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Farmers' Concern about Drought, their Perception and Remedial Measures to Maintain Crop Productivity

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ABSTRACT: Present study covers three aspects *viz.,* environmental, ecological and socio-economic problems in rural areas of Bhiwani District of Haryana (India) due to aridity and consistent drought. Also different perception of local people about the causes of drought-Reality vs. Myth, migration of local people to industrial areas and increasing small land holdings due to increasing population, remedial measures undertaken to cop-up with the situation.

Key words: Drought, perception, rainfed farming, remedial, traditional knowledge

Introduction

It has been a major concern that aridity and frequent occurrence of drought in Bhiwani have resulted in numerous environmental, ecological and socio-economic problems, particularly in rural areas. These changes have consequently resulted in decrease of land productivity, low soil water availability with depletion of arable and natural grazing resources. Moreover, these aspects have been aggravated and metamorphosed due to cumulative effect on land and water resources and migration to adjoining rural areas in recent time (Ahmad *et al.,* 2004; Khera, 2004).

Looking at the magnitude of these problems and their resultant effect on the population growth have compelled many researchers, resource conservators, and planners to work towards reducing the vulnerability of the affected population with better drought management strategies not only national but international levels also. First of all there is a need to understand all the relevant dynamic variables involved with aridity and desertification. In this article, we are looking at the micro-level study of farmers' concern about drought, their perception and remedial measures to maintain crop productivity in Bhiwani district to understand the causes of drought with socio-economic variables and their likely impact and the resulting response in terms of drought mitigation and relief policies and programmes. Secondly, it is desired that this will result in development programmes to combat drought through optimum and proper use of local potential resources without creating any ecological imbalance.

The district Bhiwani situated in western Haryana along Rajasthan boarder, is representative of river less arid and semi-arid ecosystem where drought is a significant phenomenon in damaging balance of rural economy. Being located in extreme climate condition chances of regular are monsoon remote. Apart from this, increasing pressure of growing human and animal populations has rendered the traditional adaptations less effective in farms (Jodha, 1991; Narain *et al.,* 2005). On the other hand, increased exposure of people to materialist comfort available to other communities have raised aspirations amongst these rural folk, and this has resulted in large scale migration from this rural to urban or semi-urban locations, leaving farming land uncalculated.

For a satisfactory, stable and balanced ecosystem, natural resources- thermal, environmental and economic factors need to be well understood scientifically with the support of people's initiative, experience, and wholehearted co-operation. A grass root level micro planning at block level will be more effective than district level macro planning. It has been proved that grass roots planning will undoubtedly be more effective with the participation at micro-level region.

Study area and data used

The study was conducted at Bhiwani district of Haryana (India). The site is located at 28° 19' to 29° 05'N latitude and 75° 28' to 76° 28'E longitude with an area of 5099 Sq Kms. Bajra, jowar, wheat and gram are the major crops over here. Bhiwani District is one of the few districts in Haryana, which does not have the imprint of any river or a regular seasonal stream (Anonymous, 1992). The climate over most of the year is of a pronounced continental character. It is very hot in summer reaching upto 48°C and markedly cold in winter dropping below -2°C. The rainfall is low and erratic besides being unevenly distributed during the year except for two well marked seasons *i.e.* monsoon period lasting from the middle of June to the end of September, on which *kharif* crops depend and the other is the winter rains which occur from December to February, benefiting *rabi* crop.

Methodology

As individual and group point of views, the concern of drought as a hazard, is normally considered, is the outcome of physical, economical and cultural environments. Besides, it also depends on personal characteristics of each individual, his age and educational level, religious belief and occupation which will subsequently be modified by group norms and institutions (Abu-Sin, 1985) Therefore, perception is a function of the accumulation of knowledge, ability (or otherwise) to take risks, and success in assessing drought's behavior in time and space.

A detailed socio-economic field survey was undertaken in the study area over the last four years. A questionnaire survey was undertaken in 18 randomly selected representative villages from six tehsils of the Bhiwani district (Villages-*Siwana, Lohari Jatu and Pur from Bawani Khera tehsil; Badesra, Devsar and*

Rajgarh from Bhiwani tehsil; Chhapar, Barsana and Beejna from Dadri tehsil; Dhani Lachman, Nangal and Ladawas from the Loharu tehsil; Patodi, Indiwali and Khariawas from the Tosham tehsil and Jhumpa Kalan, Lilas and Sudhiwas from the Siwani tehsil respectively). Ten respondents (again selected based on random sampling technique) were interviewed from each sample village.

The methodology was also adopted by M.H. Abu Sin (1985) to deal with three major issues; a) what people perceive about drought; b) the range of possible adjustments that their social pattern affords; c) and the possible ways to reduce losses with adoption of strategies under varying sets of circumstances.

Results and Discussion

Perception of drought

Perception has been considered as the image created in the human mind as a result of the stimuli from the surrounding environment, both physical and cultural (Abu-Sin, 1985). Based on observations and analysis of the data and group interviews, following results have been achieved about the perception of drought in the social structure of the study area.

Table 1 : Presents drought indicators based on climatic variables and their severity values experienced in the region

Indicators	No. of respondents	Percentage
Experience of old people, dreams, position of stars, *etc.*	38	21.1
Westerly dry wind after mid June with dust storms	29	16.1
Lack of cloud, poor early rains	45	25
Growth of plants and natural vegetation	68	38.8
Total	180	100.0

Source: (Field survey data)

Drought indicators based on climatic variables

Table 1 identifies predictive indicators of drought depicting that out of a total of 180 of total respondents 68 (38.8% of the respondents) feel the growth of plants as most suitable indicator of rainfall inadequacy. It is clearly apparent that people in Bhiwani district give more importance to agricultural vegetative growth conditions rather than the atmospheric indicators in drought prediction. One-fourth of the respondents consider a weak southwest monsoon or less than normal rainfall or a late monsoon as an indicator of drought. Only 16.1% believe that westerly dry wind during hot summer with much dust as an indicator of drought in that particular year. An interesting observation showed that a very strong statistic of 21.1% out of total respondents depend upon prevalent local believe which have been in circulation since ages and which strangely have turned to be quite reliable too in most cases in early assessment of rainfall situation. Some examples of the common believe have been expressed by the older generation in the study area in poems, verses and behavior of human and animals in the form as:

- It is believed that the number of days the easterly winds blow in the month of "*Jyestha*", there shall be a drought accompanied with dry winds for the same number of days in the month of "*Sawana*".

- Bigger size of fruit of "*Khejari*" and "*Kikar*" tree indicates the probability of favorable amount of rainfall, whereas a smaller size of the fruit indicates the probability of drought conditions.

- Sparrow showering sand all over itself is also considered a good indicator of rainfall.

- The depth of nest of a local bird in dry pond (*Johar*) is indicator of the rainfall conditions that greater depth indicates drought and lower depth indicates occurrence of good rainfall.

The presence of moonlight on the night of "*Makar Sakranti*" is an indicator of drought.

Therefore, the perception differs from one society to another and from one environment resource to another, there is still no working definition of drought hazard with a wider applicability. Therefore, there is a wide range of causes of drought, based purely on meteorological parameters to those based on the inability of an area to provide for the basic human needs of water and food in a particular year or years. (Abu-Sin, 1985).

Drought indicators based on socio-economic conditions

Table 2 presents the drought indicators in Bhiwani based on the socio-economic conditions in terms of agricultural wealth. It is reflected that out of a total of 180 persons selected for the survey, 48.3% of the people consider drought as the lack of plant cover, crop failure and loss of livestock. Thus, the meaning of drought to people of Bhiwani is centered on crop production required for human consumption and maintenance of animal has to support economic balance. A year in which there is drop in production severely threatens the welfare of the family and its livestock is perceived as a drought year. About 34.4% of the population feels that drought means "near-famine" conditions associated with extremely low production of crops due to poor food grain production, but at least vegetative fodder is available for their livestock. In drought conditions, people tend to lean more towards livestock economy to make use of dry vegetations, shrubs and roots. A lower percentage of 17.2 consider that a drop in crop yield due to any agricultural input factor as drought conditions like non-adoption of weeding, uneven distribution of rainfall or even excess rainfall leading to crop damage and infestation of pests and diseases. It may not be considered as a dry year by all as these conditions might vary from a field to field. Therefore, the meaning of drought to people depends upon individual outlook for his own requirement and difficulties faced in order to maintain his family and livestock population.

Table 2 : Drought Indicators based on socio-economic conditions

Drought means	No. of respondents	Percentage
Lack of plant cover, crop failure, and livestock losses	87	48.3
Near-famine conditions associated with very low production	62	34.4
Drop in crop yields, which may be due to many variables	31	17.2
Total	180	100.0

Source: (Field survey of study area)

Perception about a wet year

Table 3 illustrates the percentage figures for the perception of people about a wet year. Out of total of 180 respondents, 80 respondents (44.4%) consider a wet year as a year when there is a good crop production not only to cater the needs of the current season but the grain left out to store for the future also. The above statistic suggests that in defining a wet year, economic security is the most important factor among the meteorological conditions of an area. Since their economy revolves mainly around agricultural activities, thus a good crop yield is a significant factor. A good percentage of 36.7 respondents consider that a low indebtedness without any other secondary occupation (other than agriculture) as an indicator of a year of adequate rainfall. Low in debitness is also referred to good economic returns so that there is either no need to borrow any loan from the village merchants or the loan taken in previous year could be returned. If there is impending marriage of a daughter, part of house to be built/extended, then these too are undertaken when the rainfall is good throughout the season so that farmer's get good returns. Only 18.9% respondents consider increase in number of livestock as an indicator of a wet year.

Table 3 : Respondent's perception about a wet year

Measure of assessment	No. of respondents	Percentage of total
Sufficient crop production to allow storage for the future	80	44.4
Increase in the number of livestock	34	18.9
No need for secondary occupation and low indebtedness to village merchants	66	36.7
Total	180	100.0

Source: (Field survey of study area)

Perception of a drought year

Table 4 provides the figures for assessment of a permanent/ extreme drought year. Out of the total respondents, 36.1% consider that the shortage of food, drinking water, *etc.* in a particular year as an indicator of drought. Small farmers need to borrow a certain amount of money, which they may return later on after harvesting of field crops. However, with the failure of crops due to insufficient rain it leads to an economic crisis. In such circumstances, they are not left with any money to return to the money lender and even face hardship to buy seeds for the next crop. While another 27.8% people, preferred migration to work elsewhere, this serves as another indicator of a drought year. But during some field surveys it may be sometimes misleading because young mass and technically competent people may migrate to other places for better opportunities. These days it has been observed that people from Bhiwani region migrate mainly to nearby town areas from the village to work as a laborer at a construction site, *etc.* It was particularly noticed that the village farmer with a medium size holding does not want to work as a laborer in the village but goes to nearby city to get higher cash remuneration. During these days there is enough work at road and construction sites in rural areas being funded by the government, he is not required to leave the village. Also the farmer with a big landholding can survive the drought year by management of his savings, *etc.* People also identify drought by its immediate impact on grain and fodder, which directly influence the animal productivity and reproductivity. These perceptions are better applied to the consequences of drought, such as barrenness of soil and lack of plant cover than to drought itself (Abu-Sin, 1985).

Table 4 : Respondent's perception of a drought year

Quantification of Drought inception	No. of respondents	Percentage of total
Shortage of food, water, *etc.*	65	36.1
Migration for work elsewhere	50	27.8
Economic insecurity	45	25.0
Danger of famine and poor health	20	11.1
Total	180	100.0

Source: (Field survey of study area)

Opinions regarding wettest and driest years

Table 5 showsa very high percentage of 23.9 and 20.0, respectively for the years 2002 and 1987 the driest year over the past years. Actually, these were the years of severe drought when both the crops, food grains and fodder failed completely. The years which were viewed not even as a dry year when a farmer and his livestock were not adversely affected due to stored grain of previous season. On the other hand, the years when there are rich crop yields and animal productivity were considered as wet years. However, during extreme flood year there was heavy damage of crop losses of standing crops and animal's causalities. Such causalities were largely in a few pockets where cloudbursts type events took place in monsoon months of year 1993.

Table 5 : Opinions regarding the wettest and the driest years over the past years

Year	Driest year		Wettest year	
	No. of respondents	Percentage	No. of respondents	Percentage
1968-69	12	6.7	12	6.7
1983	19	10.6	19	10.6
1987	36	20.0	36	20.0
1991	14	7.8	14	7.8
1995	4	2.2	4	2.2
1996	15	8.3	15	8.3
1998	8	4.4	8	4.4
2000	18	10	18	10
2001	11	6.1	11	6.1
2002	43	23.9	43	23.9

Source: (Field survey of study area)

Remedial measures for improving crop productivity

Characteristics in drought conditions: Table 6 presents the performance and characteristics of major food grain crops (pearl millet, guar and moong bean) grown in the study area, providing the stable economic base for the farmers. With the advancement of agricultural technology for cultivation of these crops, farmers have been tempted to adopt new hybrid fertilizer responsive varieties where yield potentials are three to four times over the local/desi cultivars. These crops are sown with the onset of southwest monsoon rains normally in the last week of June to first fortnight of July. The study area being located in less rainy areas, it is very essential to conserve the rainwater in the furrows of the cropped area with no competition from the weeds so that fertilizer and soil water are completely utilized by the cropped plants. Plant population is maintained to survive within the availability of soil water in the root zone. Split doses of nitrogen fertilizer are preferred, whereas other fertilizers are used as basal doses on soil test basis. Pearl millet, being a nutritive food both for human and animal's consumption, is widely cultivated in the area under rainfed conditions. In low and erratic rainfall years, when the monsoon showers are not intense or there is late onset or early withdrawal of monsoon, the inadequate availability of soil water is preferred for short duration crops like moong bean, moth and ephemeral grasses. Pearl millet crop during such years will provide very poor uneconomic yield and may be useful to harvest as green fodder for animals. In years, when monsoon rains are very good pearl millet, guar and even sorghum as green fodder are preferred in the area.

Table 6 : *Kharif* crops (bajra, guar and moong) grown in the Bhiwani area

Practices	Bajra (pearl millet)	Guar	Moong bean
Sowing date	In the month of June/July with the onset of monsoon	In the month of July/August with good rains	In the month of April (in irrigated areas) / In the month of July (in rainfed areas)
Suitable soil	Sandy, sandy loam and loamy soils	Sandy to sandy loam and loamy soils	Sandy to sandy loam soils
Crop maturity	90-110 days	140-170 days	45-65 days
Cultivation practices adopted	Planting in parallel rows by *Kera* method, Seed rate about 1-2 kgs per acre	Dispersed in the field by broadcasting method and also by ploughing in rows (*Kera* method); seed rate about 10-20 kgs per acre	Mostly by *Kera* method but sometimes by broadcasting method too; seed rate 4-5 kgs per acre
	Seed buried in top soil to allow quick germination by early showers	---	---
	Planted immediately after monsoon rains	Planted when soil is fairly moist	Planted after harvest of wheat (*baisakhi*) / after onset of monsoon
	Weeding once after 25 to 30 days	---	Little time for weeding
Drought resistance	High (average dry year yields about 60% of average wet year yield)	It is drought sensitive. Irrigation need with withdrawal of monsoon	Only 1-2 irrigation are enough
Other characteristics	Storage capacity low, hybrid varieties are preferred	High storage capacity under moisture-free capacity, guar gum extraction,	High storage capacity, pulse crop
	Used both for human consumption as well as cattle feed; rich in minerals, proteins and iron; Multiple use and stable crop under rainfed conditions	Traditionally used as cattle feed but with increasing industrial use only by-products are available for cattle. Stable crop in good rainfall years.	High yielding and disease resistant variety is available, lesser yield potential. Also risk factor is high in case of seed borne disease, unstable crop
Preference in food crop	High particularly in arid areas: good taste, easy to prepare; nutritionally very rich and therefore is exported	In absence of rain at pod formation, yield drastically reduces Processed locally for gum production By-products for cattle feed	Rich in proteins

Crop strategies adopted to mitigate drought conditions

Choice of crops as well as the cropping systems are influenced by various factors such as size of land holdings and quality of soil and water resources.

Table 7 presents the cash returns per acre from the crop combinations like bajra + moong or bajra + *til* which are much more remunerative than the monoculture. It was observed during the field survey that farmers with smaller land holdings usually prefer the mixed cropping as the family members work as labor during the harvesting period and they tried to generate the complete requirements of the family. The usual trend is that in one acre of land, the farmer would mix around one kg. Seeds of bajra, four kg seeds of guar and around one kg seeds of moong and moth and dispersed them in the field. In the case of good rainfall or assured irrigation, the farmers with smaller holdings have also adopted the practice of growing cash crops like vegetables for better returns.

Even in dry years, cultivation of short duration crops like moong/moth provide better returns. But during wet or good rainfall years, bajra + moong mixed cropping give better returns. However, bajra + til combination provide still higher returns because of higher prices of oilseed til crop.

Table 7 : Farmer strategies in a simple wet/dry year sequence (For a farmer with less than 5 *acres* land)

Crop	Average yield per *acre* in 'quintals'		Cash returns /per acre (in ₹)		Crop combination	Cash returns per acre (₹)		Percentage deviation from average of wet and dry years
	Wet	Dry	Wet	Dry		Wet	Dry	
Bajra	6 to 12	2 to 3.2	5000 to 8,000.	1400 to 2000.	Bajra + Moong	10,000.	2500	50
Gawar	4 to 8	1.2 to 1.6	Nearly 10,000	1800 to 2000	Bajra + *Til*	13,000	4800 to 5000	47
Moong/ Moth	4 to 5.6	0 to 1.2	8,000 to 12,000	2400 to 3600.	*Guar* + Bajra	10,000	1800 to 2000	37

Source: (Field survey of study area)

Crop strategies during dry/wet years continuity

In contrast, farmers with a higher land holding prefer monoculture-cropping system with the aid of mechanization tools and less labour intensive crops. The major deterrents to the mixed cropping system in this case are different times of maturing of different crops, denser plant population which act as a big obstacle during the time of harvesting. Besides, a different spray and fertilizers requirement for different crops is another major factor. For example, in the crop of bajra, urea is used as a fertilizer, while DAP is used for the crop of guar. As opposite to the farmer with a smaller holding, more labour is required at the time of harvesting the crops and one cannot do with merely family members working as labourers. So scarcity of labour too discourages a bigger farmer for going for mixed farming technique. The economic returns gaps are reduced due to the use of tractor drawn implements. Competition of weeds with crops is also observed as a major problem to utilize water and nutrient resources reducing the crop yields.

Table 8 : Farmer strategies in a simple wet/dry year sequence (For a farmer with *more than 5 acres* land)

Crop	Average yield per *acre* in 'quintals'		Cash returns /per acre (in ₹)		Crop combination	Cash returns per acre (₹)		Percentage deviation from average of wet and dry years
	Wet	Dry	Wet	Dry		Wet	Dry	
Bajra	10	2to4	8000	1500 to 2000.	Bajra + Moong	10,000	2500	34
Guar	7	2	9,000	1800 to 2000	Guar + Bajra	10,000	1500 to 2000	10
Moong/ Moth	5 to 7	0.8 to 1.2	10,000	2500 to 3500	Guar + Moong/ Moth	12,000	3000	20

Source: (Field survey of study area)

Preference of crops in dry/wet years

Table 9 presents the cropping systems adopted in the study area under rainfed and irrigated conditions. Crops grown in the district are divided into two main categories, *i.e. kharif* and *rabi*, locally named sawani and sadhi. The former is the summer and rainy season sowing and latter the winter sowing. Any crop which does not fall in timing within these two harvests is known as a *zaid* crop and its harvest is called *zaid kharif* or *zaid rabi*, according to the harvest with which it is assessed. Toria (an oilseed) is cultivated as a *zaid kharif* while vegetables, melon, tobacco and green fodder as *zaid*/*rabi*.

The major *kharif* crop of the district is bajra, which occupies about 55% of the cropped area. Other important *kharif* crops are moth and guar almost entirely a fodder crop. Bajra crop is particularly good as this crop does well on sandy soil, low and erratic rainfall and high temperature conditions.

The major *rabi* crop is gram, which occupies about 42% of the cropped area. The other *rabi* crops are wheat, barley, oilseeds and vegetables. A part from these, tobacco is grown in some villages of Loharu and Badhara blocks and a few villages of Bhiwani block. The quality of tobacco is particularly good. The *rabi* crops are mainly grown where underground water quality is good and tube wells are main source with benefit of sprinkler irrigation.

Bajra, *guar* and pulses (during *kharif*) are comparatively drought resistant and grow well in sandy loam soils. Gram, oilseeds and barley (during *rabi*) are suitable for these soils for the water requirements of these crops are smaller compared to wheat. The dry and hot climate prevailing in the district is suitable for cotton but its area is limited by the scanty irrigation facilities available during summer. Groundnut has been introduced consequent upon the availability of canal water during the rainy season, *i.e.* July to September, in almost all the newly developed irrigation systems.

Table 9 shows that with the availability of irrigation facilities, a change is observed in the ranking of the crop preference in wet and dry years. In the case of *kharif* crops, bajra occupies the first place in a dry year followed by g*uar*, moth, moong and cotton, respectively. Whereas, in a wet year, bajra is replaced by cotton in the ranking of preference. The second place goes to bajra followed by g*uar*, moong and moth, respectively. Even in the case of pulses, moong is preferred over moth in a wet year or when enough water is available, whereas in a dry year moth is preferred as it is a more drought resistant crop out of the two.

Table 9 : Ranking of crop preference

Wet year			Dry year		
Crop	**No. of respondents**	**Percentage of total**	**Crop**	**No. of respondents**	**Percentage of total**
For *kharif* crops					
Cotton	63	35	Bajra	67	37.2
Bajra	53	29.5	*Guar*	52	28.9
Guar	37	20.5	Moth/Moong	34	18.9
Moong / Moth	27	15	Cotton & mixed cropping	27	15
Total	180	100.0	Total	180	100.0
For *rabi* crops					
Wheat	54	30.0	Barley	52	28.9
Mustard	46	25.5	Gram	48	26.7
Barley	32	17.8	Taramira	34	18.9
Gram	27	15	Mustard	26	14.4
Taramira	21	11.7	Wheat	20	11.1
Total	180	100.0	Total	180	100.0

Source: (Field survey of study area)

Socio-economic aspects

Socio-economic adjustment to drought

Mitchell (1974) emphasized the following responses that people can make in the situations of drought hazard such as (i) dealing with the cause of hazard (ii) modifying the hazard (iii) adjusting methods to minimize hazard losses (iv) advance planning to minimize losses and (v) bearing the losses (Abu-Sin, 1985). In fact, with the exception of the first and second, remaining are measures of reducing damage from hazard. The people in Bhiwani have been taking precautions to adjust cropping plans with the arrival of southwest monsoon season with adoption of mid-season corrections with late arrival or early cessation or long breaks of monsoon conditions.

Table 10 : Adjustments to minimize drought damage in cultivated crops

Adjustment	No.	Percentage
Careful cultivation of appropriate drought- resistant short duration crops	68	37.8
Change balance within crop-livestock economy	28	15.5
Adjust cultivation practice of crops *i.e.* use of seeds, fertilizers and costly inputs	50	27.8
Bringing fodder, *etc.* from relatives in nearby areas	31	17.2
Total	180	100.0

Source: (Field survey of study area)

Out of the total of 180 respondents, 37.8% opt for the careful cultivation of the appropriate drought resistant crops as the major adjustment to minimize drought damage in agriculture. In a dry year, Bajra is the major *kharif* crop as it is more drought resistant. Emergency irrigation by tube wells or wells are also adopted in a few cases. In the case of availability of ground water, at least food crops are sown so that the situation of drought can be dealt with at least that particular year. 27.8% of the population felt that adjustment of cultivation practices of crops was a way to minimize drought damage. For example, deep ploughing, suitable plant population, row-to-row and plant-to-plant distance, soil moisture conservation (soil mulching), use of split dose of fertilizers are commonly practiced. And in the case of scarcity of water after the crops have been sown, the technique of ploughing and thinning of plant population is adopted for conserving moisture. Besides sowing more seeds per acre during wet year and low seed rate during dry year is adopted according to the availability of soil water in the root

zone during the season. Besides, rain water is conserved in root zone after every effective rainfall by soil mulching in order to remove the soil crust for improving the infiltration rate of the top soil and to provide a soil mulch for reducing the evaporation losses and maintaining the soil water reserve for uptake of soil water by roots as well as deeper penetration of roots in the soil. Another 17.2% of the respondents suggested that getting fodder from the relatives is also a way to compensate the drought damage. In that case, at least the livestock could survive and the people tend to sustain on the livestock economy in such years to reduce the damage. However, in circumstances when the fodder is not available, people opt to adjust with the resources available by selling their livestock as a last option for survival of family members.

Socio-economic adjustments in drought spells

When droughts fall in continuously in two or more years, there is cumulative impact of this grave situation leading to famines and large-scale causalities (Table 11). Out of the total respondents 36.1% considered participating in the government run relief operations as the preferred adjustment whereas 26.1% people considered changing their mode of living *i.e.* shifting from agriculture occupations to construction sites of roads, canals, buildings, *etc.* to balance the damage of livelihood. Another option was that when drought struck for two or more successive years at least the cattle should be kept and the younger generation could temporarily migrate to nearby towns *etc.* for labor work to survive the drought.

Table 11 : Preferred adjustments when drought strikes for two or more successive years

Adjustment	No.	Percentage
Participating in Government relief programmes	62	34.4
Changing mode of living (*i.e.* out of agriculture)	47	26.1
Shifting more towards livestock economy	42	23.3
Migrate to the other areas as a temporary sustenance	29	16.1
Total	180	100.0

Source: (Field survey of study area)

Conclusion

The study shows that majority of respondents' perceive drought as lack of growth of plants, lack of plant cover, crop failure and livestock losses. Moreover, the people of the area are facing the scarcity of water, food and fodder. Lack of employment has resulted into economic insecurity among them. Hence, they are migrating out for work elsewhere even though they have medium to large-scale land holdings.

Secondly, this article deals with understanding of people's perception about drought, their diverse local livelihoods and socio-economic adjustments resulting in creating programmes to combat drought through full and proper use of local potential resources without creating any ecological imbalances. Thus, it is important to look at drought severity not in terms of shortage of rainfall but in the terms of the demand made by man and its livestock on the water's supply. The survey results also indicated that migration as a coping strategy by much smaller number than expected due to the option of getting work in relief programmes in or near their villages.

Keeping in view of drought study conducted in the area it is proposed that evolution of new drought resistant crop varieties, raising of short duration grass and fodder crops for animal population, awareness of *in-situ* soil moisture conservation measures after each effective rainfall will benefit the farmers to make use of technology developed for rainfed agriculture. Government policies on grain and fodder banks, crop insurance schemes, use of drip and sprinkler irrigation, cooperative societies to provide farmer's requirement on seeds, fertilizers, machinery; use of crop weather outlook reports through remote sensing and agro-meteorological forecasts will certainly enhance the socio-economic status of poor farmers in this zone.

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