

Spatial Patterns of Food Security in Haryana: A District-level Analysis

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Abstract

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In today's era the issue of food security is gaining much more attention as food is one of the three basic requirements of man and is still a serious issue for many poor people. Ensuring food security is a big challenge due to increase in population, climate change etc. especially in developing Asian countries like India. The present study is significant in a way that it examines the variations in spatial patterns of food security at district level in one of the food bowl states of India namely Haryana. This study also tries to identify the factors behind the spatial variations in food security. Despite being self-sufficient in foodgrains production, the state has vast regional contrasts in terms of land productivity, farm labour and standard of living. At present, food grains production is almost stagnant in the state and natural resources are also experiencing degradation due to their extensive use. For this study, secondary data have been collected from various state government offices. Further food availability, food accessibility and food utilization indices have been calculated by using different indicators. The results of the study reveal that the districts situated in central and north-west part of the state having better agricultural infrastructure are more food secure than the districts situated in southern and northern parts of the state which have the disadvantageous state which have sandy soil, poor irrigation facilities and undulating topography.

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1. Introduction

The concept of food security emerged in 1970s due to global food crisis (1972-74) which reduced global supplies and threatened the food security status of food importing nations. This term food security was first used in World Food Conference held in Rome in 1974. At that time food security was defined as the 'availability at all times of adequate supply of basic foodstuffs' (UN, 1975). This concept has undergone sufficient change since 1970s.

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In 1980's, a new dimension of accessibility was added in its concept after Amartya Sen's (1981) theory of food entitlement. As per this theory, people are usually starved mainly because of lack of the ability to access food rather than because of its availability. Therefore, FAO in 1983 defined food security as "ensuring that all people at all times have both physical and economic access to the basic food they need". During 1990s a third dimension – food utilization - also became prominent in food security discussions. This dimension is determined primarily

by people's health status. In 2001 FAO refined the definition of food security and said, "Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". To date this is the clearest and most widely accepted definition of food security. The concept of food security therefore, encompasses three main dimensions- availability, accessibility, and utilization. The interaction between these three explains the level of food security of any region/area.

This study is divided into five sections. Section I. is Introduction which explains the concept of food security and also discusses some important food security studies of India. Section II. gives a brief description of the study area. Section III. describes the objectives of the paper and also discusses the data sources and methodology used in this study. Section IV. includes the result and discussion part and last section V. includes concluding observations and further recommendations.

In today's era the issue of food security is gaining much more attention as food is one of the three basic requirements of man and is still a serious issue for many poor people. Achieving food security is a challenging task due to ever increasing population, climate change etc. especially in developing Asian countries like India. India is an agriculture based economy and food production has increased tremendously after the Green Revolution of the 1960's. Its production has increased from 74.23 million tonnes in 1966-67 to 254.44 million tonnes in 2011-12. Despite this India is facing the problem of food insecurity. India has 25 per cent of the world's hungry population and 43 per cent children under the age of five years are malnourished (FAO, 2012). India is ranked 63 among 78 countries in the Global Hunger Index 2013. It has been rated worse than Pakistan (57), Nepal (49), and Sri Lanka (43) in South Asia (Jitendra, 2013).

Many scholars such as Minhas (1976), Suryanarayana (1996, 2008), Mohammad (2001), Swaminathan (2002), Chakravarty and Dand (2005), Golait and Pradhan (2006), Sidhu et al. (2006) and Goel (2011) have studied food security, poverty and

hunger situations in Indian context. Minhas (1976) defined national food security as a means which will enable India to come out of food imports thus reducing her vulnerability in the balance of payments which is considered to be inconsistent with a stable and self-reliant pattern of development. Suryanarayana (1996) examined the temporal changes in calorie intake in different population groups of the country during 1990s.

Mohammad (2001) studied regional pattern of food security in India at district level using demand and supply indicators (total population and agricultural production in terms of kilocalories and monetary value) and explained that in spite of fourfold increase in food grain production, around half of the world's poor live in India and don't have clear access to food. He emphasized that future food programmes should be targeted not only to increase food production but also to enhance access to food through participatory approach of people. The M. S. Swaminathan Research Foundation (MSSRF) and the World Food Programme (WFP) in their atlases also analyzed that India is a food surplus country, maintaining a sufficient buffer stock and exporting food commodities. Yet, India has the largest absolute numbers of undernourished people in the world. This is the so called 'Paradox of South Asia' where high levels of child and maternal malnutrition, as well as micronutrient deficiencies co-exist with high levels of food supply.

Chakravarty and Dand (2005) tried to explore causes of the widespread food insecurity in India and observed that the problem is not of general systemic failure that arises due to a supply shortage but main reasons of food insecurity are the shrinking of agrarian and informal sector incomes and failures of support led measures to combat poverty i.e break down of targeted Public Distribution System in most regions of the country. Sidhu et al. (2006) in their study revealed that the food and nutritional insecurity prevails even in the food-surplus areas, with low-income households being more vulnerable to it. Goel (2011) examined that farmers of Punjab state are facing several environmental problems particularly that of water depletion due to following same cropping pattern i.e. rice-wheat. This has endangered

farmers' own food security, which may create a threat to food security situation of the country. The present study is also conducted in the context of one of the food bowl states of India i.e. Haryana. The study explains the regional variations in food security patterns and the reasons behind these.

Study Area

The present study determines the spatial pattern of food security in Haryana. It is a landlocked state in northern India and is located between 27°37' to 30°35' N latitude and between 74°28' and 77°36' E longitude.

The altitude of Haryana varies between 200 metres to 1200 metres above sea level. It stretches over 44,212 sq. kms, covering 1.34 percent of total geographical area of the country and it is the 20th largest state among 29 states of the country in terms of area. Himachal Pradesh lies in its North, Punjab in Northwest and Rajasthan in its South side. Yamuna River along with Uttarakhand and Uttar Pradesh demarcates its eastern boundary. The state has four geographical regions; largest area is covered under Yamuna-Gaggar plain. In the North East lies the Shivalik Hills region, in the South the Aravalli Range and to the South East a semi-desert sandy plain. Administratively, the state is organized into twenty one districts (Fig.1).

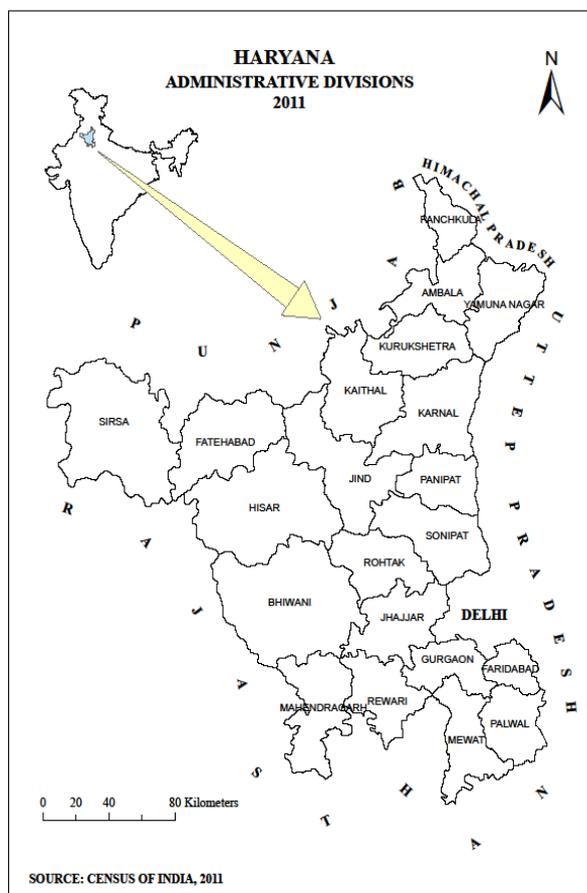


Fig. 1 Study Area Map (Haryana)

According to 2011 census the total population of Haryana is about 2.54 crore and it is the 17th most populated state in India. The state has agriculture based economy. Agriculture sector contributes about 14.5 percent to its Gross Domestic Product (GDP).

Nearly 80 percent of the total geographical area of the state is under cultivation of which about 84 percent is irrigated (through tube wells and an extensive system of canals) with cropping intensity of 184 percent. Wheat and rice are the dominant crops of the state. Two-third population is engaged in agriculture and allied activities. The state is self-sufficient in foodgrains production and it is one of the food bowl states of India. It is second largest contributor to India's central pool of foodgrains after Punjab. After the implementation of Green Revolution technology the foodgrains production has increased tremendously i.e. from 2.59 million tonnes

in 1966-67 to 18.34 million tons in 2011- 12 (Fig. 2) (Statistical Abstract of Haryana, 2012).

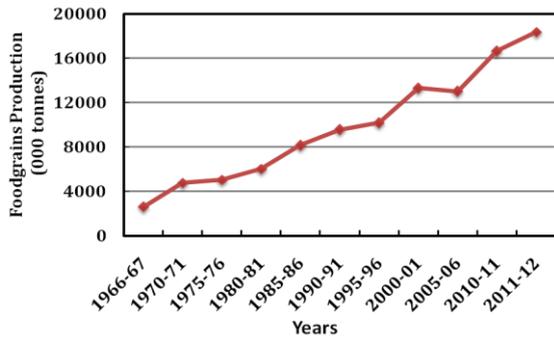


Fig. 2. Foodgrains Production in Haryana (1966-2012)

Despite its impressive economic performance, the state has performed poorly in terms of reduction of hunger. These days there is a huge concern about the food security situation in different regions of the state. Therefore, a study in a surplus state is very important to show how the state is performing in terms of food security. Hence, the main objectives of conducting this study were to:

1. To examine the spatial patterns of food security in Haryana on the basis of food availability, food accessibility and food utilization components.
2. To identify the factors behind the spatial variations in food security patterns in the region.
3. To suggest measures for improving food security level in the food deficit areas.

2. Data Sources and Methodology

To achieve the above said objectives, secondary data have been collected for foodgrains production, per capita income, main work forces, urbanization level, potable drinking water and primary health centers, from various departments of Haryana such as Directorate of Agriculture, Department of Economic and Statistical Analysis, and Directorate of Census Operations, in Haryana respectively. Foodgrains surplus and deficit districts were computed by using the following formula:

$$\text{Food Availability (per head per day)} = \frac{\text{(total food grains production)}}{\text{(total population} \times 365)}$$

Further in this study food availability, food accessibility and food utilization indices have been calculated by respectively using per capita availability of food grains production; per capita income, availability of fair price shops, urbanization level, main work force indicators; potable drinking water and primary health centers indicators. By averaging these three indices the overall food security index has been computed. For each variable, an index (food accessibility, Food utilization) has been constructed by using the Max-Min approach, which is then calculated by applying the following general Range Equalization Method (REM) as adopted by the UNDP:

$$\text{Variable Index} = \frac{(Xi - \text{Min } X)}{(\text{Max } X - \text{Min } X)}$$

Here, Xi - Value of the variable
 Min X- Minimum value of X in the scaling
 Max X- Maximum value of X in the scaling

3. Results and Discussion

Food security as mentioned before has three main dimensions - access to food, availability of food, and utilization of food. The interactions and combinations of these dimensions represent food security (FAO). The detailed description of these dimensions of food security in Haryana is given below.

Food Availability

It refers to the availability of sufficient quantities of food of appropriate qualities, supplied for all people at all times through domestic production or imports (including food aid). In 1970s when the concept of food security emerged, this dimension was given much importance. Food availability generally includes the per capita availability of food grains and dairy products provided by livestock. In Haryana, per capita availability of food grains has increased from 1302 grams in 1971 to 1882 grams in 2011. Per capita availability of milk has also increased from 352 grams in 1971 to 680 grams in 2011. For this study,

per capita availability of food grains is considered an important indicator for food availability.

Spatial Pattern of Food Availability

Agricultural production is not uniform over the whole state due to which per capita availability of food grains also varies from 258 grams in Faridabad district to 3881 grams in Fatehabad district. Out of 21 districts only 8 districts have food grains availability higher than the state average (1982g). The spatial pattern of food availability in the state is explained by dividing the state into three categories i.e. areas of high food availability, areas of medium and of low food availability (Fig.3).

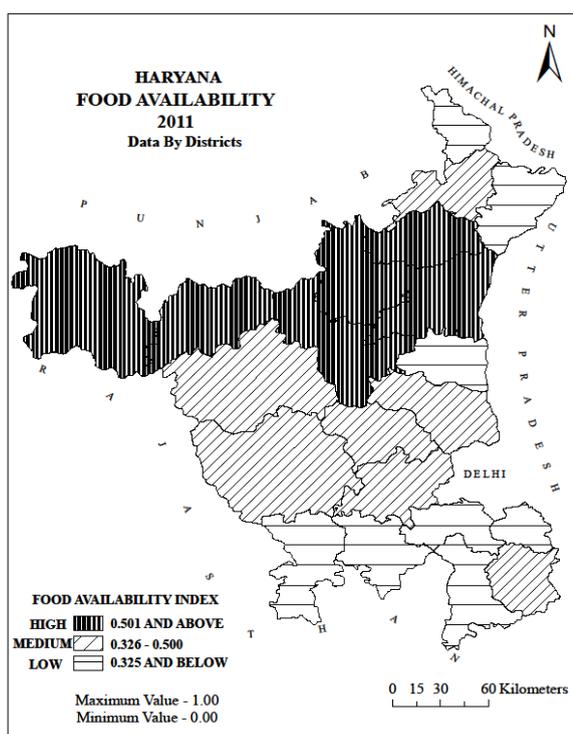


Fig. 3 Food Availability Pattern

Areas of high food availability, with index value above 0.5 fall over districts adjacent with Punjab state. These are surplus in food grains production due to availability of irrigation facilities, fertile plain and large size land holdings. These districts are Fatehabad, Sirsa, Kaithal, Jind, Kurukshetra and Karnal. Green Revolution technology was first implemented in this part of the state. Farmers in these areas are using high yielding

seed varieties, chemical fertilizers and pesticides in their farms. Therefore, these districts are leading in terms of per capita availability of food grains in the state.

Availability of food grains is moderate (index value between 0.326 and 0.5) in areas situated in central and western part of the state. These cover districts of Hisar, Bhiwani, Jhajjar, Sonapat, Rohtak and Ambala. During the early years of Green Revolution, some part of these districts performed better in terms of food grains production but lately these districts are facing the problem of resources depletion mainly declining underground water table and soil salinity/alkalinity. This caused the agricultural production to decline in this area, resulting into lower availability of food grains.

Areas of low food availability (index value below 0.325) are found located in extreme north-east and south Haryana. These areas are having undulating topography due to presence of Shivalik hills in north and Aravalli hills in south. The slope gradient is also steep which creates the problem of soil erosion in these parts. South and south-west areas experience arid climatic conditions because of its closeness to dry Rajasthan state. Also, there are poor irrigation facilities and soil is also not as fertile as in other parts of the state.

Food Accessibility

It refers to physical and economic access by individuals to adequate resources (entitlements) to acquire appropriate foods for a nutritious diet at all times. Food access is also a function of the physical environment, social environment and policy environment that determine how effectively households are able to utilize their resources to meet their food security objectives (USAID 1999). Accessibility is mainly used in economic terms and generally determined by the purchasing power of any household and its income level. It requires that individuals have enough resources to obtain or produce food. After Sen's entitlement theory, this dimension was included in the food security concept. Studies by many scholars such as Noor Mohammad (2001), Chakravarty and Dand (2005), Sidhu et al. (2006) also showed that it's not food availability but

access to food which is more important for food security within a region. In 1994, the World Bank in its study also observed that "it is common to have 20 to 30 percent of a country's population consuming less than 80 percent of caloric requirements even though national level food availability is at or greater than 100 percent".

There are so many indicators for calculating the food accessibility. In this study, indicators such as per capita income, fair price shops for Public Distribution System, employment (% of main workers) and urbanization level had been used for determining the accessibility of food. It is generally considered that urban people have higher access to food than the rural people. Food accessibility is also directly associated with employment and per capita income, where the higher the per capita income or the higher the employment ratio, the higher will be the food accessibility. Regarding the importance of fair price shop George (1979) in his study on Kerala concluded that the Public Distribution System has positively contributed to the reduction of food problem. Similarly, Parsuraman and Rajarentnam (2011) said that Public Distribution System which includes fair price shops directly contributes to food security of poor families and he recommended that it should be extended to families above the poverty line also.

Spatial Pattern of Food Accessibility

Depending upon employment structure, urbanization level, availability of fair price shops and per capita income of people food accessibility is not uniform in Haryana. It varies from region to region, family to family and person to person. In terms of per capita income Gurgaon district scored first rank followed by Faridabad, Panipat and Panchkula. Fair price shops are more available in Hisar, Bhiwani, Faridabad and Sirsa whereas these are poorly available in Rohtak, Rewari and Mewat. Employment structure and urbanization pattern go side by side. In highly urbanized districts such as in Gurgaon and Faridabad, employment rates are high. In developed districts of Sirsa, Fatehabad, and Hisar, the employment rates are also sufficiently high. In the light of above mentioned indicators the food

accessibility pattern is categorized into three parts i.e. areas of high food accessibility, areas of medium accessibility and areas of low food accessibility (Fig. 4).

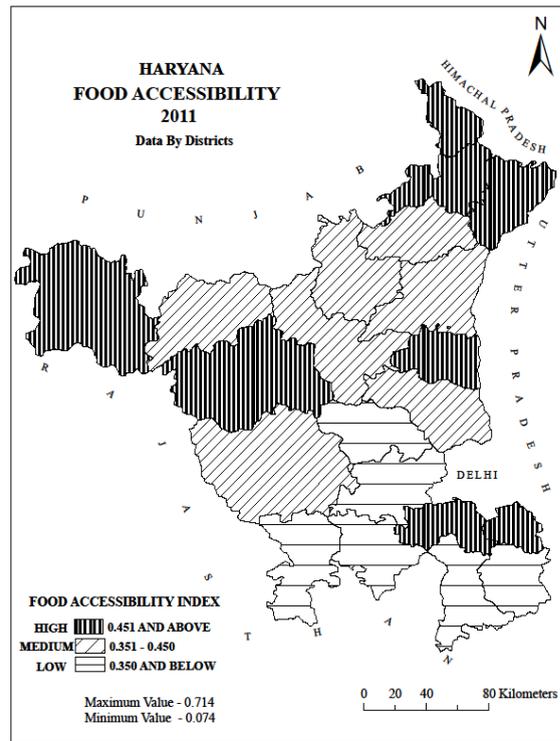


Fig. 4 Food Accessibility Pattern

Areas having index value of more than 0.714 have high food accessibility in the state. Eight districts out of twenty one come under this category. These are Gurgaon, Faridabad, Hisar, Panipat, Sirsa, Yamunanagar, Panchkula and Ambala. These districts stand high in various accessibility indicators. For example Gurgaon, Faridabad, Panipat, Panchkula districts are having high urbanization level, better employment opportunities and higher per capita income. Hisar, Sirsa, Ambala districts are having large number of fair price shops as compared to other districts. The ratio of agricultural labourers is also high in these districts as these are agriculturally developed areas.

The northern and central parts of state are medium food accessibility areas with index value ranging from 0.35 to 0.45. These districts are Karnal, Jind, Bhiwani, Kurukshetra, Sonipat Fatehabad and Kaithal. Some of these districts are performing better

in one indicator while some others are performing better in other indicator but none is leading in all indicators of food accessibility. Districts of Bhiwani, Kurukshetra, Jind, Fatehabad, and Kaithal provide better opportunities to agricultural labourers as these are agriculturally developed areas. But these are lagging behind in per capita income and in urbanization level. Therefore these areas fall under moderate accessibility category.

Areas having index value below 0.35 are having low food accessibility. Six out of twenty one districts fall under this category. These districts are Rohtak, Rewari, Jhajjar, Palwal, Mahendragarh and Mewat. These districts have low urbanization level due to reduced employment opportunities, less availability of fair price shops and these areas are not much developed agriculturally. Therefore, these districts display low food accessibility.

Food Utilization

This dimension is related to utilization of food through adequate diet, clean water, sanitation, and health care, to reach a state of nutritional well-being for which all physiological needs are met. It is concerned with the nutritional requirements of people, based on their age and sex. While utilization focuses on nutrition; it also includes food storage, processing, health and sanitation as they relate to nutrition (USAID, 1992). This is reflected through people’s health status. There are many studies at global level which show that along with food availability and accessibility the utilization dimension is equally important. The South Asian Enigma i.e. levels of malnutrition in Asia are higher than in Africa is well known (Oxfam working paper, 2010). By considering the importance of food utilization, a new term of food and nutrition security is also used by many organizations such as FAO, USAID, UNICEF etc. and it is achieved when access to nutritious diet is coupled with a sanitary environment, availability of safe drinking water and adequate health services in order to ensure a healthy and active life for all the family members (CFS, 2012).

Spatial Pattern of Food Utilization

In this study access to safe drinking water and access to health services i.e. population served by primary health centers have been considered as major indicators for measuring food utilization. Availability of safe drinking water is more in those areas which are adjacent to Yamuna canal in eastern part of the state. But the areas situated in southern part of the state have semi-arid climatic conditions. Rainfall amount is low and this also resulted in water shortage including safe drinking water. In terms of availability of primary health centers (PHC’s) in the state as a whole, one PHC is serving 58000 persons against the standard norm of 30,000 persons. This clearly speaks about the poor health infrastructure in the state. The index of food utilization however, varies notably from a minimum of 0.075 in Mewat to a maximum of 0.917 in Kurukshetra district (Fig. 5).

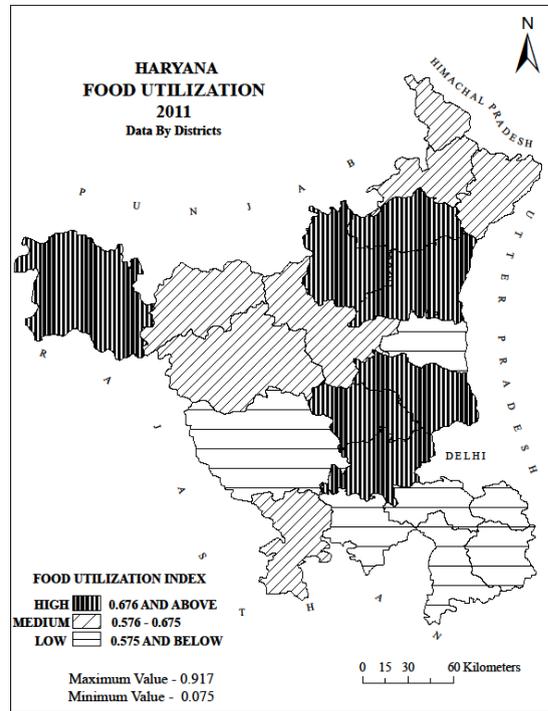


Fig.5 Food Utilization Map

Areas of high food utilization having index value of more than 0.676 cover districts of Kurukshetra, Jhajjar, Sirsa, Kaithal, Rohtak, Karnal and Sonapat. These areas have better drinking water facilities partly due to their location close to the

Yamuna canal. As regards to health facilities, all these districts faced much better as the population served per PHC is below the state average of 58000 persons.

Areas which have better primary health centers but do not have better drinking water facilities come under the medium food utilization category with index value ranging between 0.576 to 0.675. Eight out of twenty one districts fall into this category. Districts having better drinking water facilities are Ambala, Hisar, Mahendragarh, Yamunanagar, Rewari, Fatehabad, Panchkula and Jind while districts having better health facilities (lower than state average population per PHC) are Mahendragarh and Rewari. Some of these areas face problems of declining groundwater level which

explain the problems of drinking water. Areas of low food utilization (index value below 0.575) include the districts which are located in southern parts of the state. These districts are Gurgaon, Panipat, Faridabad, Palwal, Bhiwani and Mewat. Southern parts of this type of areas have semi-arid climatic conditions, receiving less amount of rainfall and adjoin the dry Rajasthan state. The primary health centers are serving a population higher than the standard norms, where one PHC is serving more than 80,000 population per districts.

On the whole, eastern Haryana has better food utilization index compared to western and southern Haryana. Refer Table 1 for Haryana Food Security Status 2011.

Table 1: Haryana Food Security Status

Districts	Availability Index	Accessibility Index	Utilization Index	Food security Index
Fatehabad	1.00	0.361	0.486	0.616
Sirsa	0.945	0.488	0.706	0.713
Kaithal	0.834	0.360	0.485	0.561
Jind	0.700	0.431	0.496	0.543
Kurukshetra	0.629	0.404	0.649	0.561
Karnal	0.542	0.542	0.699	0.561
Hisar	0.498	0.560	0.693	0.584
Bhiwani	0.478	0.425	0.744	0.549
Jhajjar	0.419	0.275	0.591	0.428
Sonipat	0.391	0.372	0.615	0.460
Rohtak	0.342	0.337	0.527	0.402
Palwal	0.338	0.251	0.336	0.309
Ambala	0.327	0.452	0.621	0.467
Yamunanagar	0.32	0.479	0.627	0.476
Panipat	0.29	0.506	0.468	0.421
Mahendragarh	0.28	0.183	0.425	0.296
Rewari	0.252	0.320	0.470	0.348
Mewat	0.186	0.074	0.060	0.107
Gurgaon	0.091	0.714	0.556	0.454
Panchkula	0.044	0.459	0.419	0.308
Faridabad	0	0.684	0.472	0.386

*District wise food availability, food accessibility, food utilization & overall food security index calculated values

Food Security Regions of Haryana

The spatial patterns of food security in the state reveal that the central and north-western parts of the state have better agricultural infrastructure and are more food secure than the districts situated in southern and northern parts of the state. Additionally, the southern and northern parts are at a disadvantage due to sandy soils, poor irrigation facilities and undulating topography.

Broadly, three main regions of food security emerge (Fig. 6):

- (i) High food security region (index value 0.55 and above)
- (ii) Medium food security region (index value 0.401-0.55)
- (iii) Low food security region (index value 0.400 and below)

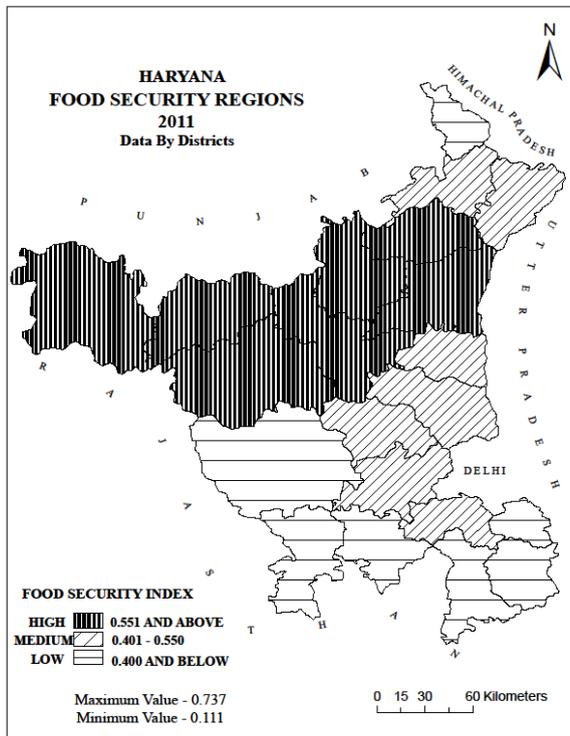


Fig. 6 Food Security Regions

- (i) *High food security region (index value 0.55 and above)*

This region comprises six out of twenty one districts of Haryana. These are Sirsa, Fatehabad, Kurukshetra, Kaithal, Jind, Hisar, and Karnal. These districts performed better in all the

three dimensions of food security. These areas have fertile soil, intensive irrigation facilities, better agricultural infrastructure and gentle slope which are good for agricultural production. These districts are also ahead in terms of main work forces for agricultural work and in allied activities. This provides a lot of employment opportunities. In terms of food utilization, these areas have better drinking water and health facilities. Therefore these districts have a high level of food security.

- (ii) *Medium food security region (index value 0.401-0.55)*

Areas having index value between 0.4 to 0.55 is categorized under medium food security. A major part of state comes under this category and specifically covers districts of Jhajjar, Ambala, Sonapat, Yamunanagar, Rohtak, Gurgaon and Panipat. Some of these districts (Ambala, Rohtak, Panipat) are performing better in food availability dimension particularly in per capita availability of foodgrains. Industrially developed district of Gurgaon have higher level of food accessibility but is lagging behind in food availability and utilization dimensions. Similarly, Yamunanagar in the north is backward in employment and health infrastructure which make it to lag behind the first type of districts.

- (iii) *Low food security region (index value 0.400 and below)*

This region consists of districts having index value of less than 0.4. These districts are located in the extreme northern and southern parts of Haryana. Panchkula district in the north, Rewari, Mahendragarh, Palwal and Mewat in the south particularly fall in this region. As discussed earlier, these districts are performing very poorly not only in food availability dimension, but also in food accessibility and utilization dimensions. Districts located in southern part experience semi-arid climatic conditions, sandy soil and undulating topography. Deep underground water also requires borehole water pump and irrigation facilities which are not readily available. Therefore, these areas are

less food secure and more vulnerable to food insecurity.

4. Conclusions and Recommendations

It follows from above discussion that food security patterns in Haryana vary markedly. The southern parts of the state, alongwith a small pocket of unfavorable physical climatic conditions in the north display low levels of food security. The southern areas are lagging behind in all the three dimensions of food security due to undulating topography, semi-arid climatic conditions, less irrigation facilities, low groundwater table and poor soil quality. The eastern parts largely lack in accessibility due to lower employment levels and low per capita income. The status of food utilization is very low in this part and some of these areas are also facing the problems of declining groundwater level. The agriculturally developed northern Haryana is most food secure. These areas are surplus in foodgrains production due to availability of better irrigation facilities, fertile soil, and large size of land holdings. Along with food availability these areas have higher workforce in agricultural production and also lead in drinking water and health infrastructure.

To minimize disparities in levels of food security in the study area the following measures should be adopted:

- Foodgrains production should be increased in southern districts by improving and extending irrigation facilities.
- In central districts which face the problem of declining groundwater level, crops suited to local conditions should be grown.
- To increase food accessibility, government should start new short and long term programmes like Mahatma Gandhi National Rural Employment Scheme.
- To improve food utilization health infrastructure should be strengthened. Districts such as Bhiwani, Mewat, Palwal and Mahendragarh that have very inadequate number of primary health

centers should be brought under particular focus.

- Effectiveness of Public Distribution System is very necessary because it's not availability of food but the proper distribution of food among poor people that can help to solve the problem of food insecurity among the poor in remote rural backward areas of the state.

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