



## Nutritional Status, Dietary Diversity and Household Food Security of Population in Arid Western Rajasthan

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**Abstract:** The study uses cross-sectional data of a sample of 350 individuals from two villages of Jodhpur district of western Rajasthan. This paper examines the socio-demographic characteristics, extent of food security, diet composition and diversity as well as nutritional status at the household level. To this end, subjective and objective measures like Household Food Insecurity Access Scale (HFIAS) and Household Dietary Diversity Score (HDDS), 24-hr dietary recall and BMI were employed. Average HFIAS score of the villages were 0.83 and 0.90 representing 70-74% of population as food secure. Mild food insecurity was observed in the area specifically of qualitative nature rather than quantitative. Dietary diversity scores for the villages were 7.23 and 6.96. Per capita intake of calorie and protein were found 2001.04 kcal and 59.96 g, respectively. Dietary deficiency of fresh fruits and vegetables reflected in lower availability of beta-carotene and vitamin-C through the diet. Findings suggested that around 30% of the selected population was having low BMI and women were more prone to under nutrition compared to men.

**Key words:** Food security, socio-demographic characteristics, dietary diversity, nutritional status, beta-carotene.

Worldwide there is a significantly greater proportion of dry lands spread in almost 3 billion ha characterized by high evaporation rates, run off and high day temperature with lower humidity and soil fertility. Hundred per cent of arid to hyper arid lands are in developing countries (Millennium Ecosystem Assessment, 2005). As far as India is concerned, 75% of total arable land (108 Mha) of the country is rainfed. Around fifty per cent of this rain fed area comes under dry lands ( $\approx 47$  million hectare) spread in the north western plateau of India known as Great Indian Desert (Thar). Rajasthan is a state covering largest portion ( $\approx 61\%$ ) of this dryland area geographically, which forms the eastern extremity of the great arid and semi-arid belt of the world (Sharma and Mehra, 2009). It is the most populated desert area in the world compared to Arabian and Sahara with high desertification rate and increasing loss of inherent biodiversity. Harsh climatic conditions in such areas affect the lives of human and cattle adversely and make it difficult and insecure (Dhir, 2003). Unstable state of agriculture and regular famines made food security in these areas a

cause of concern not only for the government but also for community at large (Rao *et al.*, 2003). Historically, because food security was envisioned at the regional and national level and was considered synonymous with national food self-sufficiency, it was principally measured at the macro level by assessing national food production and supply (Maxwell, 1996). However, the aggregated measures at national level often mask major disparities at the micro level. Further, to help policy planning and effective allocation of resources, food security must also be considered at the household or individual level. In addition, not only food availability but also access to food has to be taken into account Sen (1981). Prevalence measurement should also include subjective perception of food security which should result in food sufficient in quantity and quality (FAO, 1996). In India, though the country has become self-reliant in food production but still there are disparities in availability and the condition of every state is different in this aspect. Being a state with widespread dry land, food security is an area of concern in Rajasthan. Thus, the present research attempts to study the macro and micro aspects of food access and availability by analyzing

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food security status, dietary diversity, per capita availability of nutrients and nutritional status in rural households of desert areas of western Rajasthan. The need of such studies are high for many operational agencies which are involved in regular measurements and monitoring of changes and for assessing the impact of food and agricultural programs. Further, such databases help in effective futuristic planning and management in the target areas.

## Materials and Methods

### *Setting, sampling and design*

In India, Thar Desert, forms a part of the country's north-west arid zone. The study was carried out in Jodhpur district located between 26.2900° north and 73.0300° east. The annual precipitation in the study area is low, and ranges from 250-300 mm. It is highly erratic and about 90% of the rainfall is received during July and August. Delayed onset and early withdrawal of monsoon is quite common. Summer temperature remains high, reaching up to 48°C in May and June at some places. Dust storms are quite common with wind velocity above 30 km hr<sup>-1</sup> (CAZRI, 2001). Our survey unit was the household, which was defined as a group of persons sharing housing and meals, managing a common budget, and led by a head of household. For study purpose Bheejwadia and Ummednagar villages of Osian *panchayat samiti* (administrative unit) were selected randomly. Both the villages were rainfed and mono-cropped while some areas of the village were partially irrigated by tube wells. Cereals, pulses and vegetables were grown mainly in the villages. The households in each village were selected by cluster sampling. A total of 30 households were selected from each village representing different caste, landholding size and settlement pattern. This paper presents results for two rounds of data collection on a random sample of 60 households covering 350 individuals. The first round of data collection took place at the beginning of the rainy season (end of May to mid-August) and the second round took place at the beginning of the dry season (mid-October to mid-December) during 2012-13. All the data were collected by trained enumerators through face-to-face interviews.

## Objective Methods

Primary and secondary data were collected for the purpose of study. Various subjective and objective indicators were used to measure the availability, access and utilization of food.

### *Food availability*

24-hr dietary recall was used to collect the food intake data. Availability of food grains (cereals) and other food groups like pulses, milk, vegetables etc. were also calculated by measuring the consumption (g or ml/cu/day) in the study area. Supply of various nutrients through diet was also calculated and compared with the recommended dietary allowances (RDA).

### *Food access*

Food access is strongly linked with list of entitlements that includes initial endowments such as land, assets etc. and what is available with exchange like the price of their produce or the wages. To measure the food access information on assets most importantly land, educational level, occupation and annual income was collected and used for deriving the socio-economic status of households. Socio-economic status was calculated using the method of Kuppaswami (1986) adapted with some modifications. This is a multidimensional score based method that takes in to account the above criterion, (educational level, occupation, income and land size) and is highly useful as field survey instrument.

### *Food absorption*

To assess the food absorption, nutritional status of the population was measured using Body mass index (BMI) to provide additional complementary data of the prevailing nutrition situation of the area. It was also assessed on gender basis to understand the difference between the food availability and absorption in males and females.

## Subjective Methods

Two subjective indicators, household food insecurity access scale (HFIAS) which formally measures several dimensions of household food insecurity, and the household dietary diversity score (HDDS) which complements this measure by the assessment of household dietary adequacy was also used in the survey.

### *Socio-demographic features*

Data was collected on socio-demographic aspects such as caste, age, sex, number of family members, education, size of land holding, agricultural pattern in different seasons, major crops, availability of irrigation water, irrigation sources, production level, occupational information, drinking water availability, hygiene, gender preference, etc. by personal interview using a pre-structured interview schedule by trained enumerators qualified in survey administration and collection of quantitative and qualitative information.

### *Socio-economic status (SES)*

For assessment of socio-economic status modified Kuppaswami scale (Kuppaswami, 1981; Ghosh and Ghosh, 2009) was used. In the modified scale, the educational and occupational criterion remains the same. However, to modify economic criteria, national urban consumer price index for India was noted for the year (2011-12) and the conversion factor between the index of 1976 and 2012 was determined. Subsequently, all the income groups in the scale were multiplied with the conversion factor to get appropriate income groups.

### *Dietary survey (24-hr recall)*

Dietary data was obtained from the respondents through an oral questionnaire of diet survey using a set of standardized cups suited to local conditions. Multiple recalls were carried out with the help of trained enumerators. For this purpose, housewife or a member (respondent) who invariably cooks and serve food to the family members was asked about the types of food preparations made according to meal pattern during the previous 24 hours. An account of the raw ingredients used for each of the preparations was obtained. Information on the total cooked amount of each preparation was noted in terms of standard cups by weight/volume. Manual calculation of nutrient intakes was carried out for each respondent with the help of food composition table (Gopalan *et al.*, 2000).

### *Body mass index*

Individuals (adults > 18 yrs.) were classified according to their BMIs based on classification

proposed by WHO (<http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi>). For this purpose, all the members in the household were examined for anthropometric measurements (height and weight). The measurements were taken following standard techniques (Bamji *et al.*, 2010). Body weight is the most widely used and the simplest reproducible anthropometric measurement for the overall evaluation of nutritional status. For measurement of body weight electronic balance (Atlas weighing equipments, India) was used. Height was measured by using antropometer on a leveled surface, without shoes, looking straight with heels together and toes apart. To calculate the body mass index (BMI) following formula was used.

$$\text{Body mass index (BMI)} = W / H^2$$

W = Weight (kg), H = Height (mt)

### *Dietary data and household food insecurity access scale (HFIAS)*

It has been defined as a gold standard promising tool to measure the adequacy of household's diets (Becquey *et al.*, 2012; Knueppel *et al.*, 2010; Maes *et al.*, 2009; Haddad *et al.*, 1994). This tool has already been tested for external validation and is quite efficient in measuring the household food insecurity conditions in both rural and urban settings (Coates *et al.*, 2007; FANTA, 2003). The standardized HFIAS questionnaire, which consists of a list of 9 specific questions about worry, availability and accessibility to foods for the household during the previous 30 d, was field tested and used. The standard procedure for scoring was used: zero was attributed if the event described by the question never occurred, 1 point if it occurred 1 or 2 times during the previous 30 d (rarely), 2 points if it occurred 3-10 times (sometimes), and 3 points if it occurred 10 times (often). For each household, the HFIAS score corresponded to the sum of these points and could range from 0 (food security) to 27 (maximum food insecurity). The respondent was preferably the spouse cooking in the household or the head of the household. Average HFIAS score for the sample population was computed by the following formula.

$$\text{Average HFIAS score} = \text{Sum of HFIAS scores in the sample} / \text{Number of HFIAS scores in the sample}$$

Household food insecurity access prevalence (HFIAP) status indicator is an additional indicator used to report household food insecurity prevalence. The HFIAP indicator categorizes households into four levels of household food insecurity; food secure, mild, moderately and severely food insecure. Household food insecurity access prevalence was computed by using following formula.

$$\text{HFIA prevalence} = (\text{Number of households in HFIA category}) \times 100 / \text{Total number of households}$$

#### *Household dietary diversity score (HDDS)*

The household dietary diversity score (HDDS) is meant to reflect, in a snapshot form, the economic ability of a household to consume a variety of foods. Dietary diversity score of each family were created by summing either the number of individual foods or food groups consumed over the reference period. The HDDS of sample population can be created by the following formula.

$$\text{Average HDDS} = \text{Sum (HDDS)} / \text{Total number of households}$$

For this purpose, an open qualitative recall of all foods consumed during the previous 24 h was performed with respondent, preferably a woman or the head of household. From this open qualitative recall, the enumerator, with

the assistance of the respondent, checked which food groups were consumed from a list of locally adapted food groups. The HDDS was constructed according to FAO (2007) recommendations by recompiling all the food groups in 12 food groups and attributing 1 point for each group consumed in the previous 24 h. The score (0-3) reflected as poor, (4-6) as fair, (7-9) as good and (10-12) as very good in terms of dietary diversity.

#### *Statistical analysis*

All the statistical analysis was done using MS Excel. Simple descriptive statistics was used by taking the sampling design into account. Clustered smooth column plots were drawn to graphically represent the relationship between each of the candidate indicators. Bivariate and multivariate correlation coefficient were calculated to study the relation among the selected study variables.

## **Results and Discussion**

### *Socio-demographic characteristics*

A total of 350 individuals were surveyed in two selected villages covering 60 households, 30 from each village. Most households comprised a male head of household with spouse, children and their parents. The particulars of households from each village are described in Table 1. As far as social and cultural setting of the area

*Table 1. General characteristics of sample population*

Socio-economic characteristics	Category	Bheejwadia (%)	Ummednagar (%)
Age	Up to 30 yrs	50.82	53.89
	31-50 yrs	25.96	26.34
	>50 yrs	20.99	18.56
Education	Illiterate	33.33	36.64
	Primary	34.50	30.68
	Secondary - High school	16.50	19.20
	Intermediate	5.67	10.15
	Graduate	10.00	3.33
Caste	General	13.52	13.23
	Other backward caste (OBC)	78.15	79.69
	Scheduled caste (SC)	8.33	7.06
Land holding size	Up to 3.5 ha	58.15	56.07
	3.51-7.00 ha	35.40	37.48
	> 7 ha	6.45	6.45
Family type	Nuclear	74.19	75.19
	Joint	25.81	24.81



is concerned, caste system was dominant that included people of general or forward castes like *Rajputs* and *Bramhins* and reserved classes such as other backward class (OBC) like *Patels* and Scheduled caste/tribe (SC/ST) *Harijans*. Educational level was found low with wide spread illiteracy especially among female. Factionalism, veil system, poor hygiene and gender preference towards male child was observed.

#### *Socio-economic status (SES)*

Socio-economic status of farm families was assessed by using modified *Kuppaswami* scale. Scores were provided for each attribute (educational status, occupation and monthly income of households). It was observed that approximately half of the population (53.33%) was in lower middle category and the percentage of households in upper lower category was lesser (33.33) in Bheejwadia village whereas in Ummednagar the percentage of households belonging to upper lower category were slightly higher (46.66) than the low middle category (43.33). Multiple livelihood strategies were adopted by farm families in both the villages. It was observed that three four or five livelihood strategies were adopted by maximum number of farmers. Agriculture was the major source of income and food. Other strategies of income generation like livestock rearing, labor activities, entrepreneurship and service were adopted by farm families as sources of additional external remittances.

#### *24-Hr dietary recall*

The dietary composition was assessed by 24 hr dietary recall method. Per capita nutrient

intake was also assessed for calorie, protein, iron, calcium, phosphorus, thiamine, riboflavin, niacin, beta-carotene and vitamin C on the basis of data obtained (Table 2). The per capita calorie and protein intake in Bheejwadia and Ummednagar villages were calculated and found as (2034.38 kcal, 59.96 g) and (1967.70, 58.95 g), respectively. The vitamin and mineral intake was also assessed. The average per capita intake of beta carotene and vitamin-C was found highly deficient in the population which may also be correlated with the deficient intake of fresh vegetables and fruits which are the major sources of these nutrients.

#### *Nutritional status of the population*

Nutritional status was measured by calculating body mass index (BMI) of adult individuals. All the individuals having body mass index more than 18.50 were considered as normal. The cases which reflected BMI, <18.50 were subdivided in to three categories according to the degree of severity viz. severe (BMI<16.00), moderate (BMI 16.00-16.99) and mild (BMI 17.00-18.49), respectively. A total of 181 adult individuals were surveyed from 30 households at village Bheejwadia. Data pertaining to BMI revealed that 29.43% of individuals were having low BMI. When the cases were further categorized according to the degree of severity it was revealed that severe, moderate and mild cases were 8.90, 8.21, and 12.32%, respectively (Table 3). Higher proportion of women had low BMI as compared to men. It was seen that a total of 15.05% of woman were having low BMI and percentage of severe and mild cases were higher in women. Analysis of the incidence of low

Table 2. Nutrient intake of selected population

Nutrient	Bheejwadia	Ummednagar	RDA (ICMR)
Calorie (kcal)	2034.38	1967.70	2300
Protein (g)	59.96	58.95	60
Iron (mg)	19.27	19.30	21
Calcium (mg)	611.71	604.43	600
Phosphorus (mg)	1567.12	1510.53	600
Beta-carotene (µg)	941.73	807.62	4800
Thiamine (mg)	1.88	1.87	1.4
Riboflavin (mg)	2.56	2.80	1.4
Niacin (mg)	17.69	19.83	17
Vitamin-C (mg)	20.42	25.96	40

\*Computed on the basis of Gopalan *et al.*, 2000.

\*\*RDA - Recommended Dietary Allowance values were taken from [http://www.pfndai.com/Draft\\_RDA-2010.pdf](http://www.pfndai.com/Draft_RDA-2010.pdf)

Table 3. Gendered classification of under nutrition

Grades of BMI	Incidence of under nutrition (%)			
	Beejwadia		Ummednagar	
	Male	Female	Male	Female
Severe (<16.00)	3.42	5.47	1.68	5.82
Moderate (16.0-16.99)	6.16	2.05	2.41	4.25
Mild (17.00-18.49)	4.79	7.53	3.33	12.50
Total	14.37	15.05	7.42	22.57

BMI in different socio-economic conditions in Beejwadia village revealed that the aggregate percentage of cases of low BMI was more in low middle category than the upper lower because of high population. However, severity wise upper lower category was more prone as more numbers of severe cases were found in this class compared to lower middle category.

Likewise, a total of 167 individuals were surveyed from 30 households in Ummednagar village. The extent of malnutrition in Ummednagar was not much different than Beejwadia. A total of 29.99% cases of low BMI were observed, among which severe 7.5, moderate 6.6 and mild cases were 15.83%, respectively in the sample population. It was further observed that in Ummednagar village the extent of low BMI among females were quite higher 22.57% than the males 7.42%. When the incidence of low BMI in different socioeconomic status was explored in this village it showed an obvious trend. The cases of low BMI were highest in upper lower category 20.16%, followed by low middle category 13.44%, and upper middle class 0.84%.

Significantly negative correlation ( $r = -0.135$ ) was found between the age and nutritional status of individuals. When it was further

studied on gender basis among males and females selectively highly significant negative correlation ( $r = -0.307$ ) was observed between the nutritional status and age of females. When the correlation between socioeconomic status and BMI was explored it showed a significant positive correlation ( $r^2 = 0.173$ ) between the variants which showed as the SES increases the nutritional status also increased.

#### Household food insecurity access scale (HFIAS)

Household food insecurity access scores (HFIAS) were used to measure the subjective perception of food security. Average HFIAS score for village Bheejwadia and Ummednagar were 0.83 and 0.90, respectively (Fig. 1).

Household food insecurity access prevalence test (HFIAP) categorizes households as food secure, mildly food insecure, moderately food insecure and severely food insecure and help to understand the severity. The study indicated that in village Bheejwadia and Ummednagar, 70-74% of households were food secure. None of the households were found in severely food insecure category in both the villages. Mild food insecurity was seen in 23-26% of population, while about 3-4% were moderately food insecure.

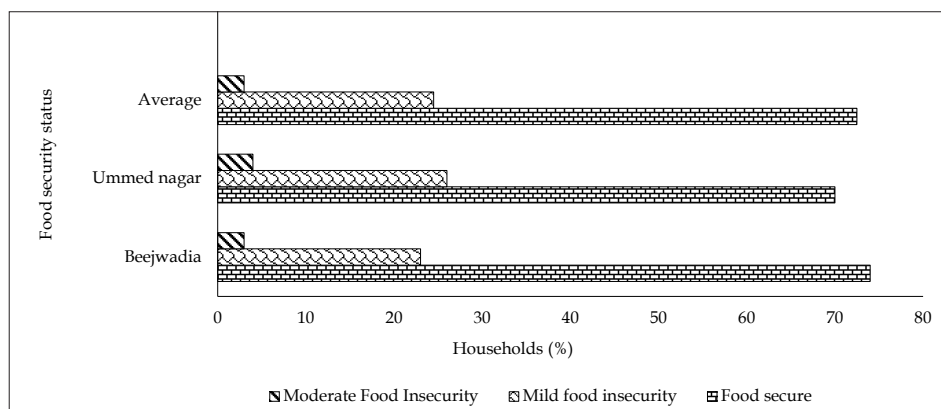


Fig. 1. Food security status of households.

### Household dietary diversity score (HDDS)

Dietary diversity reflects the involvement of different kind of food groups in the diet which is related to the economic ability of the household regarding access of foods and dietary adequacy as per the nutritional requirements. All the information related to dietary diversity was collected from the women member of the household primarily responsible for meal preparation and serving. Average HDDS for village Bheejewadia and Ummednagar was 7.23 and 6.96, respectively, which reflects the average availability of 12 standard food groups in the diet of households (Fig. 2).

As far as dietary profile is concerned it was observed that pearl millet (bajra) was the staple food grain cultivated due to lack of irrigation facility with majority of farmers. In addition to pearl millet mainly pulses contributed as the second largest part of the typical diet of the people. Some farmers who had assured irrigation facility cultivated wheat in their farms. As stated earlier livestock was an integral part in the life of the people thus the availability of milk and milk products was good in their regular diet. Scarcity of water to grow fresh green vegetables had their effect on the diet. Vegetables, which grow itself as wild in the farmers' fields in kharif such as *kachri* (*Cucumis calosus*), *kachra* (*Cucumis calosus*), *mateera* (*Citrullus lanatus*), *tindsi* (*Praecitrullus fistulosus*) and leguminous vegetables like cluster bean (*guar phalli*), were largely eaten especially by those families who did not have assured irrigation facility to cultivate vegetables. Dried pods (*sangri*) of *Prosopis cineraria* (khejri) were also used for vegetable purpose. People used

to preserve '*kachri*', '*sangri*', and '*guar phalli*' by sun drying to eat in the off season. Farmers having assured irrigation facility were taking lady finger, brinjal and cucurbits in kharif and spinach, tomato, cauliflower, cabbage, peas, onion and garlic in rabi season. Consumption of fruits was quite low. However, inclusion of seasonal wild fruits was observed in the diet like, *mateera* (*Citrullus lanatus*), muskmelon (*Cucumis melo*), round melon (*Praecitrullus fistulosus*), *kakdi* (*Cucumis spp.*), *ber* (*Ziziphus mauritiana*), *aomla* (*Phyllanthus emblica*), *pilu* (*Salvadora oleiodes*), etc. Consumption of animal products like meat and eggs was very low due to the religious reasons.

As far as the food security of population was concerned it was affected by several factors. The situation of mild food insecurity reflects the worry of the households regarding adequacy of diets or the qualitative aspects rather than quantity which indicated that there was no direct food shortage but people were getting limited variety of food stuffs. Availability of cereals such as wheat, vegetables and fruits was limited for reasons stated above. Overall, variety in their food basket was found low. They were also concerned sometimes about the future food security of the households, which could be understood as agriculture was not very promising in the region, generally possible in one season only, households were primarily dependent on the yield of their own field for the food supply and if the yield get affected due to some reason such as drought or crop diseases it adversely affects the food security. Dietary diversity was certainly found low as the households were having limited

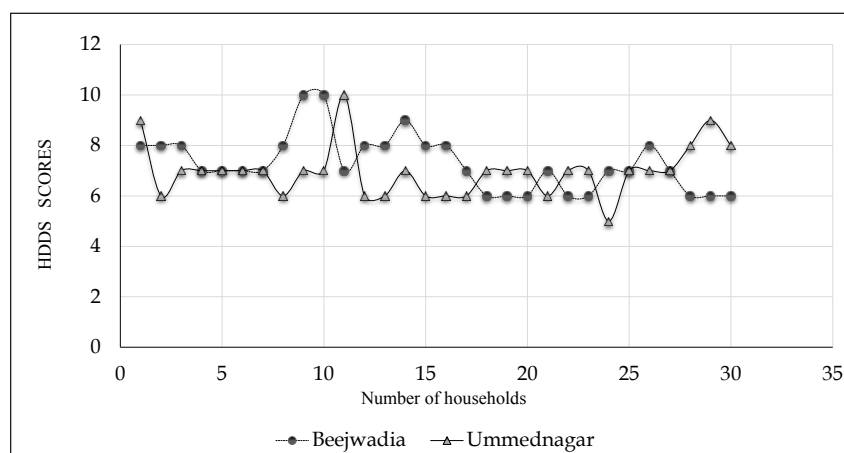


Fig. 2. Household dietary diversity in the selected villages.

choice of food. Moderate food insecurity was observed in 3-4% of population which were landless and having labor wages as the primary source of their livelihoods. Here it is essential that the term 'diet lower in quantity' should not be confused with the 'absolute hunger'. The major food item in their diets were pearl millet bread and rarely wheat, local available vegetables and pulses. The consumption of vegetables, pulses and milk and milk products was certainly low due to lower purchasing power of such households. Goat milk was mostly used for household purposes in these sections. Fruits and green vegetables were rare in their diets. The diet available was having very low diversity and absolutely lacking preferred food items.

## Conclusions

It may be concluded that food insecurity does exist at household level and its severity varies across areas, socio-economic status, genders and it also has a seasonal dimension. Since, people were following livestock mix farming, the area was under partially irrigated system and economic access also increased due to more employment opportunities in non-farm sector. Regarding the availability of different food groups and dietary diversity, it was fair in the study area. People were using their own diet related indigenous coping strategies to cope up with the natural scarcity. Households with lower income were more food insecure particularly those who did not have good land size and irrigation facility and depend largely on labor wages. The extent of under nutrition was approximately similar in both the villages but its severity varied across genders and SES. There was positive correlation between prevalence of under nutrition and socio-economic status and more severe and moderate type of under nutrition prevailed in the lower socio-economic strata. There is lot of scope for improvements particularly for the resource poor sections of the community where the status is not very appreciable and efforts are needed to increase the level of income to improve the food access then only the their future can be better secured.

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