



Drought coping strategies followed by dairy farmers in Bundelkhand region of Uttar Pradesh

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ABSTRACT

Rainfed agriculture is highly risky, however, the livelihood of millions of resource poor farmers and agricultural labourers depends on it. The risks associated to agriculture in rainfed areas is increasing due to the adversities induced by climate variability indicated by increased frequency of droughts and floods. This paper analyzes the drought coping strategies followed by dairy farmers in Bundelkhand region of Uttar Pradesh utilizing a descriptive research design. Data were collected through personal interview and focus group discussion using both qualitative and quantitative techniques. The data were analyzed using frequency and percentage. The findings of present investigation show that majority of the farmers could not grow fodder crops during drought. However, they try to cope with drought by adopting strategies such as storing wheat straw and other crop residues (gram/lentil/mustard/linseed, etc.) in advance for meeting their feed shortage; providing feed and water twice a day and using crop residues (wheat straw/*bhusa*, paddy straw, *jowar* stover).

Key words: Bundelkhand, Dairy farmer, Drought, Drought coping strategy, Uttar Pradesh

The variability of rainfall in India is well attested and the timing and intensity of rain is as important with regard to crop production and grazing as the total annual rainfall. Warmer and drier conditions increase the likelihood of heat stress in cattle which adversely affects reproductive performance in dairy animals (Van den Bossche and Coetzer 2008). There is normally a decrease in milk production for cows under heat stress. Droughts lead to water shortage, which in turn leads to a decrease in milk production (Siemes 2008). Global climate change is predicted to alter rainfall patterns, potentially reducing total amounts of growing season precipitation and redistributing rainfall into fewer but larger individual events (Fiala *et al.* 2009). Tao *et al.* (2003) reported the results of a macro-scale water balance model, which predicted that in the years 2021–2030, water demand will increase world-wide due to the climate change. If the temperature and rainfall conditions changes more rapidly than the change in CO₂ then the consequences could be much more serious (Lawlor 1998). The rising temperature decreased the total dry matter intake and milk yield in Haryana cow (Lal *et al.* 1987). The productivity of Sahiwal cow also showed a decline due to increase in temperature and relative humidity (Mandal *et al.* 2002).

The estimated annual loss at present due to heat stress among cattle and buffaloes at the all-India level is 1.8 M tonnes, that is nearly 2% of the total milk production in the country, amounting to a whopping over 2,661 crore (Upadhyay 2010). Upadhyay *et al.* (2007) stated that thermal stress on Indian livestock particularly cattle and buffaloes decreased oestrus expression and conception rate. Maurya (2010) concluded that during drought, length of service and dry period of all dairy animals increased from normal. Research studies from India have found that meteorological parameters like temperature, humidity and rainfall explained 52 and 84% variations in the seasonality of foot and mouth disease (FMD) in cattle in hyper-endemic division of Andhra and Mesoendemic region of Maharashtra, respectively (Ramarao 1988).

The climate of Uttar Pradesh is tropical, but variations exist because of difference in altitudes. Shortage of rain during the highly variable monsoon season can cause droughts in state leading to severe loss to man and property. Recently, in 2002 and 2004, drought related financial losses were reported to be ₹ 75.40 and 72.92 billion (Anonymous 2013). Bundelkhand is drought prone region and it also faces enormous problems of low rainfall, low agricultural and animal productivity, water crisis, soil erosion, degradation of water resources, fodder crisis, high rate of mortality in cattle and unsustainable sources of livelihood, etc. On an average, 96% of the farmers' income is being earned from the crop and livestock enterprise in the region. The region has the highest cattle-to-human ratio and a high

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proportion of workers depend on livestock resources for their sustenance. The region has 50% of the indigenous cattle which are unproductive and only 0.50% of crossbred as compared to national average of 15%. Regeneration of the degraded forest (50–64%) and restoring carrying capacity of the grazing land has tremendous possibility to support better livestock production and supply of the minor products (Anonymous 2008). Dairy production is an important component in the entire region with greater focus on buffalo rearing for milk over cattle rearing. This is also corroborated by the last two livestock census data indicating increase in buffalo population and decrease in cattle population (Livestock Census 2012). Dairy entrepreneurship is able to provide daily income and security to farmers. Responding to the challenges of drought requires basic understanding of it, on that basis strategies for rearing animals in drought condition can be devised and appropriate adaptation as well as mitigation options can be explored. Coping strategies refer to the specific efforts, both behavioural and psychological, that people employ to master, tolerate, reduce or minimize stressful events. Two general coping strategies were distinguished: problem-solving strategies are efforts to do something active to alleviate stressful circumstances, whereas, emotion-focused coping strategies involve efforts to regulate the emotional consequences of stressful or potentially stressful events. People use both types of strategies to combat most stressful events (Folkman and Lazarus 1980).

MATERIALS AND METHODS

Locale of the study: Uttar Pradesh, situated between 23°52' and 31°28' North latitudes and 77°3' and 84°39' East longitudes, is fourth largest state in the country covering about 7% of India's total area. State has 4 regions namely, Eastern, Western, Central and Bundelkhand. Among these regions, the Bundelkhand region is one of the least developed. Bundelkhand is spatially very highly rural based where over 80% population (except, Jhansi where more migratory population lives) is living in villages (Anonymous 2013).

Sampling plan: The present study was conducted purposively in Bundelkhand region of Uttar Pradesh. As in the region, livestock occupies a prominent position contributing significantly to the livelihood security, coping mechanism to mitigate risks and it provide daily income. This region consists of 7 districts namely Jhansi, Jalaun, Mahoba, Lalitpur, Hamirpur, Banda and Chitrakoot. Out of 7 districts, Banda and Chitrakoot districts were selected purposively based on the component indices and priority rank of rainfed area given by National Rainfed Area Authority (Table 1). From each district, 2 blocks and two villages from each block were selected randomly. Farmers were selected proportionately on basis of land holding, however, a total of 20 farmers were selected from each village representing each category of farmers who had at least one milch animal (cattle/buffalo) at the time of investigation (Table 2). The farmers were interviewed

Table 1. Prioritization of rainfed district of Bundelkhand region of UP based on rainfed areas prioritization index (RAPI) and component indices

District	NRI	ILI	RAPI	Priority rank
Banda	0.7638	0.3446	0.3759	1
Chitrakoot	0.8097	0.2925	0.3627	2
Mahoba	0.8110	0.3068	0.3571	3
Hamirpur	0.7651	0.4024	0.3558	4
Jhansi	0.7755	0.4517	0.3324	5
Lalitpur	0.8412	0.3315	0.3287	6
Jalaun	0.8123	0.4828	0.2975	7

Source: Anonymous (2012). NRI, natural resource index and ILI, integrated livelihood index.

Table 2. Selection of respondents from each village

Villages	Land less	Marginal	Small	Medium	Large	Total
Baherwapurwa (V1)	2	3	3	9	3	20
Sahewa (V2)	2	3	6	8	1	20
Jasaipur (V3)	1	5	4	7	3	20
Mungus (V4)	1	2	5	9	3	20
Narayanpur (V5)	1	2	7	8	2	20
Chandragahana (V6)	2	8	3	4	3	20
Itahadevipur (V7)	1	4	4	6	5	20
Jorwara (V8)	1	3	7	7	2	20
Total	11	30	39	58	22	160

personally and focus group discussion during January-March 2014.

RESULTS AND DISCUSSION

Feeds used during drought: Majority (63.13%) of the respondents were using crop residues (wheat straw/bhusa, paddy straw, jowar stover, etc.) for feeding the animals during drought followed by 20% of respondents who were feeding crop residues and tree leaves, 9.37% of respondents were feeding crop residues and followed grazing practice and rest 7.50% of the respondents were using crop residues along with feeding of tree leaves and grazing (Table 3). The tree leaves used for feeding to livestock were neem (*Azadirachta indica*), peepal (*Ficus religiosa*), Mahua (*Madhuca indica*), Gular (*Ficus racemosa*) and sheesham (*Dalbergia sissoo*). Gular and Mahua were the most used trees as far as feeding of leaves are concerned. During winter

Table 3. Distribution of respondents according to feeds used during drought (n=160)

Practices	Frequency	Percentage
Crop residues	101	63.13
Crop residues + tree leaves	32	20.00
Crop residues + grazing	15	9.37
Crop residues + tree leaves+ grazing	12	7.50

and summer, they were using *jharberi* (*Zizyphus rotundifolia*) for feeding of animals. This weed grows well under dry condition and serves as an alternative feed during stress condition. This weed is specially fed during summer as its growth and development is fast during this season as well as its leaves and stems are tender. This is fed to the animal after chaffing and mixing with dry fodder. In case of non-availability of dry fodder, it is fed to the animal alone. *Kans* (*Saccharum spontaneum*) a perennial weed, which is growing abundantly in this area was also used to feed the animal by chaffing and mixing it with dry fodders. *Doob* grass (*Cynodon dactylon*) was also used as a feed material during drought, and was mostly fed to the milking animals. *Bansi* (local name), a semi-aquatic weed found on the banks of river, is used extensively for feeding of animals. Due to drought, the shortage of water is common phenomenon which inhibits growing of fodder crops and grazing land becomes almost dry without any significant vegetation for grazing of animals. Under these circumstances for sustaining milk production and productivity, respondents fed dry fodder along with tree leaves, however, few farmers followed grazing practice at road side, common grazing lands and fellow land, etc., where grass and common weeds were available for grazing of animals. These types of feeding strategies were mostly adapted by landless, marginal and small farmers as they were having less dry fodder with them. They mixed leaves with dry fodder and used alternative fodder sources from the beginning of drought condition, so that their dry fodder stock should last longer and could feed their animals up to a longer period of time with their existing stock. The tree leaves and other unconventional materials serve as a green fodder in the absence of cultivated green fodder thereby making unpalatable dry fodder into the palatable one. On the basis of result it could be concluded that tree leaves and weeds were used by most of the farmers to feed their animal to sustain milk production.

Feeding practices followed during drought: Majority (61.88%) of the respondents (Table 4) were feeding stored feeding materials (stored crop residues) for maintaining desired production and productivity of the animals during drought due to occurring of frequent drought and flood situations nowadays most of the farmers stocked feeding materials for future use whenever these were available in abundance. The farmers who are having enough storage space follow this practice. About 19.37% of the respondents fed their animals by purchasing straw whereas, limited feeding/control feeding for maintaining minimum level of

Table 4. Distribution of respondents according to feeding practices followed during drought (n=160)

Practices	Frequency	Percentage
Limited/control feeding + feeding only to ensure animal survival	13	8.13
Limited/control feeding + feeding to maintain minimum level of production and growth	17	10.62
To maintain desired production by purchasing feed and fodder from outside	31	19.37
To maintain desired production and productivity by feeding stored feeding materials	99	61.88

production and growth while limited feeding/control feeding only to ensure animal survival by 10.62 and 8.13% of the respondents, respectively. The farmers who grew only *rabi* crops could store crop residues of this season crops only thereby having a limited stock of feeding material combined with lack of enough storage space force them to follow limited/control feeding. However, the farmers who were having their own irrigation facilities can grow 2 or 3 crops in a year enabling them to store a sufficient quantity of feed materials. However, only few farmers were having such kind of facilities as creation of them is too costly due to low water-table. Scarcity of feeding materials in the local area forced the farmers to purchase feed stuff from the distance places which further increases the cost of feeding. From the above discussion, it can be concluded that farmers of this area were used to store feed and feeding materials in the form of crop residues, weeds and grasses in advance for life saving feeding of their animals during drought as well as in the extreme climatic conditions.

Frequency of feeding and watering during drought: Majority (66.25%) of the respondents (Table 5) were providing feed and water twice a day followed by 18.13 and 15.62% who provided feed and water thrice and once a day, respectively. It was interesting to note that none of the farmers provided *ad lib.* feed and water to the animals. Due to drought, availability of water and feeding material became scarce thereby farmers provided feed and water twice or once a day. Those farmers who had sufficient amount of feeds and fodder fed animals *ad lib.* feeds but those who faced scarcity, reduced the quantity along with frequency of feeding as well as watering. In the latter case, the aim of the farmer was to save the life of the animals instead of production and productivity. It can be concluded

Table 5. Distribution of respondents according to frequency of feeding and watering during drought (n=160)

Practices	Frequency	Percentage
Once a day	25	15.62
Twice a day	106	66.25
Thrice a day	29	18.13

that most of the respondents of such area kept their animals under fed because of scarcity of feed and fodder and unaffordability to purchase the feed and fodder.

Advance strategies for meeting feed shortage: Majority (67.50%) of the respondents (Table 6) stored wheat straw and other crop residues (gram/lentil/mustard /linseed etc.) followed by 20% who stored wheat straw and paddy straw while about 12.50% of the respondents stored wheat straw, crop residues (gram/lentil/mustard/linseed etc.), paddy straw along with storing of dried *jowar*/maize stalks locally known as *kadvi* or stover. This finding is similar to studies done by Singh *et al.* (2012), who reported that majority of the respondents preserved fodder crop in the form of hay and stored wheat straw, paddy straw and crop residue. During drought, availability of green fodder and natural grasses is drastically reduced, therefore, crop residues are normally used as maintenance fodder to save the life of animals as its demand is increased due to lesser supply of green fodder. Most of the farmers in the region stored all crop residues for future uses. In case of further availability of crop residue in the next season, these were sold or put into other uses, like burning as a fuel, used as a litter materials etc.

Fodder production practices during drought: Most (80%) of the respondents (Table 7) were not growing any fodder during drought situation because most of them did not have sources of irrigation even than those having source

Table 6. Distribution of respondents according to strategies for meeting feed shortage in advance

Practices	(n=160)	
	Frequency	Percentage
Storage of wheat straw + paddy straw	32	20.00
Storage of wheat straw + storage of crop residues (gram/lentil/mustard / linseed etc.)	108	67.50
Storage of wheat straw + crop residues (gram/lentil/mustard/linseed etc.) + storage of <i>kadvi</i> + paddy straw	20	12.50

Table 7. Distribution of respondents according to fodder production practices in drought

Practices	(n=160)	
	Frequency	Percentage
Change irrigation system/pattern (sprinkler/pipe <i>etc.</i>) + water harvesting for fodder production + altering sowing time	4	2.50
Change irrigation system/pattern (sprinkler/pipe <i>etc.</i>) + altering sowing time	22	13.75
Change irrigation system/pattern (sprinkler/pipe <i>etc.</i>) + integrated fodder production system	6	3.75
No fodder production	128	80.00

of irrigation like tube-well, were also not able to grow fodder due to lowering of water-table. About 13.75% of the respondents were growing fodder by changing irrigation system/pattern (use of sprinkler system/pipe, *etc.*) with altering sowing time with the use of tube-well (self/governmental) followed by 3.75% of the respondents were growing fodder by changing irrigation system/pattern (use of sprinkler system/pipe, *etc.*) along with integrated fodder production system. This system of coping strategy seems to be quite effective for combating drought, however, this is followed by a very less number of respondents and thereby it needs immediate promotion among the farmers. Only 2.50% of the respondents raised fodder with the use of harvested rainwater along with changing irrigation system/pattern (use of sprinkler system/pipe, *etc.*) and altering sowing time. This strategy is also quite effective, however, it may be difficult to harvest rain water in case of drought prevailing for years together. The result showed that majority of the farmers were unable to grow fodder due to scarcity of water during drought. However, few farmers raised fodder by following alternative practices in which some farmers who did not have his own tube-well they raised fodder crops on leased land having irrigation facility.

Management practices during drought: A sizeable portion (30%) of the respondents (Table 8) were doing traditional prayer to combat drought as a religious belief followed by 28.75% of the respondent who avoided long distance grazing for animals along with traditional prayer. They were avoiding long distance grazing to save the animals from higher temperature generally prevailing during drought. It causes heat stress in animals resulting in dehydration in animals, which generally results in reduction in milk yield and even death of animals. Whereas, about 16.25% of the respondents were avoiding long distance grazing, reducing herd size along with traditional prayer, they were reducing herd size by culling unproductive animals to save feed and fodder for productive animals. While, 14.38% were not doing any activity during drought. This might be due to that they were having sufficient income from other sources to combat drought thereby not giving much attention to animals, further they were having enough

Table 8. Distribution of respondents according to management practices during drought

Practices	(n=160)	
	Frequency	Percentage
Avoid long distance grazing + reduce herd size + traditional prayer	26	16.25
Avoid long distance grazing + traditional prayer	46	28.75
Replacement of large bovine with small/non-ruminant animals + reduce herd size + traditional prayer	17	10.62
Traditional prayer	48	30.00
Do nothing	23	14.38

Table 9. Distribution of respondents according to practices for sustaining milk production during heat stress

Practices	(n=160)	
	Frequency	Percentage
Feeding and milking during cool hours + water wetting 3-4 times + feeding extra concentrate mixture to overcome heat stress + feeding green fodder during heat stress	14	8.75
Feeding and milking during cool hours + Water wetting 3-4 times + feeding green fodder during heat stress	18	11.25
Feeding and milking during cool hours + water wetting 3-4 times	82	51.25
Water wetting 3-4 times + feeding extra concentrate mixture to overcome heat stress	27	16.87
Water wetting 3-4 times + feeding extra concentrate mixture to overcome heat stress + feeding green fodder during heat stress	19	11.88

feed and fodder reserves for their animals. A close look of the results revealed that only 10.62% of the respondents were replacing large bovine with small/non-ruminant animals, reduced herd size and recited traditional prayer. Large animals are being replaced with small/non-ruminant animals to have economy in feeding. In this region, most of the farmers were doing traditional prayer by reciting holy *Ram Charit-Manas* in singing way for a long period and performing *Yagya*. They strongly believe that after reciting *Ram Charit-Manas* there will be rain.

Practices for sustaining milk production during heat stress: More than half (51.25%) of the respondents (Table 9) were feeding and milking during cool hours with water wetting 3–4 times, followed by 16.87% who were feeding extra concentrate mixture with water wetting 3–4 times, 11.88% were providing extra concentrate mixture, feeding green fodder with water wetting 3–4 times, 11.25% were feeding and milking during cool hours, feeding green fodder with water wetting 3–4 times while, 8.75% of the respondents were feeding and milking during cool hours, feeding extra concentrate mixture and feeding green fodder with water wetting 3–4 times to overcome heat stress. Perennial natural grasses like bermuda grass (*Cynodon dactylon*), *kans* (*Saccharum spontanium*), etc. were used as green fodder. Water wetting regulates the body temperature of animals during drought, which generally remains high in comparison to the average normal temperature. Farmers reported that extra concentrate was provided to meet the nutritional requirement of the animal to combat heat stress as good quality fodder was not available in sufficient quantity. The major practice followed by the farmers to sustain milk production during heat stress was feeding and milking during cool hours with water wetting 3–4 times. During cool hours (early morning and evening) animals become normal due to reduction in

environmental temperature leading to the sufficient release of required hormones for proper let-down.

Drought coping strategies at community level: Most of the farmers reported that community ponds were filled with the governmental tube-well for arranging drinking water to the animals during scarce water availability. This was the most common coping strategy at community level however; most of the water is lost through evaporation. The second strategy was the use of pipe for conveyance to save water from evaporation as well as leaching losses. In this region, rainfall is not very scarce but main problem was the lack of adoption of water conservation methods because of that most of rain water is drained in rivers and cause water shortage during most of the months of year. Percolation of water to the lower layer of the soil is also less due to presence of hard pan as well as presence of gravels. Undulated topography also adds to the fast runoff of the water resulting less time available for percolation. Owing to these reasons groundwater recharge is slow.

It can be concluded from the study that during drought, farmers followed major coping strategies as feeding of stored crop residues, purchasing feeding materials from market, feed twice a day to save feed materials, stored crop residues for future use, feed unconventional feeding stuffs like *Saccharum spontanium*, *Cynodon dactylon*, *Saccharum munjo*, etc. and very few of them grow fodder with the use of tube-well water along with altering sowing time. Further, regarding other management practices, they were doing traditional prayer to combat drought and practiced water wetting during heat stress. The animals were left loose and subjected to force grazing on non-palatable and miscellaneous vegetation as a life saving strategy. During drought, shortage of fodder and feed with the farmers were the major limiting factor, however, they still desired to save the life of animals. Therefore, there is an urgent need of inventory of anti-quality factors in all kinds of plants growing naturally in drought prone areas. Further, it is suggested that drought resistance fodder crops/varieties, animal breeds to be introduced, rain water harvesting techniques, creation of water bodies in grazing areas, restoration of existing water bodies to be promoted in the area.

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