POPULATION GROWTH AND FOOD SECURITY IN EASTERN UTTAR PRADESH: A CORRELATIVE ANALYSIS

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and
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ABSTRACT

Food security is one of the most heated and debated topics in the contemporary world. The concept of food security basically stands on four pillars namely, food availability, food stability, food accessibility and food utilisation. Present study analyses the condition of food security in Eastern Uttar Pradesh because Central and Western Uttar Pradesh are agriculturally and industrially more developed than Eastern Uttar Pradesh. Thus, its condition with respect to various dimensions of food security, i.e., food availability, food stability, food accessibility and food utilisation has been examined here incorporating the dimensions of population growth and population pressure. Only one district of the study area namely, Pratapgarh, is experiencing high food security. Four districts are experiencing low food security. Twenty two districts are experiencing moderate food security and a slight fluctuation in the variables of food availability, food stability, food accessibility and food utilisation, in a negative direction would make these districts a low food secure region. Only one district - Pratapgarh -is having high food security and moderate population pressure and two districts of Sant Kabir Nagar and Sant Ravidas Nagar are having low food security and low population pressure. Further, Pratapgarh district is having high food security and moderate population growth, and Shrawasti district is having low food security and low population pressure.

Keywords: Food Security, Population Growth, Eastern Uttar Pradesh, Food Availability, Food Utilisation.

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Introduction

Food security is one of the most heated and debated topics in the contemporary world (Hashmi and Shakeel, 2012). Since the beginning of human civilisation, population growth and food security, in their wide ranging dimensions, are closely interlinked with each other. It has been acquiring distinct elements in different times. But it never lost its significance despite technological advancement. And, that is why it has attracted various scholars to approach these problems from various angles. These approaches explain the problem and causes behind food security (Jha, 2003). In a developing and predominantly agricultural country, where agriculture not only contributes an overwhelming share of national income but also absorbs a large part of the work force, the interaction between population growth and food supply is of great interest (Shakeel, 2014). It is a well-known fact that population as a serious problem has been in the world's agenda since five decades and not simply as the subject of scientific study or public discussion but also as a decisive factor in the development of a country. Governments of both developed and developing countries have adopted policies and programmes to influence demographic trends. Knowledge of existing population and its past and future trends is of vital importance, especially in connection with planned schemes for future economic and social development (Chandana, 2007). The same is the situation with foodgrain production because food is the main concern for the well-being of any living creature and therefore, is of paramount importance. It is one of the basic necessities of human being along with air and water, and the basic idea from which the system of food security has evolved to ensure foodgrains for all.

Methodology

Objectives:

The objectives of the present study are to examine the spatial pattern of food availability, food stability, food accessibility, food utilization and henceforth determine the food security in Eastern Uttar Pradesh. This paper also studies the impact of population growth and population pressure on the food security condition in the study area. Finally, some measures and suggestions have been provided for improvement of food security in the study area.

Study Area:

Eastern Uttar Pradesh has been chosen as study area as Central and Western Uttar Pradesh are agriculturally and industrially more developed than Eastern Uttar Pradesh because of its close proximity to the Green Heart Land of India, i.e., Punjab and Haryana where Green Revolution techniques were first applied with enormous success and also due to the nearness with national capital New Delhi. Eastern Uttar Pradesh is most backward and thus, its condition with respect to various dimensions of food security has been examined here.

Eastern Uttar Pradesh has been taken as the study area which is a homogenous alluvial tract which forms an important part of Indo-Gangetic Plain. Geographically, Eastern

Uttar Pradesh lies between the latitudes of 25° 102 and 26°212 N and longitude of 82° 102 and 84° 402 E. Due to high fertile plain of Ganga, the region has high population density and dominance of agriculture as economic activity (Sisodia and Kumar, 2004). Eastern Uttar Pradesh has a maximum population density of 776 persons per sq km (Census of India, 2001) against the whole of India, that is, 324 persons per sq km. In terms of agriculture, of the total production of foodgrains in Uttar Pradesh, about 34 per cent comes from Eastern Uttar Pradesh while its area accounted for about 35 to 37 per cent of the total foodgrains area.

The present study is based on the secondary sources of data to show the trend and pattern of population growth and status of food security in Eastern Uttar Pradesh. Districts have been chosen as the unit of study and data have been collected from various published and unpublished records of government and non-government organisations. Data regarding agriculture have been obtained from the Bulletin of Agriculture Statistics of Uttar Pradesh for various years from Ministry of Agriculture, Department of Statistics and Economics, Lucknow, Government of Uttar Pradesh. Agricultural data have been used for the years 1969-1972, 1979-1982, 1989-1992, 1999-2002 and 2006-2009. Three-year moving average has been taken to remove the weather abnormality and fluctuations in the data taken for study. Data concerning infant mortality rate (IMR) and maternal mortality rate (MMR) have been obtained from Family Welfare Statistics in India, Statistics Division, Ministry of Health and Family Welfare, Government of India. Data on number of beds in allopathic hospitals/ dispensaries per lakh of population, maternal and child health care centres (MCH) per lakh of population and number of primary health centres (PHC) per lakh of population have been obtained from statistical diary of Uttar Pradesh for the year 2008.

Coefficient of consumption has been calculated because amount of food consumed varies from person to person on the basis of age, sex, climate, income, occupation, etc. According to Singh's scale, each unit of population is equal to 0.773 consumption units or 1000 person equals to 773 consumption units (Chakravarty, 1970). Coefficient of production has also been calculated because all foodgrains produced are not available for consumption as some are lost in transportation, storage, destruction by insects and pests, kitchen waste, use of seeds, etc. Thus, Chakravarty (1970) has suggested a total deduction of about 16.8 per cent of the total gross production for obtaining net food available for consumption. The coefficient of production is therefore, 0.832 (100-16.8=83.2).

The data regarding the variables of accessibility i.e., employment rate, literacy rate and urbanisation and district-wise population for the year 2008 have been projected using the analytic method of population estimation (Khan, 1998). The formula assumes that the population has been increasing at a constant rate, observed during the census period that is 1991 to 2001, thus:

$$PP = P_1 + n/N*(P_2 - P_1)$$

where PP is the projected population; P1 is the population of the previous census; P2 is the population of succeeding census; N is the number of years between the censuses; n is the number of years between the previous census and the year for which population would be projected.

In order to standardise the raw data of all the variables, the method of z-score has been used (Smith, 1973). Z-score quantifies the departure of individual observations and expresses it in a comparable form. The formula is thus:

$$Zi = \frac{xi - \overline{xi}}{SD}$$

where, Zi is the standard score of the ith variable; xi is the original value of individual observation; $\overline{x}i$ is the mean of variable and SD stands for the standard deviation. In first step district wise z-score of each indicator has been calculated. The values so obtained are added district-wise and average is taken to calculate the composite z-score as the index of development, by the formula

$$CS = \frac{\sum Zij}{N}$$

where, CS refers to composite z-score; Zij stands for the sum of z-scores of variable j in observation i; and N symbolises the number of variables. Correlation matrix based on Karl Pearson's technique has been used to examine the relationship between the variables of food availability, stability and accessibility. Student's t-test technique has been chosen to identify the significant relationship between the variables at one per cent and five per cent level of significance.

In order to show the spatial pattern of food availability, food stability, food accessibility, food utilisation and food security in Eastern Uttar Pradesh, the districts have been divided into five categories depending on their status with respect to each of the indicators into very high, high, medium, low and very low. The districts have been delineated on the basis of scores obtained by Mean and Standard Deviation method.

Results and Discussion

Trends of Population Growth during 1901 to 2011:

During the very first decade of the 19th century, i.e., 1901 to 1911, there were several local famines and even a severe famine in 1907 in Uttar Pradesh. Plague was evidenced in Bengal and Bombay presidencies, both plague and malaria followed Uttar Pradesh where they held the population practically in a stationary state or can be said in a declining condition (Mitra. 1978, p-22) and this can be seen in the growth rate of the study area where, the population of Eastern Uttar Pradesh decreased from 18.56 million to 18.36 million and the average growth rate of -1.10 per cent was observed (Table 1). Moreover, the urban population of the study area has decreased and rural population experienced increment because the plague spread mainly in urban

populated area and because of this people migrated from urban areas to rural areas (Parveen, 2002).

During the second decade (1911-21), the total rural and urban population of the study area has increased due to the diminishing effect of the diseases and famines. Despite the fierceness of the influenza epidemic with which the period (1901-1921) closed, the era of great pestilences, particularly plague, was practically over. Famines during 1921 were less regular than it was before 1901. At the same time, there was little noticeable improvement in public health or sanitation activity during 1901-1921. Nutrition may have slightly improved giving way to greater survival in the next period to come, i.e., 1921 and onwards (Mitra, 1978).

Third decade (1921-31) was the most prosperous period in terms of population growth and is also known as great demographic divide of 1921 (Haub and Sharma, 2006) because it marks a shift between relative static population and rapidly increasing population. During this decade, the total rural and urban population of the study area has increased up to fourth decade (1931-41) because of diminishing effect of diseases and famines, improvement in the nutritional standard of the people, development in the medical and healthcare facilities. If we look at disaggregate level, then the reason behind the increase in population is the decline in the death rate. As far as our death rate is concerned, it has been declining, though slowly. From 1901 to 1914, the death rate was about 33 per 1000; from 1922 to

1930 the death rate was about 26 per 1000 and from 1931 to 1941 it was about 23 per 1000. The most important cause for this decrease in the death rate may be the steady decline in infant mortality which came down from 195 in 1920 to 160 in 1940 and the decrease in mortality from cholera and plague (Agrawal, 1947).

During the fifth decade (1941-51), which was politically most disturbed decade of the 19th century due to World War II and partition of the country, the total and rural population of the study area has decreased because of migration of people to some other parts of the study area and also to Pakistan. But the urban population has increased (Table 1) because of the influx of people from other parts of the country and from Pakistan to urban centres of the study area (Chandna, 1985).

After the demographic divide of 1951, the population has further increased up to the decade from 1971 to 1981 as the crude birth rate increased from 39.9 in 1951 to 41.7 in 1961 accompanied by decline in crude death rate from 27.4 in 1951 to 22.8 in 1961 (GoI, 2011). Control on the epidemic diseases like malaria, improvement in the drinking water facility, better drainage, better health conditions, efficient handling of famine, use of antibiotics and general improvement and economic development have contributed to the decline in death rate. Increase in the life expectancy at birth has also contributed to increase in population. Life expectancy during 1941-51 was 33 years for male and 32 years for female which increased to 42 for male

and 41 for female during 1951-60. It further increased to 46 for male and 44 for female during 1961-70 (Khairoowala, 1987). But the urban population has decreased from 22 to 7 per cent. This is because of the changes in the urban definition of town. At all-India level, 800 towns were declassified and in Eastern Uttar Pradesh, number of towns has decreased from 109 to 52 (Census of India, 1991). Then from 1951-61, the urban population start increasing rapidly. This is again due to the changes in the definition of towns, and in Eastern Uttar Pradesh the number of towns has increased from 52 to 179 (Mohan and Pant, 1982). After the decade from 1971-81, this also acted as a second demographic divide because after this period, the population growth rate has stabilised. The total and rural population of the study area recorded only a meagre increase up to 2001 because of increase in the investment of population control programmes, involvement of different NGOs, private sector organisations and multi stakeholders in the distribution of contraceptive products and increase in the ranges of contraceptive products distributed by these organisations. But the urban population has rapidly declined from 1971-81 to 1999-01 this is due to the decrease in the share of natural increase of population. Later, after year 2000, the total rural and urban population of the study area has further decreased following the implementation of the Uttar Pradesh Population Policy of 2000 and increasing literacy rate through which people became more aware of the benefits of having smaller families, and also about the contraceptive products and services available in the market.

Spatial Pattern of Indicators of Food Security

Food Availability Regions: Food security of any region mainly depends on food availability which is a function of domestic agricultural production or through imports from surplus areas. Three districts of Balrampur, Maharajganj and Siddhartnagar are having high availability of food, followed by districts of Bahraich, Varanasi, Gonda, Ambedkarnagar and Basti having high food availability (Figure 2). Due to increase in the irrigational facilities and development in the infrastructure of agriculture, the above-named districts form high food availability regions. The increased consumption of fertilisers and application of high-yielding varieties of seeds have resulted in an increase in the yield of crops and subsequently, the production of foodgrains. It may be noted that the availability of livestock, meat and milk are also high in these districts. Districts namely, Kushinagar, Ghazipur, Chandauli, Sultanpur, Azamgarh, Shrawasti, Deoria, Gorakhpur, Sant Kabir Nagar, Ballia, Mau, Jaunpur, Kaushambi and Pratapgarh are having moderate food security. Though livestock availability in most of the districts is moderate, the foodgrain production and calorie availability in these districts are low, making these districts to fall into the category of moderate food availability region. Meat and milk availability is also moderate except in districts of Sultanpur, Bahraich and Mau. Faizabad, Mirzapur, Allahabad, Sant Ravidas Nagar and Sonbhadra districts are having low food availability (Figure 2). Due to high growth rate of population and low agricultural development in the above districts, food

availability is low. Districts of Varanasi and Sant Ravidas Nagar have very low food availability as majority of the population is engaged in textile industries and household industrial works, and only a handful of population is engaged in agriculture and allied sectors. Mirzapur, Sonbhadra and Allahabad districts also have very low food availability, because these districts lie in the Vindhyachal mountain region and their hilly topography is not suitable for cultivation of crops.

Food Stability Regions: It can be viewed that (Figure 3), very high level of food stability is found only in one district of study area - Allahabad. Due to development in the infrastructure of agriculture in the form of increased consumption of fertilisers and irrigation development, both surface and sub-surface water have led to an increase in area under foodgrain cultivation and hence, in the productivity of crops making these districts to have very high and high food security. The storage capacity in these districts are also high thus, they are able to maintain stability in food supply even at the time of shortage. Further Azamgarh, Gorakhpur, Ballia, Chandauli, Faizabad, Pratapgarh, Kushinagar, Ghazipur, Gonda, Jaunpur, Varanasi, Maharajganj, Ambedkarnagar, Basti, Sultanpur, Mau, Deoria, Mirzapur, Siddhartnagar, Kaushambi Bahraich, Sant Ravidas Nagar and Sant Kabir Nagar districts have moderate food stability. Irrigation facilities, consumption of fertiliser and storage capacity in these districts are not as high as in that of high food stable districts. Three districts of Balrampur, Shrawasti and Sonbhadra have very low food stability. Food stability in these districts is low because concentration of almost all the variables of food stability is low. Storage capacity in these districts is low and thus, they are unable to maintain the stability in food even at the time of shortages. Farmers in these districts are still backward and have inappropriate knowledge about the advanced agricultural technologies like modern means of irrigation. The most recent data available from Government of India show that in Eastern Uttar Pradesh, the percentage of total irrigated area under foodgrains is 56.10 per cent, which is far below than that of the State average of 68.58 per cent. The percentage of total irrigated area in the districts of Balrampur, Bahraich, Shrawasti and Sonbhadra is lowest at 37.47, 35.30, 32.16 and 24.21 per cent, respectively. Though the fertiliser consumption has increased during the last decade, still these districts have lowest fertiliser consumption per hectare of land, except Sonbhadra and Sant Ravidas Nagar. Fertiliser consumption in Sonbhadra and Sant Ravidas Nagar is little high but the percentage of net irrigated area to net sown area is low resulting in low yield. As per the genetic recommendation, it is said that high yielding varieties of seeds with high application of chemical fertiliser gives higher yield only when sufficient amount of water is applied in the field. Thus, the farmers are unable to increase the production and productivity of crops on existing agricultural land. This is the reason why the districts of Sonbhadra and Sant Ravidas Nagar have low food stability despite having high fertiliser consumption.

Food Accessibility Regions: The availability and stability of food would loose its meaning until people have access to the available food. The district-wise distributional pattern of food accessibility shows (Figure 4) that the districts of Varanasi, Sonbhadra, Kaushambi and Pratapgarh form high food accessibility region because the proportion of urban population and literacy rate is much higher in these districts. Literacy is usually seen to have a high correlation with employment, hence providing better access to food. But in spite of having low rate of urbanisation and literacy rate, Kaushambi, Pratapgarh and Sultanpur districts lie in the high food accessible region. The per capita income of people in these districts is high leading to better purchasing power. The long roads and good network of roads enable the farmers to have an easy access to the agricultural inputs, and delivery and marketing of the agricultural produce to make food available to the needy at the right time.

Seventeen districts namely, Allahabad, Sultanpur, Shrawasti, Chandauli, Ghazipur, Mirzapur, Mau, Faizabad, Balrampur, Jaunpur, Maharajganj, Sant Ravidas Nagar, Gonda, Azamgarh, Gorakhpur, Bahraich and Deoria have moderate food accessibility. The medium urbanisation and literacy, and low connectivity of places by roads put these districts in the category of moderate food accessibility region. Kushinagar, Ambedkarnagar, Ballia, Siddhartnagar, Basti and Sant Kabir Nagar experienced very low food accessibility. Despite lesser number of persons per fair price shop, the accessibility of food in these districts is low because of lower employment rate and low rate of urbanisation, which eventually leads to low purchasing power. Urbanisation is low in these districts, which results in reduced amount of urban amenities and facilities related to health, sanitation and other infrastructural facilities that are essential for improving the accessibility of population towards food. Though literacy is more than 50 per cent in these low and very low food accessibility districts, unemployment and poverty prevail on a large scale. Even though there has been great hype over MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act), it has been found that only 17.52 per cent of the total population are engaged as main workers and 16.23 per cent of population are engaged as marginal workers. Leaving the categories of low and very low food accessibility districts, if all the districts of Eastern Uttar Pradesh are taken together, it becomes evident that not even a single district of the region has more than one-third of its population employed for more than six months in a year. These figures on employment show that the condition of employment generation programmes is very disheartening in the study area.

Food Utilisation Regions: Figure 5 shows that the districts of Siddhartnagar, Basti, Pratapgarh and Kaushambi form high food utilisation region, located on northern and western parts of the study area. High availability of primary and medical healthcare facilities, including maternal and child healthcare facilities and availability of safe drinking water, keep these districts in the category of high

food utilisation region. Faizabad, Ballia, Deoria, Balrampur, Chandauli, Azamgarh, Jaunpur, Gonda, Sultanpur, Bahraich, Maharajganj, Ghazipur, Shrawasti, Mirzapur, Kushinagar, Mau, Allahabad, Sant Kabir Nagar and Gorakhpur districts form notable moderate food utilisation regions located on the north-eastern, north-western, south-eastern and central parts of the study area. Four districts namely, Mau, Allahabad, Sant Kabir Nagar and Gorakhpur form low food utilisation region followed by Sant Ravidas Nagar, Ambedkarnagar, Sonbhadra and Varanasi making very low food utilisation region on central and southern parts of the study area.

Food Security Regions: The present study reveals that there is variation with respect to food availability, stability, accessibility and utilisation among the districts of study area. Thus, with the purpose of delineating the food secure region (Figure 6), the z-scores of all 22 variables, five of food availability, five of food stability, six of food accessibility and six of food utilisation were taken district-wise (Table 2) and composite z-score for food security has been calculated. It is observed that the district-wise variation of z-score varies from maximum value of 0.410 in Pratapgarh to minimum value of -0.774 in Sonbhadra district (Table 3).

Only one district - Pratapgarh - recorded high food security because, out of 22 variables, 16 have contributed positively to food security. Moderate food security regions are found in the north-central, south-western and eastern parts of Eastern Uttar Pradesh. The districts which recorded moderate food security are

Kaushambi, Chandauli, Allahabad, Maharajganj, Basti, Siddhartnagar, Ghazipur, Faizabad, Balrampur, Azamgarh, Sultanpur, Varanasi, Gonda, Jaunpur, Deoria, Kushinagar, Bahraich, Mau, Gorakhpur, Mirzapur and Ambedkarnagar. The values of z-scores reveal that out of 22 variables, 15 have contributed positively in Chandauli, 14 in Siddhartnagar and Ghazipur; 13 in Kaushambi; 12 in Maharajganj, Basti and Faizabad; 11 in Azamgarh; 10 in Allahabad, nine in Balrampur, 15 in Sultanpur, 11 in Varanasi, 10 in Gonda, 10 in Ballia, 11 in Jaunpur, nine in Deoria, seven in Kushinagar, 12 in Bahraich, 10 in Mau, nine in Gorakhpur, 11 in Mirzapur and 10 in Ambedkarnagar. Availability of food and livestock, and higher consumption of fertiliser with adequate irrigational facilities, accompanied by higher productivity of the crops and higher purchasing power, are responsible for high food security in these districts. Also, there is good network of roads in these districts leading to better access to the agricultural inputs, and better delivery and marketing of the agricultural produce. Regarding food utilisation, these districts have the facility of safe drinking water which saves people from various types of waterborne diseases and helps in proper intake of food. Availability of hospitals and number of beds per lakh of population are also high, providing primary healthcare and basic medical facilities to the masses. Maternal and child healthcare centres are also high leading to low infant and maternal mortality in the above districts. There are evidences which show that malnutrition is major cause for high infant and maternal

mortality. Since these districts have low infant and maternal mortality, it goes on to prove that the nutrition security of these districts is good leading to better food utilisation and hence, food security.

The four districts, which recorded low food security namely, Shrawasti, Sant Kabir Nagar, Sant Ravidas Nagar and Sonbhadra, form very low region of food security and are situated in the north-central and southern parts of study area. The condition of overall food availability is poor in these districts. Poor irrigation facilities with low consumption of fertiliser lead to low productivity of crops. Availability of safe drinking water, medical and primary healthcare facilities are also low. The development in the infrastructure of agriculture is highly required because the consumption of fertiliser and yield per hectare are low. Storage capacity and the number of fair price shops should be increased to secure better access towards food.

Relationship between Food Security and Population

In this section, the relationship between all the indicators of food security, i.e., food availability, stability, accessibility and utilisation have been shown with population pressure and population growth. Hence, an effort has been made to delineate the food security regions with respect to population pressure and population growth. Also, to statistically determine the relationship between food security and population, correlation analysis has been performed. Correlation analysis has been employed in two ways. The inter-relationship

of the variables of food security has been established along with the relationship with that of the dependent variables, i.e., population pressure and population growth.

Population Pressure and Food Security Regions: On the basis of z-scores of food availability, food stability, food accessibility and food utilisation, composite z-scores has been calculated for food security for each district. On the basis of mean and standard deviation method, the district-wise z-score has been arranged in three categories of high, medium and low, and then, it has been interrelated with population pressure (Figure 7). Three districts of study area (Sonbhadra, Allahabad and Mirzapur) have high population pressure, of which Sonbhadra have low food security, located on the southern tip of study area and remaining two districts - Allahabad and Mirzapur - have medium food security and forms a notable region in south-western portion of study area. Medium population pressure and medium food security are experienced in 17 districts. They are Sultanpur, Bahraich, Azamgarh, Jaunpur, Gonda, Ghazipur, Balrampur, Gorakhpur, Ballia, Maharajganj, Kushinagar, Siddhartnagar, Basti, Chandauli, Deoria, Ambedkarnagar and Faizabad. These districts cover a major portion of the study area forming a distinguished region in the eastern, north-western and central parts of the study area. Pratapgarh district lies in the category of medium population pressure and high food security, whereas Shrawasti district lies in the category of medium population pressure and low food security, both located on the western part. Low population pressure and

medium food security category includes three districts of Kaushambi, Mau and Varanasi. Sant Kabir Nagar and Sant Ravidas Nagar districts are in the category of low population pressure and low food security.

Population Growth and Food Security Regions: The inter-relationship between population growth and food security in Eastern Uttar Pradesh (Figure 8) reveals that Bahraich and Faizabad districts, which forms a notable region in north-western part of study area, lie in the category of high population growth and medium food security. Sant Kabir Nagar district alone lie in the category of high population growth and low food security. Medium population growth and low food security is found in the districts of Sonbhadra and Sant Ravidas Nagar. Nineteen districts namely, Allahabad, Maharajganj, Kushinagar, Mau, Chandauli, Mirzapur, Ambedkarnagar, Ghazipur, Sultanpur, Varanasi, Gonda, Azamgarh, Deoria, Gorakhpur, Balrampur, Ballia, Jaunpur, Siddhartnagar and Basti are in the category of medium population growth and medium food security. Pratapgarh lies in the category of medium population growth and high food security, and Kaushambi experiences low population growth and medium food security. Low population growth and low food security is found only in Shrawasti district.

Population and Food Security

Inter-relationship between the Variables of Food Security: The inter-correlation matrix bring out the causal relationship among the variables of food availability, food stability, food

accessibility and food utilisation (Table 5). The correlation analysis reveals that there is a high degree of correlation between the variables of food availability and food stability. Variable X_3 (pulses availability in kg per head per annum) is negatively correlated with X_9 (percentage of net irrigated area to net sown area) at one per cent significance level. This is because pulses are generally grown under rain-fed areas and due to the advancement in the irrigation facilities both in surface and sub-surface water, these crops are replaced by fine cereals (wheat and rice), which are more remunerative and profitable, less risky to grow and highly yielding. In India, majority of population is vegetarian and they depend on pulses for their protein requirement. Thus, the low availability of pulses are putting a great threat to the nutritional security of the people in the study area. Variable X_1 (pulses availability in kg per head per annum), though insignificant but have a negative correlation with X_{11} (fertiliser consumption in kg per hectare). Increasing fertiliser consumption is biased towards the fine cereals, and as per the genetic set-up, the new high -yielding varieties of cereals thrive on high dozes of fertilisers, which points to a shift in cropping pattern from pulses to fine cereals. The variable X_4 (cereals availability in kg per head per day) is positively correlated with X_{10} (area under foodgrains) at five per cent significance level. This indicates that increase in area under foodgrains is largely contributed by increase in area under cereals. Again the variable X_4 (cereals availability in kg per head per annum), is positively correlated with X_{13} (yield of foodgrains) and this implies

that the increase in the yield of foodgrains is mainly contributed by increase in yield of cereals and not that of pulses, as availability of pulses (X_3) have a negative correlation with X_{13} (yield of foodgrains). Variable X_5 (oilseeds availability) is having a positive correlation with X_3 (pulses availability) at one per cent significance level because pulses and oil seeds are generally grown as mixed crops in the study area.

Variable X_{16} (literacy rate) is positively correlated with variable X_9 (irrigation) and X_{11} (fertiliser consumption). This shows that increasing literacy in the rural areas enables the farmers to enhance their knowledge about the modern agricultural technologies, modern means of irrigation and uses of chemical fertilisers in their field to increase the production of foodgrains in the study area for ensuring food security. In the present study, it has also been found that production of foodgrains has recorded a three-fold increase and this is experienced due to advancement in the irrigation facilities, both in surface and sub-surface water and application of chemical fertilisers.

Variable X_{19} (urbanisation) has a negative correlation with X_2 (foodgrains availability), X_4 (cereals availability), and though insignificant, also has a negative correlation with X_3 (pulses availability). Variable X_{16} (literacy rate) has a significant negative correlation with X_3 (pulses availability), X_4 (cereals availability) and X_5 (oilseeds availability) but has a significant positive correlation with X_6 (livestock availability) and though insignificant also has a positive

correlation with X_7 (meat availability). This shows that as people become more urbanised and literate, there is a shift in their eating habit from cereals to non-cereals. This is the reason why variable X_{19} (urbanisation) has a positive correlation with X_6 (livestock availability) and X_7 (meat availability). It has been found in several studies that as people become more literate and urbanised with increasing income, their eating habits changes from cereals to non-cereals like fruits, vegetables, meat and other livestock products. Variable X_{19} (urbanisation) is positively correlated with variable X_{12} (storage capacity) at one per cent significance level. It implies that, urban areas have more food stability because of good storage facilities and they are able to supply food to the people, even at the time of shortage, without any break in the availability of food. Variable X_{19} (urbanisation) is also positively correlated with variable X_{16} (literacy rate) revealing that urban population is more literate, having more employment and job opportunities leading to better access to food.

Variable X_{22} (maternal mortality rate) is negatively correlated with variable X_6 (livestock availability) at five per cent significance level. Since livestock products provide micro and macro nutrients to lactating, pregnant and normal women, it is negatively correlated with maternal mortality. In a multi-agency report during 2009, it was found that iron deficiency, which leads to anaemia during pregnancy, is associated with one-fifth of the total maternal deaths each year. Variable X_{16} (literacy rate), though insignificant has a negative correlation with variable X_{21} (infant

mortality rate) and X_{22} (maternal mortality rate). Education plays an important role in reducing neonatal and infant mortality and helps in increasing child's weight with respect to age, immunisation and improved sanitation in the household. Education, especially of women, is very important because it is women who are more concerned towards food security of their families by way of producing and procuring food, and raising kitchen gardens and orchards. In spite of their big role, they are suffering from undernourishment and women of child bearing age and pregnant women are at greater nutritional risk than any other population groups. But in the study area, poor literacy is the main cause of maternal and infant mortality. Variable X_{19} (urbanisation) is negatively correlated with variable X_{20} (safe drinking water) and X_{24} (maternal and child healthcare centres) at one per cent significance level. Urban areas of Eastern Uttar Pradesh have high growth rate of population, triggered by immigration of the people coming in search of jobs and better living conditions. Thus, due to continuously increasing population, consumption of water increases and the per capita availability of safe drinking water declines, leading to shortage of drinking water. Due to high density of population living in urban areas, the availability of maternal and child healthcare centres per head is also low, leading to poor health and hygiene of the people.

Relationship between Population and Food Security: A correlation matrix has been prepared taking the 25 variables of food security from X_1 to X_{25} and the variables of population, i.e., population pressure (Y_1) and population growth (Y_2). Correlation between population pressure/growth and the variables of food security has been tested at one per cent and five per cent significance level. The inter-correlation matrix discloses the relationship between population pressure (Y_1) and other variables of food security. Here, population pressure Y_1 is significantly correlated with X_8 (milk availability in kg per head per annum), X_{10} (area under foodgrains) and X_8 (length of roads per lakh of population). Population pressure (Y_1) is negatively and significantly related with X_6 (persons per livestock) at one per cent level and with X_9 (percentage of net irrigated area to net sown area) and X_{13} (yield of foodgrains) at five per cent significance level.

In Eastern Uttar Pradesh, all the districts with high population pressure, i.e., (Sonbhadra, Allahabad and Mirzapur) are having low food availability. The districts which are having moderate population pressure are also having moderate food availability except four districts, among which three are having high food availability (i.e., Balrampur, Maharajganj and Siddhartnagar) and one (Faizabad) having low food availability. Most of the districts of low population pressure have moderate food availability, except one district (Sant Kabir Nagar) having low food availability. This shows that population pressure is inversely related with food availability in Eastern Uttar Pradesh. Regarding the relationship between population pressure and food stability in the study area, it can be concluded that they are

positively related with each other. The districts of low population pressure are associated with the districts of moderate food stability and districts of high population pressure give a mixed picture. Among three high population pressure districts (i.e., Allahabad, Mirzapur and Sonbhadra), first one has high, second one has moderate and third one has low food stability, respectively. The relation between population pressure and food accessibility shows a highly diversified picture. Though the districts of moderate population pressure are having moderate food accessibility, still some districts are having low and high food accessibility. The condition is also similar for high and low population pressure districts because some districts have low, some have moderate and some have high food accessibility. Regarding population pressure and food utilisation, it can be concluded that though having a mixed picture, they are inversely related to each other. More than 50 per cent districts of the study area are characterised by moderate population pressure and moderate food utilisation. Three districts, which are having high population pressure (i.e., Sonbhadra, Allahabad and Mirzapur) have low and moderate food utilisation, respectively. Among five districts of low population pressure, one district (Kaushambi) is having high, two (Mau and Sant Kabir Nagar) are having moderate and remaining two (Varanasi and Sant Ravidas Nagar) are having low food utilisation. The relationship between population pressure and food security reveals that most of the districts having moderate population pressure, also have

moderate food security. Among the three high population pressure districts, one is having low (Sonbhadra) and two (Allahabad and Mirzapur) are having high food security. The districts which are having low population pressure are associated with moderate and low food security.

Conclusion

The study concludes that during the early two decades of 19th century, the fluctuation of population in the study area was mainly due to famines, diseases and epidemics. Later, the effect of famines and diseases diminished and population starts increasing not because of increase in birth rate but because of decline in the death rate. During the later part of 19th century, the population of Eastern Uttar Pradesh increased, but the rate of growth of population declined due to increase in the investment of population control programmes, involvement of different NGOs, private sector organisations and multi-stakeholders in the distribution of contraceptive products and increase in the ranges of contraceptive products distributed by these organisations. After the year 2001, the growth rate of population has declined significantly, showing the success of Uttar Pradesh Population Policy and population control programmes initiated specially in rural areas. Still, more than 50 per cent of the districts have population growth rate over 25 per cent. So, further initiation is required to control the population up to replacement level fertility.

Green revolution is responsible for change in cropping pattern. The condition of food security is not very satisfactory because

only one district is highly food secure. About 81 per cent of the districts are having moderate food security and even a slight fluctuation in the variables of food availability, food stability, food accessibility and food utilisation, in a negative direction, would make these districts low food-secure regions. Advanced irrigational facilities and increased consumption of fertiliser are required for strengthening the availability of food. Stability in the availability of food should be given priority and this can be achieved through increasing storage capacity and maintaining buffer stocks at village level. Good transportation network should be developed so that farmers can have an easy access to the modern agricultural inputs and also can take agricultural produce to the market. There is a need for quality literacy because literacy will lead to employment and income, which further leads to better access to food. Population growth should be checked in order to lessen the dependency burden on working population.

Table 1: Decadal Growth and Growth Rate of Total Rural and Urban Population (in Lakh) in Eastern Uttar Pradesh

Year	Total Population	Rural Population	Urban Population	Year	Eastern Uttar Pradesh		
1901	185.69	172.15	13.54		Person	Rural	Urban
1911	183.64	172.52	11.13	1901-1911	-1.1	0.21	-17.79
1921	185.02	173.46	11.55	1911-1921	0.75	0.55	3.82
1931	197.63	184.3	13.24	1921-1931	6.82	6.25	15.36
1941	222.03	206.08	15.95	1931-1941	12.35	11.82	20.46
1951	248.28	228.75	19.53	1941-1951	11.83	11	22.51
1961	282.9	261.94	20.96	1951-1961	13.94	14.51	7.31
1971	331.71	304.36	27.35	1961-1971	17.25	16.19	30.47
1981	416.52	372	44.51	1971-1981	25.57	22.23	62.75
1991	527.21	466.26	60.96	1981-1991	26.58	25.34	36.94
2001	666.11	587.87	78.23	1991-2001	26.69	26.08	31.33
2011	798.88	701.49	97.39	2001-2011	19.93	19.33	24.49

Source: Census of India 1991, Series-25, Uttar Pradesh, General Population Tables, Part II-A
Census of India 2001, Series 10, Uttar Pradesh, Primary Census Abstract.

Table 2: District-wise Distribution of Food Availability, Food Stability, Food Accessibility and Food Utilisation by Indicators in Eastern Uttar Pradesh (2008)

| Districts | Food Availability | | | | | | Food Stability | | | |
	Calorie availability (per head per day)	Production of foodgrains (kg per head per annum)	Population per livestock	Production of meat (kg per head per annum)	Production of milk (kg per head per annum)	Percentage of net irrigated area to net cropped area	Area under foodgrains (in 1000 ha)	Fertiliser consumption (in kg/hectare)	Storage capacity per thousand population (in quintals)	Yield of foodgrains (kg/ha)
	1	2	3	4	5	6	7	8	9	10
Allahabad	1876	185.83	3.58	0.502	70.01	51.33	482.81	396.01	400.53	2056
Kaushambi	2523	224.38	2.53	0.736	0.00	60.44	159.15	231.32	48.99	1814
Pratapgarh	2094	207.72	2.98	0.614	67.21	65.41	288.25	223.96	154.56	2073
Varanasi	1036	91.17	8.08	1.724	48.69	55.10	143.87	217.02	332.50	2112
Chandauli	2990	307.02	4.28	0.336	78.69	60.02	234.21	202.27	231.51	2309
Ghazipur	2738	250.44	3.27	0.918	90.16	59.46	373.02	198.57	89.89	2166
Jaunpur	2506	221.20	3.77	0.549	82.86	58.81	416.89	178.81	30.47	2170
Mirzapur	1909	184.14	2.73	0.734	72.47	53.87	248.46	176.85	188.46	1669
Sonbhadra	906	87.18	1.81	0.114	84.07	24.21	145.28	168.06	93.35	975
SRN	1273	121.42	5.74	0.456	53.48	59.93	90.21	152.94	135.43	1936
Azamgarh	2869	243.57	3.57	0.575	93.52	60.14	475.80	151.25	194.14	2136
Mau	2186	193.47	4.10	0.824	79.45	68.90	185.65	144.19	155.93	2077
Ballia	2398	218.44	4.70	0.617	73.14	54.56	320.58	143.48	448.55	1972
Gorakhpur	2051	199.73	6.26	0.649	59.13	59.66	355.97	142.25	299.02	2222
Maharajganj	4348	344.85	4.14	0.786	64.64	50.57	325.53	140.72	145.12	2483
Deoria	2653	232.52	5.34	0.537	64.09	52.41	295.04	140.21	79.60	2247
Kushinagar	4611	204.79	5.26	0.530	61.70	76.06	245.35	132.60	31.31	2601
Basti	4390	228.41	4.44	0.447	88.96	66.46	239.95	127.98	203.83	2036
SN	3720	365.26	3.43	0.670	77.45	48.76	362.21	122.21	19.01	2133

(Contd.......)

Table 2 (Contd.....)

	1	2	3	4	5	6	7	8	9	10
SKN	2819	259.09	4.39	0.498	64.09	52.14	199.25	117.58	18.56	2098
Faizabad	2588	180.39	3.14	0.487	71.37	73.50	187.90	112.18	323.97	2294
AN	3603	312.23	3.78	0.623	74.59	63.03	252.97	108.70	26.26	2658
Sultanpur	2775	248.93	2.82	0.902	84.54	63.12	385.06	101.88	28.29	2206
Gonda	4586	242.60	2.94	0.592	101.83	68.77	350.36	93.22	261.05	2033
Balrampur	6352	290.14	3.10	0.000	0.00	37.47	231.92	86.54	18.40	2213
Behraich	3980	309.35	2.22	0.872	85.98	35.30	452.97	76.78	187.60	1889
Shrawasti	3148	297.29	2.91	0.000	0.00	32.16	176.41	66.55	8.08	1785

Table 2 (Continued)

Districts	Employ-ment rate	No. of persons per fair price shop	Literacy rate	Per capita income	Length of roads per lakh popula-tion	Urbani-sation	Drinking water (%)	Infant mortality rate	Maternal mortality rate	No. of beds in allopathic hospitals/ dispensa-ries per lakh of popu-lation (including PHC)	No.of MCH centres/ sub-centres per lakh of population	No.of PHC centres/ lakh of popula-tion
	1	2	3	4	5	6	7	8	9	10	11	12
Allahabad	17.73	2847	68.32	9920	97.90	24.03	61.44	88.00	442.00	36	9.13	1.49
Kaushambi	21.34	3266	59.22	15120	102.72	7.82	86.64	83.00	442.00	35	12.4	2.77
Pratapgarh	17.25	2713	66.14	18020	116.46	5.18	83.56	88.00	442.00	51	11.58	2.38
Varanasi	22.59	2714	72.69	13820	79.02	39.12	52.39	78.00	346.00	45	8.58	1.24
Chandauli	15.12	2501	66.02	11804	126.21	10.94	77.51	81.00	346.00	37	12.65	2.23
Ghazipur	18.54	2203	67.29	12978	117.50	7.83	80.76	82.00	346.00	33	11.11	2.01
Jaunpur	17.47	2244	68.54	11863	115.78	7.66	82.33	78.00	346.00	37	11.23	2.07
Mirzapur	18.76	2539	60.98	8011	128.13	13.42	73.37	83.00	308.00	42	10.71	1.98
Sonbhadra	19.75	2654	57.64	12601	139.79	21.17	70.84	62.00	308.00	31	9.18	1.89
SRN	16.61	2444	66.39	11244	78.67	12.76	76.29	80.00	308.00	28	9.93	1.79
Azamgarh	16.33	2296	65.44	10558	94.41	7.74	81.12	79.00	385.00	41	10.75	2.3
Mau	18.37	2077	70.62	11268	98.28	20.65	69.80	76.00	385.00	30	10.38	2.22
Ballia	13.98	2306	64.77	9437	77.33	9.71	80.09	72.00	385.00	43	11.82	2.67
Gorakhpur	14.01	2180	65.85	10496	82.57	20.01	71.06	61.00	354.00	37	10.38	2.02
Maharajganj	16.46	2882	54.86	14158	88.34	5.15	81.18	87.00	354.00	30	10.86	2.11
Deoria	13.06	2292	67.10	10550	89.14	9.91	79.71	75.00	354.00	48	11.66	2.37
Kushinagar	15.28	2726	53.10	10045	82.66	4.45	82.27	83.00	354.00	33	9.92	1.81
Basti	18.59	1988	52.00	10095	91.50	5.70	85.54	84.00	412.00	57	11.26	2.61

(Contd.......)

Food Accessibility   Food UtiliSation

Table 2 (Continued)

	1	2	3	4	5	6	7	8	9	10	11	12
SN	20.46	1947	51.19	12796	76.96	3.99	85.22	91.00	412.00	41	11.61	3.47
SKN	15.03	2390	53.51	11600	64.88	6.54	68.48	65.00	412.00	27	11.26	1.79
Faizabad	19.01	2775	59.02	10507	97.02	12.89	77.49	98.00	451.00	43	10.62	1.79
AN	5.61	2242	68.70	11957	105.52	9.00	79.46	72.00	451.00	27	9.87	0.38
Sultanpur	17.32	2688	63.98	14741	117.64	4.87	83.36	48.00	451.00	39	10.99	2.15
Gonda	22.23	2345	48.91	13880	75.96	7.14	81.37	72.00	434.00	35	10.58	1.88
Balrampur	26.49	2435	40.03	15039	89.22	7.88	81.33	93.00	434.00	30	11.16	1.93
Behraich	19.62	2635	39.19	12456	78.29	9.70	82.56	66.00	434.00	33	10.99	1.84
Shrawasti	23.78	2956	26.09	20431	87.16	1.85	72.28	103.00	434.00	27	9.69	1.82

Source: Calculation is based on unpublished data obtained from Directorate, Ministry of Agriculture, Dept. of Statistics and Economics, Lucknow, U.P. State Planning Institute and Directorate of Food Supply Department, Lucknow, UP.

Census of India, (Uttar Pradesh) of the 1991 and 2001; www.up.gov.nic.in; www.districtsofindia.com.

SRN – Sant Ravidas Nagar, SN – Siddhartnagar, SKN – Sant Kabir Nagar and AN - Ambedkarnagar.

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Table 3: District-wise Distribution of Food Availability, Food Stability, Food Accessibility and Food Utilisation (in Z-Scores) in Eastern Uttar Pradesh (2008)

Districts	Food Availability					Food Stability				
	Calorie Availability (per head per day)	Production of food grains (kg per head per annum)	Population per live-stock	Production of meat (kg per head per annum)	Production of milk (kg per head per annum)	Percentage of net irrigated area to net cropped area	Area under foodgrains (in 1000 ha)	Fertilizer consumption (in kg/hectare)	Storage capacity per thousand Population (in quintals)	Yield of food grains (kg/ha)
	1	2	3	4	5	6	7	8	9	10
Allahabad	-0.853	-0.667	-0.235	-0.309	0.136	-0.378	1.866	3.696	1.949	-0.100
Kaushambi	-0.326	-0.104	-1.007	0.405	0.000	0.363	-1.147	1.182	-0.829	-0.865
Pratapgarh	-0.675	-0.347	-0.676	0.034	0.031	0.768	0.054	1.070	0.005	-0.045
Varanasi	-1.538	-2.048	3.074	3.430	-0.659	-0.071	-1.290	0.964	1.411	0.078
Chandauli	0.055	1.102	0.279	-0.817	0.459	0.329	-0.449	0.739	0.613	0.701
Ghazipur	-0.151	0.276	-0.463	0.964	0.887	0.283	0.844	0.682	-0.505	0.249
Jaunpur	-0.340	-0.151	-0.096	-0.165	0.615	0.230	1.252	0.381	-0.975	0.260
Mirzapur	-0.826	-0.691	-0.860	0.399	0.228	-0.172	-0.316	0.351	0.273	-1.326
Sonbhadra	-1.644	-2.106	-1.537	-1.496	0.660	-2.585	-1.277	0.217	-0.478	-3.524
Sant Ravidas Nagar	-1.345	-1.607	1.353	-0.449	-0.481	0.321	-1.789	-0.014	-0.146	-0.478
Azamgarh	-0.044	0.176	-0.243	-0.087	1.012	0.339	1.800	-0.040	0.318	0.153
Mau	-0.601	-0.555	0.147	0.675	0.488	1.051	-0.901	-0.148	0.016	-0.034
Ballia	-0.428	-0.191	0.588	0.042	0.252	-0.116	0.355	-0.158	2.328	-0.367
Gorakhpur	-0.711	-0.464	1.735	0.141	-0.270	0.300	0.685	-0.177	1.147	0.426
Maharajganj	1.162	1.654	0.176	0.561	-0.065	-0.440	0.401	-0.201	-0.069	1.252
Deoria	-0.220	0.015	1.059	-0.203	-0.085	-0.290	0.118	-0.208	-0.587	0.504
Kushinagar	1.376	-0.390	1.000	-0.225	-0.174	1.634	-0.345	-0.324	-0.968	1.628
Basti	1.195	-0.046	0.397	-0.477	0.842	0.853	-0.395	-0.395	0.395	-0.164
Siddharthnagar	0.649	1.951	-0.346	0.206	0.413	-0.588	0.743	-0.483	-1.065	0.144

(Contd.......)

Table 3 (Contd.....)

	1	2	3	4	5	6	7	8	9	10
Sant Kabir Nagar	-0.085	0.402	0.360	-0.323	-0.085	-0.313	-0.774	-0.554	-1.069	0.033
Faizabad	-0.273	-0.746	-0.559	-0.356	0.187	1.426	-0.880	-0.636	1.344	0.655
Ambedkarnagar	0.554	1.178	-0.088	0.061	0.307	0.573	-0.274	-0.689	-1.008	1.809
Sultanpur	-0.121	0.254	-0.794	0.914	0.678	0.581	0.956	-0.793	-0.992	0.375
Gonda	1.355	0.161	-0.706	-0.033	1.322	1.041	0.633	-0.926	0.847	-0.172
Balrampur	2.794	0.855	-0.588	0.000	0.000	-1.506	-0.470	-1.027	-1.070	0.399
Behraich	0.862	1.136	-1.235	0.824	0.731	-1.682	1.588	-1.176	0.266	-0.630
Shrawasti	0.183	0.960	-0.728	0.000	0.000	-1.938	-0.987	-1.333	-1.152	-0.958

Table 3 (Continued)

Districts	Food Accessibility						Food Utilisation					
	Employment rate	No. of persons per fair price shop	Literacy rate	Per capita income	Length of roads per lakh population	Urbanisation	Drinking water (%)	Infant mortality rate	Maternal mortality rate	No. of beds in allopathic hospitals/dispensaries per lakh of population (including PHC)	No. of MCH centres/sub-centres per lakh of population	No. of PHC centres/lakh of population
	1	2	3	4	5	6	7	8	9	10	11	12
Allahabad	-0.019	1.124	0.829	-0.933	0.087	1.633	-2.027	0.770	1.068	-0.119	-1.670	-1.000
Kaushambi	0.888	2.452	0.004	1.006	0.341	-0.398	1.191	0.351	1.068	-0.231	1.701	1.327
Pratapgarh	-0.142	0.700	0.632	2.088	1.066	-0.730	0.798	0.770	1.068	1.848	0.856	0.618
Varanasi	1.201	0.703	1.226	0.521	-0.910	3.523	-3.183	-0.068	-0.904	1.051	-2.237	-1.455
Chandauli	-0.677	0.030	0.621	-0.230	1.580	-0.007	0.026	0.184	-0.904	-0.005	1.959	0.345
Ghazipur	0.182	-0.915	0.736	0.207	1.121	-0.397	0.441	0.267	-0.904	-0.500	0.371	-0.055
Jaunpur	-0.086	-0.787	0.850	-0.209	1.030	-0.418	0.641	-0.068	-0.904	0.063	0.495	0.055
Mirzapur	0.238	0.148	0.164	-1.645	1.682	0.303	-0.503	0.351	-1.684	0.624	-0.041	-0.109
Sonbhadra	0.486	0.512	-0.139	0.067	2.297	1.274	-0.826	-1.409	-1.684	-0.736	-1.619	-0.273
Sant Ravidas NAgar	-0.301	-0.152	0.655	-0.439	-0.928	0.221	-0.130	0.100	-1.684	-1.101	-0.845	-0.455
Azamgarh	-0.371	-0.622	0.569	-0.695	-0.098	-0.409	0.487	0.016	-0.103	0.491	0.000	0.473
Mau	0.140	-1.313	1.038	-0.431	0.107	1.209	-0.959	-0.236	-0.103	-0.881	-0.381	0.327
Ballia	-0.962	-0.588	0.507	-1.113	-0.999	-0.162	0.355	-0.571	-0.103	0.830	1.103	1.145
Gorakhpur	-0.955	-0.988	0.606	-0.718	-0.722	1.129	-0.799	-1.493	-0.739	0.001	-0.381	-0.036
Maharajganj	-0.340	1.236	-0.391	0.647	-0.418	-0.733	0.494	0.687	-0.739	-0.959	0.113	0.127
Deoria	-1.192	-0.635	0.719	-0.698	-0.376	-0.137	0.307	-0.319	-0.739	1.447	0.938	0.600
Kushinagar	-0.637	0.743	-0.550	-0.886	-0.718	-0.821	0.634	0.351	-0.739	-0.528	-0.856	-0.418
Basti	0.195	-1.598	-0.650	-0.868	-0.251	-0.664	1.051	0.435	0.452	2.655	0.526	1.036

Table 3 (Contd.....)

	1	2	3	4	5	6	7	8	9	10	11	12
Siddharthnagar	0.666	-1.725	-0.724	0.140	-1.018	-0.879	1.010	1.022	0.452	0.483	0.887	2.600
Sant Kabir Nagar	-0.699	-0.323	-0.513	-0.307	-1.656	-0.559	-1.128	-1.158	0.452	-1.275	0.526	-0.455
Faizabad	0.302	0.896	-0.014	-0.714	0.040	0.237	0.024	1.609	1.253	0.771	-0.134	-0.455
Ambedkarnagar	-3.064	-0.791	0.864	-0.173	0.489	-0.250	0.275	-0.571	1.253	-1.268	-0.907	-3.018
Sultanpur	-0.124	0.619	0.436	0.865	1.128	-0.768	0.773	-2.583	1.253	0.255	0.247	0.200
Gonda	1.110	-0.466	-0.930	0.544	-1.071	-0.483	0.519	-0.571	0.904	-0.218	-0.175	-0.291
Balrampur	2.181	-0.180	-1.735	0.976	-0.371	-0.391	0.513	1.189	0.904	-0.894	0.423	-0.200
Behraich	0.455	0.453	-1.811	0.013	-0.948	-0.164	0.671	-1.074	0.904	-0.501	0.247	-0.364
Shrawasti	1.500	1.470	-2.999	2.987	-0.480	-1.147	-0.643	2.028	0.904	-1.311	-1.093	-0.400

**Table 4: District-wise Distribution of Food Availability, Food Stability, Food Accessibility,
Food Utilisation and Food Security (In Composite Z-Scores)
in Eastern Uttar Pradesh (2008)**

Districts	Food availability	Food stability	Food accessibility	Food utiliSation	Food security
Allahabad	-0.386	1.406	0.454	-0.496	0.244
Kaushambi	-0.258	-0.259	0.716	0.901	0.275
Pratapgarh	-0.327	0.370	0.602	0.993	0.410
Varanasi	0.452	0.218	1.044	-1.133	0.145
Chandauli	0.216	0.387	0.219	0.267	0.272
Ghazipur	0.303	0.311	0.156	-0.063	0.177
Jaunpur	-0.027	0.230	0.063	0.047	0.078
Mirzapur	-0.350	-0.238	0.148	-0.227	-0.167
Sonbhadra	-1.225	-1.529	0.750	-1.091	-0.774
Sant Ravidas Nagar	-0.506	-0.421	-0.158	-0.686	-0.443
Azamgarh	0.163	0.514	-0.271	0.227	0.158
Mau	0.031	-0.003	0.125	-0.372	-0.055
Ballia	0.053	0.408	-0.553	0.460	0.092
Gorakhpur	0.086	0.476	-0.275	-0.575	-0.072
Maharajganj	0.698	0.189	0.0004	-0.046	0.210
Deoria	0.113	-0.093	-0.387	0.372	0.001
Kushinagar	0.317	0.325	-0.478	-0.259	-0.024
Basti	0.382	0.059	-0.639	1.026	0.207
Siddhartnagar	0.575	-0.250	-0.590	1.076	0.203
Sant Kabir Nagar	0.054	-0.535	-0.676	-0.506	-0.416
Faizabad	-0.349	0.382	0.125	0.511	0.167
Ambedkarnagar	0.402	0.082	-0.488	-0.706	-0.177
Sultanpur	0.186	0.025	0.359	0.024	0.149
Gonda	0.420	0.284	-0.216	0.028	0.129
Balrampur	1.020	-0.735	0.080	0.323	0.172
Behraich	0.463	-0.327	-0.334	-0.019	-0.054
Shrawasti	0.138	-1.273	0.222	-0.086	-0.250

Source: Calculation based on Table 2.

## Table: 5 Correlation Matrix between the Variables of Food Security

	Y_1	Y_2	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}
Y_1	1																										
Y_2	0.2	1																									
X_1	-0.06	-0.059	1																								
X_2	-0.107	-0.155	.697**	1																							
X_3	0.348	-0.211	0.153	0.111	1																						
X_4	-0.136	-0.139	.689**	.997**	0.03	1																					
X_5	0.18	0.031	.664**	0.288	.515**	0.248	1																				
X_6	-.557**	-0.035	-0.223	-0.316	-.648**	-0.265	-0.322	1																			
X_7	-0.288	-0.047	-0.11	-0.07	-0.046	-0.067	-0.131	.409*	1																		
X_8	.498**	0.102	0.256	0.266	0.169	0.254	-0.035	-.607**	-0.247	1																	
X_9	-.395*	0.114	0.022	-0.112	-.569**	-0.066	-.411*	0.308	0.093	0.054	1																
X_{10}	.531**	0.149	0.211	.398*	-0.052	.405*	-0.078	-0.222	0.035	.502**	0.017	1															
X_{11}	0.223	0.034	-.505**	-.385*	-0.023	-.386*	-.382*	0.112	0.052	-0.176	0.1	0.16	1														
X_{12}	0.104	0.254	-0.317	-0.369	-0.173	-0.357	-0.335	0.307	0.145	-0.018	0.192	0.179	.396*	1													
X_{13}	-.458*	0.082	.462*	.461*	-.557**	.510**	-0.038	.401*	0.208	-0.171	.595**	0.24	-0.112	-0.054	1												
X_{14}	0.12	-0.24	0.176	-0.099	.527**	-0.143	.441*	-0.258	0.231	0.066	-0.36	-0.151	-0.046	-0.039	-.445*	1											
X_{15}	0.081	-0.075	-0.136	-0.152	.439*	-0.189	0.045	-0.221	0.11	-0.362	-0.182	-0.222	0.274	0.009	-0.179	0.285	1										
X_{16}	-0.067	0.245	-.609**	-.450*	-.496**	-.412*	-.615**	.417*	0.175	-0.105	.499**	0.068	.565**	0.328	0.195	-.531**	-0.217	1									
X_{17}	-0.073	-.515**	0.161	0.264	0.351	0.237	0.163	-0.279	0.196	-0.076	-0.314	-0.167	-0.179	-.408*	-0.103	.459*	.433*	-.461*	1								
X_{18}	.509*	-0.007	-0.325	-0.193	0.296	-0.219	-0.106	-.464*	-0.228	0.308	-0.058	-0.014	0.325	-0.144	-0.316	-0.065	0.142	0.328	0.031	1							
X_{19}	0.042	0.246	-.598**	-.681**	-0.161	-.672**	-0.221	.486*	.427*	-0.336	-0.08	-0.203	.478*	.544**	-0.235	0.089	0.063	.481*	-0.264	0.046	1						
X_{20}	0.033	-0.116	.498*	.522**	0.151	.513**	0.099	-.459*	-0.352	.457*	0.236	0.264	-0.377	-.381	0.197	-0.137	-0.141	-0.216	0.085	0.099	.841**	1					
X_{21}	-0.265	-0.366	0.243	0.182	0.072	0.177	0.179	-0.077	-0.066	-0.217	0	-0.193	0.138	-0.003	0.133	.381*	0.213	-0.317	0.246	-0.08	-0.171	0.03	1				
X_{22}	-0.042	-0.066	.417*	.428*	0.238	.411*	0.239	-.398*	0.028	0.199	0.104	0.219	-0.143	-0.047	0.241	0.121	0.192	-0.353	.403*	-0.238	-0.326	0.235	0.139	1			
X_{23}	0.062	-0.047	-0.126	-0.201	-0.163	-0.189	-0.234	0.185	0.108	0.103	0.32	0.157	0.198	.394*	0	0.003	-0.201	0.277	-0.206	0.092	0.071	0.169	0.077	0.037	1		
X_{24}	-0.184	-0.05	0.303	.521**	0.192	.508**	0.053	-0.253	-0.228	0.244	0.176	0.164	-0.13	-0.158	0.171	-0.086	-0.162	-0.025	0.006	0.077	-.595**	.685**	0.021	0.156	0.276	1	
X_{25}	-0.006	-0.247	0.086	0.223	0.116	0.215	-0.035	-0.171	-0.162	0.202	0.008	0.147	-0.029	-0.048	-0.198	0.279	-0.19	-0.11	0.017	-0.043	-0.37	.499**	0.128	-0.03	.426*	.664**	1

**. Correlation is significant at the 1% level. *. Correlation is significant at the 5% level. Y_1 - Population pressure, Y_2 - Population growth, X_1 – Calorie availability/head/day, X_2 – Foodgrains availability kg/head/annum, X_3 – Pulses availability kg/head/day, X_4 – Cereals availability kg/head/day, X_5 – Oilseeds availability kg/head/annum, X_6 – Livestock availability (population per livestock), X_7 – Meat availability kg/head/annum, X_8 – Milk availability kg/head/annum, X_9 – Percentage of net irrigated area to net cropped area, X_{10} – Area under foodgrains (in '000' hectares), X_{11} – Fertiliser consumption (kg/hectare), X_{12} – Storage capacity (per thousand population in quintals), X_{13} – Yield of foodgrains (kg/hectares), X_{14} – Employment rate, X_{15} – Number of persons per fair price shop, X_{16} – Literacy rate, X_{17} – Per capita income, X_{18} – Roads per lakh population, X_{19} – Urbanisation, X_{20} – Drinking water facilities, X_{21} – Infant mortality rate, X_{22} – Maternal mortality rate, X_{23} – Number of beds in allopathic hospitals per lakh oopulation, X_{24} – Number of MCH centres and Sub-centres per lakh population, X_{25} – Number of PHCs per lakh population.
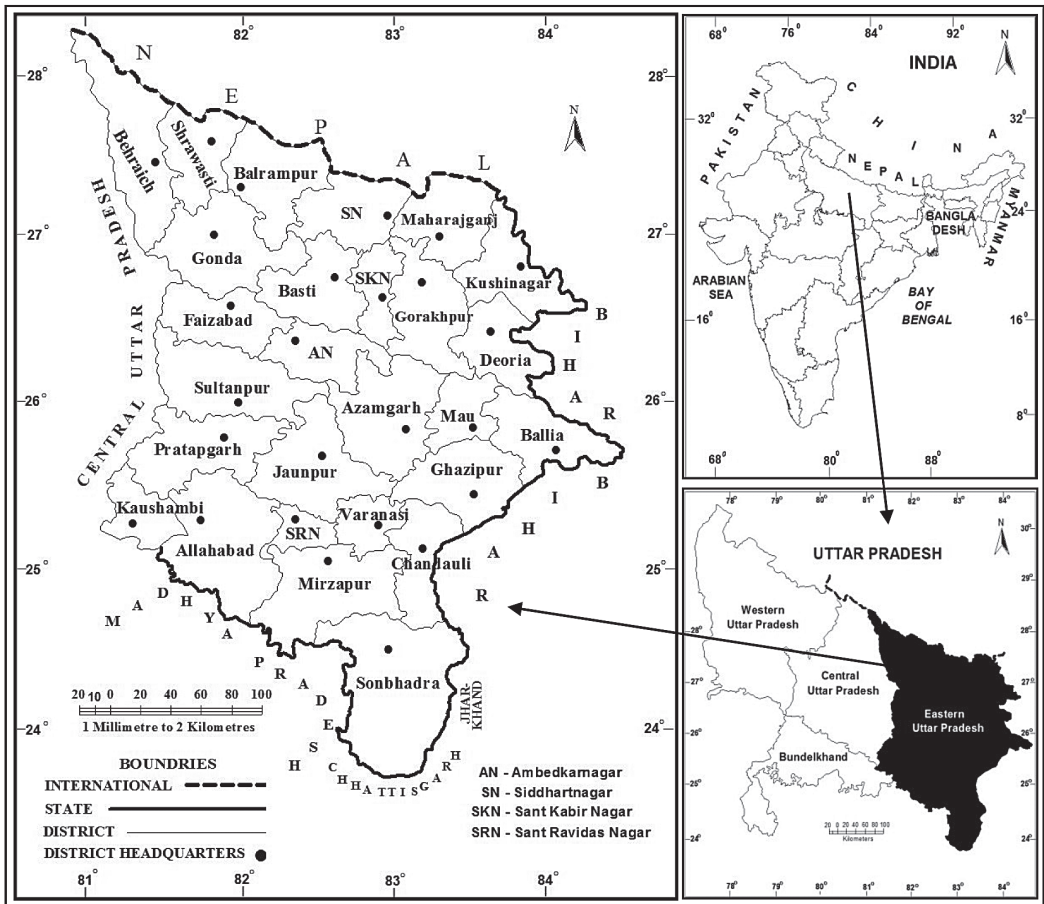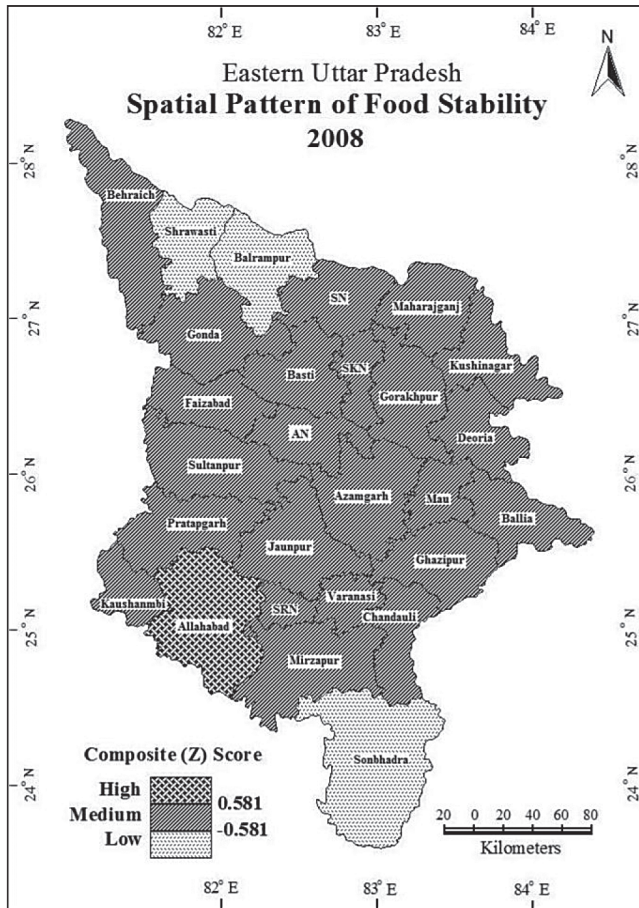
Figure 1: Map of Eastern Uttar Pradesh, the study area

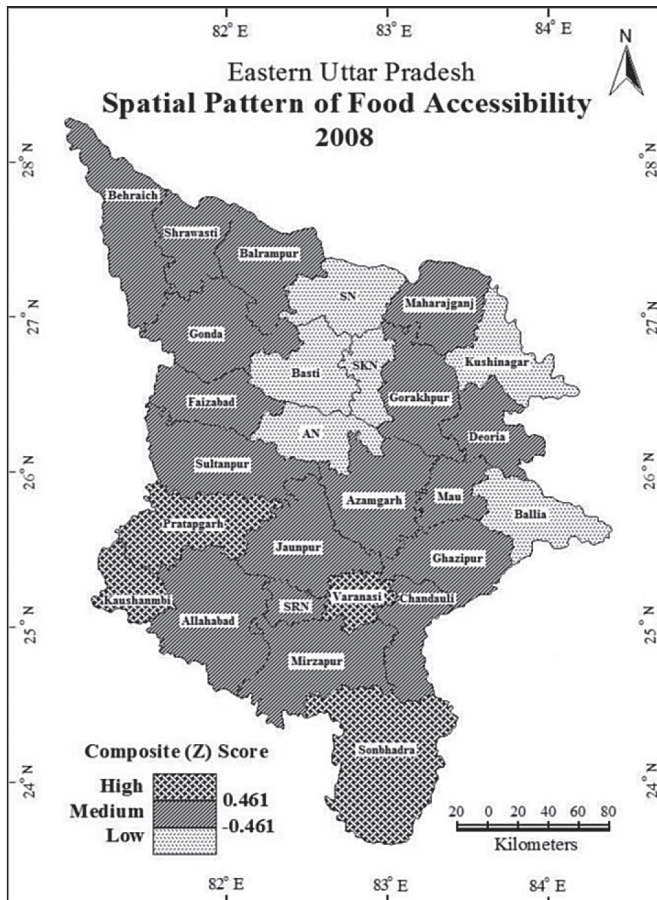Source: National Atlas and Thematic Mapping Organisation, Kolkata (2008).
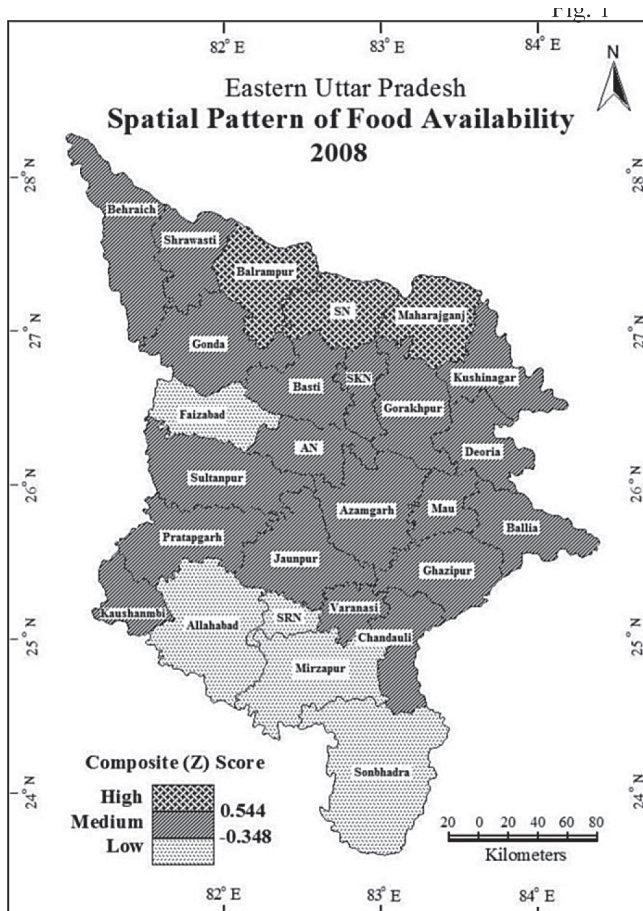
Figure 2: Spatial Pattern of Food Availability Regions
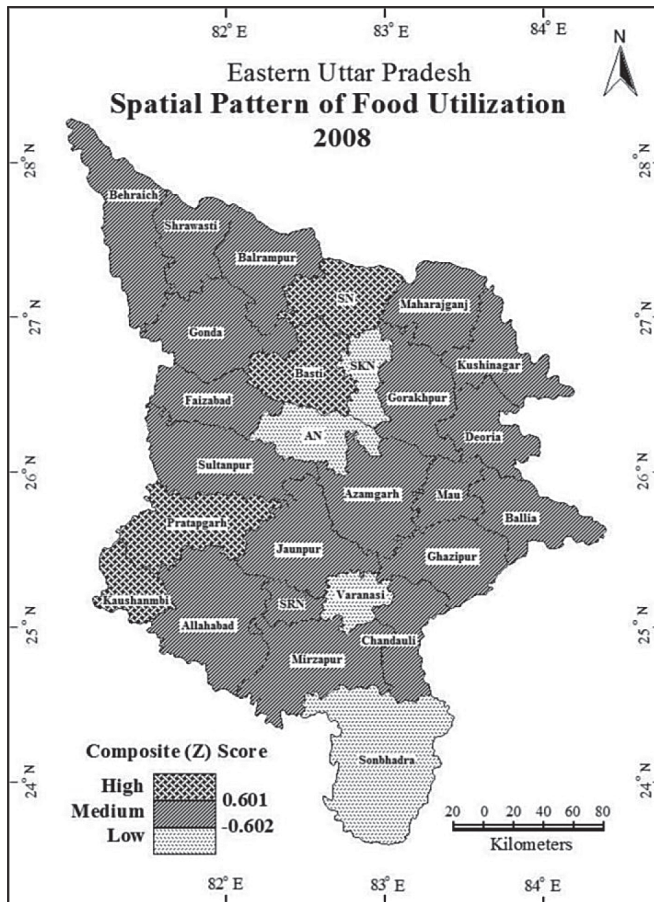
Source: Prepared by author.

Figure 3: Spatial Pattern of Food Stability Regions
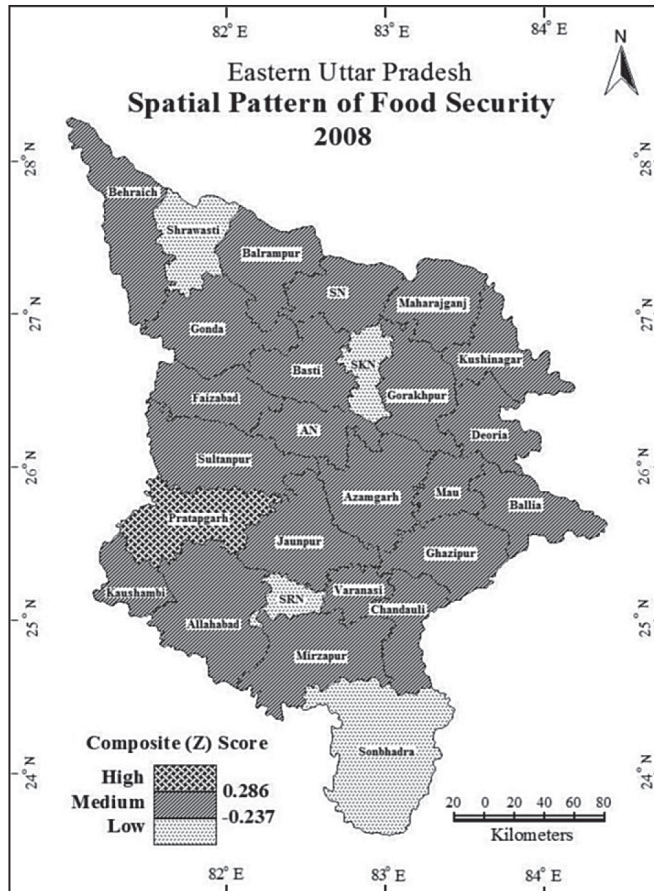
Source: Prepared by author.

Figure 4: Spatial Pattern of Food Accessibility Regions
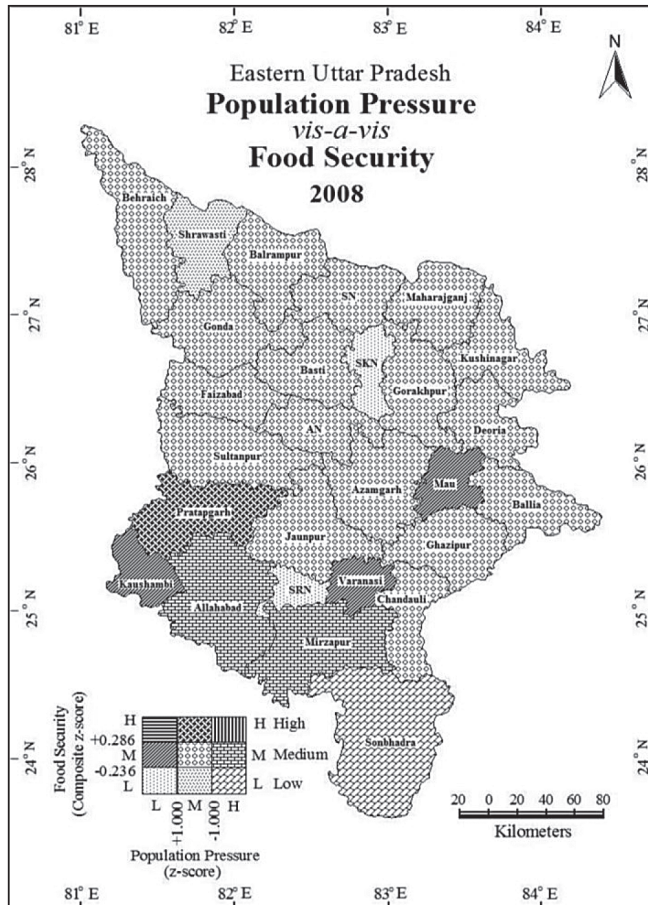
Source: Prepared by author.

Figure 5: Spatial Pattern of Food Utilisation Regions

Source: Prepared by author.
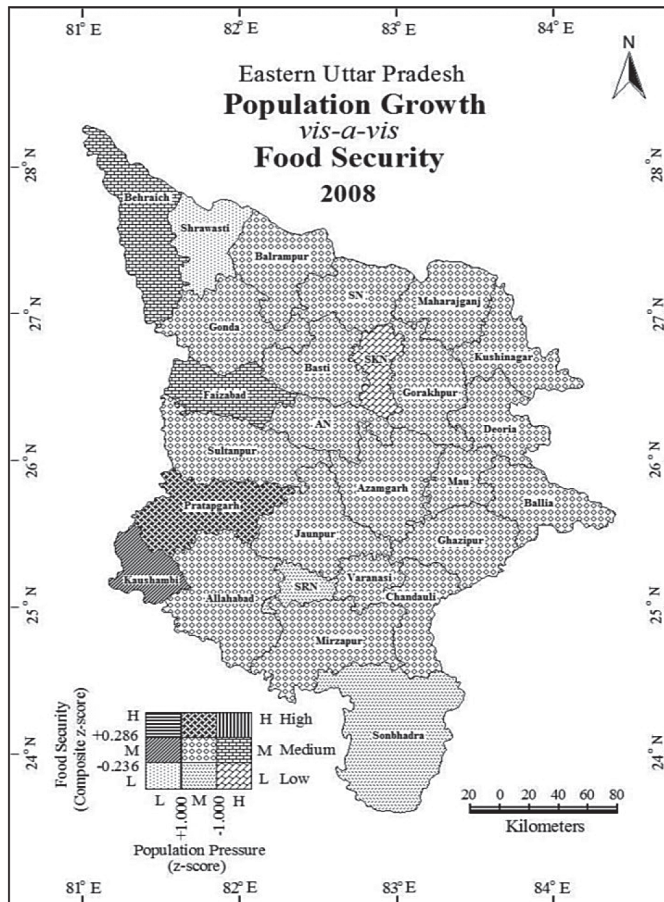
Figure 6: Spatial Pattern of Food Security Regions

Source: Prepared by author.

Figure 7: Population Pressure and Food Security Regions

Source: Prepared by author.

Figure 8: Population Growth and Food Security Regions

Source: Prepared by author.

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