POPULATION CHARACTERISTICS AND AGRICULTURAL DEVELOPMENT IN JORHAT DISTRICT, ASSAM

BIMAL BARAH
Research Scholar

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School of Human and Environmental Sciences
North-Eastern Hill University
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Chapter-I

Introduction

A perceptible change in the course of human history took place with the advent of the cultivation of crops and the rearing of animals, i.e. agriculture, by the people on the earth some 7000 to 10000 years ago. Consequently, an inseparable relationship has been growing up between population and agriculture and dynamism in different spheres of the society appeared through time. This gradual development of population-agriculture nexus has attracted the attention of scholars, and as a result, numerous studies have been appeared to evolve theories and models covering these two aspects. Geographers' interest also subsequently develops over this issue, not only because the relationship varies spatially, but also because the pattern of relationship has itself been changing through time. The space-time dimensions of the relationship between population and agriculture have been a central theme for long and even today the problem has not lost its significance mainly due to the fact that the future of many developing countries is closely related to this issue (Kulkarni 1981). However, before entering into the problem in detail, an attempt has been made first to conceptulise these two aspects, population characteristics and agricultural development, the main focus of the present work.

In his first text on population geography, Clarke (1965) clearly categorises population characteristics into three main groups and, accordingly, the first group includes the absolute number of human population. Clarke also states that the significance of this group lies in its locational (distribution) and proportional (density) context of the area concerned. Second group of population characteristics includes a number of measurable attributes of population and can be classified as physical (age, sex, race, intelligence, etc.), social (marital status, family, household, literacy and education, etc.), and economic (occupation, income, etc.). The third group of population characteristics includes the dynamics of population consisting of fertility, mortality and migration. The basic point is that if these population characteristics are studied only from the demographic viewpoint, it

will reflect a part of the reality because these are related directly or indirectly to the various economic activities of the people. If this is so, it becomes relevant in the present day context to concentrate attention on the link exists between the population attributes as stated above and any kind of economic activities. Agriculture being a primary economic activity and a huge absorber of human labour force has a specific pattern of link with the various population characteristics. Variations in the context of agricultural landscape that developed over the globe today can be said to be the product of the variations in population attributes, if other conditions being equal. For instance, the absolute number of human population can cause for the appearance of either extensive or intensive methods of farming, supply of labour to agriculture is directly related to the age-sex composition of population, intensiveness in the use of various inputs for better output is related to the demand coming out of population pressure, diffusion of the modern farm technology and its degree of acceptance by the farmers depends on the literacy and education level of the latter, and so on. Thus, the entire set of population characteristics is contributing either singly or collectively towards the development of agricultural conditions.

Let us turn our attention towards the concept of agricultural development and its various ways of measurement. In general, agricultural productivity that is related to land, labour and capital has been considered as a reliable index of agricultural development. It is a relative concept and, hence, is useful for understanding and comparing agricultural performance of various agro-ecological regions. It also indicates the output in relation to input. Since the basic purpose of agriculture is to produce agricultural goods (output) either for consumption or for trade through the use of various inputs and since the efficient use of the latter (inputs) depends largely on the quantitative (number) and qualitative (education, intelligence, etc.) attributes of population, it is evident that the population-agriculture relationship is complex and multifarious. The present work is an attempt to

examine in what way this complexity exists and how far the various population attributes are playing decisive role in conditioning agriculture of a given area.

1.0. Statement of the Problem:

Agricultural structure and subsequent development takes place due to the vast multiplicity of a number of interconnected biotic and abiotic components. Although all of them contribute for agricultural growth, yet they do not contribute equally in shaping the space-time variations of agricultural landscape. Hence, it is desirable to observe the dominant factors that may be decisive in conditioning the regional structure of agriculture. But the ranking of the factors according to the level of dominance over agricultural activities is a complex exercise requiring detail systematic investigation. Notwithstanding this complexity, there are some convenient ways of categorising factors according to the level of significance and these provide ideal grounds for geographers to carry out systematic investigation. But, most geographical investigation on agriculture till today have tended to emphasise more on the role of physical factors and the resultant agricultural structure. However, a few of the geographers have attempted to incorporate non-physical factors including biotechnological, infrastructural, institutional, etc. studying agricultural structure very recently. But much lesser work has been done on the pattern of interrelationship between population and agriculture. Since population is a decisive force of conditioning agricultural system, the closure examination of the impact of this force in patterning land-use of a given locality is definitely imperative for theoretical understanding and practical solution of many agricultural problems.

In the background stated above, the present work has been designed to deal with these two vital issues and their interconnections. It is to be noted here that there is an existence of two divergent views relating the population-agriculture relationship. The first view sees population as a dependent force on agriculture while the second seems to take

an opposite stand seeing population as an independent force. Some traditional propositions including the Malthusian doctrine are in favour of the former stand stating that food supply is the limiting factor of population growth while agricultural development is the result of autonomous invention. It further states that food supply increases due to inventions, which are independent of population, change (Kulkarni 1981). The simple explanation is that if the supply of food increases, population will increase and a new equilibrium would be achieved between the two. In a sense, if population is less than the food supply, population will expand and if it is already beyond the level of subsistence, it itself will come down to reach an equilibrium through the positive check (Lekhi 1996, p.84). Cipolla (1962) have strengthened this stand by stating that the number of people has been regulated by the availability of food throughout the greater part of the human history.

Another group of scholars adopts an opposite stance seeing population as an independent force. Prominent among them is Boserup (1965) who categorically maintains the view that although the production-increasing inventions may occur independently, the adoption of new knowledge depends on population "push". She suggests that agricultural development is due to some kind of compulsion and this compulsion relates to rising trend of population. According to Boserup (1965), "where there is a population pressure, population does not go down. It rather leads to various technical and other changes which result in agricultural growth and increase in food supply". She has supported this contention through an examination of agricultural development of some African and Latin American countries. She stated that the transition from the pre-agricultural stage to the agricultural stage as well as in the subsequent developments in agriculture was an outcome of the population pressure (Kulkarni 1981). This statement has been supported by Clark

(1967) who explained the entire course of human history in the context of population growth.

These two different stands can be said to be complementary rather than mutually exclusive. Simon (1977) says that the Malthusian stand refers to invention, which are relatively labour saving, while the population push stand taken by Boserup and Clark refers to inventions that are output increasing but require more labour as well. Although the universal applicability of these stands are not too strong, yet it is not uncommon to see that some cases in history are better explained by the first while others by the second stand (Kulkarni 1981, p.341). The present work has been centered around the second stand as propounded by Boserup. Here it has been accepted that population is an independent force and contributes significantly towards change in agricultural structure. There is also a logic behind the acceptance of the Boserupian statement. Clark and Haswell (1970) say that the change in agricultural methods is not exogenous, rather results from the population growth. In order to demonstrate that this proposition is true, rather than converse, namely that new agricultural methods are discovered, and that population growth is the consequence of these discoveries (Malthus' theorem), we have the convincing case that nearly all these changes call for much greater effort on the part of the cultivator, who therefore is most unlikely to adopt them until he is compelled to by rising population (Clark and Haswell 1970, p.55). Clarke's statement has further been strengthened the proposition made by Trewartha (1953) who considers population as the point of reference from which all other elements are observed and derive meaning and significance. This discussion simply indicates multifarious role of population - agriculture relationship. It is a fact that population is a producer as well as a consumer. It has impact on demand as well as on supply. Demand, in a simple way, comes out from absolute number of population. It

indicates that more people will need more agricultural commodities and, as such more supply would be indispensable which again would be derived by making higher output. Thus, the supply would be enlarged but this enlargement cannot be considered an autonomous process. It basically comes through the effect on various inputs-effect on the pattern of landuse, on the supply of labour, investment, techniques of cultivation, etc. These attributes of agriculture-related change have been made possible only by the attributes of population, namely, its number, density, literacy, age-sex composition of population, etc. In this context population is seen as a determining force and the entire change in agricultural structure can be said to be dependent on it.

At this juncture also the problem is not over. The basic issue is as to how and in what ways the various attributes of population (as stated by Clarke 1965) could be correlated with the attributes of agricultural development. Since the entire set of elements are not possible to incorporate nor has any relevancy to include, the study has been deliberately restricted to examine the interrelationship between a few attributes of population (viz., size and distribution of population, population pressure, age-sex composition, literacy and education, household and family structure, labour, etc.) and a few indicators of agricultural development (viz., land and labour productivity, intensiveness in the use of input, cropping pattern , etc.). In order to examine the relationship between these two sets of attributes, the Jorhat district of Assam has been taken up as a micro areal unit of investigation.

2.0. The Study Area:

Jorhat is a centrally located district in the upper part of the Brahmaputra valley. It covers an area of about 2851 sq. km. (or 3.64 % of the total geographical area of the state).

It also supports more than 8 lakh people representing 3.89 percent of the state's total population. Agriculture is the principal occupation and more than 80 percent of the total population depends on it as a way of living. Around 60 percent of the total land is used for the cultivation of crops mainly paddy, both summer and winter. Existing population of the district releases sufficient number of labour force for the operation of agriculture. In order to examine the population- agriculture relationship, the district can be taken up as an ideal unit of investigation because the agro-ecological conditions of the district are congenial both for the production of crops and human occupation. However, in the present analysis of population-agriculture nexus, Majuli has been excluded from the analysis because the latter itself has a specific set of agro-ecological conditions with insular location not comparable with other parts of the state. The details of the study area are presented in Chapter-II of the present work.

3.0. Objectives:

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

i. to examine the structure of agriculture in Jorhat ,

ii. to analyze the characteristics of population in Jorhat,

iii. to correlate the attributes of population with the attributes of agriculture stated in the statement of the problem,

iv. to examine the effect of population factors on agricultural conditions, and

v. to suggest the development strategy of agriculture in the light of the population.

4.0.Hypotheses:

The study is basically related to the impact of population characteristics on agricultural conditions. Therefore, putting forward the Boserup view (1965) of positive effects of population on agricultural practices and development under the conditions of high population density, the following hypotheses have been formulated to test the validity of the facts taking Jorhat as an empirical unit of investigation:

1. Under the conditions of abundant labour supply to the agricultural practices, the land productivity moves up with the decline of labour productivity.
2. Intensity of agricultural land use at a greater scale is emanating from the higher pressure of population.

4.1. Justification: In the context of the objectives and hypotheses stated above, the Jorhat district of Assam is considered to be a suitable micro areal unit to test the validity of the Boserupian view of population-agriculture nexus. Although the variation in respect of the climatic conditions of the area is not pronounced, yet the existing soil types and population pressure seem to vary according to the variations of the altitude and slope from the flood plain belt of the north to the hilly ranges of the south of the district. Therefore, the identified agro-ecological zones of the district (presented in chapter-II) are distinct micro areal unit with a specific set of man-nature relationship. The way the population attributes is related to the agricultural attributes in various agro-ecological zones could be expected to be an interesting correlative study in its spatial dimensions. This would be helpful not only in understanding the pattern of relationship between the population and agriculture, but also give a new insight in solving many practical problems faced by the people of the state at large and the people of Jorhat area in particular.

5.0. Sample Design and Methodology:

Since the basic purpose of the present study is to examine the relationship between population and agriculture, the greater emphasis is therefore given on to the collection of data from the field through sample technique. It is also true that a complete enumeration is not possible for an individual researcher due to the limitations of money, time and energy (Kothari 1990). At the same time, the survey of that kind is not required in the context of a universe characterized by homogeneous conditions. In this situation, a part of the universe can explain the reality and as such sampling becomes an indispensable tool for a researcher. In the present work, the samples are attempted to draw in such a way that can successfully explain the population-agriculture relationship of the study area and help in achieving valid and reliable conclusions. Therefore, the sample design to be used in the present study has been decided by the researcher by considering the basic objectives of the inquiry proposed earlier along with other related factors. The various stages involved in designing the samples are presented below.

5.1. Selection of Villages as Samples: In order to select villages for detail investigation, the four agro-ecological zones (stated in Chapter II) of the district have been taken up as strata so that the population-agriculture nexus of each strata can be examined and analysed. Then, on the basis of population size of the villages, remotivity and their (village's) distance from the nearest market/urban centres, a total of 19 villages (3.15% of the total villages of Jorhat) has been selected as samples (Table-1.1). It is to be noted here that there are 606 villages in Jorhat (2.44% of the total villages of Assam) as per 1991 census and out of this, 396 villages are located in the built-up zone (zone C) and 150 in the flood plain zone (zone D). In the moderately steep to steep land zones, i.e., in zones A and B, the number of villages are few, only 21 and 41 respectively from each zone. Therefore, the proportions of villages selected as samples from each zone stand at 9.52, 4.88, 2.52

Table-1.1: Basic Information of the Sample Villages.

Zones	Name of the SampleVillages	Population Size	Households T	Households SH	Households (%)	Remotivity (km)	Distance from Jorhat Town (km)
A	1.Lahing Gaon	939	198	21	10.65	05	19
	2.Kankhowa	1358	272	28	10.29	06	20
B	1.Medeluajan	218	41	09	21.95	02	15
	2.Paninora	1552	301	42	13.95	05	13
C	1.Gajpuria	1136	214	18	8.41	02	10
	2.Bebejia	2191	418	29	6.94	02	05
	3.Sologuri	2024	327	23	7.03	02	06
	4.Mohimabari	1412	240	22	9.17	03	25
	5.Phalengichuk	1030	168	13	7.74	01	15
	6.Sonari Gaon	1142	202	21	10.40	02	05
	7.Kharikatia	1932	765	46	6.01	02	04
	8.Baghmoria	1481	274	18	6.87	03	03
	9.Pukhuripara	155	29	5	17.24	04	10
	10.Dhekiakhowa	559	98	1	11.22	03	18
D	1.Neul Gaon	891	76	10	13.15	03	11
	2.Pakhimora	1069	199	25	12.56	01	09
	3.Balichapori	1976	352	36	10.22	02	08
	4.Hukimora	1355	243	22	9.05	05	08
	5.Borkhat	376	73	8	10.96	05	10

Abbreviations: T= Total Households, SH= Sample Households.

and 3.33 percent respectively for zones A, B, C and D. Thus, the proportions of villages taken up as sample from each zone are larger than the proportion of villages of Jorhat to the total villages of Assam. Although the size of the samples is seen lower in percentage term, it can be considered representative because there exists homogeneity within each zone in respect of prevailing agro-ecological conditions.

So far as the size of the population is concerned, the villages of the study area have been categorized first according to the size of the population (Table-1.2) and then a few villages from each size class have been selected randomly as samples. It is seen that the representation of villages from the large sized class is more than the remaining classes.

Table-1.2: Total and Sample Villages according to their Size of Population.

Size Class	Category	Total Villages	Sample Villages	
			No	%
0---500	Small Size Village	163 (26.72)	03	1.84
501-1000	Medium Size Village	175 (28.63)	03	1.72
1001-3000	Large Size Village	245 (40.16)	12	4.89
Above 3000	Very Large Size Village	27 (04.43)	01	3.57
Total villages of all size classes		**606 (100.00)**	**19**	**3.14**

NB: Bracketed figures indicate percentage of villages to total villages of Jorhat district.

This is because of the existence of more villages (245 or 40.16%) in this particular size class than other classes. Moreover, it was also intended to select at least one- percent village as sample from each 10 percent of the total villages of the study area. But due to the limitations of time, money and energy as already stated, it becomes difficult to have achieved the desired target. However, 1.84 percent villages from its small size (0-500) class, 1.72 percent from medium size (501-1000), 4.89 percent from large size (1001-3000) and 3.57 percent from very large size (above 3000) have been taken up as sample villages for detail investigation. Since the items of the universe of the present are homogeneous and attempted to study intensively, a small sample can be expected to yield real representation of the universe.

In order to understand the remotivity of the villages, the distance from the nearest motorable road (in km) either the national highway or the state or district roads, is taken up for consideration. The remoteness of the villages is expected to indicate the probable

impact on the agricultural activities of the inhabitants. Thus, depending on the distance, three categories of villages have been identified, viz., very less remotivity (within 2 km), moderate remotivity (2-4 km) and high remotivity (4-6 km). Accordingly, 9 villages from the very less remotivity, 5 from the moderate and 5 from the high remotivity categories have been selected (Table-1.1). So far as the distance of the villages from the nearest market/urban centres is concerned, attempts have been made to select villages from various distance range. As evident from the Table-1.1, the 3 villages have been selected from above 20 km distance, 4 villages from 15-20 km distance range, 4 from 10-15 km, 4 from 5-10 km and another 4 from within 5 km distance range. This categorization, according to the distance, has been done in order to understand the impact of urban/market centres on existing land use pattern of the villages.

5.2. Selection of Sample Households: After selecting villages for sample survey, the attention has now been directed towards the selection of households for conducting detail investigation. In selecting households no statistical technique has been introduced, rather the personal judgement has been applied. To have representation from all categories of households, the outer structure of the houses (whether RCC construction, Assam Type or simple thatched and bamboo made houses) has been taken up for consideration assuming the house structure as the reflection of the economic status of the farmers. Applying this simple logic, a few households from each structure has been selected and the heads (or any other representative in absence of heads) of these selected households have been approached for certain relevant information already designed for the purpose. Altogether, 406 number of households has been surveyed which are around 10 percent of the total households of the selected sample villages. The number of households taken up as sample from zone A is 49(10.43% of the total households of the sample villages), zone B is 51(14.92 %), zone C is 205(7.50 %) and from zone D is 101(10.71 %).

5.3. Collection and Processing of Data: In order to collect data from the sample households, a household schedule (Appendix-I) containing all relevant aspects for the purpose has been prepared and this (schedule) has become the main tool for collecting data. With this simple but systematically prepared schedule, the heads of the households have been approached for face to face interview. After explaining the basic purpose of the inquiry to the respondents whenever required, the latter was asked certain questions from the schedule in the order the questions are listed and the replies are recorded in the space meant for the purpose. In this way, the entire information have been collected from the sample households and then the collected information have been tabulated and processed with the help of using computer.

5.4. Other Sources of Data: Besides the primary data collected from the field through the household schedules, some secondary data have also been used in the present work. These are collected from different sources including various governmental and non-governmental publications. The Statistical Handbook published by the Government of Assam, Guwahati and other census publications are the main sources of secondary data. Some other information has been collected from various books, journals and other periodicals.

5.5. Testing of Sample Characteristics: Whether the sample characteristics collected for the purpose are reflective of the reality or not, are necessary to test at this juncture. In doing this no statistical technique has been applied rather the mean of the sample and the mean of the universe have been calculated and compared. If the mean of the sample is found closer to the mean of the universe, the representation is expected to be reliable for drawing meaningful conclusion. Keeping this in view, the characteristics of samples are tested and retained for analysis. In Table-1.3 the socio-cultural characteristics of the samples are presented.

Table-1.3: Socio-cultural Characteristics of the Sample Households.

Characteristics	Sample Total	Households (%)	District (%)	Deviation (%)
Caste				
General Caste	103 }			
OBC	235 }	83.25	80.30	+2.35
ST	47	11.57	12.09	-0.52
SC	21	5.47	7.61	-2.14
Religion				
Hinduism	392	96.55	95.59	+2.96
Islam	12	2.95	4.32	-1.37
Christian	02	0.50	1.52	-1.02

Abbreviations: OBC= Other Backward castes, ST= Scheduled Tribe, SC= Scheduled Caste.

It is now evident from the data that the caste wise representation of samples from the study area is quite reflective of the existing caste composition. The proportion of population belonging to the general and Other Backward Caste (OBC) in the district is 80.30 percent (1991) while the proportion of samples from these two categories stand at 83.25 percent, slightly higher than the district average. In the context of the Scheduled Tribe (ST) and Scheduled Caste (SC) groups, the district has 12.09 and 7.61 percent share respectively in the total population. The proportions of samples from these two groups are very close to the district average as 11.57 and 5.47 percent respectively. Although there are variations of the mean of the universe and the mean of the samples, the difference is seen to be within ± 3 percent, which is very much closer to the reality. Religion wise, there are 96 percent samples from the Hindus, 2.95 percent from Islam and only 0.50 percent from the Christians. Theirs strength to the total population of the district stand at 93, 4.32 and 1.52 percent respectively. In this context also, the variations seem to lie within ± 3 and, therefore, the samples can be considered representative from the societal background of the study area.

As far as the basic population characteristics of the samples are concerned, these are also found to be meaningful for testing the hypotheses proposed in the present study. The

validity of the collected sample households for representing the population conditions of the district can be understood from the scenario presented in Table-1.4.

Table-1.4: Population Attributes of the Sample and the District.

Attributes of Population	Sample No	(%)	District % to total popn.	Deviation
Distribution				
Zone A	281	11.50	4.42	+7.08
Zone B	340	13.91	6.79	+7.12
Zone C	1189	48.66	64.15	-15.49
Zone D	633	25.91	24.62	+1.29
Total of All Zones	2443	0.33	3.34	-3.00
	Sample		District	Deviation
Density(persons/h)	3.32		3.03	+0.29
Sex Ratio	949		928	+21.00
Average Family Size	6.00		5.80	+ 0.02
Literacy Rate	88.41		65.51	+22.09
Main Workers(%)	37.86		34.38	+3.48

As indicated by the data given in Table-1.4, there has been a good representation of population from all agro-ecological zones of the study area because the deviations of the sample households means lie within ± 7 percent except the zone C where the mean greatly deviates from the district average. But this is still within a tolerable limit in the sense that the characteristics of the universe are homogeneous. As far as the density of population of the samples is concerned, it is seen that the density of the samples is very close to the district average (deviation is only .29 percent). Similarly, the average size of the family and the proportion of total main workers to total population of the samples are also very close to the district average with a deviation of only .02 persons per family and 3.48 percent respectively and as such, the representation could be considered reflective of these population attributes of the study area. Significant variations have been noticed only in the context of the sex ratio and the literacy rate of the samples. It is not uncommon to have a

deviation between the sex ratio of the samples and the sex ratio of the population of the study area. Because, the former reflects the ratio typical of the rural population while the latter is the average condition of both rural and urban areas. The rural out migration has caused for a larger number female per thousand of males in the rural area due the sex selective nature of migrants. Therefore, the sex ratio of the sample, which is entirely collected from the rural area, is seen larger than the average ratio of the district. In the context of the literacy rate, the collected samples show greater proportion of literate persons than that of the study area as a whole. After the completion of the "Total Literacy Campaign" in Jorhat, the position of the district in educational front becomes quite impressive and the district is now one of the highly literate districts of Assam. In that context, the samples are successfully representing the educational reality of the district. Considering the population attributes of the samples and comparing these with the district averages, it can be concluded that the size of the samples are quite reflective of the prevailing population conditions of the district and hence would be valid for testing the hypotheses proposed in the present study.

After testing the population characteristics, it has now been attempted to test the validity of the agricultural characteristics collected through household sampling. Because the basic purpose of the of the present study is to examine the population-agriculture relationship in Jorhat by collecting relevant information through sampling. Therefore, there should be a good representation of both population and agriculture-related aspects of the district. In this background, testing of the sample household characteristics related to agriculture is equally imperative. However, in the context of the total geographical area, the district covers about 3.63 percent of the total geographical area of Assam, but the area covered by the sample is only 0.25 percent of the total geographical area of the district (Table-1.5). In general, the coverage seems to be very less but this does not mean that it

fails to represent reality. The area under possession of a household is different from the area under possession of a district. The total area of any district covers the areas of all kinds including the area under forest, marshes and swamps, water bodies etc. besides crop lands, while the area under possession of each household generally covers only the crop land and hardly have ownership of forests or other plantation areas. Therefore, the comparison of the mean of the sample and that of the universe is not relevant. Similarly the proportion of land not available for cultivation of the samples is significantly deviating from the proportion of the district (-39.01 percent). Of the total land of the samples, 18.56 percent is seen to be not available for cultivation due to the use of this land for dwelling houses. The wastelands as well as fallow land among the samples are practically nil indicating that the entire land has been used for the cultivation and production of crops. Because of this, the share of the net sown area to the total area of the sample is very high, around 81 percent against the district average of 42.42 percent The area sown more than once in a year among the samples is 14.48 percent, but this share is seen to be lower than the district average of 27 percent. Thus it is clear that in terms of the total area and the area not available for cultivation, the means of the samples are lower than the means of the universe but in the context of the net sown area the mean of the sample is larger. Similarly, the mean of the total cropped area of the sample household is larger than the mean of the universe. However, the higher or lower values of mean in these cases are less relevant to test the validity of the samples. What is important here is to examine the representation from each category and theirs relative share to the total land and in this context it is evident from the data (Table-1.5) that the size of the samples are sufficient to test the hypotheses. Because of the total land of the samples of 0.25 percent, only 18.56 percent are not available for cultivation while 80.96 percent is the net sown area. That the area is

suitable for cultivation and production of crops can be understood from this and the collected sample households are therefore a good representative of the prevailing realities.

Table-1.5: Agricultural Characteristics of the Samples Households (SH).

Land Categories	Total Land of the SH (in hectares)	Total Land of the SH (in p.c.)	District Total (in p.c.)	Deviation
Total Land	735.84	0.25	3.63 *	-3.38
Land not available for Cultivation	136.59	18.56	57.57 **	-39.01
Net Sown Area	595.77	80.96	42.42 **	38.54
ASMO	106.61	14.48	27.00	-12.52
Total Cropped Area	701.78	95.37	58.32	37.05

* percentage to total geographical area of the state. ** percentage to total geographical area of the district. ASMO-area sown more than once.

5.6. Methods Used: With a view to examine the relationship between the population and agricultural attributes of the study region, certain statistical techniques are used. First, a few population and agricultural attributes are taken up as determinants to analyze the characteristics and pattern of change in other attributes included in the present study. Second, a correlation matrix of X_1. Xn dimension has been prepared in order to examine the degree and nature of relationship among the attributes. Third, multiple regression analysis (Kothari 1996) has been applied to estimate the value of Y (dependent variables related to agricultural attributes) with respect to the value of X (independent variables related to population characteristics) with the help of following equation,

$$Y = a + b_1X_1 + \ldots + bnXn \quad \ldots \quad \ldots \quad \ldots \quad (1).$$

Besides these statistical techniques, some other cartographic techniques like graphs and bar diagrams, are used to supplement the relevant analysis. Maps are also used to depict the spatial pattern of variation of population-agricultural nexus.

6.0. Arrangement of Materials:

The materials of the present study have been arranged in a coherent manner to have a better access to the analysis. Accordingly, the first chapter of the work deals with the statement of the problem along with its basic objectives, hypotheses and relevant methods used for the collection of primary data from the field. The second chapter is devoted entirely for examining the agro-ecological conditions of the study area including its population and agricultural characteristics. The third chapter incorporates the review of literature related to the field of population and agricultural relationship and through this; it has been attempted to identify the gap going to be filled up by the present work. The fourth chapter includes the interpretation of primary data regarding the characteristics of population and agriculture of different agro-ecological zones identified for the present purpose. The fifth chapter includes primarily the examination of the pattern of relationship between population and agriculture under different agro-ecological setting. Finally, conclusions and suggestions are included in the last chapter.

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Chapter-VI

Findings, Suggestions and Conclusions

The basic thrust of the present work is centered around two important issues-population and agriculture. In a developing country like India with agriculture as the base of the economy, the coordination of these two issues is inseparable. But except a few areas of the western part of the country where green revolution is successful, the nexus between population and agriculture is not satisfactorily developed. Assam is no exception and for that matter, the district Jorhat is also in the same line. After a detailed examination of the population and agricultural relationship of the area, it has come to the notice that the quantitative and qualitative dimensions of the district's population are yet to be utilized for the development of agriculture inspite of having its suitable agro-ecological conditions. The present study has revealed a number of interesting facts regarding the nexus between population and agriculture. These are given below;

1. The population of the district has been increasing at a rate 33.10 percent (1971-1991). Although low in comparison to other districts of Assam, yet the present rate is enough to lead for higher pressure of population on existing land resources (306 persons/km^2, higher than the state's average of 286/km^2). Unfortunately, the agricultural structure of the area remains traditional except a certain variations. This indicated by the low use of high yielding variety of seeds and fertilizer and lower productivity of crops. For instance, the average yield of all kinds of paddy in the area is only 1560 kg/ha compared to more than 2000kg/ha in other parts of the country. Thus, the area remains in poverty in the midst of plenty as far as the potentials for agricultural development are concerned.

2. While examined population and agricultural characteristics of the samples of four agro-ecological zones in the light of five determinants, viz., family size, population density, literacy rate, size of land holding and crop intensity, then a few interesting features have come in to the notice which are common for all ecological zones. These are:

   a. With the increase in the size of family, the dependency ratio and the proportion of labour to the total population are found to be increasing. This has resulted more use of labour input per hectare of land than required. Among the agricultural attributes, the size of land holding is seen to be increasing with the increase of family size. The causes are apparent, i.e.; larger family size means more dependents and more labourers as the persons below 19 years of age are also the potential labourers for agricultural practices. Moreover, large families are the joint families and yet to divide their agricultural land among themselves and as such larger holding size is seen among these families;

   b. With the increase in the density of population, the educational status (high school and above) and the supply of labour is becoming abundant. But land holding size and production per unit of labour declines significantly. Higher density means higher pressure of population on agricultural land and, therefore, labour intensity is more on agricultural land resulting lower per capita output;

   c. With the increase in the share of literate persons (below lower primary level) in the households, family size is becoming larger. This is attributable to the fact that poor educational status has caused for a lack of awareness among the people relating the benefit of small family norm. Since the educational background is poor, labour productivity is also lower;

d. The effects of land holdings are seen over both land and labour productivities. Larger the size, higher is the volume of production and productivity. This signifies the fact that productivity is basically a function of the horizontal expansion of agriculture rather than the vertical expansion, indicating a traditional structure in the prevailing agriculture.

e. Changes in crop intensity is seen to be developing due to the pressure of population, but the changes are not perceptible and have no specific pattern to be identified.

3. Examining the relationship between population and agricultural attributes through correlation matrix, following facts have been derived;

a. Regardless of the type of agro-ecological conditions, the density of population (i.e. pressure) has emerged as the most influential factor in determining the intensity of labour structure. This suggests that whenever the pressure of population is more, the supply of labour to the agricultural practices is also more in a situation where agriculture is the main occupation and employment opportunities other than agricultural sectors is extremely limited.

b. As soon as supply of labour is more to the agricultural operation, the intensity of labour input per hectare of land is also more leading to a decline of per man production, i.e. labour productivity. This is what exactly happening in the study area.

c. The hypothesis proposed "under the conditions of abundant labour supply, land productivity moves up with the decline of labour productivity" is only partially valid. Because, with the increasing use of labour input per hectare of agricultural land in various agro-ecological zones, the land productivity is not moving up as expected in the hypothesis (although the relationship is positive, it is not significant

even at 95 percent confidence level), but labour productivity is declining significantly. Thus the second part of the hypothesis is valid in the study area.

d. Regarding the second hypothesis that the "intensity of cropping at a greater scale is emanating from the higher density of population" is also not strongly applicable. Although both density and crop intensity is positively related in all agro-ecological zones of the area, yet the relatiionship is not significant even at 95 percent level of confidence. It indicates that whatever the change in crop intensity is taking place, it is not due to the higher density of population alone but due to the other physical and non-physical factors.

4. Examining the role of population factors on the development of agriculture through multiple regression analysis, the following facts have been obtained;

a. The multiple effects of population factors on land productivity in the hilly zones (moderately steep to steep land and piedmont zones) are found stronger than that of the plain zones (built up and flood plain zones). More than 50 percent of variations in land productivity of the hilly zones are explained by population factors alone and only less than 50 percent of variations are explained by the other factors.

b. Similarly the multiple effects of population factors on labour productivity in the hilly zones are stronger than that of the plain zones already stated. More than 70 percent variations in labour productivity are explained by population factors in the hilly zones while in the plain zones, less than 40 percent variations in labour productivity are explained by population factors.

c. In determining crop intensity, population factors are again found to be playing significant role and more than 50 percent of variations in crop intensity in the hilly zones are being explained by population factors. In the plain zones, it is less than

40 percent and thus the role of other factors are seen to be more prominent (more than 60 percent).

5. The study has confirmed that the population and agricultural attributes are interrelated. But depending on the nature of agro-ecological conditions, the degree of relationship tends to vary as reflected by the four agro-ecological zones of the area. Similarly, the impact of population factors on agricultural development also depends on the type of agro-ecological conditions. More suitable ecological setting means lesser effort of man, as the environment is easier to utilize and opposite is the case when environment is comparatively difficult.

Suggestions:

The present work reflects not only the population-agriculture nexus under different agro-ecological settings, but also reveals some interesting areas of research that a geographer can pursue to enrich the theoretical basis of the subject. In this context, the following suggestions can be made for conducting research in due course of time.

First, the distance factor can be incorporated in examining both the population and agriculture characteristics and also the variations of their relationship according to the variations of the distance either from the nearest nodal centres or from the main road. Distance is an important aspect in geography and it forms the basic dimension of space with considerable influence on the operation of the spatial system (Knowles et al.,1998). It is also stated that for the development of inherent agricultural potentialities, road accessibility is a dire needs (Singh and Dhillon, 1994, p. 173) which is determined by the distance both in time and cost perspectives. The fact is that with the increase of distance, the land use pattern tends to vary. Sandhu (1977) studied the variations in the intensity of sugar cane cultivation in the light of accessibility in Haryana. With a view to classify areas in the context of accessibility, the Chief Engineers (1958) recommendation (known as

Nagpur Report) is seen to be relevant in Indian agricultural context. It says that areas lying within 4 km from a transport point are treated as "fairly accessible", within 8 km as "simply accessible", but beyond 8 km as "inaccessible" and beyond 16 km as "highly inaccessible". The objectives of this classification is to see that in a highly developed agricultural area no village is more than 3 km away from a link road or more than 8 km away from a main road (Singh and Dhillon, 1994, p.173). In what ways the model is applicable in examining the agricultural structure of the state in general and Jorhat in particular is a vital question that the geographer of the region can answer for the betterment of the society.

Secondly, smaller and smaller areas can be taken up as a micro areal unit of investigation. The attributes of population and agriculture and their interconnection can be studied against the backdrop of the distance from the nearest urban centres located within the smaller regional unit. Thus a hierarchy in the regional system can be worked out which would be more meaningful in analyzing the spatial structure of agricultural activities in relation to the human population. In Jorhat, for instance, there are 223 villages in the Jorhat Thana itself over an area of 500 sq. km. Out of this total villages, 20 percent of villages lies within 8 km of distance, 50 percent lies within 8-16 km distance and 30 percent lies beyond 16 km distance from the Jorhat town (1991). How far these clusters of villages vary in terms of their population and agricultural characteristics and in what ways the distance factor contributing towards such variations, can be an interesting aspect for detail investigation. It will help in formulating models for planning and development of the area.

Thirdly, the study has also revealed that a large part of the population has been not properly utilized. This indicates that due to the abundant supply of labour to the agricultural practices, there exists under utilization of labour input and the contribution of

additional labourers to the production process is insignificant. Geographers have immense scope to formulate models that can give direction to the systematic use of the qualitative aspects of the population of the study area.

Conclusion:

Analyzing the present situation of population and agriculture of Jorhat, it can now be concluded that there is a need for micro level studies incorporating these vital issues. Reviewing the works on population-agriculture relationship, Kulkarni (1981, pp.355-356) commented that "it is essential to investigate whether agricultural change in a region is more a matter of a community's effort and of its attitudes to the adoption of new methods, and whether the human efforts and attitude are the result of the community's response to demographic pressure. At the same time, in those regions in which a notable agricultural development has taken place, it is essential to study the impact of this development has had on the demographic situation of that region". Although he is in favour of macro level studies, yet the basic issues relating population and agriculture and their interrelationship is highlighted as relevant in the developing countries like India. Agricultural development strategies should be formulated only after considering the population parameters because the latter is the basic input in agricultural development.

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References:

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