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Spatial Analysis of Level of Food Security in Fragile Ecosystem – A Case Study of Nagaur District in the Indian Desert of Rajasthan

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Abstract : *In the present study an attempt have been made to analyse the spatial of food security in Nagaur District of Indian desert. Nagaur district is a part of Indian desert which covers an area of 17,718 square kilometres which consist 33, 07743 persons. This arid tract receives very low amount of rainfall which is scanty in nature and water availability period in the study area is low and availability of water is inadequate to meet the demand of agriculture, domestic and other uses. There is absence of any perennial river in the study area. The frequency and occurrence of droughts is frequent in the study area which affect agricultural sustainability and productive potential of the land .The study have been attempted at tehsil level. Agriculture and livestock is the mainstay of the economy and mostly dependent on distribution of rainfall. The Nagaur district is continuously facing droughts since last few years and people are migrating to favourable areas. Thus, there is an urgent need to assess the level of food security in a weak ecosystem. The simple statistical techniques have been used for the processing of the data. The study reveals that the level of food security coincides with amount and availability of rainfall. There are only two tehsils Makrana and Nawa reported better situation as compare to others. Most of the tehsils lie under moderate situation whereas western margin of the study area reported an adverse situation. The irrigation facilities are also not well developed leading to low utilization of fertilizer and low agricultural production.*

Keywords : *Food availability, Food accessibility, Food Stability, Food crises*

Introduction

The concept of food security and food crisis was introduced in the 1970s. 'Food Security' was mostly related with National and Global food issues. In 1980s, the focus shifted the problems of access to food at household and individual levels. "Prior to the emergence of food security concept in the 1970s, the 1950s and 1960s was period during which food aid became a staple component of overseas development assistance" (Clay 2008). The concept of food security has defined by Scientists in different ways.

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According to Dr. Swaminathan "sustainable food security involves strengthening the livelihood security of all members within a household by ensuring both physical and economic access to balance diet, including the needed micro-nutrient, safe drinking water, environment, sanitation, basic health care and primary education."*Food security is the most heated and debated topic and in this context policy makers, planners, researchers and decision makers all over the world have been exploring ways and means to ensure food security to the millions of citizen (Tripathy et al., 2011). A family is said to be food secure when it has physical, economic and social access to the required amount of food grains in terms of quantity, quality, safety, (Sharma and Sharma, 2008), the food available should be culturally acceptable and when it is not at undue risk of losing such access (Mishra et al., 2008). The problem of food insecurity is prevalent all over the world but it is more common in developing countries like India which produces surplus food on one extreme but at the other extreme one third of the population is extremely poor and one half of the children are malnourished in one way or the other (Kannan et al., 2000). India has achieved a fourth fold increase in food grains from 50 million tonnes in 1950 to 219.3 million tonnes in 2007 to 2008 against a threefold increase in population from 33 million to more than 100 million (Kumar, 2010).

In terms of food factors, the concept of food security basically stands on three pillars, food availability, which deals with the domestic production of food grains in the area; food stability, which deals with the constancy in the availability of food in an area or to make the food available either through import from the surplus areas or by maintaining buffer stock at micro level at the time of manmade or natural disaster and harmful seasonal stability, and finally accessibility; which depends on the physical and economic access to food, guided by the purchasing power and per capita income of the people. It is of utmost importance because availability of food will be of no use, until and unless people have means to buy the available food (Chaturvedi, 1997; Girish, 1997).

The Study Area

Nagaur district is located between 26°25' N to 27°40' N latitude and 73°10' E to 75°5' E longitude in Rajasthan spread over an area of 17,718 sq. km. (Fig. 1). The maximum length of the district from north to south is about 146 km. and its maximum breadth from east to west about 229 km. Gypsum is the most important mineral of this region. The 90% gypsum of the total production of country comes from Rajasthan. Nagaur district has the highest reserve, followed by Bikaner, Jodhpur and Jaisalmer district. Other minerals are ceramic minerals and marbles. Marble found in the Bagar tract especially at Makarana in Nagaur district.

Objectives

The objectives of the present study are to find out the spatial pattern of food availability, food stability and food accessibility and henceforth determine the spatial level of food security in Nagaur district.

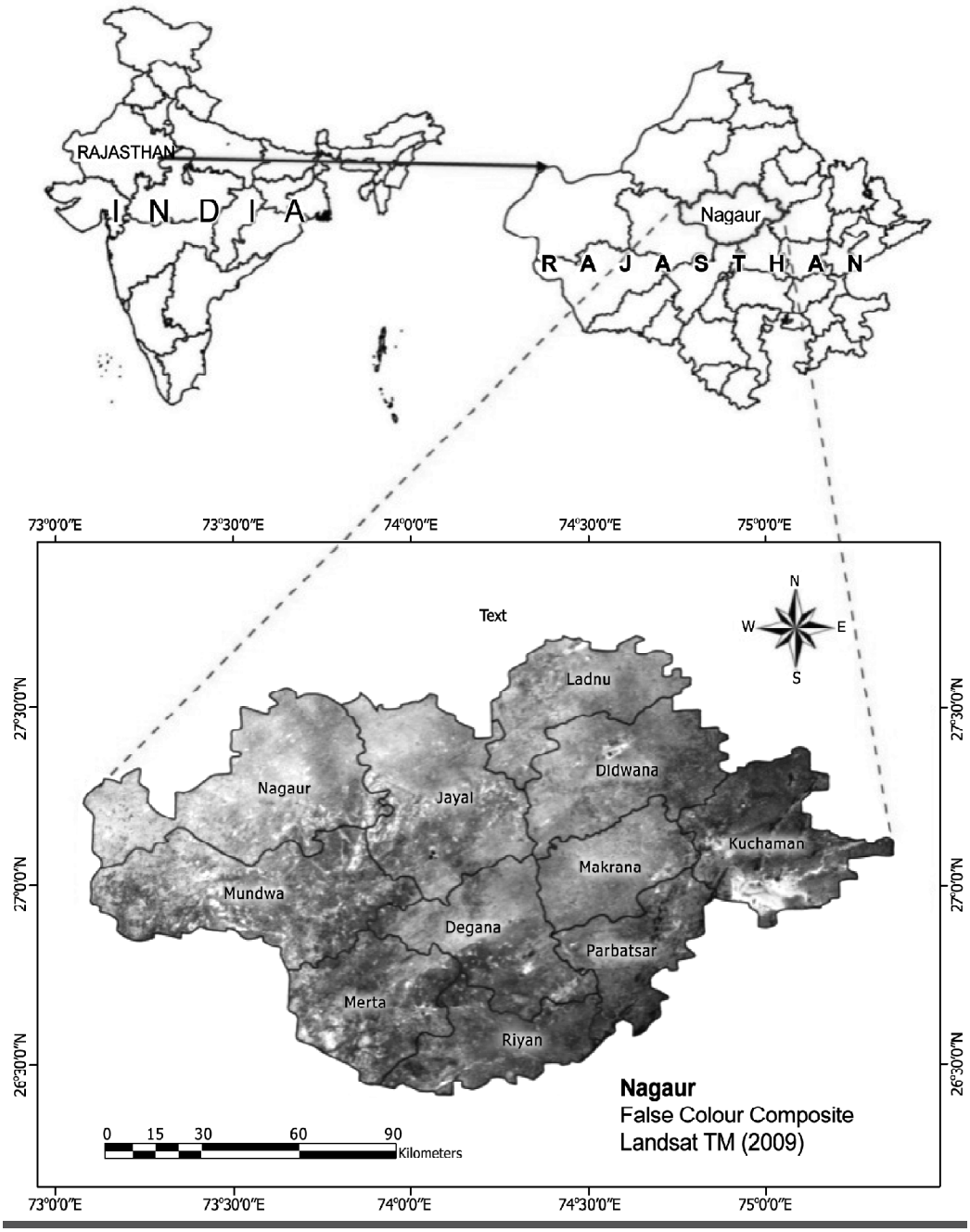

Fig. 1. Location Map of Nagaur District (Landsat TM, 2009)

Database and Research Methodology

The present study is based on primary as well as secondary sources of data to assess food security level at tehsil level obtained from the bulletin of agricultural statistics of Nagaur district for various years, published by the directorate of statistics and economics, Jaipur Rajasthan. The food availability have been analysed on the basis of cereals and pulses (food grains). There are many factors which affect the amount of food consumed, for example age, sex, occupation, income level, rural versus urban population, vegetarian and non vegetarian diet, body size, climate and for most of these the usable data is not available. The food consumed by a child and an adult is different. Similarly food consumed by a male and a female, normal and pregnant women, person working in fields and office is not similar.

In order to standardize the raw data of all the variables, the method of z-score has been used. Z-score quantify the departure of individual observations, expressed in a comparable form. The formula is thus;

$$zi = \frac{xi - \bar{x}i}{SD}$$

Where, Zi is the standard score of the ith variable; xi is the original value of individual observation; x°#i is the mean of variable and SD stands for the standard deviation. In first step tehsil wise Z-score of each selected variables like production of food grains, population per livestock , fertilizer consumption, percentage of gross irrigated area to net sown area ,have been analysed. The values so obtained are added tehsil wise and average is taken to calculate the composite Z-score as the index of level, by the formula;

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

Where, CS refers to composite Z-score; Zij stands for the sum of Z-score of variable j in observation i; and N symbolize 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.

Results and Discussion

Scenario of Food Availability

Food security of any region mainly depends on food availability which is a function of domestic agricultural production or through imports from surplus areas. To examine the overall scenario and spatial level of food availability in Nagaur district for the year 2011 the variables have been taken these are food grain availability (kg per head per annum) and livestock availability (population per livestock). The standard z-scores have been obtained for the variables of food availability separately. With the help of z-scores, the composite z-scores have been analysed in order to delineate the spatial level of the food availability at tehsil level. Nawa and Makrana reported

very high availability of food located in eastern margin of the district followed by Merta whereas Didwana and Degana lie in moderate category. There are five tehsils fall under the category of low to very low availability of food availability these are kheenvsar, Nagaur, Jayal, Ladnun and Parbatsar. The better situation coincides with distribution of amount of rainfall and availability of water and other favourable factors whereas Western margin of the study area reported under critical situation and coincides with fragility of the ecosystem.

Due to well coverage of irrigation, high consumption of fertilizer and high yield, the food grain availability is higher in eastern tehsils. The eastern margin of the district reported better situation crop husbandry is in primary occupation whereas in western margin animal husbandry is in significant position.

Table 1. Variables of Food Security in Nagaur District

Variables	Description of variables
X1	Production of food grains(kg/head/annum)
X2	Population per livestock
X3	Fertilizer consumption(kg per hectare)
X4	Percentage of gross irrigated area to net sown area
X5	Yield of food grains(kg per hectare)
X6	Employment rate(percentage of main workers to total population
X7	Literacy rate in percent
X8	Urbanization (percentage of urban population to total population

Table 2. Food Availability, Food Stability and Food Accessibility matrix in Nagaur District, 2011

	Food Availability		Food stability		Food accessibility			
	x1	x2	x3	x4	x5	X6	x7	x8
Nagaur	121.29	1.11	26.91	22.10	500.70	62.28	34.35	55.16
Jayal	78.38	1.08	25.38	8.98	823.13	58.76	0.00	0.00
Merta	253.19	1.03	15.37	35.40	819.54	61.75	20.74	33.59
Degana	234.00	0.92	24.37	21.37	1028.40	59.03	5.35	9.07
Parbatsar	169.69	0.81	25.30	13.56	1239.83	57.72	7.35	12.73
Nawa	294.13	0.98	23.03	63.72	835.55	67.75	20.76	30.64
Didwana	182.00	1.11	16.57	32.22	1536.15	67.43	13.54	20.08
Ladnu	40.23	1.16	24.26	9.52	666.02	66.45	25.92	39.01
Makrana	81.14	1.58	22.26	8.92	952.97	63.3	40.48	63.95
Kheenvsar	234.90	0.81	0.00	39.85	756.78	58.03	0.00	0.00

Source: District Statistical Handbook of Nagaur, 2011

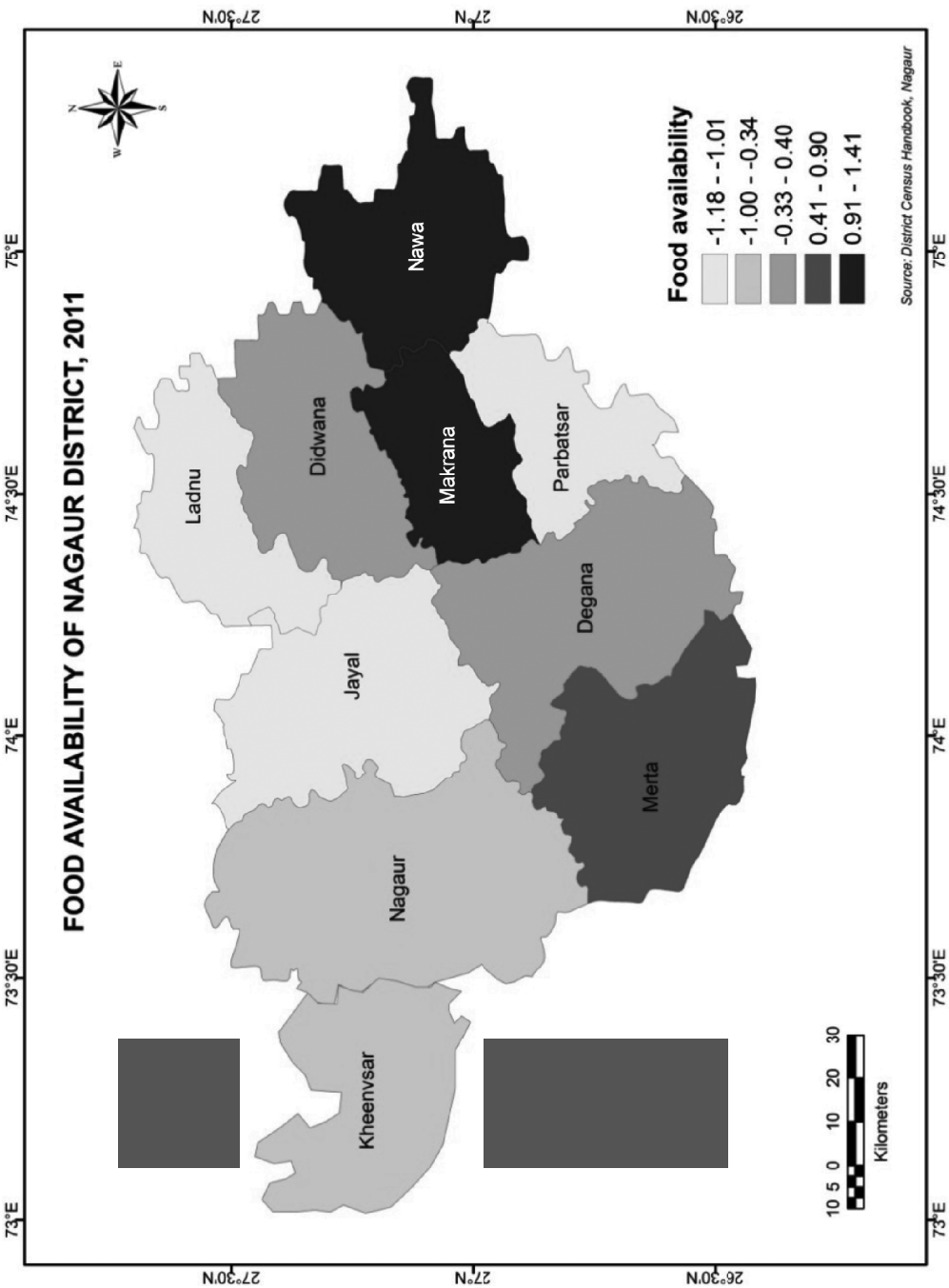

Fig. 2. Food availability of Nagaur District

Table 3. Food Availability, Food Stability and Food Accessibility Situation Analysed Based on Selected Variables by Z-Score Technique in Nagaur District, 2011

	Food Availability		Food stability		Food accessibility			
	x1	x2	x3	x4	x5	X6	x7	x8
	Z score	Z score	z score	z score	z score	z score	z score	z score
Nagaur	-0.585	0.244	0.855	-0.208	-1.479	0.008	1.312	1.372
Jayal	-1.112	0.100	0.655	-0.994	-0.330	-0.943	-1.263	-1.262
Merta	1.035	-0.139	-0.649	0.590	-0.343	-0.135	0.292	0.342
Degana	0.800	-0.665	0.524	-0.251	0.401	-0.870	-0.862	-0.829
Parbatsar	0.010	-1.191	0.646	-0.719	1.154	-1.224	-0.712	-0.654
Nawa	1.539	-0.378	0.349	2.288	-0.286	1.486	0.293	0.202
Didwana	0.161	0.244	-0.492	0.399	2.209	1.400	-0.248	-0.303
Ladnu	-1.581	0.483	0.510	-0.962	-0.890	1.135	0.680	0.601
Makrana	-1.078	2.493	0.249	-0.998	0.132	0.284	1.772	1.792
Kheenvsar	0.811	-1.191	-2.653	0.857	-0.567	-1.141	-1.263	-1.262

Table 4. Composite Index of Food Availability, Food Stability, Food Accessibility and Food Security

	food availability	food stability	food accessibility	Food security
	composit z-score	composit z-score	composit z-score	composite z-score
Nagaur	-0.341	-0.832	2.693	1.52
Jayal	-1.012	-0.669	-3.468	-5.15
Merta	0.897	-0.403	0.499	0.99
Degana	0.135	0.674	-2.561	-1.75
Parbatsar	-1.182	1.080	-2.590	-2.69
Nawa	1.161	2.350	1.981	5.49
Didwana	0.405	2.117	0.849	3.37
Ladnu	-1.097	-1.342	2.417	-0.02
Makrana	1.415	-0.617	3.847	4.65
Kheenvsar	-0.381	-2.363	-3.666	-6.41

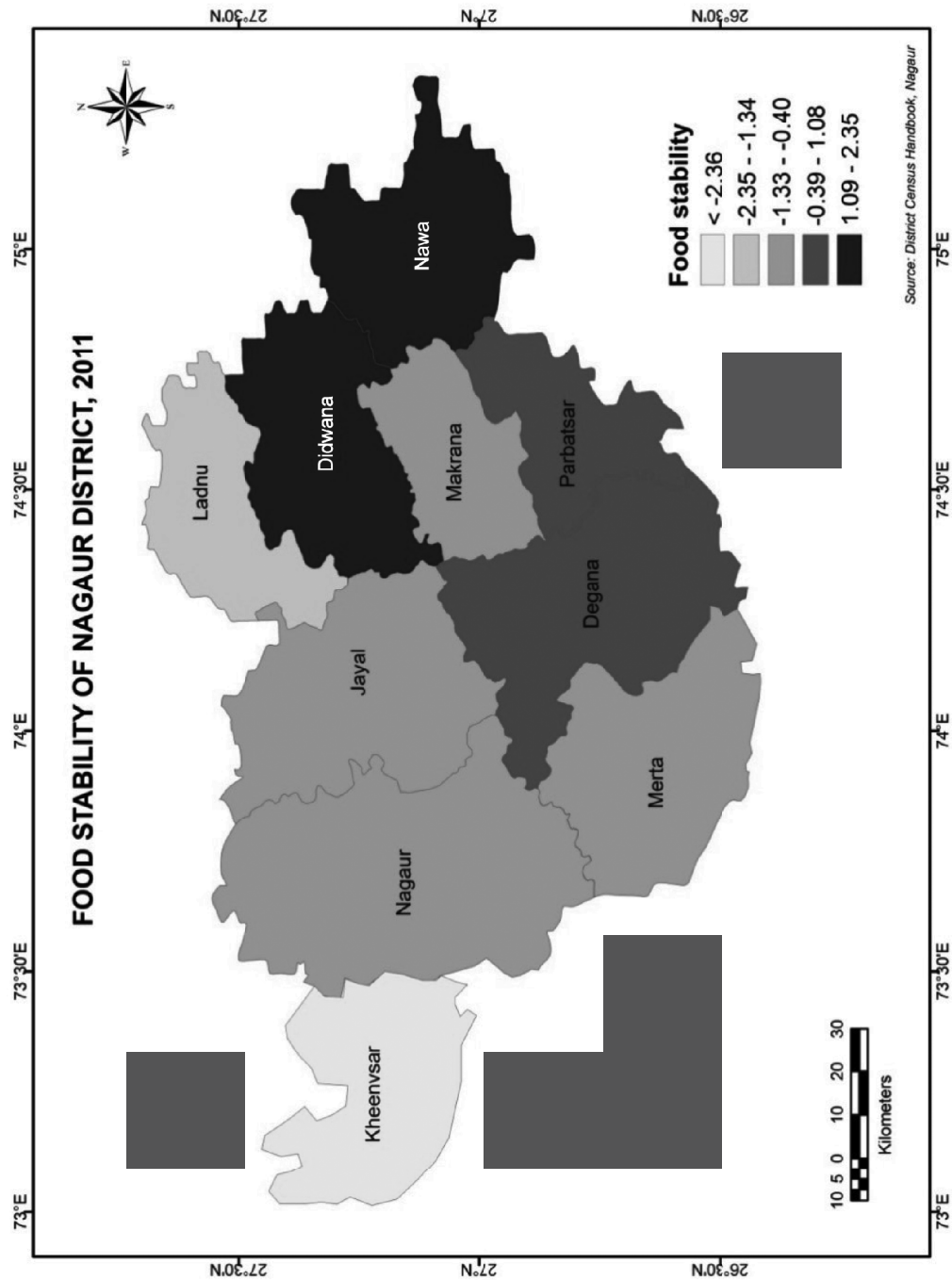

Fig. 3. Food stability of Nagaur district

Scenario of Food Stability

The dimension of stability is influenced by the sustainability of the food system which minimizes the chances of risks related to food insecurity in normal and as well as in difficult times by ensuring the food consumption at a required level (Tripathy, 2011). Food stability calls for undertaking appropriate pre-emptive steps through which harmful, suspended and inter-annual instability of supplies of food can be reduced. The spatial pattern of food stability has been examined on the basis of variables of yield per hectare, percentage of gross irrigated area to net sown area, storage capacity per thousand of population in quintals and ration shops per lakh population, and then composite z-score has been analysed as shown in (Table 3). On the basis of composite z-scores of all the variables of food stability (Table 4), it can be viewed that, very high level of food stability is found in Didwana and Nawa Tehsil of study area (Figure 3). Due to the development in the infrastructure of agriculture that is increased consumption of fertilizer and area under irrigation the yield per unit of land in these districts has increased. Storage capacity and other allied factors are favourable in these unit areas. Degana and Parbatsar enjoys high stability level another three tehsils lie under moderate category these are Nagaur,Jayal and Merta Whereas ladnu,makrana and kheenvsar falls in low to very low category of food stability region due to adverse climatic condition and fragility of the ecosystem.

Scenario of Food Accessibility

The availability and stability of food would lose its meaning until the people have access to the available food. The food accessibility in Nagaur district has been assessed on the basis of variables like employment rate, literacy rate, length of Pukka/metalled road per lakh population in kilometres, percentage of urban population and per capita income. The tehsil wise analysis shows that Makrana tehsil have very high food accessibility (Figure 4). The proportion of urban population and literacy rate is much higher in this tehsil and literacy is usually seen to have a high correlation with employment, providing better access to food. Also, the good transport network of the roads in these areas farmers are having an easy access to the agricultural inputs and better delivery and marketing of the agricultural produce to make the food available to the needy at right time. The per capita income of people in these tehsil is also high leading to better purchasing power of the people. Tehsil Merta and Didwana lie under moderate category of food accessibility. Tehsil of Kheenvsar and Jayal are showing low food accessibility to certain discouraging factors and poor accessibility.

Composite Index of Food Security

The study clearly shows that there are variations in the level of food availability, food stability and food accessibility among the tehsil of the study area coincides with fragility of the ecosystem. In order to bring out the whole scenario of spatial level of food security situation in the study area the z-scores of all eight variables, two of food availability i.e. production of food grains in kilograms/

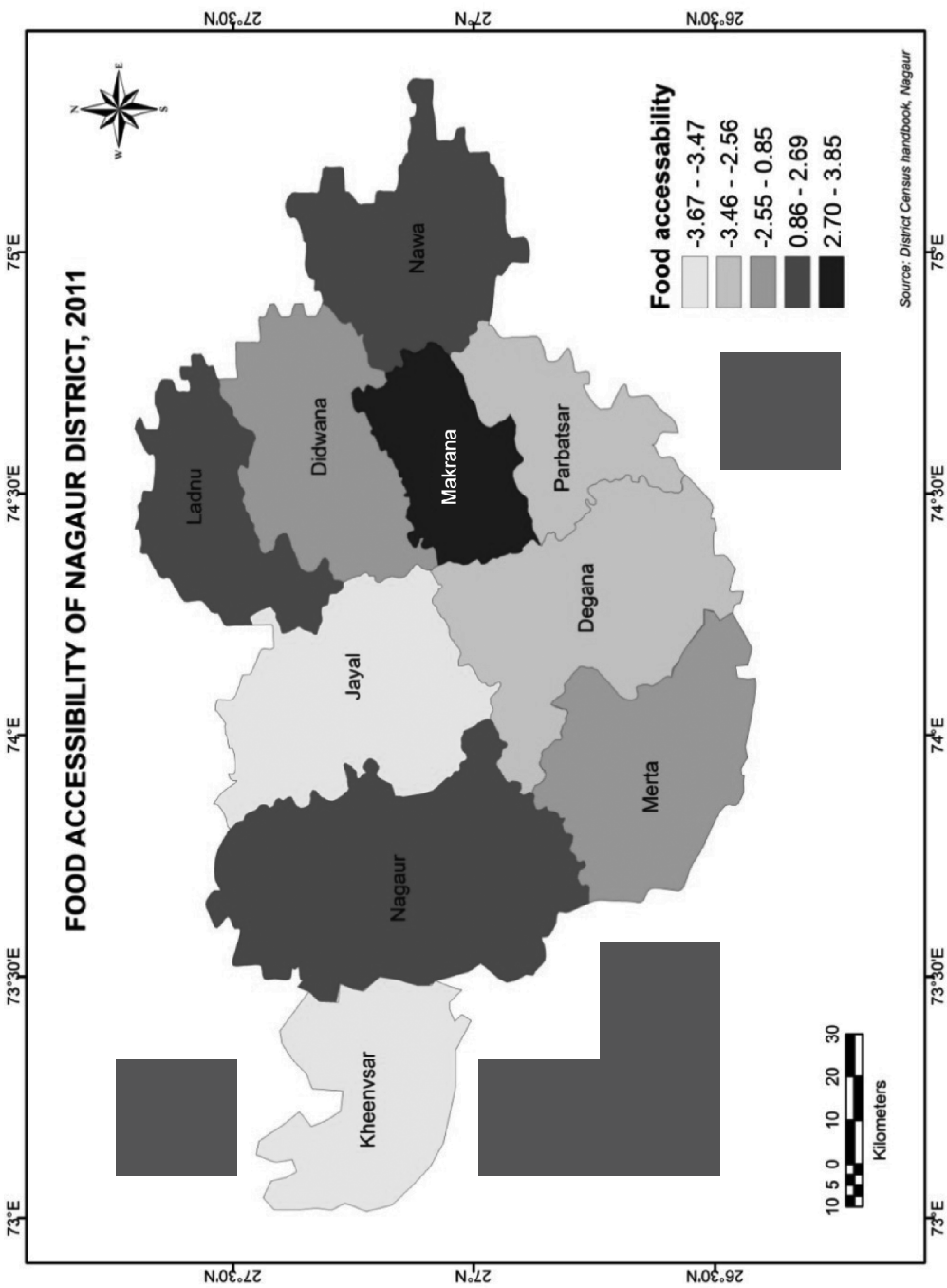

Fig. 4. Food accessibility of Nagaur district

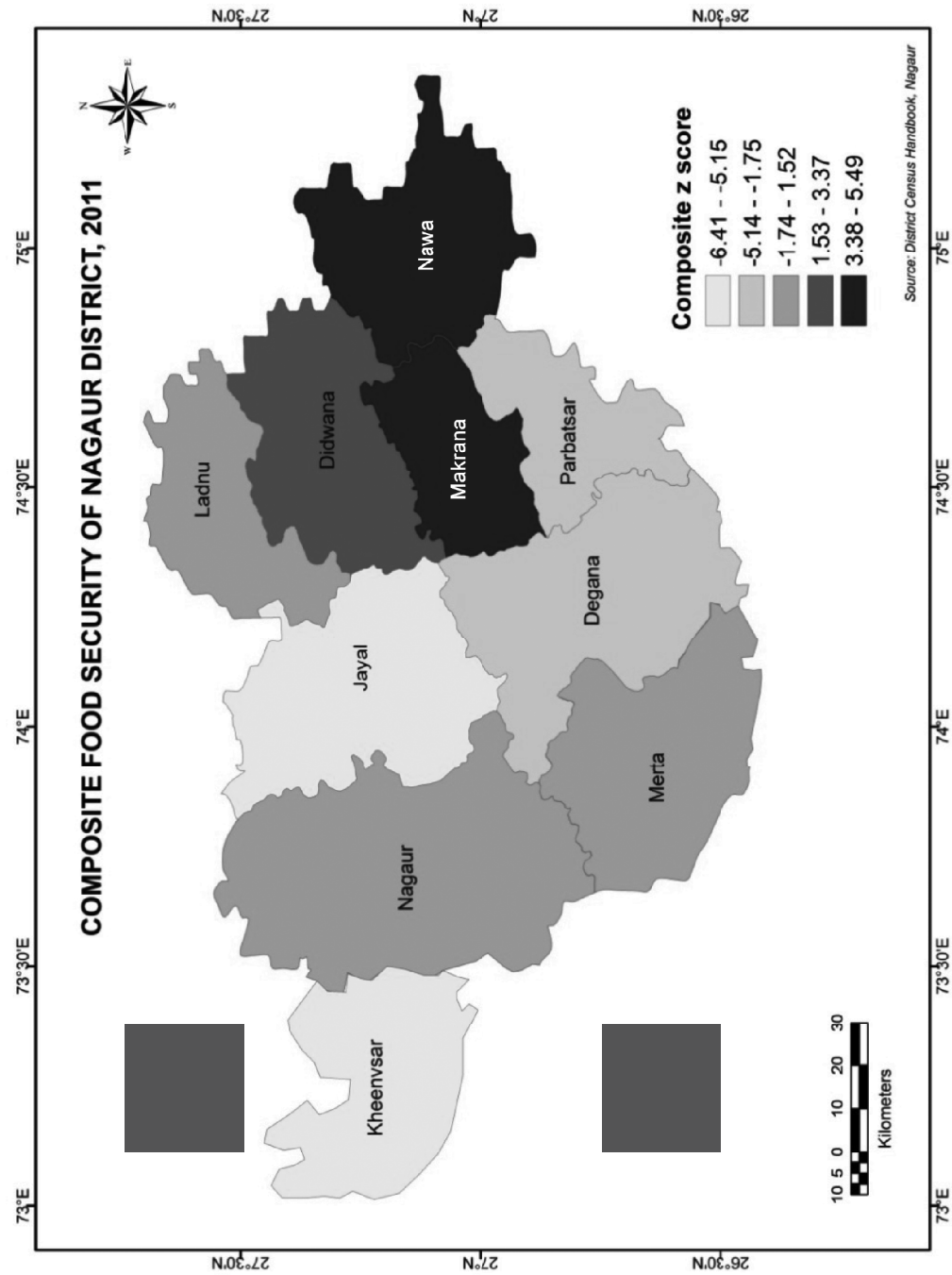

Fig. 5. Composite food security of Nagaur district

head/annum and population per livestock , three of food stability i.e. consumption of fertilizers kilogram per hectares, percentage of gross irrigated area to Net Sown area and Yield of food grains kilograms per hectare and three of food accessibility i.e. employment rate, literacy and urbanization were taken into consideration in order to assess the composite Index of food security.

There are two tehsils reported under the very high category of food secured tehsils these are Nawa and Makrana whereas Didwana reported in high category. There are three tehsils lie in moderate category of food security Index. Degana and parbatsar reported in low category whereas Kheenvsar and Jayal falls in category of very low index of food secured region. It is clearly evident that food security coincides with fragility of the ecosystem. There is varying degree of spatial vulnerabilities towards western margin of the study area reflects food insecured regions.

Conclusion and Suggestions

The study reveals that the level of food security in Nagaur district is highly critical in western margin particularly in the areas of weak and fragile ecosystem. Spatial level of Food Security coincides with distribution of rainfall and availability of water. There are two tehsils Makrana and Nawa reported very high level of food security in an arid ecosystem whereas Didwana reported high level of food security. Nagaur,Merta and Ladnu lie in Moderate category of level of food security. Deganan and Parbatsar fall in low category whereas Kheenvsar and Jayal falls under the category of very low level of food security. The human practices also govern by adversities of climate. In the western margin livestock economy is dominant and pastoral economy play an important role so animal husbandry occupy prominent position every planning should be at micro level with reference to local scenario. The eastern part of Nagaur district enjoys better situation. The level of food security is higher as compare to western margin. In eastern margin of the study area crop husbandry is prominent so every planning should be in respect of better land resource management in order to meet the demand of food and fodder.

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