A Study on Food Security Situation of Rural Households in Sistan Baluchistan Province, Iran

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Abstract: Reduction rainfall during 1998 and consequently significant reduction in the input water of Hirmand river, caused drought in Sistan and Balouchestan Province. The drought reduced crops on one hand decreased the income of the majority of rural community of this province. On the other hand has lead to remarkable changes of households feeding patterns. Therefore, this study has tried to investigate, both agricultural production and food security situation in the region. Investigations on crop and garden production during ten year period (1998-99) showed the effects of drought conditions on crops is more than garden productions. The research finding showed that improving the income of rural households. The result also showed that a relative improvement in food security during recent years and despite the occurrence of severe drought and fluctuations in agricultural production levels in the process of food security in rural areas has remained at the same level.

Key words: Food security • Farm production • Garden production • Food expenses • Food security index

INTRODUCTION

Providing food is one of the most important today's human needs. Food security is achieved when all people, in terms of quality and quantity, have access to enough, healthy and nutritious food and provide their needs and priorities for a healthy and active life [1].

When the food issue has been discussed in the global food crisis in 1970, the principle of food security in a form of a conceptual definition was formed [2]. In early 1970's, a hard food crisis due to the uncomfortable weather conditions was occurred for the world in which, in addition to the OPEC oil price rising in 1973, energy prices and other agricultural resources including fertilizer have increased causing the world to wait for the food crisis [3].

The concept of food security is widespread as determined by the interaction of biological, economical, social, agricultural and physical factors and, in order to all peoples’ access, requires adequate food provide and distribution at the macro level [4].

According to the definition of the food security, the concept of "all people's access to safe and adequate food at all times to have a healthy and vibrant life" and its coverage determined by the interaction of a range of biological, economical, social, agricultural and physical factors can be simplified by focusing on the three components of food security which are food availability, food accessibility and food utilization [5].

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life [6]. Food security for a household means access by all members at all times to enough food for an active, healthy life. In other words, food security is the guarantee of the physical availability of and economical accessibility to sufficient food (produced with bioenvironmental and sustainable social methods) in terms of quantity (amount, distribution, calories) and quality (safe, nutritious, balanced), while cultural admittance for all people at all times means having healthy and active lives to preserve human places and degrees [6].

Therefore, the food security index is formed of three major parts: availability, utilization, affordability [7] of which every one includes several subsets resulting the relationship is as follows below [8]:

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FSI= f (availability, utilization, affordability)

Using Engel relationship, Pajvian (2004) determined the households' cost basket of essential commodities. The results showed that bread, egg, sugar, tea and milk are the essentials in villages. Also, in terms of energy, than rural are located at a more suitable position than urbanites. Therefore, if energy shortages considered as a measure of malnutrition, urbanites are more exposed to malnutrition than villagers. Generally, this study confirms that about 30 percent of urbanites and 10 percent of villagers are exposed to food insecurity [9].

Using the index provided by the International Fund Agricultural Development (IFAD), Dini Torkamani estimated the food security at national level by using the raw data of FAO from 1369 to 1380. The index was based on six variables (self-sufficiency index, per capita distribution of required calorie index, the annual growth rate of food consumption, changes in food production, changes of food consumption and production index), respectively. Results showed that the synthetic indicator's rate was more than 1 at a macro level viewing the excessive food security at this level. He believed that high food security of society, at the micro level, can turn into insecurity by an inappropriate livelihood structure. Afterward, he started to evaluate the status of equality indicators (Ginny coefficient, top to down tenth consumption ratio). Ginny coefficient (0.40 for the urban population and 0.43 for a rural community in 2002) and top to down tenth consumption ratio (14.2 and 18.7 for city and village, respectively) represent the unequal distribution of income and consumption in the community and it can be concluded that with these conditions of inappropriate distribution, a considerable percentage of households are living in unsuitable conditions [10].

Using AHFSI indexes, the level of food security was estimated by Khodadad Kashi and Heidari. Findings indicated that the household food security had an ascending trend in cities from 1985 to 2000 and the numeric value of the food security index has enhanced from 87.8 percent in 1985 to 96.4 percent in 2000. It, as well, had an ascending trend in cities from 1986 to 2000 and the numeric value of the food security index has enhanced from 72 percent in 1986 to 94.9 percent in 2000 [11].

Using a two-stage demand model, Ye and Taylor have evaluated the effect of income increasing on food elements usage by the rural households in a northern region of China. The results showed that as costs of food have changed, food demand of households within the group of foods was altered from cheaper foods to more expensive ones. It was illustrated that the annual information cannot properly show the seasonal fluctuations in relation to the food element usage and panel information is needed [12].

Sardana et al. has evaluated the food costs in India states from 1965 to 1985 results showed that t the status of various states in terms of consumption patterns is significantly different. For example, the largest monthly spending in the eastern states was for meat, egg and fish, but in Western states, was for fruits and spices [13].

A drought has occurred in the Sistan and Baluchistan province by the rain and, consequently, Hirmand river's input water reduction in 1999, which after more than ten years, still showing its effects. Previously, the Sistan region was named as the granary of Iran and after the drought, its production level was reduced to the point that it cannot provide the local people's needs. Diversity of the province's agricultural products including grain, forage, horticultural products and livestock production potential in recent years was limited to areas having water sinks. Also, the groundwater level in Baluchistan region has increasingly reduced. Hamon lake’s aridity has shaken the life of regional animal husbandmen. Lake's reed-bed annihilation has formed a great disturbance in food resources of livestock so that despite the reduction of native animals, especially cattle, malnutrition and livestock food shortage are markedly seen in the region, as well. Reduction of agricultural production on one hand and, on the other hand, lack of financial afford of Sistan and Baluchistan’s rural population of have remarkably changed the dietary patterns of households. Variations in benefits and costs during recent years are other possible reasons of food security evaluation in the province. With the economical problems caused by drought, agricultural jobs were forwarded to liar jobs. Being a neighbor of Afghanistan and Pakistan, the province is an area smuggled goods that climate problems caused by ongoing multi-year drought (north of province) and monsoon floods (resulted from southern Gono storms) has undeniably affected the tendency to contraband that has increased the miscellaneous income and, on the other hand, caused a reluctance to return to the main job (after the crisis) because of such jobs’ more interest.
Therefore, this study aimed to evaluate the agricultural existing products and food security situation in the region. This was a thematic study on food security of rural households in Sistan and Baluchistan, which, simultaneously, suitable index is used in order to make food security measurable. The past ten years (from 1998 to 2007) were considered because of the continuing drought crisis and the importance of the region’s current situation compared with previous years.

**MATERIALS AND METHODS**

Because the study was conducted at the macro level and the raw statistics were provided by relevant executive agencies and, on the other hand, due to lack of accurate calculation of food calories purchased by households (case study and questionnaire implementation), information used in this study was periodical information from 1998 to 2007 provided from related agencies. Herfindal index was used to study the phenomenon of diversity in agricultural production as well as the flexibility of households’ expenditure on food commodities [14]. If the products’ acreages of the studied years was used, calculating this index is as follow:

\[ I=1,\ldots,n \quad H_i = \sum p_i^2 \]

In this equation, \( p_i \) is the share of each product’s total under cultivation surface per year, \( H_i \) is Herfindal index and \( n \) is the number of products per year. If there are \( n \) products and their share of acreage is equal, Herfindal index would be \( 1/n \) and if there is only one product, its share would be equal to one hundred percent and Herfindal index would be 1. So, Herfindal index changes will be between 1 and \( 1/n \).

AHFSI was used for evaluating the food security of rural households. So:

\[ AHFSI = 100 - [H(G+(1-G)I^*) + \frac{1}{2}CV(1-H(G+(1-G)I^*))] \times 100 \]

In this equation, \( H \) and \( P \), are the percentage and number of people intake energy or protein below the standard, respectively; \( P \), is the studied total population. \( G \) is the intensity of food poverty, \( C_o \), is the standard energy or protein, \( C_o^\prime \), is the mean energy or protein intake below the standard and \( I^* \), is the Ginny coefficient of energy or protein distribution between poverty. The CV is equal to \( \frac{S}{\bar{z}} \), which CV is the over time variation coefficient of protein or energy supply, \( S \) is the over time standard deviation of protein or energy supply and \( \bar{z} \) is the over time mean energy or protein supply (Khodadad Kashi and Heydari, 2004).

**RESULTS AND DISCUSSION**

Signs of crisis in the province were obvious when raining decreased and Hirmand’s inflow water lowered so that the amount of cultivated crops had a seven percent reduction from 1998 to 1999 and, a year after, the acreage, at once, has reduced to half; because the garden products are mainly perennial crops, acreage reduction is not happened on one occasion and agricultural products have been continually reduced. What did not let the acreage be less than 60 thousand hectares were the extent of province and drought’s non-domination in southern regions of the province, in which taking out groundwater and aqueduct’s water was possible. However, in northern regions of the province, especially Sistan, digging deep and semi deep wells is not possible because it is located in Hirmand river’s alluvium and only in some areas of Sistan, 10 m deep sinks were dug and water was kept in concrete storage tanks to be used for crop cultivation during the drought crisis. Due to the high dependency to Hirmand river and cutting off its water inflow between 1998 to 2003, Sistan region surrounded by a chronic drought, which its effect on agricultural and horticultural production process is completely evident and we will evaluate it later. The average of acreage for agricultural and horticultural products during the studied period were 125, 309 and 39,829 hectares, respectively.

Evaluating the process of cereal production from 1998 to 2007 indicated major changes and fluctuations in production and, according to the ten studied years, most years have been coincided by drought with; drop in grain production especially wheat from 2000 to 2006 can be known as a drought-induced phenomenon that, with much fluctuations, only in 2007 could reach to cereal production rate of 1377.

Wheat and other grains were considered as the farmers’ dominant products in all studied years and were cultivated much more than other products, in a way that despite the occurrence of drought, 57.75 percent of the crops grown from 1998 to 2007 were wheat and other grains.
Industrial crops include oil seeds and tobacco and other products were less than one percent of crop products and, due to the limited cultivation and that they have been planted in areas which are supplied by water sources, have grown in the studied period affected by promotional training and governmental supports in oil seeds cultivation. Cultivating vegetables such as potato, onion, edible vegetables and other ones is generally common in the hillside of the Taftan mountains of Baluchistan so that its production’s fluctuations are less than other groups of crop products and, due to the water supply strategies, have a special stage and about 6.9 percent of the cultivated crops is specified to them.

Summer productions like other crop productions have experienced fluctuations during the study so that, by the occurrence of drought, once this group’s cultivation which has grown in 9636 hectares in 1999, had a 84 percent reduction to 1554 hectares and this level of planting continued with less fluctuations in the years after and, finally, due to the boom of off-season crops (grown under plastic) in southern areas of the province (Iranshahr, Chabahar and Konarak) and water flow in Hirmand river in a period which cereal cultivation (April 2003) was impossible but kitchen garden crops cultivation was not, it had a considerable growth; cultivation, very limited, was increased by government policies to develop the greenhouse complexes. The important point in this group of products is that farmers always prefer the cultivation of wheat and other cereal grains and because cereal grains cultivation is done between the months of November and December and the interval of cereal harvest is in late May and June and culture time of summer crops is in March, cereal cultivation is prior if there is land limitation. Study conducted from 1998 to 2007 show that about 8.1 percent of lands equal to 10,247 hectares has been allocated for kitchen garden crops.

Forage crops (alfalfa, clover, forage maize and etc) have a special and important stage because of feeding the farmers’ livestock that, after the grains, are at the second important position among farmers and assigned 22.75 percent of annual planting during the ten studied years and an average of 28,508 hectares of land were used for cultivating these crops. Production process of this group of products due to high water requirement is under the direct effect of drought crises and its production fluctuations, like other crops, faced a similar crisis time reduction.

Garden Crops: Because the adverse effects and inappropriate conditions have much more lasting effect on garden crops than farm crops and fruit trees yield after several years of treatment, farmers do more safeguarding and maintaining efforts. When rainfall is decreased and drought is begun, gardeners start to make decision for irrigating the fruit trees, which was begun with drilling sink in Sistan and drop irrigation in the southern areas of the province. Finally, gardens were ruined by the peak of the water crisis because a solution to their water problem had not been found. Thus garden crops will be evaluated in two groups: the first group is crops cultivated in both Sistan and Baluchistan and the second group are crops cultivated mainly in the southern areas of province.

First Group of Garden Crops with the Priority of Production in Sistan: Granule fruit (grapes, berries and etc) production has directly been affected by drought because except mulberry trees scattered in all parts of the province, grape was the predominant culture of Sistan’s orchards decreased in granule fruit acreage due to the occurrence of drought, which has significantly ruined the gardens in the northern parts of the province and the acreage of this group of products has decreased from 3140 hectares in 1998 to 1179 hectares in 2003 so their share of total products has decreased from 10 percent in 1998 to 2.88 percent in 2004 and 2005 indicating the low stage of this group of products. During these years, about 2000 hectares of granule fruit gardens and 60 hectares of granular fruits orchards have ruined without water; recovering this damage and providing new seedlings and planting them until their yield time require many years. Obviously, the gardens which were able to overcome the problems of water supply can survive in the years after. The almost constant level changes from 2002 to 2007 confirm this that although there was a water crisis, gardens kept up their existence. What is important is the water crisis effect only on the northern areas of province (Sistan) because neither it was possible to dig semi-deep or deep wells nor the water of the dug sinks was accessible; only some of the sinks’ water was utilized, so the water crisis between the provinces areas most affected the gardens of Sistan, which the process is observable in both granule and granular fruits. Accordingly, elimination of some of the gardens such as Yaghooti grapes gardens, which is the first rate grape in Iran, has a direct effect on the economical situation of rural households.
Second Group of Garden Crops with the Priority of Production in Baluchistan: Dried fruits cultivation, due to its high economical advantages, has thrived during the studied years. Because of the appropriate central provinces' lands for growing such products especially pistachio, pistachio orchards in the district of deep and semi-deep wells were expanded and, since the climate of Khash and Zahedan is very similar to Kerman province's pistachio-making areas, acreages were reached to a 100 percent development (more than 1200 hectares in 2007 compared to 2008) by promotional and educational supports of relevant agencies during the study period; due to the preparation of water reservations for constructing the gardens, the effects of drought for such fruits are insignificant.

Considering the importance of dates in the province, this product is evaluated apart from other semi-tropical products. This product is considered as the major product of the region's garden products cultivated in more than 70 percent of gardens’ acreage in the province and due to its tree resistance against drought and dehydration, is well accustomed with regional and local climatic conditions. This product's acreage, with slight fluctuations, had an upward procedure from 1998 to 2007 from 21,583 hectares in 1998 to 31,989 hectares in 2007—and 74.7 percent of the province's gardens have been allocated to it.

Citrus gardens had some culture fluctuations during the drought crisis and although these changes were relatively minor, they experienced 1958 to 1652 hectares reduction from 1999 to 2001. The subtropical fruits from the beginning of the study period to 2007 had slight fluctuation changes mainly because their orchards are located in the Taftan mountain’s downstream lands that in acute conditions of dehydration they could be provided by water. Actually, the little reduction in acreage was related to pomegranate and fig orchards located in Sistan region. Among the studied farm and garden crops, considering that drought crisis has minimally affected the southern areas of provinces, tropical products remained safe from the related stresses. Tropical fruits (banana, mango, coconut, melon and etc), unlike other farm and garden crops that have followed a fixed or sometimes a descending trend; have followed an ascending course during the study years. This group's acreage had a significant growth from 813 hectares in 1998 to 4496 hectares in 2007-550 percent Growth—which was mainly related to the increased acreage of banana developed during the case study by an appropriate location finding and concentrated supply of water resources in the southern areas of province; the acreage of bananas has increased from 477 hectares in 1998 to 3908 hectares in 2007 indicating that this share of tropical fruits has reached from 2.6 percent in 1998 to over 10 percent in 2007. The important matter is the reception of farmers and gardeners of the Southern region of Province's of the provided suitable situations in cultivating such products which, because of the region's high potential and favorable climatic, predisposes the crop production. Emphasizing on cultivation and banana gardens preservation and supports of agricultural organization of the province caused an ascending progress in producing these products.previously, fruits were imported from outside the province but, currently, the province has no need of this product and even to export it to other provinces. Konarak, Chabahar and Sarbaz are cities having the potential for cultivating and developing tropical fruits.

Cultivation and garden crop production's common process has shown the gardens growth and development, which has grown in both acreage and production rate. Acreage increasing from 31,000 hectares in 1998 to more than 44,000 hectares in 2007 and also production increasing from 190,000 tons to 326,000 tons indicate the crop growth and despite the occurrence of drought and its unfavorable effects on gardens, orchards development upward movement is not reduced.

Diversity of Farm and Garden Crops: According to Herfindal Index calculation and obtaining the diversity index, it is resulted that farmers are willing to culture cereal crops from farm crops and subtropical crops from garden crops (including dates, figs and pomegranates and etc); acreage has an important role in determining the amount of product varieties so when cereal cultivation is increased, diversity of products would be decreased and when, because of some reasons (including drought), a crop cultivation is decreased, the diversity of products would be increased. Diversity indexes obtained during this study show this results (the diversity indexes are 0.72 and 0.85 in 1998 and 2003, respectively.

Expenses of Rural Households: Costs of rural households’ evaluation shows that by households’ budget and expenditure (revenue) rising, families allocate a little amount of their revenue for food. However, minor changes in this direction can be seen which are resulted
from stresses concerning household costs and revenues. Share of rural household food costs has declined from 56 percent in 1998 to 45 percent in 2007 and the share of nonfood costs, Similarly, has raised from 44 percent to 55 percent demonstrating that as the income of households is increased, despite that they spend more money for buying food, they share less of their income to buy nonfoods (Engel theory).

Among this group, cereal, which appropriated much of the allocated budget, is the most important. Most of household food costs were allocated to this group of foods during the first three years of study period (1998-2000) and it was at the second stage in terms of household costs during the following seven years. On the other hand, expenses related to the meat had a uniform rising growth and has appropriated the highest average of 28.5 percent during the study years that show its special position in the consumption expenditure of the rural households. Fruits and vegetables, among other groups of household expenditure, are the third priority and have grown-up significantly during the study.

**Rural Households’ Flexibility of Food Commodities:**
According to the little fluctuation of ach foods group during the study period, it is expected that the flexibility index changes have little fluctuation that range of flexibility index (0.804 in 2007 and 0.826 in 2002) confirm it. On the basis, groups of foods have great flexibility (household budget flexibility decreases by the rising of one group's share).

**Rural Households’ Food Security in Sistan and Baluchistan:** To calculate the overall index of household food security, cost for household energy needs (according to 2300 kcal base) Payment should initially be calculated and the poverty line for households’ energy achievement should be obtained. The poverty level of energy as the energy poverty line varies with income's poverty levels and, for obtaining energy, statistics relating to household expenditure should be used in all calculations (poverty gap, poverty intensity and the Ginny coefficient). Bigman index or probability coefficient of people to encounter poverty, except in 1999 which was about 14 percent, was less than 5 percent in other years of study indicating severe conditions of poverty in 378 which was more than other studied years. The overall achieved food security index represents a critical level of food security in 1999. In other studied years, it is at the middle and desirable level of food security.

With further data analysis of the household situation, Amartiasen poverty index \( H(G + (1-G)I) \) having three elements of food poverty level \( H \), intensity of food poverty \( G \), food distribution among the poor \( I \), in addition to Bigman’s probability coefficient of people to encounter poverty were calculated. Accordingly, Amartiasen poverty index had highest value in 1999 and lowest in 2005 and the probability coefficient of people to encounter poverty (Bigman index) was more than 14.3 percent in 1999 and about two percent in 2005.

Raw data analysis indicate that the highness of Bigman and Amartiasen indexes in 1999 is due to high energy supply's coefficient of variation (CV) in these years. Index of the overall food security's calculation involves calculating both the age and Bigman indexes for the years 1998 and 2007 as follow, which indicates that the security of rural households in the years 1998 and 2007 are similar.

\[
\text{sent}_{377} = H(G + (1-G)I) = 0.3(0.1638 + (1 - 0.1638) * 0.36) = 0.140
\]

\[
\text{sent}_{386} = H(G + (1-G)I) = 0.3(0.1584 + (1 - 0.1584) * 0.357) = 0.138
\]

\[
\text{Big}_{377} = \frac{1}{2} CV \left(1 - H(G + (1-G)I)\right) = \frac{1}{2} \left(\frac{3138968}{4431670}(1 - 0.3(0.1638 + (1 - 0.1638) * 0.36))\right) = 0.049
\]

\[
\text{AHFSI}_{377} = 100 - (0.140 + 0.049) * 100 = 81.01
\]

\[
\text{Big}_{386} = \frac{1}{2} CV \left(1 - H(G + (1-G)I)\right) = \frac{1}{2} \left(\frac{9120602}{12922560}(1 - 0.3(0.1584 + (1 - 0.1584) * 0.357))\right) = 0.048
\]

\[
\text{AHFSI}_{386} = 100 - (0.138 + 0.048) * 100 = 81.36
\]

Food supply and consumption patterns in the province showed that at beginning of the studied years, the main energy was supplied from cereals, especially bread and animal products (meat and dairy), vegetable and, fruits were limited and insufficient and its implications can be seen in a part of the community, particularly vulnerable groups like growing children who need micronutrients. In the final years of study, with the share of grain products reduction, the share of protein and energy enriched products (meat, dairy, fruits and vegetables) has grown up that appropriate food security in the years 2005 and 2006 confirm this (Table 1).
Table 1: The level of food security of rural households from 1998 to 2007

<table>
<thead>
<tr>
<th>Year</th>
<th>The level of food security</th>
<th>AHFSI Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1998 Critical</td>
<td>60%&gt; AHFSI</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>70%&gt; AHFSI</td>
</tr>
<tr>
<td>2006</td>
<td>2004</td>
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<td>2001</td>
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<tr>
<td>2000</td>
<td>1998 Moderate</td>
<td>80%&gt; AHFSI</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>AHFSI&gt;80%</td>
</tr>
</tbody>
</table>

Study of economical access section, by using the detailed results of expenditure and income for rural households, showed the increase of income of rural households causing households income to be improved for a better purchase and distribution.

Effect of drought on agricultural production loss and consequently, income of rural households' reduction have an important effect on the food insecurity.

The present study also showed that 1999 was the year of drought phenomenon; rural household food security was at critical stage, although government supports have influenced the food security in the years after. Thus, the findings of this study showed that low-income groups’ calorie consumption in low-income areas largely depend on changes in their incomes and is less dependant on the rising of food production.

**CONCLUSION**

**Food Availability:**
- Although food production has increased, its growth has been associated with many fluctuations. Although one of the reasons for these fluctuations is the drought phenomenon in the studied period, the government must be more active in controlling the drought phenomenon.
- Possibility of water supply through semi-wells reservoirs, irrigation new technologies and the determination and commitment to pay for water are ways that the government could adopt because, according to the existing irrigation methods (deep water), most agricultural water loss is seen.
- Changing the structure of regional agriculture from mono-product mode (60% cereals) to culture other economical products, in addition the food availability, can improve the economical access to food.
- Supporting the culture of greenhouse crops because of the low water needs
- Support farmers by digging sinks and making concrete tanks on the farms

**Utilization:** According to the quantitative (getting energy) and qualitative (getting micronutrients) viewpoints, there are some deficiencies needing adoptions to resolve them. In other words, the quality of food supply pattern, because of the high share of cereals in supplying energy and low share of animal originated foods, entails a multiplicity necessity in order to increase meat, eggs and dairy products supplement.

**Affordability:** one of the important policies that cause a more economical access of households is paying food targeted subsidies and lead it toward the low income tenth.

One of the important reasons for non-optimal use of the produced foods is the magnitude waste of agricultural products and foods, that solving this problem can cause a better access to foods. For this matter and to prevent loss of capital, warehouses, silos, can be constructed, processing industries can be developed, agricultural products should be preserved and nutritional sciences should be educated, so these cause the food and agricultural products spoilage to be reduced and promote the community's food security.

to achieve food security, those initiatives that lead to a reduction in income poverty are the most important because assessing the food security in the country and globally has shown that most people who do not have the food purchasing power are having a poor diet. Poverty is happened during the drought; because of the farmers’ unemployment, it is good to adopt and develop job opportunities for the rural society.

Establishing centers for an assured agricultural crop purchase at the harvest time is one of the governmental movements to improve the economical access.

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