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Adoption of Drought Coping Mechanisms (Ex-Ante and Ex-Post) and Estimate the Economic Costs of Adoption

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ABSTRACT

Karnataka has the second largest area under rain fed agriculture after Rajasthan in the country and agriculture dependent economy with the large share of rain fed areas makes it reliant on monsoon. The need for improving water management is probably most acute in rain fed agriculture. Drought is a common phenomenon in this State. 56 per cent of the rice grown in the state is rain fed while the rest is irrigated. However, loss of traditional varieties of rice and disrespect of farmer knowledge and oral wisdom of age-old practices is a problem everywhere. Drought stress is the major limiting factor for rice production and yield stability under rain fed rice system. Karnataka faces high risk of moisture stress at maximum tillering and reproductive stages of rice, which may lead to yield loss of 25 to 100 per cent. This study focussed on identification extent of adoption of drought coping mechanisms (ex-ante and ex-post) including varietal adoption by the rice growing farmers to cope with drought and estimate the economic costs of adoption of such coping mechanisms. Drought coping mechanisms like Crop diversification, varietal diversification, spatial diversification, liquidating assets, use of savings, change in consumption pattern and migration were the main drought coping mechanisms adopted by the farmers in the sample district.

Key words *Drought, drought coping mechanisms, economic cost of adoption. Crop diversification, Crop insurance, liquidating assets.*

The State of Karnataka has 114 lakh ha cultivable land and 72 per cent of the cultivable area is rain fed; only 28 per cent is under irrigation (GOK News, 2013). Rice is grown over an area of 1.48 m ha in the State (Directorate of economics and statistics, 2013), 44 per cent of the area is under irrigation, while the rest is under the regime of monsoon. The State is the second largest in terms of arid region, next only to Rajasthan in India, in terms of total geographical area prone to drought. Drought is a common phenomenon in State of Karnataka. The State faced consecutive droughts during the years 2001-02, 2002-03 and 2003-04 resulted in sharp decline of agricultural output (Nagaratna and Sridhar, 2004).

Variety of factors such as, adoption of traditional farming methods, poor soil fertility, unpredictable weather, high cost of inputs, poor quality of seed and lack of credit facilities are attributed to low and variable productivity. Among the various biotic and abiotic stresses, drought is one of the most important constraints in rainfed rice production, India accounts for the largest share (59 per cent) of the total drought-prone rice area in Asia. Most of these drought-prone areas are rain fed (Pandey *et al.*, 2004). Drought stress is the major limiting factor for rice production and yield stability under rain fed rice system. Karnataka faces high risk of moisture stress at maximum tillering and reproductive stages of rice, which may lead to yield loss of 25 to 100 per cent (Hanamaratti *et al.*, 2008).

When drought occurs, the agricultural sector is usually the first to be affected. Even though the meteorological drought is over, the adverse economic impact of drought may persist for several years depending upon the nature of drought. As rice farmers suffer frequently from drought, they have evolved various strategies to cope with it. Based on the case studies and focus group discussions with farmers, the most commonly used adjustments in rice production practices during drought years are allocating more area to short-duration varieties, switching to traditional varieties which are considered to be more drought-resistant, switching from transplanting to direct seeding , reducing or stopping rice sales to augment supply for home consumption etc. Due to a lack of efficient market-based mechanisms for diffusing

Table 1. Economic cost of crop diversification, during 2013.

Crop diversification	Gross Income from irrigated ecosystem	Gross Income from Rain fed ecosystem	Loss in income (Rs./ha)
	HYV growers		
Onion-Ragi	-	32000	4250
Tomato-Maize	34375		
Mulberry-Ragi	-	32000	
	DT growers		
Mulberry-Ragi		32000	10000
Mulberry-Mango	-	125000	-
Tomato-Red gram	-	42875	19125
	LR growers		
Irrigated rice-Ragi		32000	46125
Ground nut-Ragi		32000	-
Red gram-Jowar	-	42875	-

risk, farmers modify their production practices to provide "self-insurance" so that the likely impact of adverse consequences is reduced to an acceptable level. Coping strategies can be classified into ex-ante and ex-post depending upon whether they help to reduce risk or reduce the impact of risk after a production shortfall has occurred.

MATERIALS AND METHODS

The study covered the household primary data and was collected during the year 2013-14 in Kolar district by multistage random sampling method with consideration of parameters like rainfall distribution. Kolar district occupies most part of eastern dry zone of the state. Analysis of the rainfall distribution showed that there was a 50 per cent probability of occurrence of drought in Kolar district than in any other districts of southern Karnataka. Multi-stage sampling design was employed in this study for selection of sample respondents. In the first stage, rainfed rice growing district namely Kolar was selected. In the second stage, major rice growing taluks of kolar district were selected. Then during the third stage, major rice growing villages were selected from each taluk.

A pilot survey of the study area was undertaken to acquire first-hand knowledge about the area and the scope of the study before main survey. Based on the pilot survey, an interview schedule was designed and suitable modifications were made in the interview schedule.

For evaluating the specific objectives of the study, necessary primary data were obtained from the sample farmers through personal interview with the help of pre-tested questionnaire. Purpose of the survey was explained to the respondents to seek their co-operation and cross checks were made to minimize the errors. The data relating to socio economic status of formers and their perception towards adoption of drought coping mechanisms were collected through properly designed survey.

RESULT AND DISCUSSION

Ex-ante drought coping mechanisms

Spatial diversification of fields

Agricultural fields vary from location to location in attributes such as soil moisture retention and fertility. In rainfed areas, soil property can vary widely even from paddock to paddock. Similarly, distribution of rainfall can also vary among fields in different locations. These variations in soil property and rainfall across locations create an opportunity for farmers to stabilize their agricultural output through spatial scattering of fields. . Farmers diversified their land utilization by planting different crops at different land plots. This strategy may help farmers to better exploit the specific niches of different microenvironments for productivity enhancement. In spite of these potential gains, spatial diversification of fields can cause an efficiency loss due to the increased costs of moving inputs across and marketing outputs from widely separated fields. In the study area it was found that only 25 per cent of land races growers, 35 per

Table 2. Economic cost of varietal diversification

Rice Variety	Grossincome (Rs/ha)	HYV Growers		
Hamsa	78125	Varietal diversification	Gross income (Rs/ha)	Income loss (Rs/ha)
Jaya	67400	Jaya-Hamsa	78125	-
BPT-5204	114500	BPT-Hamsa	78125	36375

cent of HYVs adopters and 40 per cent of DT adopters adopted this particular drought coping strategy.

Crop Diversification

Crop diversification is a feature of traditional farming systems in India. Environmental conditions less favourable to some crops may be more favourable to others so that compensating variations in yields of different crops would impart stability to total output. In addition to risk reduction, crop diversification has several other potential benefits. These other considerations are a better exploitation of environmental niches, staggering of labour demand and meeting the demand for a range of outputs. Mixed cropping and intercropping, which is a common feature of traditional agriculture in Asia and which are a form of crop diversification that reduces output variability (Rathore 2004). Crop diversification, however can also be costly in terms of income gain forgone as farm households include crops with lower but more stable yields in their cropping pattern. In addition to the economics of size that may result from specialization are also lost as production is diversified.

About 30 per cent of HYV growers and 25 per cent of DT growers adopted diversification strategy as one of the coping mechanisms. Even though HYV growers and DT growers are having irrigation facility, availability of water was not sufficient for cultivation so they shifted from more water consuming crops like tomato, onion, mulberry etc. to less water consuming crops like ragi, maize, mango etc. Landrace growers don't have irrigation facility, they mainly depend on rainfall so they cultivated same crops as in the normal year thus only 15 per cent of land races growers adopted this mechanisms. Economic cost of crop diversification is given in the Table 1.

Varietal Diversification

Growing several varieties of a crop is a form of diversification that can stabilize total crop output if yields of different varieties are poorly correlated. Varieties with different duration can reduce risk by avoiding period-specific risk like scanty rainfall or drought. Similarly, varieties with different degrees of tolerance for pests and diseases, drought etc also help reduce losses. It was noticed that all DT adopters adopted this mechanism and they shifted from the cultivation of land races and HYVs during the previous year to DT varieties. 15 per cent of HYV growers shifted from BPT-5204 and Jaya varieties to Hamsa variety because these two varieties are long duration varieties and cost of cultivation is higher compared to Hamsa. Farmers, who were shifted from Jaya to Hamsa, did not incur any loss as Hamsa gave more yield than Jaya. BPT-5204 yields more than hamsa thus Hamsa adopters incurred a loss of Rs, 36,375/-. The landrace growers cultivated the same variety over the period. Compared to Hamsa cost of cultivation of DT variety is very less, it requires less water and drought tolerant hence DT adopters adopted MAS-946-1 variety thus increased the net income by Rs.2426.25 by reducing a cost of Rs.13676.25.

Reducing cash expenditures on inputs in rice production through adjustments in labour input is an important drought-coping mechanism. There is some savings in cash cost of labour due to shifts in crop establishment method from transplanting to direct seeding among some farmers. Table 2 shows the economic cost of varietal diversification.

Income Diversification

Diversification of income from farm to nonfarm sources is another way of stabilizing income (Kuhl, 2002, Skoufia 2003). If fluctuations in nonfarm income are independent of fluctuations in farm output, income diversification through one or more members of the family working in the nonfarm sector can stabilize total family income. The extent of income diversification may be dependent on factors such as rural education, transportation infrastructure, access to institutional credit and availability of local resources for nonfarm activities. These factors may constrain the opportunities for income diversification even when agricultural risk is high. The nature of income diversification also depends on several factors. In

Table 3. Use of saved seed for consumption

Crop	HYV HYV adopters		DT adopters		LR adopters	
	Quantity (Kg)	Cost (Rs)	Quantity (Kg)	Cost (Rs)	Gr Quantity (Kg)	Cost (Rs)
Ragi	15	180	23	276	50	600
Rice	-	-	40	640	25	400
Redgram	-	-	2.72	231.2	4.6	391.85
Cowpea	-	-	-	-	1.12	22.4

areas with environmental conditions conducive to a strong agricultural base, income-generating activities that take advantage of agriculture's forward and backward linkages expand. On the other hand, income diversification in agriculturally poor areas tends to be outward looking, with households diversifying their income geographically (Barrett, 2005).

From the last few decades a growing incidence of seasonal migration is occurring in northern part of Karnataka due to the lack of livelihoods and fodder availability. Farmers practicing such a seasonal migration chose distant towns in search of work and also in industrial sectors, plantations and rice mills. Coorg region in Karnataka has set an example for this phenomenon. Among Southern districts, a large number of agricultural labourers from Chamarajanagar and Kolar districts migrated to the nearby cities like Bangalore and Mysore in search of jobs. In the Northern region of Karnataka, people from Bijapur and Bagalkot districts make annual trips to Goa to earn their livelihood during the off-season. Farmers from Raichur migrate to Bangalore city to work as construction labours (Nagaraja *et al.,* 2008).It was reported that 35 per cent of families growing land races and 10 per cent of the families adopting DT varieties earned income from other sources by employing their family members in any one of the income diversification activities to cushion against unexpected losses that are prevalent during drought period. About 10 per cent of landrace growers migrated to city in searching of jobs.

Crop insurance

Like with other kinds of insurance, protection from crop failure could be obtained through crop insurance. It represents a financial means of risk spreading mechanisms through which the costs of natural disasters are distributed among other sectors and throughout society.

It is a contingency contract between the insurer and farmers in which farmers pay a premium to the insurer and receive indemnities under adverse conditions as specified in the contract. It is the most direct public policy response to address the problem of production risk and it provides a safety net for farmers. In surveyed taluks no one adopted this coping mechanism and some farmers don't know about crop insurance and its benefits.

Use of Savings

Farm households use savings kept in various form as a risk coping strategy. In addition to cash and deposits, savings are also practiced in the form of grain stock and investment in assets such as jewellery, livestock and land (Hoogeveen, 2003). The saving in terms of food grains although costly provides a safety net during a crisis such as drought.

About 10 per cent of HYV adopters and DT adopters and 25 per cent of landrace growers used saved seeds for consumption purpose and thus for next season sowing they borrowed seeds from their friends, relatives, neighbour and shop (Table 3). 25 per cent of HYV growers, 5 per cent of DT adopters and 30 per cent of landrace growers used their saved cash for domestic consumption.

Ex-post drought coping mechanisms

Change in consumption

Reducing large expenditures is another strategy of consumption smoothing of poor households. Low-income households attempt to minimize expenditures on health care, children's education, social functions, and purchase of new clothing when they experience a temporary decline in income. Empirical evidence from several studies in developing countries indicates that consumption smoothing is a common practice among farmers to cope up with drought (Kazianga and Udry, 2004). If farmers are able to save during better-than-normal years and use these savings to meet

Table 4. Economic cost of liquidating livestock's

Particulars	Purchased price (Rs/head)	Sold price (Rs/head)	Loss incurred (Rs/head)
Hybrid cow	27000	21000	6000
Local cow	15000	13000	2000
Sheep	2640	1900	740

consumption deficits during drought years, they may be able to maintain their consumption level over time despite short-term fluctuations in agricultural output (Kuhl 2002). About 20 per cent of HYV adopters, 35 per cent of landrace growers and only 5 per cent of DT adopters adopted this coping mechanism.

Borrowings

It was reported that 35 per cent of the farmers adopting HYV, 25 per cent of farmers growing land races and 10 per cent of DT variety adopters borrowed money from institutional sources like banks as well as from their neighbours, relatives and friends to mitigate the cause of drought. Borrowing was mostly meant to meet the consumption and medical expenditure and their children's education.

Liquidating assets

Farmers in India used their livestock inventory to reduce consumption shortfall (Rathore, 2004). Farmers liquidate assets to meet their subsistence needs. Livestock in addition to being useful for agricultural production are also an important store of wealth as well as source of income, employment and nutrition in rural society. Table 4 shows economic cost of liquidating livestock. Jewelleries are also a fixed form of capital and an important store of wealth. They serve an important role in consumption smoothing during drought years. It was reported that 5 per cent of HYV adopters, 20 per cent of landrace growers liquidated their livestock to overcome the effects of drought (Table 4). To maintain the domestic expenditures they forcibly sold their livestock at the cost which was less than the purchased cost. About 10 per cent of landrace growers and DT growers sold their jewelleries mainly for education and medical expenditures.

Various coping strategies namely spatial diversification (25 per cent of landraces growers, 35 per cent of HYV adopters and 40 per cent of DT adopters),crop diversification (15 per cent of land races growers,30 per cent of HYV adopters and 25 per cent of DT adopters),varietal diversification, (15 per cent of HYV adopters and 100 per cent of DT adopters),income diversification(35 per cent of land races growers and 10 per cent of DT adopters), use of saved seeds (25 per cent of land races growers, 10 per cent of HYV adopters and DT adopters) and use of saved cash (30 per cent of land races growers, 25 per cent of HYV adopters and 5 per cent of DT adopters) are the various ex-ante drought coping mechanisms adopted by the farmers to protect themselves from drought. Change in consumption (35 per cent of land races growers, 20 per cent of HYV adopters and 5 per cent of DT adopters), borrowings (25 per cent of land races growers, 35 per cent of HYV adopters and 10 per cent of DT adopters), liquidating livestock (20 per cent of land races growers and 5 per cent of HYV adopters), liquidating jewelleries (10 per cent each of landraces growers and DT adopters are the various ex-post drought coping mechanisms used by the farmers during drought years.

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