Mapping Food Security at District level: A Case Study of Palghar District, Maharashtra

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Article Info

Abstract

Food Security exists when all the people at all times have physical, social and economic access to sufficient, safe and nutritious food preferences for active and healthy life (FAO,1996). Mapping of food security is often a challenging task as the spatial pattern of food secure and insecure areas are often intertwined with each other especially in a country like India. Food security mapping at the 'district' level is often complex due to its dependence on regional factors. Though Maharashtra is one of the developed states in India, some of the districts perform poorly in addressing the problem of hunger and malnutrition. One of the hilly-forest districts of Maharashtra lying between Western Ghat and the Arabian Sea is Palghar which is carved out of Thane district in 2014. It falls in the category of low food secure districts of Maharashtra. The final Food Security Index (FSI) based on three dimensions namely food availability, accessibility and absorption ranges from 0.46 to 0.14. As per the current study, Dahanu is the only tehsil that it is most secure. Talasari, Vada and Palghar fall into the moderate category of food secure while Vasai, Vikramgad falls in the low category. Mokhada and Jawhar are the least food secure tehsils in Palghar district. Average food security index of Palghar district is 0.32 which is the lowest in the state. The present study suggests policy recommendation on the basis of composite mapping of food security for Palghar district so that coherence in safety net programme takes place accordingly.

Introduction

Recent estimates show that about 800 million people suffer from hunger (FAO, IFAD and WFP, 2014). Despite the decline in absolute and relative terms in the number of people in the last decades, but one in nine people go to bed hungry. Nevertheless, 2 billion people in the world suffer from micronutrient deficiencies(FAO,2015).On the other hand, it is necessary to increase global food production by 60% to meet the demand of 9.2 billion people in 2050 (Alexandratos and Bruinsma,2012). All this fact reveals the stark reality of food security and demands urgent attention. In these challenging times, Food security has become a major issue of research in the world with not only focus on food availability but access and absorption of food are also taken into consideration in present times. In India, despite a significant increase in growth rates in terms of GDP after the 1990s, but the record of decreasing malnutrition and hunger are not impressive, one-fourth hungry people in the world resides in India. It is also estimated that the prevalence of

underweight children is highest in the world. Similarly, more than 50 million children below 5 years are malnourished. Persistence malnourishment and occurrence of the hungry population define the nature of the problem of food insecurity in the country.

Availability of food does not just matter to understand food security but access to safe, nutritious food to poor households and individuals, absorption and assimilation of food into the body are also needs to analyze. Dimensions of food security are analyzed by taking accessibility, access, and absorption of food. Food entitlements through safety net programmes are an essential ingredient to secure the right to food. Right to food assures governments obligation towards the Sustainable Development Goals (SDG) which puts an obligation on the state to reduce huger totally by 2030. To secure SDGs by 2030, it is necessary to study food security at the national, state and regional level by using a macro, meso and micro-scales indicators of food security. Present study attempt to analyze

food security at meso level and micro scale. Tehsils are taken as a unit at meso level while households are taken as the unit of study at the micro level.

Objectives

Following are the objectives of the present paper

a) To analyze food availability, food accessibility, and food absorption situation of Palghar District
b) To map dimensions of food security with the help of the composite index of food availability, food accessibility, and food absorption index
c) To construct a food security index of the study area.

Database and Research Methodology

The present study is based on secondary data sources. The data has been sourced from Census of India, Economic Survey of Maharashtra, District Handbook of Palghar, Socio-Economic Survey of Palghar and departmental websites of Government of Maharashtra.

Methods of Indexing for Mapping the Food Security

The food Security Index of Palghar district was calculated by combining the following 14 indicators, viz. per capita net food grain availability (kg), yield per hectare (quintals), area under irrigation (%), road length per hundred square kilometres, per capita income (Rs), percentage of BPL households (%), percentage of ST to the total population, rural female literacy (%), main workers to total population (%), agriculture workers to total population (%), number of PDS per lakh population, percent of population with access to toilets, and percent of population with access to safe drinking water.

There are about 4 food availability indicators, 7 access indicators, and 2 absorption indicators. Equal weight has been assigned to all these indicators. Similarly, there is an implicit weight for each dimension of food security: food availability, food accessibility, and food absorption. More indicators reflect more weight to that dimension. With 4 indicators food availability get an implicit weight of 30.4% with food access received an implicit weight of 53.2% with 7 indicators, and food absorption gets 15.2% implicit weight with 2 indicators. In this way, the final food security index gives more emphasis on food accessibility underlining the fact that mere food availability is not enough to secure food security.

The Food Security Index is a summary measure of three dimensions namely as food availability, food accessibility, and food absorption. The food security index is the geometric mean of normalized indices for each of the three dimensions. There are two steps to calculating the food security index.

Step 1: Creating the Dimensions Indices

Goalpost i.e minimum and maximum values are set in order to transform the indicators expressed in different units into indices between 0 and 1.

There are 13 indicators and each indicator represented by 'x' that varies from 1 to 13. A formula similar to the Human Development Report, UNDP 2004 is used to convert individual indicators into an index. The number of observations of the 'x' indicator varies from 'i' to 'n' where 'i' varies from 1 to 8; that is 1 - 8 tehsil. Thus x_{11} represents the xth variable for the first indicator

and the first tehsil. For any given indicator the index has been calculated as follows:

Vxi = value of xth indicator for i^{th} tehsil
$Vxmin$ = minimum value of x
$Vxmax$ = maximum value of x
Ixi = Index of xth indicator for i^{th} tehsil

$Ixi = (Vxi - Vxmin) \div (Vxmax - Vxmin)$

where the value varies between 'i' to 'n' tehsils (n = 8) for the xth indicator.

The value of 'Ix' varies between 0 and 1. This means that maximum value in the series for the indicator 'x' receives an index of one. The minimum value receives an index of zero. Thus all the 8 values of an indicator vary between one and zero. All the values of Ix for a given tehsil are averaged together to obtain a composite index.

To calculate the availability sub-index, 4 indicators have been converted into an index, which is sub-index for availability. Food accessibilty index is received with an average of 7 food accessibility indicators. The food absorption sub-index is computed by averaging the 2 food absorption indices.

Step 2: Formulating the Food Security Index

The Food Security Index (FSI) is the geometric mean of the three dimensional indices, as follows:

$$FSI = (I_{availability} \; I_{accessibility} \; I_{absorption})^{1/3}$$

Based on the FSI values, four levels of food security have been identified as follows:

FSI	Category
0.60 and above	Very High
0.45 - 0.60	High
0.30 - 0.45	Medium
Below 0.30	Low

Discussion and Results
Food Availability

Food availability is a function of domestic production, stocks in PDS and import of food in the region. Domestic production is hampered by agriculture productivity, irrigation availability, capital, and mechanization. Despite all this fact, India achieves self-sufficiency in food, food grain production at the national level is not a problem. On the other hand some of the studies indicate that the decline in the demand for cereals is arising from the diversification of the Indian diet away from food grain as well as declining energy requirements of the rural working population on account of improved rural infrastructure and mechanization (Dreze and Sen, 2002; Rao, C H H, 2000). Hence, the dimension of food availability needs to examine in holistic and integrated with food systems from production to consumption.

Domestic agricultural production directly affects the food security of the region. Increasing agricultural productivity leads to an increase in rural income and lowers food prices and consequently leads to the availability of more food. Keeping all this point, the dimension of food availability is examined with the help of indicators such as production, productivity, irrigation extent and connectivity in the study region. These indicators give a broad picture of food availability in Palghar district.

Indicators of Food Availability

Production.

Agricultural production in terms of both food and non-food is taken into consideration for per capita agricultural production. Palghar district mainly produces rice. Other food crop includes Nachani and Pulses. 95 percent of food production amounts to rice production. Rice occupies 39 percent area to total net sown area in the study region. Most of the rice production takes place in Kharib season and 2 percent rice production takes place through irrigation. Palghar district produces 176721 metric tonnes of rice i.e 6percent to total rice production of the state. Very less production is contributed by Nachani and Pulses in the study region.

Production is of wheat, jowar, bajara, and maize and non-food crop are extremely low. As far as total food grain production is concerned, Palghar tehsil ranks number one while Mokhada ranks lowest in the study region. Ironically hilly and forest tehsils rank low in food grain production while coastal tehsil produces high food grain production.

Per capita, foodgrain production reflects the availability of food at the local level. Per capita, food grain production trends are not coterminous with food grain due to uneven distribution of the population in the study region. Average per capita food grain production is less than the state average (95.8 kg) whereas the national average is three times higher than Palghar districts per capita food grain production.Per capita, food grain production index is very high in Vada tehsil while it is low in Vasai tehsil (Table.1).

Productivity

The ratio between the input to output is nothing but productivity. Yield per hectare (quintal) is one of the methods to measure productivity. Agricultural productivity in the study region is not uniform across the study region. Average yield per hectare in the study region is 13 quintals.The state average of productivity is slightly higher than the Palghar district. There is a clear difference between the productivity of Maharashtra State and national average in yield per hectare which is 21 quintals/hectare and it is much higher than combined state and district average. Tehsils namely Vikramgad, Vada, Palghar and Vasai shows yield per hectare above the state average. Palghar tehsil has a high yield per hectare productivity index whereas Mokhada tehsil has low productivity index in the study region. Coastal and plain region of Palghar district have a high yield per hectare than hilly and forest tehsil. Low yield per hectare in hilly and forest tehsils attributes due to rugged topography, unavailability of irrigation, low mechanization, less capital and investment and inaccessible markets to farmers. Prominent crop in the study region is rice which is rain-fed crop and yields of rice are subject to vagaries of rainfall while prices are subject to market fluctuations; both factors are contributing to unstable income to farmers. Productivity in the Palghar district can be improved with the introduction of high yielding varieties, irrigation facilities and institutional Source: District Statistical Abstract, Palghar District 2015(Table.2).

Irrigation

Irrigation facilities directly affect agricultural productivity. Irrigation extent is calculated by taking the ratio of net irrigated area to net sown area in the study region. Irrigation plays an important role in improving agricultural production and productivity.It provides better prospects for rural employment which in turn helps to improve the food security of households in general. Net Area under irrigation is very low (4%) in Palghar District as compared to state and a national average of irrigation. Both state (18.3%) and Palghar district need to improve investment in irrigation facilities to attain national average(36.8%). Well, irrigation, bore well and canal irrigation is major sources of irrigation in the study region.Dahanu tehsil is famous for Sapota(Chiku) orchards.for better yields of Sapota requires irrigation at regular interval. Flood irrigation system is followed by farms for irrigation of Sapota.Due to the high extraction of groundwater through bore well; water table has gone during the last ten years. Modern methods of irrigation like drip and sprinkler will help immensely in the conservation of groundwater. In terms of net irrigated area, Dahanu and Palghar tehsil have the highest area under irrigation which is reflected with very high irrigation index. Generally, the coastal strip of Palghar district is having high irrigation facilities. Hilly and forest tehsil with the tribal area located in the Northwest part of study region namely Vada, Mokhada, Vikramgad have very low irrigation due to non-capacity of farmers to invest in it. Irrigation index in this tehsil is very low(Table.3).

Connectivity

Food production to Food consumption link is provided by transport. Villages having connectivity to roads enhance option for rural farmers. It connects them to regional, national and international markets. Road reduces transport cost and can reduce transaction cost with possible positive results on the prices realized by farmers. It provides options to the farmer to connect to different markets. Investment from the government on the rural road had seen the largest impact on productivity growth in recent times. Connectivity to roads in a rural area helps to connect rural poor to a large market for employment which in turn help to reduce rural poverty. The road acts as feeder roads by giving backward and forward links to agriculture by connecting farmers to urban markets. Road transport in the region divided into national highways, state highways, district roads, and villages roads. Average road length per hundred square kilometers in Palghar District and state average are 183 km and 198 km respectively. Ironically national average of road length per hundred square kilometers is less than (138 km) study area and state average. Connectivity index is very high in Talasari tehsil(Table .4) due to the development of the transport network of national highway between Mumbai and Delhi (NH-8). Development of ancillary industries surrounding national highway no.8 results in the development of the dense network in Talasari tehsil. Connectivity index is low for Mokhada tehsil in the study region due to hilly terrain and remoteness of the area. Coastal plains in the study region have moderate road length per hundred kilometers reflected through medium connectivity index.

Composite Index of Food Availability

Food availability is represented with the help of four indicators. All the indicators are closely correlated to each other and food availability. The per capita agricultural production and yield per

hectare represent local food availability, the extent of irrigation is positively correlated with per capita production and agricultural production. The road provides connectivity from farms to markets. The composite map of food availability is based on an index calculated using this availability indicator. Higher the index, higher will be the food availability and vice-versa. The 8 tehsils were grouped into three categories based on the calculation of the food availability index. Choropleth method of different shading of colour was given to these categories. The tehsils shown in the shades of dark brown, brown and light yellow depict the best, moderate and worst off tehsils in respect to food availability.

The availability index shows that Dahanu and Talasari are having high food availability and appear as dark brown in the map. This is followed by Palghar, Vasai, Vikramagad, Vada, and Jawhar in light brown on the map. Mokhada comes out as deficit areas in terms of food availability with low index(0.09) and appears as light yellow on the map. Average availability index for the study region is 0.40 (Table -5 and Fig.2).

Food Accessibility

The mere availability of food does not suffice to achieve food security but it is physical and economic access to food matters lot in food and nutrition security. Economic access to food depends upon purchasing power of households which in turn rely on access to productive assets and livelihood opportunities. Gender inequality within household influences accesses to food. In Indian society, caste is also a determining factor in both physical and economic access.

The critical significance of access to food has been famously imprinted on the public mind by Sen's description of the Bengal famine, where people went hungry and starved, not because the food was not available, but because they could not afford it (Sen, 1981). He linked the issue of access to a person's entitlement. Hence accessibility of food is closely associated with purchasing capacity, their earnings, livelihoods, and other socio-economic factors. Ultimately, accessibility of food is tied up with either paid wage employment or ownership of livelihood resource that can generate earning to households. Access to food is determined by the availability of endowments especially related to physical and economic access to food. Entitlements are available through own endeavor or state interventions through PDS or both.

The indicators that have been taken into consideration for the construction of accessibility index in the study region are per capita income percentage of BPL population, proportion of ST population to total population, rural female literacy percentage main workers to total population, percentage of agricultural labourers to total population, number of Fair Price shop per lakh population.

Indicators of Food Accessibility
Per Capita Income

Per capita income reflects access to livelihood resources of households such as land, water, buildings, and equipment. Purchasing power capacity of households depends on per capita income. Human resources like knowledge and skills to play an important role in the accessibility of livelihood resources. Hence it is evident that the income of family directly affects

choices of food of household. Per capita income of India in 2018 is Rs. 1,13,000 which is lower than the state average (Rs. 147129). Ironically per capita income of Palghar district of Maharashtra is Rs. 24888 which is far lesser as compared to Mumbai and Mumbai Sub-urban area located near to it. Vasai tehsil has the highest per capita income in the study region due to its proximity to per-urbanization, industrialization, and development of the service sector in it. Hilly and forest tehsil located in the eastern part of the study are namely Mokhada, Jawhar and Vikramgad have very low per capita income which is evident from the low-income index (Table.6). A recent development in the form of a port, national highway led to an improvement in per capita income along coastal tehsils namely Palghar, Dahanu, and Talasari respectively.

Below Poverty Line (B.P.L)

Low-income level directly affects the consumption pattern of households. BPL households are highly prone to volatile prices in the food market due to their irregular pattern of income. Often poverty is multidimensional in nature. It is more than mere income and consumption. They are different methods to access poverty. The headcount ratio below the poverty line is one of the popular measures of it. The expert committee of planning commission of India has defined the poverty line Rs. 27 per day for rural area and Rs. 33 for the urban area of the country. Households having more than this income falls under the above poverty line. 29.5 percent population of India falls under BPL. Percent of BPL households in Palghar district is much higher (57.2%) than the state average. BPL is a negative indicator which is evident from high BPL in tribal tehsil namely Vikramagad, Jawhar, Dahanu, Talasari, and Mokhada respectively. Very low BPL population is observed in Vasai tehsil with high accessibility rank (Table.7).

ST Population

Scheduled tribes faced historic injustice and discrimination from ancient times. All this type of discrimination observed in all walks of life like their livelihoods, education, health, participation in political life, access to food, and benefits of government schemes and programmes. STs are a disadvantaged section of society. Scheduled Tribes account for about 935 percent of the total population of Maharashtra. Palghar district is a tribal district of Maharashtra accounting about 66.2 percent ST population to total population of the district. ST population is a negative indicator. A high proportion of ST population to total population is seen in tehsils namely Mokhada, Jawhar, Vikramgad, and Talasari account more than 90 percent ST population to their total population. Hence ST population index is low among this tehsil while it is very high in Vasai and Palghar tehsils of the study region. Overall ST population Index is moderate (0.36) (Table.8).

Rural Female Literacy

Gender-based inequality in household consumption is very well-represented by rural female literacy. The logical argument is that higher literacy rate for women is more likely to enable women to enhance their roles in family decision-making and increase their share of household consumption. At the same time, higher literacy is also likely to lead to a better knowledge

of nutritional systems and improved health practices in the household. Enhancing female literacy has been recognized as the single most important factor contributing to the increase in food security and decline in malnutrition and mortality levels (UNICEF, 2007a). Almost 68.5 percent of females in rural Maharashtra are literates which are higher than the national average (58 percent). Rural female literacy in Palhgar district is 54.59 with low literacy index (table.9). Vasai and Palghar tehsil have higher rural female literacy due to high urbanization, employment, and education facilities near to it. All the hilly-forest and tribal tehsils in the eastern part of the study region have very low rural female literacy.

Main Workers

As per the census, main workers are defined as a person who has worked for a major part of the reference period (i.e six months or more during the last one year preceding the date of enumeration) in any economically productive activity. The ratio between the productive section of the population to the economically dependent part is a valid demographic indicator at the household level. A ratio higher than unity represents a positive scenario, with more productive population compared to the dependent population. This 'demographic divided' if effectively harnessed, leads to prosperity and hence food security (Chandrasekhar, et al. 2006). Maharashtra is the best performing states in terms of working age population with 38.94 percent main workers to total population. Palghar district has also a high proportion of main workers to the total population (34.9 percent). Interesting percent of main workers to total population is higher in tribal districts namely Vikramgad, Mokhada, and Dahanu respectively. Talasari is having the lowest proportion of main workers to the total population in the study region (Table.10).

Agricultural Labourer

An agricultural labourer is a person who works on another person's land for wages in cash or kind or shares Agricultural labourers are characterized by extremely poor physical and human capital and also the highest poverty levels(NCEUS,2007). Thus, it is expected that the proportion of agricultural labourers will be negatively related to food security i.e the more the agricultural labourers in a district, the worse will be the food security situation. Around fifty percent population of Maharashtra and India belongs to the agricultural labourer. Consequently,17.27 percent population of Palghar district belongs to the agricultural labourer. Percent of the agricultural labourer is low in semi-urban and industrially developed areas namely Vasai and Palghar tehsils. Agricultural labourer Index is high in Mokhada, Jawhar, Vada and Vikramgad tehsils due to unavailability of another source of employment apart from agriculture at the local level. Similarly, some of the agricultural workers from Dahanu and Talasari are shifting to Gujrat to work in unskilled industries like textile and ceramics(Table.11).

Public Distribution System

India Public Distribution System (PDS) is one of the largest distribution networks in the world. Food is purchased and stored by center while state government looks after the distribution of food. National Food Security Act, 2013 acts as legal entitlements to deliver food to the households. BPL and AAY

beneficiary households entitled to receive 35 kg food grains per family whereas APL households receive 15-35 kg food per family as per the existing availability of food stock. Fair price shops (PDS) are the last connecting link in the food distribution network. PDS per lakh population gives accessibility of households to the food entitlement programme. The average of Palghar district is 56.68 percent which stands out to be moderate in terms FPS. The spatial distribution is such that maximum FPS per lakh population is found in Vada (87.5%) followed by Mokhada (77.6%) and Jawhar (70.61%) lowest number (14%) of PDS per lakh population is found in Vasai tehsil(Table.12).

Composite Index of Food Accessibility

Seven indicators have been considered to examine the food access situation. The Per Capita Income, Below Poverty Income (B.P.L), ST Population, Rural Female Literacy, Main Workers, Agricultural labourer, PDS per lakh population were the seven indicators selected for food access security. The 8 tehsils were regrouped into three categories based on the food accessibility status. Palghar is having better access to food and livelihoods, and are hence put in a dark brown shade on the map. Palghar shows good performance in per capita income and lower poverty level as compared to other tehsils. The next category has been depicted in light brown on the map. Vasai and Vada are found to be the next best for food access. The most insecure provinces for food access are shown in light yellow on the map. They are Talasari, Dahanu, Vikramgad, Jawhar, and Mokhada. The per capita income, percent of BPL population, a proportion of ST population, rural female literacy are very high in these tehsils, although PDS per lakh population has been higher. (Table.13 and Fig.3).

Food Absorption

It is defined as the ability to biologically utilize the food consumed. Absorption is depend upon several factors like nutrition knowledge and practices, sanitation, access to clean drinking water which allows effective biological absorption of food and health status studies have shown that water and sanitation account for a substantial portion of the difference in infant and child mortality rates experienced by the rich and the poor (Leipziger et al 2009). Mere food availability and food accessibility do not guarantee a long and healthy life for a person. For a long and healthy life, two prerequisites needed other than the nutritional needs of the body. First is safe drinking water and sanitation. Second is access to basic health care services.

Food availability is the first step and access to food is the second step whereas food absorption is the final stage in achieving food security. The outcome of well food absorption would be a healthy and productive life of the individual in society. Nonetheless, problems of food absorption lead to an unhealthy population of malnourished adults with low body mass index. The children would be stunted, underweight and wasted. As per the latest round of NFHS-4, 50.8 percent women in the age group of 15-49 groups suffer from anaemia and 26.7 percent women from a rural area are having below normal Body Mass Index ($< 185 \ kg/m^2$). Among rural children in the under 5 years category, 3&4 percent are stunted, 21 percent are wasted and 35.8 percent are underweight. Infant Mortality 35.8 rate and

under-five mortality rate shown a decline but are still on the high side. It is very high in rural areas. As per NFHS-4, 46 per 1000 live births is IMR, while 56 per 1000 children is under-five mortality rate. High level of malnutrition reflects maternal and childcare health situation in the country. Percentage of household with access to basic drinking water and sanitation are indicators selected to calculate absorption index.

Indicators of Food Absorption
Access to Toilets
A direct relationship exists between water, sanitation, health, and human well-being, consumption of contaminated drinking water, improper disposal of human excreta, lack of personal and food hygiene, etc, have been the major causes of many diseases in India (GOI, 2003 a). Percent of the population with access to toilets in Palghar is more than the state (38%) and national (30.7%) average. Toilet access penetration is more in a rural and semi-urban area of the study region. Talasari and Dahanu have a very high percent of access to toilets while it is very low in Vasai tehsil. Ironically absorption index for access to toilets is very high (>.60) and high (0.45 - 0.60) in tribal tehsils namely Talasari, Dahanu, Jawhar, Mokhada and Vada(Table.14). This may attribute to the large benefit of government schemes related to toilet construction by tribals. The utility of toilets in the tribal area especially hilly and forest area of the study region is a questionable concern due to the availability of water. A number of toilets only on paper will not serve the purpose of good health and sanitation.

Access to Safe Drinking Water
As per the census of India, household having access to drinking water supplied from a tap or hand-pump or tube-well within or outside the premises, it is considered as having access to safe drinking water. United Nations Sustainable Development Goal (SDG) number 6 is related to ensure availability and sustainable management of water and sanitation for all. One of its targets focuses on achieving universal and equitable access to safe and affordable drinking water for all by 2030. Water plays a vital role in the functioning of body and absorption of food. Access to safe drinking water is a basic human right. In Maharashtra, 73.2 percent of households have access to safe drinking water which is low as compared to the national average (82.7 percent). Palghar has very low access to safe drinking water (55.39 percent) with very high accessibility index for Vasai (0.86) and low index (0.09) for Mokhada tehsil. Hilly and undulating terrain in Mokhada tehsil results in low suitability of natural sites for the extraction of drinking water and laying of pipeline network(Table.15)

Composite Index of Food Absorption
Two indicators have been identified to assess the food absorption index in the study region as the variables were found to be highly correlated with each other. The indicators for food absorption are the percentage of households with access to safe drinking water, the percentage of the population having access to a toilet facility. This index measures the effect of hygiene and health care outcomes in the population. The performance of indicators has been shown on the map in four classes. The very high food absorption index tehsil in dark brown with regard to

food absorption was Talasari and Dahanu. Vasai have good access to safe drinking water. The tehsil of Vada, Palghar, Jawhar, and Vikramgad have been put in the second category. The Mokhada and Vasai tehsils are the most food insecure and are placed in light yellow on the map, with respect to food absorption. They have a very low index value. Average food absorption index of the study region is 0.50 which is better than food availability and accessibility index. Remoteness in hilly and forest area, poor infrastructure, high population and lack of basic services could be some of the reasons for poor food insecure position in terms of food absorption (Table.16).

Composite Index of Food Security
To calculate the Composite Index of Food Security, the 8 tehsils have been categorized into three classes. The final food security index, which is the average of thirteen chosen indicators, as described previously, ranges from 0.46 to 0.14. Dahanu is the only tehsil that falls between the classes intervals of 0.46 which indicates that it is most food secure. Moderately food secure tehsils and their class limits are 0.42, 0.38 and 0.36. Talasari, Vada and Palghar fall into the moderate category of food secure and is depicted in light brown in the map. All the tehsils which are extremely food insecure are put in the class below 0.30. Vasai, Vikramgad, Jawhar, and Mokhada are the tehsils that fall in this low category and are depicted in light yellow on the final food security index map. Mokhada and Jawhar are the least food secure tehsils in Palghar district. (Table .17). Average food security index of Palghar district is 0.32 which is lowest in the state. The food security map of Palghar provides an overall picture of the food security situation at the tehsil level. It highlights the situations that need public action and specific interventions for food and livelihood security.

Conclusion and Recommendations
Dimensions of food security namely food availability, food accessibility, and food absorption are explored and mapped in this chapter. Food availability index is constructed by taking four indicators namely production, productivity, the extent of irrigation and connectivity respectively. The composite index of food availability gives the highest availability in Talasari and Dahanu and low in Mokhada tehsil. Per capita income, BPL population, the proportion of ST population, rural female literacy, main workers, agricultural workers and PDS per lakh population are taken into consideration for construction of food accessibility index. The composite index of food accessibility shows more accessibility in Palghar tehsil while low in Talasari and Mokhada tehsils. Indicators of food absorption are very well represented with access to Primary Health Centres(PHC) and access to safe drinking water. The very high food absorption index tehsils were Talasari and Dahanu. The Mokhada and Vasai tehsils are the most food insecure.

The final Food Security Index(FSI) based on three dimensions ranges from 0.46 to 0.14. Dahanu is the only tehsil that it is most secure. Talasari, Vada and Palghar fall into the moderate category of food secure while Vasai, Vikramgad falls in the low category. Mokhada and Jawhar are the least food secure tehsils in Palghar district. Average food security index of Palghar district is 0.32 which is lowest in the state. All the composite indices are mapped and depicted with dark brown for high value

and light brown for the low value of index.patterns of food secure and insecure areas will help to the local government in focusing need based strategies of local are related to food safety net programmes.

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Table - 1: Per Capita Food Grain Production in Palghar District

Tehsil	Per Capita Food Grain Production (kg)	Food Grain Production (Metric Tonnes)	Index
Talasari	118	18200	0.64
Dahanu	85	34238	0.45
Vikramgad	127	17489	0.70
Jawhar	142	19891	0.79
Mokhada	105	8736	0.57
Vada	158	28258	0.89
Palghar	76	41867	0.40
Vasai	14	18939	0.02
District Average	64	23452.25	0.56
State Average	95.8		
National Average	202		

Source: District Statistical Abstract, Palghar District 2015

Table - 2: Yield per Hectre in Palghar District

Tehsil	Yield per Hectre (Quintal)	Index
Talasari	12.05	0.50
Dahanu	8.90	0.35
Vikramgad	16.54	0.73
Jawhar	6.81	0.24
Mokhada	3.51	0.08
Vada	13.15	0.56
Palghar	18.29	0.81
Vasai	14.74	0.64
Average	11.74	0.49
State Average	13	
National Average	21	

Source: District Statistical Abstract,Palghar District 2015

Table -3: Irrigation in Palghar District

Tehsil	Net Irrigation Area (%)	Index
Talasari	2.51	0.15
Dahanu	15.24	0.92
Vikramgad	0.10	0.01
Jawhar	1.80	0.10
Mokhada	0	0.01
Vada	0.25	0.02
Palghar	6.14	0.38
Vasai	6.13	0.37
Average	4.02	0.24
State Average	18.30	
National Average	36.80	

Source: District Statistical Abstract,Palghar District 2015

Table – 4: Road Density in Palghar District

Tehsil	Road Length/'00 km^2	Index
Talasari	281.08	0.91
Dahanu	168.11	0.34
Vikramgad	199.04	0.50
Jawhar	238.17	0.69
Mokhada	148.19	0.24
Vada	172.4	0.36
Palghar	107.27	0.04
Vasai	150.16	0.25
Average	183	0.42
State Average	198	
National Average	138	

Source: District Statistical Abstract,Palghar District 2015

Table 6: Per Capita Income in Palghar District

Tehsil	/capita Income (Rs.)	Rank
Talasari	10309	0.08
Dahanu	26775	0.16
Vikramgad	9164	0.07
Jawhar	9335	0.04
Mokhada	5557	0.02
Vada	11877	0.06
Palghar	36635	0.33
Vasai	89455	0.59
Average	24888	0.17
State Average	147129	
National Average		

Source: District Statistical Abstract,Palghar District 2015

Table - 5: Composite Index of Food Availability

Tehsil	Food Grain Production (Metric Tonnes)		Yield/Hectre (Quintal)		Net Irrigation Area (%)		Road Length (/'00 km^2)		Availability Index
	Index	Rank	Index	Rank	Index	Rank	Index	Rank	
Talasari	0.31	6	0.50	5	0.15	4	0.90	1	0.46
Dahanu	0.75	2	0.34	6	0.95	1	0.34	5	0.59
Vikramgad	0.29	7	0.72	2	0.006	7	0.49	3	0.37
Jawhar	0.35	4	0.24	7	0.11	5	0.69	2	0.35
Mokhada	0.04	8	0.07	8	0	8	0.24	7	0.09
Vada	0.59	3	0.55	4	0.01	6	0.36	4	0.38
Palghar	0.96	1	0.81	1	0.39	2	0.03	8	0.55
Vasai	0.33	5	0.63	3	0.38	3	0.25	6	0.40
Average	0.45		0.48		0.25		0.41		0.40

Source: Calculated by author

Table - 7: BPL Households in Palghar District

Tehsil	% of BPL Households	Rank
Talasari	68.73	0.14
Dahanu	69.70	0.13
Vikramgad	71.10	0.10
Jawhar	70.88	0.11
Mokhada	66.27	0.17
Vada	54.95	0.31
Palghar	37.10	0.54
Vasai	19.55	0.76
Average	57.28	0.28
State Average	30.70	
National Average	27.50	

Source: District Statistical Abstract,Palghar District 2015

Table - 8: Proportion of ST to total population in Palghar District

Tehsil	Proportion of ST to Total Population (%)	Rank
Talasari	90.61	0.10
Dahanu	69.11	0.33
Vikramgad	91.82	0.08
Jawhar	91.64	0.09
Mokhada	92.08	0.07
Vada	57.02	0.46
Palghar	30.56	0.75
Vasai	7.32	1.00
Average	66.27	0.36
State Average	9.35	
National Average	8.63	

Source: District Statistical Abstract,Palghar District 2015

Table - 9: Rural Female literacy in Palghar District

Tehsil	Rural Female Literacy (%)	Rank
Talasari	45.37	0.09
Dahanu	44.84	0.08
Vikramgad	53.76	0.23
Jawhar	46.18	0.10
Mokhada	47.56	0.13
Vada	61.88	0.36
Palghar	67.69	0.46
Vasai	69.44	0.49
Average	54.59	0.24
State Average	68.50	
National Average	58.75	

Source: District Statistical Abstract,Palghar District 2015

Table - 10: Percent of Main Workers in Palghar District

Tehsil	Main Workers to Total Population (%)	Rank
Talasari	27.14	0.04
Dahanu	36.20	0.22
Vikramgad	41.87	0.34
Jawhar	31.79	0.14
Mokhada	41.37	0.33
Vada	32.94	0.16
Palghar	34.89	0.20
Vasai	33.02	0.16
Average	34.90	0.20
State Average	38.94	
National Average	29.94	

Source: District Statistical Abstract,Palghar District 2015

Table - 11: Proportion of Agriculture Workers in Palghar District

Tehsil	Agriculture Workers to Total Population (%)	Rank
Talasari	13.90	0.28
Dahanu	15.80	0.32
Vikramgad	18.16	0.37
Jawhar	26.32	0.55
Mokhada	31.96	0.67
Vada	21.18	0.44
Palghar	8.80	0.17
Vasai	2.06	0.02
Average	17.27	0.35
State Average	52.70	
National Average	54.60	

Source: District Statistical Abstract,Palghar District 2015

Table - 12: PDS per lakh Population in Palghar District

Tehsil	PDS /'00,000 Population	Rank
Talasari	44.68	0.35
Dahanu	52.00	0.42
Vikramgad	66.84	0.57
Jawhar	70.61	0.61
Mokhada	77.88	0.68
Vada	87.45	0.77
Palghar	40.00	0.30
Vasai	14.00	0.04
Average	56.68	0.47
State Average	43	
National Average	43	

Source: District Statistical Abstract,Palghar District 2015

Table - 13: Composite Index of Food Accessibility

Tehsil	1		2		3		4		5		6		7		Accessibility Index
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
Talasari	0.07	5	0.05	5	0.1	5	0.08	7	0.17	8	0.25	6	0.38	6	0.22
Dahanu	0.25	3	0.04	6	0.33	4	0.07	8	0.40	3	0.29	5	0.46	5	0.43
Vikramgad	0.05	7	0.015	8	0.087	7	0.22	4	0.54	1	0.33	4	0.63	4	0.33
Jawhar	0.06	6	0.02	7	0.089	6	0.10	6	0.29	7	0.49	2	0.67	3	0.31
Mokhada	0.01	8	0.01	4	0.085	8	0.12	5	0.53	2	0.60	1	0.75	2	0.32
Vada	0.09	4	0.31	3	0.46	3	0.36	3	0.32	6	0.39	3	0.86	1	0.36
Palghar	0.37	2	0.63	2	0.74	2	0.46	2	0.37	4	0.15	7	0.33	7	0.37
Vasai	0.96	1	0.95	1	0.99	1	0.49	1	0.33	5	0.02	8	0.04	8	0.31
Average	0.23		0.05		0.1		0.24		0.37		0.31		0.51		0.33

Source: calculated by author   1= /capita Income (Rs), 2= % of BPL Households, 3 = % of ST to total population , 4= Rural Female literacy (%) , 5= Main workers to total population (%) , 6= Agriculture workers to total population (%) , 7= PDS/lakh population   A = Index   B = Rank

Table -14: Population with access to Toilets in Palghar District

Tehsil	Population with access to Toilets (%)	Rank
Talasari	77.80	0.77
Dahanu	60.09	0.58
Vikramgad	46.25	0.43
Jawhar	57.80	0.56
Mokhada	62.20	0.60
Vada	51.50	0.49
Palghar	35.20	0.32
Vasai	7.80	0.03
Average	49.83	0.47
State Average	38.00	
National Average	30.70	

Source: District Statistical Abstract,Palghar District 2015

Table - 15: Population with access to Safe Ddrinking Water in Palghar District

Tehsil	Population with access to Safe Drinking Water (%)	Rank
Talasari	58.64	0.56
Dahanu	64.72	0.63
Vikramgad	43.51	0.41
Jawhar	38.92	0.36
Mokhada	14.02	0.09
Vada	58.04	0.56
Palghar	78.86	0.78
Vasai	86.46	0.86
Average	55.39	0.53
State Average	73.20	
National Average	82.70	

Source: District Statistical Abstract,Palghar District 2015

Table - 16: Composite Index of Food Absorption

Tehsil	Percent of population with access to toilets		Percent of population with access to safe drinking water		Absorption Index
	Index	Rank	Index	Rank	
Talasari	0.76	1	0.54	4	0.50
Dahanu	0.57	3	0.60	3	0.45
Vikramgad	0.43	6	0.37	6	0.32
Jawhar	0.55	4	0.32	7	0.34
Mokhada	0.60	2	0.04	8	0.27
Vada	0.48	5	0.53	5	0.41
Palghar	0.31	7	0.76	2	0.40
Vasai	0.02	8	0.84	1	0.30
Average	0.47		0.50		0.37

Source: Calculated by author

Table - 17: Composite Index of Food Security

Tehsil	Availability Index		Accessibility Index		Absorption Index		Food Security Index	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Talasari	0.46	3	0.22	8	0.50	1	0.39	3
Dahanu	0.59	1	0.43	1	0.45	2	0.49	1
Vikramgad	0.37	6	0.33	4	0.32	6	0.34	5
Jawhar	0.35	7	0.31	7	0.34	5	0.31	7
Mokhada	0.09	8	0.32	5	0.27	8	0.22	8
Vada	0.38	5	0.36	3	0.41	3	0.38	4
Palghar	0.55	2	0.37	2	0.40	4	0.44	2
Vasai	0.40	4	0.31	6	0.30	7	0.33	6
District Average	0.40		0.33		0.37		0.39	

Source:Calculated by author
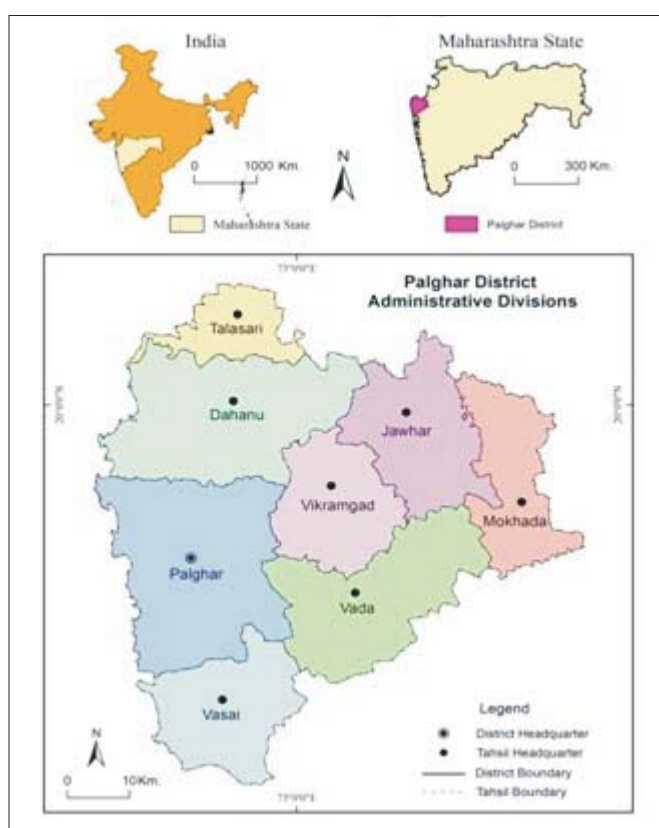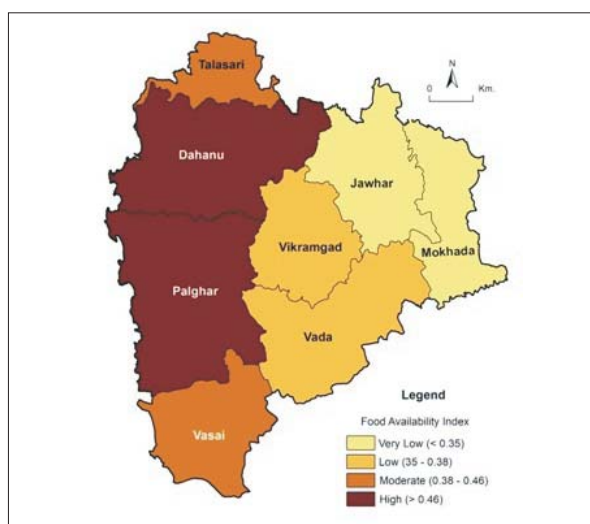

Fig. 1: Location of Study Area

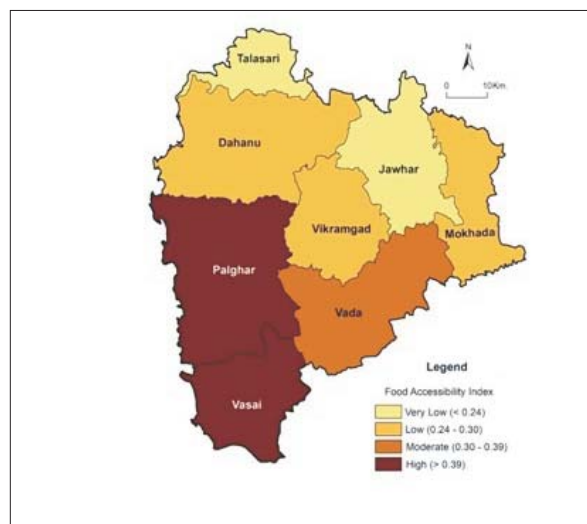Fig. 2: Composite Map of Food Availability
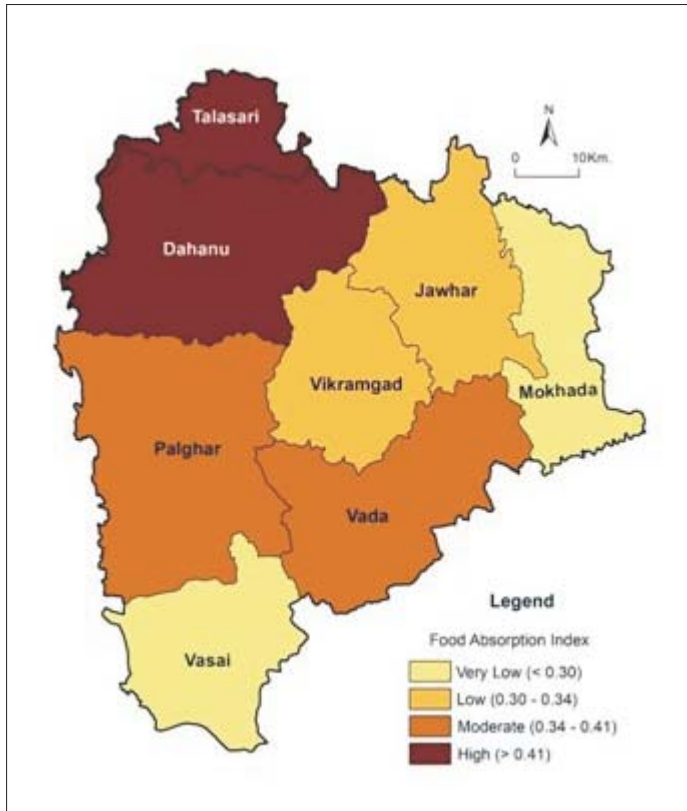

Fig. 3: Composite Map of Food Accessibility

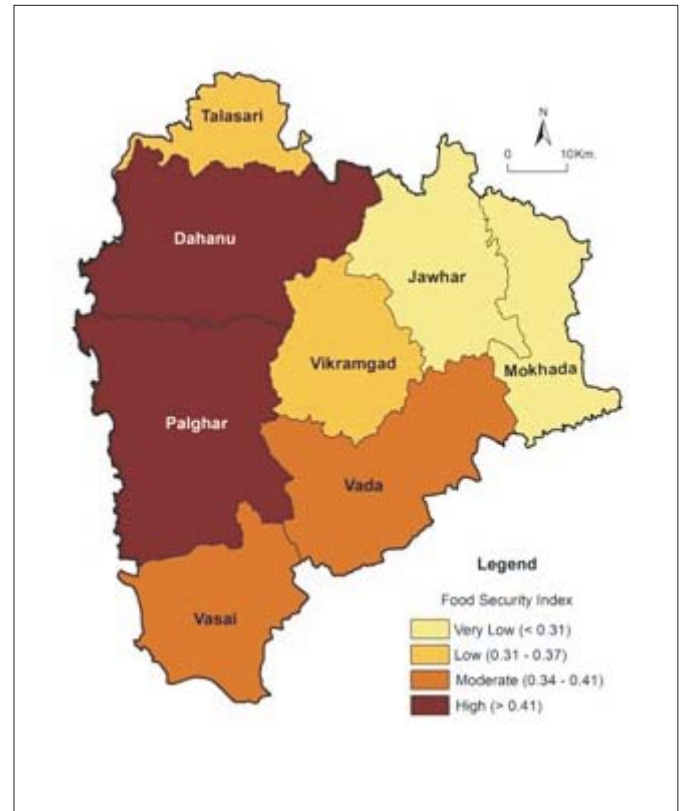Fig. 4: Composite Map of Food Absorption

Fig. 4: Composite Map of Food Security Index

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