

NUTRITIONAL AVAILABILITY PATTERNS IN MADHYA PRADESH

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ABSTRACT : The quantitative and qualitative aspect of food-nutrients availability have been discussed in the present study. The study is based on food balance sheet method. In Madhya Pradesh, per caput food-nutrient availability is about 1965 calories in 1981, as against the recommended requirement of 2400 calories, suggesting a net deficiency of 18 per cent. Nearly three-fourths of the area of the state is deficit in respect of nutritional availability. Spatially, the areas north of the Narmada-Son axis are surplus, while the areas south of it are excessively deficit.

The study of nutritional availability patterns in a region assumes significance due to a number of reasons. It provides a reliable evaluation of food surplus or food deficit situation and affords an important tool for planning a rational food regulation system in an area. The surplus or deficit availability of nutrients affects the regional distribution of population and mobility behaviour of people and hence it may be employed as an yardstick for gauging the level of socio-economic attainments. The nutritional availability connotes the actual food available for human consumption in an area and in a given period. It must be distinguished from the food intake or food consumption and refers to the per caput amount of net food available for human consumption expressed in terms of the available quantity of the nutrients. Since the purpose of nutritional availability is the identification of surplus or deficit conditions in respect of food production, the measurement of nutritional availability

must rest on the determination of the quantity of food that may fetch human consumption locally or otherwise. An effort has been made in the present study to present a systematic and interpretative analysis of per caput food availability in different parts of Madhya Pradesh measuring in terms of the nutritive value of different food constituents. The aspect of nutritional availability, i.e. quantitative and qualitative, has been considered. Therefore, former has been measured as caloric content of the food-stuffs and the latter as the value of different nutrients, viz. proteins, vitamins, minerals, etc., which are available in different food-stuffs.

METHODOLOGY

FAO (1957) and Sukhatme (1962) have suggested two methods of estimating the level of food availability or food consumption in an area, viz. (i) the food

balance sheet method, and (ii) the consumer survey method. The consumer survey method is based on a representative sample of households in a region and ideally covers their total expenditure in a given period for food and other items, the quantities of food purchased and consumed. This method is useful for smaller areas. Madhya Pradesh, the study area, is so large that this method is difficult to be used. The food availability has been calculated with the help of food balance sheet method which has been adopted by Dube and Misra (1981). The food balance sheet shows the estimated per caput per day availability of a foodstuff in an area in a given period. It is measured from the total production, adjusted for in and out movements in trade, for changes in stocks, and for any quantities used for animal feeding, seed, industrial production, or other purpose apart from food. When such commodity balances are available for all main foodstuffs the caloric value and content of other nutrients, viz. proteins, minerals vitamins, etc. can be calculated for the diet. Thus for the analysis of regional and spatial variations of food availability in Madhya Pradesh districtwise food balance sheets have been prepared. The data derived from those sheets were compiled and mapped into choropleth system of mapping to depict spatial variations therein. The primary consideration in the regional studies in respect of the evaluation of *inter se* relationship between population and food output is the determination of the surplus-deficit situation of areas in respect of food production. The study involves the consideration of all the possible sources of food in Madhya Pradesh in the range of cereals, pulses, vegetables, oils, milk, and all kinds of flesh foods. The food production data have been obtained from Commissioner of Land Records, Gwalior. Data for the analysis of the current patterns have been averaged from the five years data for the period 1976-77 to 1980-81, which are nearer to the Census year, i.e. 1981.

NUTRITIONAL REQUIREMENTS

In the planning of a diet, energy requirement, i.e. caloric food requirements of the individuals need to be considered by the nutritional geographer. Besides, energy food also comprises such nutrients as proteins, fats, minerals, and vitamins which are essential for the body. Experimental work in nutrition have revealed that an adequate diet must contain sufficient quantities of some forty different chemical substances and that only one of these needs to be deficient for the remainder to be inadequate to support health (Carpenter, 1969). FAO and WHO (1975) have recommended the requirement of calories, proteins, and other selected nutrients based on the amount considered necessary to meet physiological needs and to ensure good health, assuming that energy requirement are met. Obviously, the nutritional requirements vary with age, size of the body, sex, activity, occupation, foods to be digested, clothing, temperature of the body, the surrounding atmosphere, functioning of certain glands of internal secretion, etc. Mukharjee (1981), Swaminathan and Bhagwan (1960), Aykroyd (1962), and Gopalan (1980) have suggested the standard requirement of all the necessary nutrients in a daily diet as recorded in the Following Table 1.

The first function of food is to provide the energy, which it supplies in a chemical form. The chemical energy (calories) is liberated in the tissues and converted by the muscles into chemical work which enables the individuals to carry out the physical, mental and socio-economic activity and provides heat necessary to maintain the body temperature. Generally proteins, fats, and carbohydrates are oxidised in the body to provide the energy required for various activities of life. While vitamins and minerals do not supply energy, they play an important role in the regulation of several essential metabolic processes in the body.

TABLE 1 : RECOMMENDED PER CAPUT PER DAY REQUIREMENT OF NUTRIENTS

Nutrients	Requirements
Energy	2400.0 calories
Proteins	68.0 gram
Fats	60.0 gram
Carbohydrates	605.0 gram
Minerals :	
Calcium	900.0 milligram
Phosphorus	1000.0 milligram
Iron	17.0 milligram
Vitamins :	
Vitamin A (carotene)	1500.0 microgram
Vitamin B ₁ (thiamin)	1.3 milligram
Vitamin B ₂ (riboflavin)	1.4 milligram
Vitamin B ₂ (niacin)	12.6 milligram
Vitamin C	49.0 milligram

Some minerals are important components in the body structures like bones and teeth. The deficiency of food nutrients causes a wide ranges of deficiency diseases and retards the working capacity of individuals.

NUTRITIONAL AVAILABILITY PATTERNS

The quantitative and qualitative aspects of the nutritional availability have been considered in the present study. However, the former has been measured as the caloric content of the foodstuffs and the latter measures the value of different nutrients in different foodstuffs available for human ingestion. The quantitative food in developing regions such as Madhya Pradesh

comes primarily from the grains. Other foodstuffs have negligible share in the daily diet of people in this state. On the other hand, the qualitative food availability depends upon the availability of fruits, fresh vegetables, milk, fats, and flesh foods. The availability of these foodstuffs in negligible in the study area. Table 2 reveals that Madhya Pradesh, as a whole, is deficient in the availability of calories, proteins, fats, carbohydrates, calcium, vitamin A, vitamin B complex, and vitamin C. Table 2 reveals that the deficiency of calories (19.78 per cent), proteins (7.63 per cent), and vitamin B₂ (riboflavin, 23.57 per cent) is marginal, while the deficiency of vitamin A (68.42 per cent), vitamin C (88.45 per cent), fats 54.03 per cent), carbohydrates (40.85 per

TABLE 2 : PER CAPUT PER DAY AVAILABILITY OF NUTRIENTS IN MADHYA PRADESH, 1981

Nutrients	Require- ment	Actual avail- ability	- Defici- ency + Surplus	Percentage Departure
Energy (calories)	2400.0	1965.27	-474.73	-19.78
Proteins (gram)	68.0	62.81	- 5.19	- 7.63
Fats (gram)	60.0	27.58	- 32.42	-54.03
Carbohydrates (gram)	605.0	357.86	-247.14	-40.85
Minerals :				
Calcium (mg)	900.0	506.01	-393.99	-43.78
Phosphorus (mg)	1000.0	1480.83	+480.83	+ 48.08
Iron (mg)	17.0	31.39	+ 14.39	+ 84.65
Vitamins :				
Carotene (microgram)	1500.0	548.64	- 95.36	-63.42
Thiamin (mg)	1.3	1.60	+ 0.30	+ 23.08
Niacin (mg)	12.6	14.06	† a.46	+ 11.59
Riboflavin (mg)	1.4	1.07	- 0.33	-23.57
Vitamin C (mg)	49.0	5.66	- 43.34	-88.45

Source : Calculated from the Nutritional Balance Sheet of Madhya Pradesh.

cent), and calcium (43.78 per cent) is substantial. On the other hand the state has recorded surplus availability of iron (84.65 per cent), phosphorus (43.08 per cent), and vitamin B₂ (niacin, 11.59 per cent).

CALORIC AVAILABILITY

About one-fifth of the districts of the state (22 per cent) are included under the surplus category where availability of calories is more than the recommended requirement i.e. 2400 calories per caput per day. Rest of the three-fourth (78 per cent) districts of the state are classed under deficient category. The surplus

areas extend over the Malwa plateau in the western part of the state, the Raisen-Vidisha plateau in the central part, and the Morena plateau and Lashkar plain in the extreme northern part of the state. The caloric availability in these areas ranges between 2716.37 calories in the Morena plateau to 3102.81 calories in the Umatwara plateau. On the other hand deficit areas extend over the Dandkaranya, the Chhattisgarh region and the Baghelkhand region in the south east; the Rewa plateau, and the Baghelkhand region in the north; the Central Madhya Bharat plateau and the Narmada valley in the central parts; the Satpuras in the south central part; and the Nimar uplands, and the Western Malwa plateau in the western part

of the state. The caloric availability varies from 894 in the Bhopal plateau to 2340 in the Khichiwara plateau.

PROTEINS AVAILABILITY

The sufficiency of protein in a diet is an important measure of the adequacy and quality of the diet. Their importance is enhanced many times because they are required for the growth and development of body. It forms the machinery of the body, the pumps, muscles, catalysts, membranes and vital fluids like blood. Protein may be derived from two sources, i.e. animal sources and vegetable sources. Animal protein are derived mostly from meat, fish, milk and its products. Among vegetable sources nuts and pulses are important. Soyabean is unique in vegetable protein sources while cereals and vegetables are poor in respect of proteins content.

In Madhya Pradesh proteins are obtained from cereals, pulses, and vegetables. The availability of animal proteins is considerably small. The per caput proteins availability is about 62.81 gram as against the recommended requirement of 68 gram, which is 7.63 per cent smaller than the prescribed requirements. In the state proteins availability varies from 33.87 gram in Bhopal district to more than 117.76 gram in Vidisha district. Spatially, north-eastern Malwa region in the west, and the Lashkar plain in the extreme north are the extremely surplus areas in regard to the per caput per day proteins availability, while the Morena plateau, the Chhatarpur upland, and the Narsinghpur plain are excessively surplus in this regard.

On the other hand entire Satpura-Maikal range, the Rewa plateau, the Baghelkhand plateau, the Chhattisgarh region, and the Dandkaranya are the proteins deficit areas. In fact the rice

growing areas of the state are deficit while wheat and jowar growing areas are surplus in the availability of proteins.

FATS AVAILABILITY

The foodstuffs that are rich in fats are oilseeds and nuts. Cereals, pulses, and vegetables contain negligible amount of fat. Oilseeds and milk are the only sources of fats in Madhya Pradesh. It has been found that the availability of fat is very low in the state and animal fats are practically negligible. Per caput per day availability of fats is only 27.28 gram as against the requirement of 60 gram which is 54.03 per cent deficit (Table 2). Fats availability is ten times higher in Rajgarh district (100.48 gram) than that of Raipur district (8.94 gram). Only three areas of the state, viz. the Morena plateau and the Gwalior plain in the north, and the eastern Umatwara plateau in the west, are surplus in terms of fats availability when compared with the recommended requirement. Rest of the state is deficit in this regard

CARBOHYDRATES AVAILABILITY

They play a key role in providing dietary bulk, and thereby, contribute to bowel movement and elimination of toxic components from the system (Leveille, 1975). Carbohydrates can be absorbed into the blood stream and utilized by the tissue cells only as simple sugars, such as glucose. The availability of carbohydrates is only 357.86 gram as against the recommended requirement of 605 gram. In fact, Madhya Pradesh, as a whole, is 40.8 per cent deficit in the availability of the carbohydrates. It is about three times higher in Shajapur district (546.64 gram) than that of Bhopal district (157.26 gram). This reveals that entire state is deficit in this regard. Of those 84 per cent districts of the state are excessively deficient.

MINERALS AVAILABILITY

Minerals constitute an essential part of a perfect human diet. Three types of minerals are necessary in the diet, calcium, phosphorus, and iron. Bones and teeth are made up mainly of calcium and phosphorus, and iron is an important constituent for stimulation of blood formation.

Calcium gives strength and hardness in the teeth and bones. Besides, the contraction of the heart and muscles is activated by a proper intake of the calcium. Fortunately, milk, cheese, green leafy vegetables are sufficiently rich in this mineral. Many of the cereals contain some amount of this nutrient but rice is very deficient and therefore, insufficiency of calcium is one of the most important defects of the diet of rice eaters. The availability of this mineral is 506.01 milligram per caput per day registering 43.78 per cent deficiency. About 95 per cent districts of the state are deficit in this regard. Only two areas, viz. Morena plateau and the Chhatarpur upland are classed as surplus

The utilization of calcium in the body is closely related to that of phosphorus because most of the calcium is deposited in the body either in the bones or teeth as calcium phosphate. Cereals, pulses, nuts and oilseeds are rich in phosphorus. Phosphorus deficiency is rarely encountered in the state because the food consumed by the population is predominantly cereal based. Madhya Pradesh is 48.08 per cent surplus in phosphorus availability. It ranges from 2843.54 milligram in Vidisha district to 821.28 in Bhopal district. About 91 per cent districts of the state are surplus in the availability of phosphorus

Iron is an important factor in determining the capacity of the blood to transport oxygen to the tissues. Green leafy

vegetables and millets especially bajara is good source of this nutrient. The state is excessively surplus in the availability of iron (84.65 per cent), when comparison made with the recommended requirement. It ranges from 14.8 gram in Surguja district to 75.48 gram in Vidisha district. Spatially, entire state is surplus in the availability of iron

VITAMINS AVAILABILITY

They are essential for body growth and health. It has been seen that many diseases like night-blindness, dental decay, dental caries, scurvy, beri-beri, etc. are chiefly the result of the deficiency of vitamins. Most of the vitamins are now being referred to in a majority of cases by names relating to their chemical structures, as for example carotene (Vitamin A), thiamine (Vitamin B₁), etc.

Vitamin A (carotene) is present in some animal products like butter, ghee, whole milk, curd, etc. Leafy vegetables such as spinach, amarnath leaves, etc. as well as ripe fruits such as mangoes, papayas and tomatoes are rich in this vitamin. The availability of carotene is about 548.64 microgram as against the recommended requirement of 1500 microgram, within the state. It varies from 148.99 microgram in Rajgarh district to more than 1005.89 microgram in Chhatarpur district. Spatially entire state is excessively deficit in the availability of this vitamin

Vitamin B₁ (thiamin) is concerned with the proper functioning of the nervous system and with carbohydrates metabolism. Its deficiency results in many diseases, viz. digestive disturbances, growth failure, weakness, anemia, beri-beri, etc. Among the commonly used foods the richest sources of thiamin are unmilled cereals, pulses, and nuts, particularly groundnut. The availability of thiamine is 1.6 milligram as against

the recommended requirement of 1.3 milligram, suggesting a slight sufficiency of 23.08 per cent. It ranges between 0.52 milligram in Raigarh district of the Chhattisgarh basin in the east and 3.68 milligram in Vidisha district of the Malwa plateau. Nearly two-third state is surplus in the availability of this vitamin. These areas extend over the Madhya Bharat plateau, the Bundelkhand uplands, the Rewa plateau, the Malwa region, and the adjoining areas of the Satpuras

Vitamin B₂ (riboflavin) is concerned with several oxidation processes inside the cell. Deficiency of riboflavin in daily diet may cause loss of hair, soreness of the lips and tongue. Wheat, pulses, green leafy vegetables, milk, egg, fish are good sources of riboflavin. Availability of this vitamin in Madhya Pradesh is 1.07 milligram as against the recommended requirement of 1.4 milligram, suggesting a deficiency of 23.57 per cent. It ranges between 0.48 milligram in rice growing Durg district of the Chhattisgarh basin and 2.27 milligrams in wheat growing Vidisha district of the Malwa plateau. About 29 per cent districts of the state are surplus, while rest of the 71 per cent districts are deficit in the availability of riboflavin. Surplus areas extend over the Madhya Bharat plateau, the Bundelkhand upland in the northern part of the state; and the adjoining areas of the Malwa plateau in the western part

Vitamin B₂ (niacin) is a vitamin intimately concerned in several metabolic reactions. Deficiency of niacin causes pellagra disease. Cereals, pulses, nuts and meat are good sources of niacin and groundnut is particularly rich in this vitamin. The availability of the vitamin is 14.06 milligram as against the standard requirement of 12.6 milligram, suggesting a slight sufficiency of 11.59 per cent. It ranges from 7.41 in Jabalpur district to 28.16 milligram in Vidish district. Spatially, all parts in the

south of the Narmada-Son valleys are deficient, while areas north of them are surplus in the availability of niacin

Vitamin C is found in fresh fruits and green vegetables. Besides, orange, lemon grape-fruits, and amla are its richest sources. Madhya Pradesh is seriously deficient in the availability of this vitamin. The availability of vitamin C is 5.66 milligram per caput per day against the requirement of 49.0 milligram. It ranges from 1.62 milligram in Durg district to more than 17.0 milligram in Indore district. Spatially, entire state is excessively deficient in the availability of this vitamin. More than 90 per cent districts of the state are conspicuously deficient

NUTRIENT AVAILABILITY REGIONS

The spatial and regional disparities in the situation of nutrient availability in Madhya Pradesh will be more clear by the determination of nutrient availability regions. This regionalization has been based on the grouping of the districts by making use of the Kendall's ranking method (Kendall, 1939). Districts are ranked in descending order for each of the indices and then, obtained ranks are summed and averaged to find composite score for each district. The first ranking district, has the lowest availability, and the last ranking district, has highest availability of nutrients. The regions are based on the availability of twelve nutrients, viz. calories, proteins, fats, carbohydrates, vitamin A (carotene), Vitamin B₁ (thiamin), vitamin B₂ (riboflavin), vitamin B₂ (niacin), vitamin C, calcium, phosphorus, and iron. Three types of nutrient availability regions may be recognised, i.e. dynamic, prospective, and problematic

I. DYNAMIC AVAILABILITY REGIONS

They cover forty per cent districts including about one-third of the total population (31 per cent) of the state and extend

in three compact areas, (i) the Malwa plateau in the west, (ii) the Bundelkhand upland in the north, and (iii) the Madhya Bharat plateau in the extreme northern part of the state.

The Malwa plateau is a fertile black soil tract and agriculturally developed part of the state. The nutritional availability is quite large because of smaller degree of population concentration and surplus production of foodstuffs. The density of population is lower than that of the Chhattisgarh basin. Proportion of net sown area in this region is very high, intensity of irrigation and double cropped area is moderate. Consequently, the high nutrient availability in these areas is associated with the small size of population, more food production, and more agricultural development.

The Madhya Bharat plateau is the second high nutrient availability region. Food production is higher than the size of population in this part, especially the Morena plateau yielded higher food production in combination with larger population. The Lashkar plain and the Khichiwara plateau registered high food production and medium population size. As a whole this is one of the most developed parts of the state in terms of agriculture.

The Bundelkhand upland occupies Tikamgarh and Chhatarpur districts of the state. The Chhatarpur upland registered medium food production but smaller population, while Orchha upland (Tikamgarh) registered lower food production with smaller population size. These are the areas where the agricultural conditions are not different from those of the Madhya Bharat plateau.

II. PROSPECTIVE AVAILABILITY REGIONS

Nearly one-fifth districts supporting about 16 per cent population of the state recorded moderate availability of nutrients. They include the Rewa plateau and the Damoh plateau in the north; the Gwalior plain of the Madhya Bharat plateau; the western Sondwara plateau of the Malwa region; the Hoshangabad plain of the Narmada valley; and the Betul plateau and the Maikal plateau of the Satpuras. These areas are those parts of the state where net sown area is small and the area under double cropping is large. The population size is small.

The Rewa plateau recorded high food production and medium population size, while Damoh plateau supports smaller population and low level of nutrient availability. The situation in the Betul plateau, the Panna range, and the Sondwara plateau is similar with the Damoh plateau. The Gwalior and Hoshangabad plains are the areas where population size and food production both are medium.

It, therefore, follows that the prospective nutrient availability regions generally have medium or smaller size of population. They yield low to medium amount of food production.

III. PROBLEMATIC AVAILABILITY REGIONS

About forty per cent districts supporting about 53 per cent population of the state recorded lower availability of nutrients. They extend over the Dandkaryana, the Chhattisgarh region, the Baghelkhand region, and the Satpuras. These are those parts of the state where density of population is highest and the cultivated area is small. The proportion of backward classes is high in these areas.

The rice growing tribal Dandkaranya in the extreme southern part of the state, recorded lower availability. It is associated with the very low proportion of cultivated area (only 19 per cent) and very high proportion of forested area (64 per cent). Area under double cropping, irrigation, high yielding varieties, and use of fertilizers is very low. These conditions resulted in lower food production and the level of nutrients availability is consequently low.

The Chhattisgarh basin, the rice bowl of the state, also recorded low level of availability. It is the most densely populated part of the state. The proportion of cultivated land is medium; and the double cropped area, irrigated area is high and very high respectively. But the larger size of population results in lower availability. Other conditions are not different from those of the Dandkaranya region.

The Baghelkhand undeveloped region recorded very low proportion of net sown area, irrigated area, double cropped area, and lower productivity of soils. These conditions resulted in lower food production and lower availability of nutrients.

The entire Satpura region except the Betul plateau also recorded lower availability of nutrients. The proportion of cultivated land, and double cropped area is very low. On the other hand size of the population is large. These conditions result in the lower availability of nutrients.

It, therefore, follows that the lower availability areas are generally those parts of the state where either the population size is very large or the agricultural development is low in comparison to the population size. Besides, the more urbanised parts of the

state evidence lower level of nutrient availability because of very low amount of food production and a larger size of population.

CONCLUSIONS

The quantitative and qualitative aspects of nutrients availability, have been discussed in the present study, are the best indicators to the determination of nutrient availability regions. The quantitative nutrient (calories) availability is about 1965 calories as against the recommended requirement of 2400 calories, suggesting a net deficiency of 18 per cent. About one-fifth of the total districts of the state are surplus in the availability of calories. They extend over the Kauntal plateau, western Umatwara plateau, northern part of the Malwa plateau, and the Raisen-Vidisha plateau. Nearly two-third districts of the state are deficient in this regard. They extend over the Dandkaranya, the Chhattisgarh region, the Baghelkhand region, the Central Madhya Bharat plateau, the Rewa plateau, the Bundelkhand uplands, the Narmada valley, and the Satpuras.

Madhya Pradesh is deficient in the availability of proteins, fats, carbohydrates, calcium, vitamin A (Carotene), vitamin B₂ (riboflavin), and vitamin C. It is surplus only in terms of the availability of iron, phosphorus, vitamin B₁ (thiamin), and vitamin B₂ (niacin). Nearly one-third population (31 per cent) of the state recorded surplus nutrient availability and about one-sixth (16 per cent) population recorded moderate deficiency of nutrients, while rest of the population (53 per cent) of the state is malnourished.

The areas in the north of the Narmada-Son valleys are surplus in the availability of nutrients and those in the south of the valleys are deficient in this regard. Moreover, the Malwa plateau, the

Madhya Bharat plateau, and the Bundelkhand upland are the surplus areas of the state, while the Narmada valley, the Satpura-Maikal region, the Baghelkhand region, the Chhattisgarh region, and the Rewa plateau are the deficient areas in respect of the nutrients availability.

It, therefore, follows that the rice growing eastern districts of the state are deficient in nutrients availability, while the western and northern areas of the state are surplus. The Narmada-Son valley stands as a divide between the surplus north and the deficit south.

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