
317	64	Barbhaj,	0.38489	0.70141	-0.83424	0.51127
318	64	Barbhaj,	0.05498	0.63940	-1.25676	-0.86975
319	64	Burnihata	-0.15758	1.87477	-0.27990	0.53087
320	64	Burnihat,	0.15771	0.54783	0.53693	0.27146
<b>321</b>	<b>64</b>	<b>Burnihat,</b>	0.30523	<b>2.53598</b>	-0.47290	-0.22103
322	64	Amchauk,	-0.63699	0.99756	-0.02912	0.55071
<b>323</b>	<b>64</b>	<b>Amchauk,</b>	0.41165	<b>2.90507</b>	-1.50870	0.34005
<b>324</b>	<b>64</b>	<b>Rajabagan,</b>	0.16641	<b>2.52758</b>	-1.20199	0.20042
325	64	Rajabagan,	-0.12505	1.86785	-1.12267	-1.51222
326	64	Norbong,	-0.36431	0.94342	-2.13194	-1.16804
327	64	Norbong,	1.16451	1.75511	-1.24093	-0.41742
328	64	Norbong,	1.36610	1.14565	-1.21506	-0.44110
329	64	Norbong,	-0.93024	1.15536	-1.52325	-1.86494
330	64	Norbong,	1.01522	1.21985	-1.34544	-0.36793
331	64	Norbong,	1.06722	0.27761	-1.30045	-0.44170
332	65	Garbhang	0.52095	0.74655	1.59144	0.23468
333	65	Garbhanga	0.31904	-0.24395	1.72540	0.43624
334	65	Garbhanga	-0.13943	0.03090	1.76007	0.87751
335	65	Beharbari	0.45601	0.04666	1.98305	0.25211
336	65	Lalunggaon	-0.89058	0.21072	0.51159	-0.67337
337	65	Ahomgaon	-0.62406	0.26975	1.20248	-1.23752
338	65	Dhalbama	0.09435	0.54227	0.79515	0.37357
339	65	Mainakhulung	-1.11402	-0.23540	1.37432	-1.35939
340	65	Pamohi	0.29980	-0.79329	1.55819	0.63263
341	65	Maghowpara	-0.15141	-0.09626	-1.00313	1.54731
342	65	Devchatal	-0.49351	0.21786	-1.73413	0.25140
343	65	Chakard	0.10581	0.06096	-1.56703	-1.13603
344	66	Kahikuchi	0.21356	0.93732	1.28273	0.66955
345	66	Kahikuchi	0.56648	0.53769	0.16639	-1.15967
346	66	Bullarpar	-0.71384	0.33338	0.25707	0.98389
347	66	Borjhar	0.22537	0.44497	-1.48091	-0.70972
348	66	Barsila	0.44333	1.41668	-0.25878	-0.16060
349	66	Patgaon	-0.10155	1.49748	-1.45368	-1.01938
350	66	Patgaon	0.15890	0.82589	-1.28126	-1.06208
351	66	Patgaon	0.61218	0.17736	-1.65902	1.14695
352	66	Patgaon	0.06262	0.34537	-1.60525	0.12242

353	67	Dharapur	-1.02571	0.02216	-0.14500	-0.78149
354	67	Dharapur	0.86072	0.59453	0.50785	0.16921
355	67	Garal	0.58346	0.03675	0.30532	-0.96723
356	67	Azara	-1.20212	0.27828	-1.87360	-1.20131
357	67	Mirzapur	0.00017	-0.48521	0.79257	0.10920
358	67	Ganeshpara	0.08489	-0.59953	-1.08809	-3.02394
359	67	Borjhar	2.26957	-0.47817	-0.81919	0.60805
360	68	Amingaon	-0.36558	-0.88788	0.54809	-1.79079
361	68	Luthiya	0.25653	0.85368	1.76793	0.20121
362	68	Luthiya	-0.92752	-0.37038	1.71293	-1.31625
363	68	Ghoramara	-1.02735	-0.10248	0.99914	-1.31311
364	68	Ghoramara	0.44648	0.34633	-0.08911	-0.89645
365	68	Agyathuri	-0.98167	-0.07544	0.54130	1.43952
366	68	Agyathuri	0.44657	0.46010	0.73394	-1.27694
367	68	Numalijalah	0.36315	1.39593	-0.62177	0.34417
368	68	Sila	1.13805	1.21067	-1.31783	-0.19625
369	68	Sila	0.01974	0.16477	-0.69496	-0.06458
370	68	Sila	1.30130	0.38591	-1.35691	0.11499

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- (ii) Milk and Guwahati: a retrospect**  
  
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