1.0. Introduction:

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 categorizing 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 emphasize 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, infrastructure and institutional, etc. and studied 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 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.

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,
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. Accordingly, Therefore, from the agro-ecological point of view, the district has been divided in to four zones such as moderately steep to steep land, piedmont, built-up and flood plain zones and the population-agriculture relationship of each zone has been examined and analysed. 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. Following stages have been involved in the process of collecting data from the field.

5.1. Selection of Villages as Samples: In order to select villages for detail investigation, the district has been divided into four agro-ecological zones and each zone has 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. 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 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. As such, this could be expected to be meaningful in achieving the objectives stated above.
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 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. 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 $X_1$, $X_n$ 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,

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

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.

7.0. Findings:

The basic thrust of the present work is centered on 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/km², higher than the state’s average of 286/km²). 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 relationship 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.

8.0. 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 underutilization 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.

9.0. 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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