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Farmers' coping and adaptive strategies towards drought in Pishin district, Balochistan

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ABSTRACT

Background: Balochistan province is prone to droughts and had been severely impacted during the drought from 1998-2002. Orchard and livestock farming are the main sources of earning livelihoods of the people.

Objectives: The objective of this study is to understand farmers' coping and adaptive mechanism towards drought hazard.

Methods: The study is primarily based on primary data collected through a structured questionnaire from 215 households. Both descriptive and inferential statistics were used to assess the coping and adaptive strategies being practiced by the farmers.

Results: The study results demonstrate that during recent long dry period, farmers have shown considerable strength in handling adverse effect of drought on their agricultural practices. A number of various adaptation initiatives have been employed at both on-farm and off-farm utilizing their indigenous methods under the regional conditions to minimize their exposure to drought hazards. These techniques involve crop diversification and mixed cropping, water management that include high span of watering and decreased in area; digging tube wells; water channel constructions/cemented pond for water storage; buying water; use pipe and drip/bubbler system for watering; divides the garden and use more soil around the tree; extra pruning of trees branches; and cutting down some trees for purpose of raising survival of fruit bearing trees; agricultural inputs adjustments, seeking off-farm employment, assets depletion, consumption smoothing, borrowing, and migrating to other places for alternative sources of income.

Conclusions: Farmers adapted number of ex-ant and ex-post coping/adaptive strategies to deal with drought hazard. However, investigation of the strategies used by the farmers indicates that most of the coping and adaptive strategies implemented by them in the study area are more reactive rather than more proactive, autonomous rather than well-planned and the current adaptive capacity of the farmers is still inadequate to cope with the future challenges of drought.

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1. INTRODUCTION

Drought is one of the major threats among all natural hazards to people's livelihoods and socio-economic development. Drought is a normal characteristic of climate and is considered to be the most complex but least realized of all natural hazards affecting more people than any other hazards (Hagman, 1984). It stand first in terms of the number of people affected when measured among all natural hazards and have affected 50% of the 2.8 billion people who suffered from all disaster in the quarter of a century since 1967 and out of 3.5 million people killed by disasters; 1.3 million human lives were lost because of direct and indirect impacts of droughts (Obasi, 1994). Drought not only affects various sectors of the society that include

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agriculture, economy etc. but also have negative impacts in the areas not affected directly by this hazard. The spatial extent of this phenomenon is wide spread and it is evident that about half of the earth's terrestrial surfaces are vulnerable to this natural hazard (Kogan, 1995).

Droughts have always recorded excessive impacts on farming communities compare to non-farming communities. In almost all developing countries, economy of rural communities is excessively dependent on agriculture and agriculture exclusively depends on rainfalls. Droughts ultimately result in rarity of ground and surface water sources and put production of crops and rearing of livestock on devastation. For instance, during the period of 1980s and early 1990s in Africa and several other countries, people suffered adversely from agricultural drought which was said to be the most disgraceful famine in near history (Gommes & Petrassi, 1994). About 80% of the world's crop land which produces over 60% of the world's food is comprised on rain-fed farms. For instance, in sub-Saharan Africa where 95% of food comes from rain-fed farms, agricultural production has already been affected because of climate variability. In South Asia, river-flow and groundwater are the main sources used for irrigating agriculture. Severe droughts triggered by climate change adversely affect these sources which serve as backbone of the livelihood of millions of smallholders in rural areas and their irrigation (Nellemann et al., 2009). In various parts of the continent in Asia, droughts have severely affected the agriculture sector. The study conducted by IPCC, indicates a decline in the production of maize, wheat and rice over the past several decades in several parts of Asia. The reasons include the increasing frequencies of El Niño events, decline in the number of rainy days, the increasing water stresses, owing to increasing temperature (Bates et al., 2008). The multi-year drought in 1999-2000 affected up to sixty million people in Central and Southwest Asia. Severe impacts of droughts have been observed in the counties like Iran, Western Pakistan, Afghanistan, Turkmenistan, Uzbekistan, and Tajikistan (IRI, 2001).

Like many countries in Asia, droughts are common in Pakistan also and carry multiple devastating impacts. The most severe droughts had occurred recently at the national scale in 1998 continuing up to 2002 in some regions and had deeply affected the farming sectors throughout the country with severe consequences on rural agro-based livelihood communities (GoB, 2007). Southern, south-western, western, and north-western regions have been severely affected by this long dry spells, however severity of drought was much higher in Balochistan and Sindh provinces. Agriculture growth badly suffered high level of setbacks and recorded an overall negative growth of 2.6%. While major crops that include wheat, rice, cotton showed a negative growth of almost 10% during 2000-01 drought period (Ahmad et al., 2003).

Balochistan is least developed province of the country and agriculture is the main source of livelihood of majority (85%) of the population who lives in the rural areas. Agriculture activities mostly depends on natural resources and are highly vulnerable to drought induced impacts, therefore for communities engaged in agricultural activates face difficulties to sustain their livelihood even after drought (Osbahr et al. (2008). In addition, poor farm household with their limited ability of coping and adaptation make them more vulnerable during extreme weather event such as drought. Therefore, these communities are in needs and can be made more vulnerable to risky weather events and their related climatic risks by promoting their coping and adaptive capacity (Adger et al., 2003).

In the past, no researcher has investigated the farmers' coping and adaptive behavior particularly in the context of drought in Balochistan. However, different aspects of droughts, particularly, the adverse impacts of droughts on livestock (FAO/WFP, 2002a; Shafiq & Kakar, 2007), livelihood and the role of government organization (GOs) and non-governmental organizations (NGOs) (Qureshi & Mujeeb, 2004), the range land productivity and soil degradation (Islam et al., 2004), and water conservation and harvesting institutional and policy mechanism (Ahmed et al., 2004) have been assessed by researchers and organizations in Pakistan. In addition, some other studies emphasized on identification of drought affected areas in terms of severity (UNDP, 2001; WRRI, 2001) and on ground water planning (Bhatti et al., 2008) in the context of drought. The current study is the first of its kind that primarily deals with farmers' coping and adaptive

behavior towards drought induced impacts in the context of Balochistan. The prime objective of the current study is to evaluate the copping as well as adaptation behaviors of farmers towards drought following their insight into previous droughts experience. In addition, this study suggests strategies to the agriculture extension department and the policymakers to formulate policies/strategies and extend effective services for promoting farmers' adaptation and sustaining their livelihood against the shocks of drought in the future.

2. METHODS

2.1 Research design

This is a cross-sectional study. In order to achieve the desired objectives, combination of both exploratory (descriptive) and explanatory (inferential) research design has been used in this study.

2.2 Setting

District Pishin, which is situated in the North-West of Balochistan province, has been selected as the study area for this research. District lies in the drought prone region and was severely affected (UNDP, 2001; WRRI, 2001) during the recent drought period (1998-2002). Geographically, Pishin District extends from 30° 04′ to 31° 17′ North latitudes and from 66° 13′ to 67° 50′ East longitudes. The district is divided administratively into four tehsils: Pishin, Karezat, Huramzai, and Barshore – and twenty seven 27 union councils (a union council is the lowest unit of administration).

The district has a total area of 7,819 square kilometers. According to 1998 census figures, population of the district was 367,183 with population density of 47 people per square kilometer. Moreover, average household family member was 7. Majority of the population in the province lives below poverty line and the figures indicate that almost 40% population in the district live below poverty line and the corresponding figures for the province and Pakistan are 52% and 33% respectively (Arif & Nazim, 2012). Majority of the cropped area (86.07%) in the district is irrigated, mostly from the groundwater sources such as tube wells and dug wells followed by Karezes. Weather of the district is highly suitable for orchard farming. About 68% of the irrigated area covers fruit production. Major fruits include apple, grapes, apricots and almond, while wheat and barley are also consider as the minor crops of the district. In addition, livestock is also considered as one of the important source of livelihood of the rural people in study area.

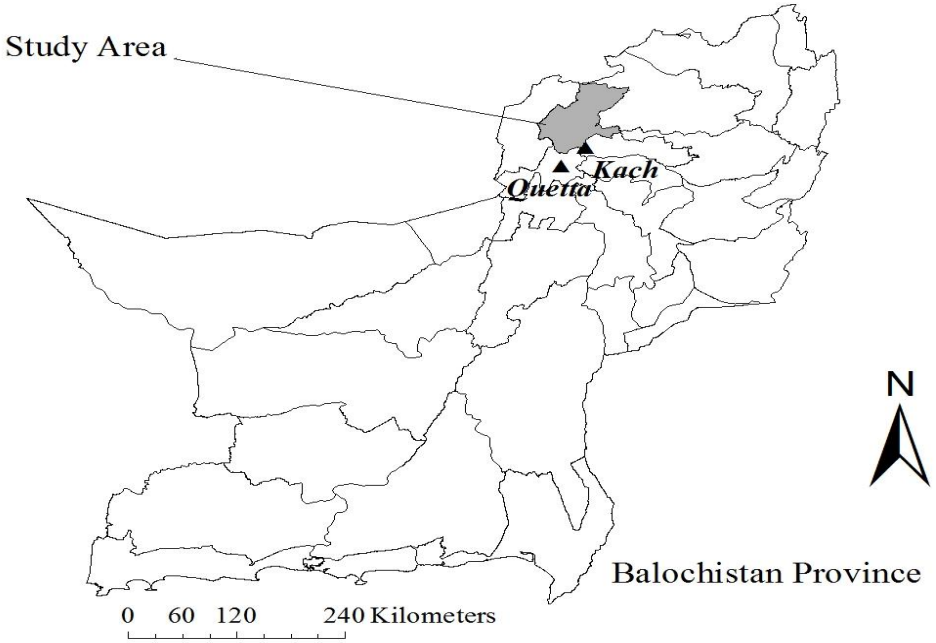

Figure 1 Map showing Pishin District, Balochistan Province

2.3 Participants

Orchard farmers were participants of this study. Farmers were selected through multistage sampling technique and were interviewed personally by the principle researcher.

2.4 Data sources

The study is primarily based on primary data collection with a structured questionnaire from the farm households.

2.5 Sample design

A sample of 215 orchard farmers was chosen (Equation 1) using statistical method developed by Arkin and Colton (1963) and interviewed personally. Farmers' were selected through multistage sampling technique. Firstly, with the consultation of key informants and District Agriculture Officer and after visiting the study area, out of 27, a sample of 20 union councils were purposively selected. In the second stage, villages within each union council were randomly selected. Finally, due to the absence of sampling frame and lack of information, farmers' were purposively selected. According to the State Bank of Pakistan, there are three major classifications of farmers in the province of Balochistan: small/subsistence (up to 32 acre of land), medium class holding (between 32 to 64 acres of land) and large class (more than 64 acres of land). According to the Agriculture Census 2010 report, 84% of the farmers possess less than 25 acres of farming land in the Balochistan province. Out of the total, majority of farmers are small holders. They are most susceptible to the severity of droughts impacts. Thus, for this study, small farmers haven been selected as target group purposively.

$$= \frac{Nz^2\,PQ}{Ne^2 + z^2\,PQ} \qquad (1)$$

Where; n = Sample size
N = Total number of households
Z = Confidence interval (1.96 for 95%)
P = Expected rate of occurrence (15%)
Q = (1 – P) i.e. Complement of P
e = Error limit (5% = 0.05)

So, Sample size, n = 195.3 ≈ 215

2.6 Data analysis methods

The primary data of this study was processed as well as statistically analyzed using SPSS. Descriptive statistics such as frequency, percentage etc. is used to present general information of the sampled respondent regarding their coping and adaptive strategies along with their demographic and socio-economic conditions (for instance, education level, level of income, household size, occupation etc.). Apart from this, Chi-square is used in order to identify the association between landholding size and coping/adaptive strategies being practiced by the farmers to mitigate the adverse effect of droughts. For this purpose, farmers are further classified following equal class interval method into three sub categories that include: marginal farmers (<=10.67 acres), semi-small farmers (10.68 – 21.34 acres), and small farmers (21.35 to 32.0 acres) in order to bring the finer differences within the small/subsistence farmer group to understand their coping and adaptation behavior.

3. RESULTS

3.1 Socio-economic profile of the farm households

The socio-demographic profile showed that farmers' age ranged from 28 to 80 years and their average age was 50 years. The average family size of the sampled respondents is 9 persons compared to that of

the district's average of 7 persons. The results indicate that 34.4% of the respondents are uneducated, and only 23.7% had primary education. One fourth of the respondents had attained high school whereas one fifth had higher education. Majority (85%) of the respondents were engaged in agriculture sector. Only 15% were employed in government organizations: service holders, and farming was their secondary occupation. A significant percentage (60.9%) of the respondents had no additional/secondary source of income. The findings showed that the average farming experience was approximately 27 years and 38.1% of the farmers had more than or equal to 30 years of farming experience. The average non-farm and farm land holding size was 6.47 acres and 10.27 acres respectively. The proportion of households with marginal land holding farmers was 61.4% whereas only 9.3% of the households were small land holding farmers. The mean annual income of the respondents was 4,243.02 USD. The annual income of almost half of the respondents ranged from 427.15 to 2,847.66 USD. Whereas, only one- fifth of the households had an annual income of more than 4,746.10 USD.

3.2 Coping Strategies

Farmers adopted varieties of exe-ant and exe-post coping and adaptive strategies to mitigate the effects of droughts on their agricultural practices in order to sustain their livelihood in the study area. Following section discusses those strategies in detail.

3.2.1 Diversification strategies (Exe-ante strategies)

Crop diversification/management

Crop diversification strategy is well known practice adapted by farm household during the drought period to avoid high risks. Adger et al. (2003) found that farmers' usually diversify their crops in their fields in order to minimize risk caused by drought situation. Table 1 indicates that about 27% of the farmers diversified their crops and cultivated crops that are more resilient to drought and requires less water. That includes *Black Amber Apples* and *Kadja*, vegetables, grapes, wheat etc. to lessen losses in their productions. Farmers also indicated that the pattern of cropping changes accordingly to the effects of droughts in the study areas over the last so many years. Replacing the dominant varieties of apples like *Shin* and *Tor Coloo* apples with *Black Amber Apples* and *Kadja*. Farmers argued that these varieties take less water and mature quickly as compared to Shin and Tor Coloo varieties. They also pointed out that Kadja apple become ready for harvesting in the month of August while on the other hand *Shin Coloo* and *Tor Coloo* get ready for harvesting in September and November respectively.

Apart from these strategies, farmers are shifting towards vegetables cultivation and argue that they are more resilient to dry conditions. They have started cultivation of Patato, okra, tomato chilly and onion, etc. Most of the farmers stated that the clear cultivation advantages of vegetables is the short span practice and their market requirements. In addition, cultivation of wheat is becoming popular among the farmers. They have pointed out that it depends on rainfall and harvested in May or June in the study area. About 25% of the farmers shifted towards mixed copping and argued that this strategy enables them to cultivate more than one crop in their field. Farmers are now compelled to cultivate different alternative vegetables such as onion, potato, and okra, and many more along with trees of apples in their respective farmlands. The chi-square statistic shows that the practice of both plantation of drought tolerant crops and mixed or intercropping does not differ significantly with respect to landholding. However, semi small and small farmers are in better position compared with the marginal landholders to practice these adjustments to cope with drought.

Table 1 Percentage distribution of farmers adapted crop diversification

Crop diversification/management	Land holding (Acres)						Total	
	Marginal (<= 10.6)		Semi-Small (10.7-- 21.3)		Small (21.4 – 32.0)			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Planted drought tolerant crops	31	101	20	43	8	12	59	156
Chi-square = 3.208 (p= 0.201)	(23.5)	(76.5)	(31.7)	(68.3)	(40.0)	(60.0)	(27.4)	(72.6)
Mixed or inter cropping	27	105	21	42	6	14	54	161
Chi-square = 4.040 (p= 0.133)	(20.5)	(79.5)	(33.3)	(66.7)	(30.0)		(25.1)	(74.9)

Source: Survey data, 2011

Adjustment of agricultural inputs in drought years

Apart from management of crops, adjustment in inputs use is also one of the indispensable adaptive strategies farmers commonly practice in the area. Most of the Farmers (84.6%) minimize the quantity of fertilizer in their respective fields. Farmers, who utilize this technique, stated that because of water scarcity and production decline, they were unable to utilize the ordinary amount. Since apple trees need large quantity of watering and this mostly results in low production of miner size apples compared to the average size and weight of apples prior to drought conditions. Droughts commonly not only result in water scarcity for crops but they also expose crops to pest attacks. Probability of Kharra (spider mites) attacks on the orchards usually increased during the dry spell as compared to normal situation. Due to long dry spell, dust covered the leaf that enabled the spiders and mites to create cage for themselves, which resulted the fall of apples from the trees in the early stage. Mixed response is evident in order to respond to pest attacks (see Table 2) in the study area. Farmers that use very little pesticide (24.2%) indicated that trees need more watering and some of them pointed that they were unable to afford it during the whole drought period. In contrast, heavy attacks of pests and dust problems are the only reasons pointed by the farmers (48.8%), who have raised this inputs utilization in their fields. The chi-square statistic indicates that landholding has statistically significant influence on the farmers' choice over pesticides adjustment and semi small and small farmers are better able to adapt this practice in order to cope better with climate change. In addition, decline in production of manure, and its unavailability during drought were mentioned as reasons behind its reduced application in the fields. Farmers' who have adapted the use of manure indicated that it is less expensive as well as keep the moisture in the trees. They also pointed out that use of manure gives more strength to apple trees and make them more resilient during the long dry period. However, the adjustment in manure use is differs significantly with respect to landholding in the study area (see Table 2).

Managing water scarcity in drought years

To lessen the adverse impacts of droughts, farmers have utilized various techniques to tackle shortage of water in the area. The increased spans of watering, decreasing in area, using of pipes for watering, digging number of tube wells and wells, extra chopping down of trees' branches, water channels constructions, sacrificing trees' parts etc. were all notable (Table 3). The increased spans of watering and decreasing in area strategies are most widely practiced by 92.1% of farmers in their fields, although it has been a temporary remedy, inevitable strategy to protect the orchards. Farmers argued that increased spans of watering and decrease in the area resulted in very low apples weight in particular and in other fruits, and this has ultimately laid effects on the quantity as well as quality of the fruits productions. Most often apple

trees require watering after every two weeks but due to long dry spell they have changed the time interval from three to four weeks. On the other hand, this strategy make the trees more vulnerable to pest attacks.

Table 2 Percentage distribution of farmers' adjusted in input use in drought years

Input adjustment	Land holding (Acres)						Total	
	Marginal (<= 10.6)		Semi-Small (10.7-- 21.3)		Small (21.4 – 32.0)			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Farmers' adjusted in fertilizer input in drought years								
▪ Use less	109	23	55	8	18	2	182	33
Chi-square = 1.219 (p= 0.544)	(82.6)	(17.4)	(87.3)	(12.7)	(90.0)	(10.0)	(84.7)	(15.3)
Farmers' adjusted in pesticides input in drought years								
▪ Use less	35	97	15	48	2	18	52	163
Chi-square = 2.590 (p= 0.274)	(26.5)	(73.5)	(23.8)	(76.2)	(10.0)	(90.0)	(24.2)	(75.8)
▪ Use more	54	78	37	26	14	6	105	110
Chi-square = 9.373 (p=0.009)	(40.9)	(59.1)	(58.7)	(41.3)	(70.0)	(30.0)	(48.8)	(51.2)
Farmers' adjusted in manure input in drought years								
▪ Use less	44	88	30	33	4	16	78	137
Chi-square = 6.293 (p= 0.043)	(33.3)	(66.7)	(47.6)	(52.4)	(20.0)	(80.0)	(36.3)	(63.7)
▪ Use more	9	123	7	56	5	15	21	194
Chi-square = 6.697 (p= 0.035)	(6.8)	(93.2)	(11.1)	(88.9)	(25.0)	(75.0)	(9.8)	(90.2)
▪ Use as per requirement	38	94	20	43	6	14	64	151
Chi-square = 0.179 (p= 0.914)	(28.8)	(71.2)	(31.7)	(68.3)	(30.0)	(70.0)	(29.8)	(70.2)

Source: Survey data, 2011

In addition, some farmers (59.1%) digging more tube wells or wells near the existing ones, constructed water channel from tube well to field and cemented pond so as to lessen water loss in drains and buy water, which may lay more financial burdens on the farmers. Table 3 indicates that landholding is statistically significant (chi square = 13.97, p = 0.001) in influencing farmers' choice over adapting new and better technologies and the farmers with the large landholding are better able to cope with the water shortage compared with the marginal farmers during the time of extreme event. Another key mitigating strategy, which is practiced mostly by the farmers, is the utilization of pipe for watering and installing of bubbler/drip irrigation for apples and crops replacing flood irrigation. Nonetheless, because of vast cost of installing pipes, farmers are unable to get them installed on large scale. Extra pruning of the tree' branches is another adaptive strategy that was practiced by the farmers during the long dry spell. Farmers pointed out that trees having fewer branches are anticipated to absorb less water. In addition, farmers chopped down some trees due to unavailability of water in order to avoid the complete failure of their orchard.

Table 3 Percentage distribution of farmers' adapted water scarcity strategies (**multiple strategies**)

Water management	Land holding (Acres)						Total	
	Marginal (<= 10.6)		Semi-Small (10.7 – 21.3)		Small (21.4 – 32.0)			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Increase/change span and decrease area for watering	120	12	60	3	18	2	198	17
Chi-square = 1.342 (p= 0.511)	(90.9)	(9.1)	(95.2)	(4.8)	(90.2)	(10.0)	(92.1)	(7.9)
Dug more well/tube well, constructed water channel and cemented pond and buy water	65	67	46	17	16	4	127	88
Chi-square = 13.97 (p= 0.001)	(49.2)	(50.8)	(73.0)	(27.0)	(80.0)	(20.0)	(59.1)	(40.9)
Use pipe, drip and bubbler system for watering	45	87	29	34	7	13	81	134
Chi-square = 2.66 (p= 0.265)	(34.1)	(65.9)	(46.0)	(54.0)	(35.0)	(65.0)	(37.7)	(62.3)
Divide the garden into small plots and use more soil around the tree	21	111	7	56	3	17	31	184
Chi-square = 0.802 (p= 0.670)	(15.9)	(84.1)	(11.1)	(88.9)	(15.0)	(85.0)	(14.4)	(85.6)
Sacrifice a portion of trees and extra pruning of trees' branches	49	83	33	30	9	11	91	124
Chi-square = 4.133 (p= 0.127)	(37.1)	(62.9)	(52.4)	(47.6)	(45.0)	(55.0)	(42.3)	(57.7)

Source: Survey data, 2011

Income diversification

Regardless to adjustment of farm-levels, the farmers utilize various off-farm adaptation strategies to deal with production shortfalls. Seeking income generation in off-farm activities such as wage laboring, business, services, working in hotels, driving, etc. were all considered important element for generating income by 33% of the farmers in the long and harsh dry period of droughts. However, the chi-square statistic shows that income diversification does not differ significantly with respect to landholding (see Table 4).

3.2.2 Household adjustment to drought (Exe-post strategies)

Economization of expenditure/consumption smoothing

Economization of expenses or smoothing of consumption is highly practiced by most of farm households when they confront a short-term decline in their income. It has been evident that around 80 % of the farmers economized their expenditures due to production and income decline in the study area (see Table 5). Farmers have not only decreased the number of meals (14%) per day but they have also minimized purchasing of expensive food items (69%) so that they can be able to tackle income losses. Moreover, farm households have also limited health care expenditures (27%), clothing purchasing (53%), and expenditure on children's education (28%). Apart from this, farmers put some restriction on their household maintenance (74%), and social activities' expenditures (70%) during the long dry period in the area.

This study reports that marginal and semi small farmers have minimized expenditure on social function relative to the farmers with large landholding (chi-square = 5.650, p = 0,059). Contrary to this, semi small and small farmers has reduced expenditure on health compared with the marginal farmers (chi-square = 4.678, p = 0,096). It has also been observed during the field survey that farmers have put their whole energy by putting some constraint on social events and household consumption in order to save their garden from complete failure.

Table 4 Percentage distribution of farmers' diversified income sources

Income diversification	Land holding (Acres)						Total	
	Marginal (<= 10.6)		Semi-Small (10.7 – 21.3)		Small (21.4 – 32.0)			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Farmers' seek alternative sources of income because of drought	43	89	23	40	5	15	71	144
Chi-square = 0.940 (*p= 0.625)*	(32.6)	(67.4)	(36.5)	(63.5)	(20.0)	(75.0)	(33.0)	(67.0)
Type of income source in addition to agriculture	*Frequency*				*%age*			
Business	33				15.4			
Daily wages	19				8.8			
Employment	8				3.7			
Hotel	6				2.8			
Driver etc.	5				2.3			

Source: Survey data, 2011

Assets depletion

Besides the income diversifications, the survey data unearthed that 80% of the farm households had sold their belongings to reduce and mitigate the drought induced impacts. The results indicate that majority of the respondents 171 (79.5%) adapted asset depletion strategy in order to mitigate the impact of drought through selling their livestock, 110 (51.2%), agriculture tools, 89 (41.4%), household utensils, 90 (41.9%), agricultural land 27 (12.6%), and 28 (13%) by selling non-agricultural land. The chi-square test statistic indicates that selling of agricultural equipment differs significantly with respect to landholding. Farmers (semi small and small farmers) are in better position compared with the marginal landholders in the study area, not only to use agricultural land and equipment in order to reduce the consumption shortfall but also to save the orchards from complete failure by investing in agricultural inputs during drought period.

Migration

As it has been mentioned prior, orchard farming is one of the primary sources of livelihood of rural communities in the study area. As a result of the recent droughts in the area, several orchards turned dried, and consequently a significant proportion (56%) of the respondents' family moved to other areas for seeking off-farm employments which may help them to survive the drought periods. The chi-square statistic indicates that there is no association between migration and landholding to cope with the drought event in the study area.

Table 5 Percentage distribution of farmers' economized expenditures or consumption smoothing (**multiple responses**)

Economizing expenditure/consumption smoothing	Land holding (Acres)						Total	
	Marginal (<= 10.6)		Semi-Small (10.7 – 21.3)		Small (21.4 – 32.0)			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Farmers' adjusted expenditures/ consumption smoothing because of drought	106	26	53	10	13	7	172	43
Chi-square = 3.491 (p= 0.175)	(80.3)	(19.7)	(84.1)	(15.9)	(65.0)	(35.0)	(80.0)	(20.0)
Reduced number of meals	22	110	8	55	2	18	32	183
Chi-square = 0.945 (p= 0.623)	(16.7)	(83.3)	(12.7)	(87.3)	(10.0)	(90.0)	(14.9)	(85.1)
Ate less expensive food	93	39	44	19	12	8	149	66
Chi-square = 0.904 (p=0.636)	(70.5)	(29.5)	(69.8)	(30.2)	(60.0)	(40.0)	(69.3)	(30.7)
Clothes	65	67	37	26	11	9	113	102
Chi-square = 1.592 (p= 0.451)	(49.2)	(50.8)	(58.7)	(41.3)	(55.0)	(45.0)	(52.6)	(47.4)
Children' Education	34	98	20	43	6	14	60	155
Chi-square = 0.808 (p= 0.668)	(25.8)	(74.2)	(31.7)	(68.3)	(30.0)	(70.0)	(27.9)	(72.1)
Health	29	103	23	40	6	14	58	157
Chi-square = 4.678 (p= 0.096)	(22.0)	(78.0)	(36.5)	(63.5)	(30.0)	(70.0)	(27.0)	(73.0)
House construction	95	37	50	13	13	7	158	57
Chi-square = 2.013 (p= 0.366)	(72.0)	(28.0)	(79.4)	(20.6)	(65.0)	(35.0)	(73.5)	(26.5)
Social/family events	92	40	49	14	10	10	151	64
Chi-square = 5.650 (p= 0.059)	(69.7)	(30.3)	(77.8)	(22.2)	(50.0)	(50.0)	(70.2)	(29.8)

Source: Survey data, 2011

3.3 Other strategies

The 1998 to 2002 drought was regarded one of the most severe droughts because 87% of farmers sought financial aid from their relatives, friends, middleman, and some from banks etc. for the means of agriculture like, tube wells digging, household expenditures and other inputs to subside the production losses confronted because of harsh droughts. Apart from it, helping one another at critical times is believed as one of the major coping strategies practiced by most of the farmers during droughts. Sharing of agricultural instruments was practiced by (57%) of farmers, water sharing was practiced by (43%), money sharing and man power sharing was practiced by (32%), and food sharing by (13%) during the harsh periods of drought.

Table 6 Percentage distribution of farmers' depleted assets (**multiple responses**)

Assets depletion	Land holding (Acres)						Total	
	Marginal (<= 10.6)		Semi-Small (10.7 – 21.3)		Small (21.4 – 32.0)			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Farmers' depleted assets because of drought	103	29	54	9	14	6	171	44
Chi-square = 2.779 (p= 0.249)	(78.0)	(22.0)	(85.7)	(14.3)	(70.0)	(30.0)	(79.5)	(20.5)
Livestock	74	58	32	31	4	16	110	105
Chi-square = 3.469 (p= 0.177)	(56.1)	(43.9)	(50.8)	(49.2)	(20.0)	(80.0)	(51.2)	(48.8)
Agricultural equipment	44	88	36	27	9	11	89	126
Chi-square = 10.084 (p=0.006)	(33.3)	(66.7)	(57.1)	(42.9)	(45.0)	(55.0)	(41.4)	(58.6)
Household utensils	55	77	29	34	6	14	90	125
Chi-square = 1.608 (p= 0.447)	(41.7)	(58.3)	(46.0)	(54.0)	(30.0)	(70.0)	(41.9)	(58.1)
Agricultural land	10	122	13	50	4	16	27	188
Chi-square = 7.735 (p= 0.021)	(7.6)	(92.4)	(20.6)	(79.4)	(20.0)	(80.0)	(12.6)	(87.4)
Non-agricultural land	14	118	9	54	5	15	28	187
Chi-square = 3.302 (p= 0.192)	(10.6)	(89.4)	(14.3)	(85.7)	(25.0)	(75.0)	(13.0)	(87.0)

Source: Survey data, 2011

Table 7 Percentage distribution of farm HHs members migrated to seek alternative sources of income

Migration	Land holding (Acres)						Total	
	Marginal (<= 10.6)		Semi-Small (10.7 – 21.3)		Small (21.4 – 32.0)			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Farm HHs members migrated to nearby cities to seek alternative sources of income because of drought	76	56	35	28	10	10	121	94
Chi-square = 4.040 (p= 0.133)	(57.6)	(42.4)	(55.6)	(44.4)	(50.0)	(50.0)	(56.3)	(43.7)

Source: Survey data, 2011

This study shows that there is an association between landholding and borrowing of money from relatives and Banks. Marginal and semi small farmers are more inclined to borrow money from relatives as compare to the farmers with large landholding (chi-square = 10.292, p = 0,006). While semi small and small farmers have greater access to financial institution relative to marginal farmers in order to obtain credit during the time of crises (chi-square = 7.322, p = 0,026).

Table 8 Percentage distribution of farmers' borrowed money and help the community (**multiple responses**)

Borrowing loan/helping the community	Land holding (Acres)						Total	
	Marginal (<= 10.6)		Semi-Small (10.7 – 21.3)		Small (21.4 – 32.0)			
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Farmers' borrowed money for agricultural inputs and HHs consumption because of drought	115	17	57	6	16	4	188	27
Chi-square = 1.549 (p= 0.461)	(87.1)	(12.9)	(90.5)	(9.5)	(80.2)	(20.0)	(87.4)	(12.6)
Friends	66	66	26	37	6	14	98	117
Chi-square = 3.469 (p= 0.177)	(50.0)	(50.0)	(41.3)	(58.7)	(30.0)	(70.0)	(45.6)	(54.4)
Relatives	99	33	42	21	8	12	149	66
Chi-square = 10.292 (p=0.006)	(75.0)	(25.0)	(66.7)	(33.3)	(40.0)	(60.0)	(69.3)	(30.7)
Middleman	38	94	17	46	5	15	60	155
Chi-square = 0.162 (p= 0.922)	(28.8)	(71.2)	(27.0)	(73.0)	(25.0)	(75.0)	(27.9)	(72.1)
Banks	27	105	24	38	6	14	57	157
Chi-square = 7.322 (p= 0.026)	(20.5)	(79.5)	(38.7)	(61.3)	(30.0)	(70.0)	(26.6)	(73.4)
Farmers' help community by providing food, money, agriculture inputs, water, manpower etc.	87	45	45	18	14	6	146	69
Chi-square = 0.640 (p= 0.726)	(65.9)	(34.1)	(71.4)	(28.6)	(70.0)	(30.0)	(67.9)	(32.1)

Source: Survey data, 2011

4. DISCUSSION

Dagel (1997) argues that different farmers have different meaning of drought and it is mostly linked with their perception of the physical environment, level and type of engagement with agricultural activities, and the extent to which it affects their financial well-being. Based on the perception and awareness, farmers' coping strategies towards drought are developed mainly to mitigate negative impacts of the hazard. According to Campbell et al. (2011), "coping strategies are devised by farmers to buffer short-term stresses and shocks within their farming systems and often exist alongside more long-term adaptive strategies". To deal better with the long-term changes, Cooper et al. (2008) pointed out that adaptive strategies are better suited and more sustainable than coping strategies.

Based on the perception and awareness of the drought, two types of coping strategies have been identified among the farm households to handle distress conditions. These strategies can be classified into ex-ante or risk management and ex-post or crisis management strategies. Ex-ante are the initiatives that are taken by a farm household before the initiation of a particular climate event and usually interlinked with the historical experience and the expectations of the likelihood of the bad or good events. These strategies are known as risk-reducing strategies. On the other hand, the strategies that take place after the event, i.e. ex-post strategies, in order to rearrange what already has occurred (Stern, 1999). The ex-ante

coping strategies can also be referred to as "income smoothing mechanisms", and the ex-post strategies can also be called the "consumption smoothing mechanisms" (Bhandari et al., 2007). The ex-ante strategies as pointed out by Jodha (1981) are often recognized as permanent characteristics of the farming systems and as a result of which they are overlooked in risk management.

Findings of this study reveals that farmers adopted varieties of ex-ante and ex-post coping strategies in order to mitigate the negative effects of drought on their livelihood. Among them, diversification of crops / management of crops, agricultural inputs adjustments, management of water, diversification in income, depletions in assets, adjustment of expenditures and migrations were notable. Crop diversification is well known strategy adapted by the farm household to avoid risk imposed by the drought period. The results indicate that most of the farmers in the study area diversified their crops and cultivated crops that requires less water and more resilient to drought situation. Similar results have been found by other researchers (Adger et al., 2003; Campbell et al., 2011; Habiba et al., 2012) who indicated that farmers have more or less adapted the similar agricultural adjustment towards droughts to decrease the production and income losses. Apart from crops diversification, majority of the farmers made adjustment in agriculture inputs such as fertilizers, pesticides and manure and argued that drought not only causes water scarcity but also responsible for more pests attacks on their crops. In addition, almost all the farmers tried to tackle water shortage by utilizing various water management strategies in the study area. Similar to findings of Deressa et al. (2009), this study also reveals that landholding has significant association with adapting new and better technologies. This is also evident in the current study that farmers with the large landholding are better able to cope with the water shortage compared with the marginal farmers during the time of extreme event. Apart from ex-ant strategies, most of the farmers also adapted ex-post strategies such as income diversification, consumption smoothing, assets depletion, migration etc. in order to sustain the livelihood of their family members. Several empirical studies also indicated that consumption smoothing is one of the common practice adapted by the farmers in different parts of the world (Bhandari et al., 2007; Harrower & Hoddinott, 2004; Kuhl, 2002; Morduch, 2005; Rosenzweig & Wolpin, 1993; Townsend, 1994). For instance, Bhandari et al. (2007) found that poor farm household economized their expenditures in their basic needs. They economized their expenditures in health care, food intake, social activities, children's education, and purchasing of new clothes in the Eastern part of India during the long drought period. Moreover, Barrett et al. (2001) state that income diversification in non-crop productions has been remarked as an indispensable strategy for livelihoods in rural communities, specifically in Africa. Paul (1998) pointed out that disposition of households and personal belongings particularly in developing countries, is interlinked with the onset and intensification of drought. In addition, several other studies documented that the short-term as well as the permanent movement to areas for earnings from mega cities or from faraway places is another mechanism practiced by farm households for coping droughts (Kuhl, 2002; Lazo & Tapay, 1999; Shah & Shah, 2005).

Similar to previous researches regarding farmers' coping/adaptive strategies, this study also evident that farmers in the study area have shown considerable efforts in coping with the impacts of droughts. They adapted number of ex-ant and ex-post coping/adaptive strategies to deal with drought hazard in order to lessen drought induced impacts on their agro-based livelihood. However, investigation of the strategies used by the farmers to cope with the drought indicates that most of the coping and adaptive strategies implemented by them in the study area are more reactive rather than more proactive, autonomous rather than well-planned and the current adaptive capacity of the farmers is still inadequate to cope with the future challenges of drought.

5. CONCLUSIONS

The main focus of this research was to assess the farmers' coping and adaptation behavior towards drought hazard in order to secure their livelihood. The findings suggest that farmers have expressed considerable strength in coping with the effects of droughts on their agricultural practices during the recent unfavorable long dry periods. Most of them have employed numerous adaptation initiatives on both levels on-farm as well as off-farm utilizing indigenous strategies under the regional conditions to subside their exposure to harsh droughts hazard. These strategies take in management of crops via diversification of crops and mixed system of cropping, agricultural inputs adjustments, management of water, ranging from highly increasing span of watering to decreasing in the areas, digging of more tube wells/wells, water channel constructions/cemented pond storages for water, buy water, use pipe and drip/bubbler system for watering, divide the garden and use more soil around the tree, extra trees branches pruning, sacrificing of trees' parts so as to increase survival of the remaining rest of fruit trees, seeking some off-farms employments, depletion in assets, consumption, borrowing, smoothing, and shifting to other areas for alternative source of incomes.

Policy implications

In order to further strengthen the farmers' coping/adaptive ability, this study suggest few policy recommendations below that might help the farmers and policy makers to mitigate drought induced impacts in future. Efficient drought forecasting and information dissemination to farmers might help them to select drought tolerant crops, better water management practices and use of input with the guidance of government extension workers. In addition, policies need to emphasize on efficient water use technologies at farm level with the support of extension services. Moreover, access to affordable credit schemes particularly for the marginal farm households might enable them to mitigate the impacts of in future. Similarly, policy interventions that improves farmer-to-farmer extension (social capitals) will also be very helpful for farmers to disseminate important information and enhance their adaptive capacity through group discussion. Agricultural extension workers and relevant government agencies need to work more closely in order to understand farmers' needs/problems and their potentials. Consistent efforts and strong policy instruments from agriculture department are needed to introduce the farmers to crop-specific coping and adaptation strategies against droughts and their impacts in drought-prone areas of Balochistan province.

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REFERENCES

Adger, W. N., Huq, S., Brown, K., Conway, D., & Hulme, M. (2003). Adaptation to climate change in the developing world *Progress in Development Studies, 3*, 179-195. doi: 10.1191/1464993403ps060oa

Ahmad, S., Bari, A., & Muhammad, A. (2003). Climate change and water resources of Pakistan: Impact, vulnerabilities, and coping mechanisms Retrieved Proceedings of Year End Workshop

Ahmed, S., Hussain, Z., Qureshi, A. S., Majeed, R., & Saleem, M. (2004). Drought mitigation in Pakistan: Current status and options for future strategies. Retrieved Working Paper 85

Arif, N., & Nazim, A. (2012). Clustered Deprivation: District Profile of Poverty in Pakistan.

Arkin, H., & Colton, R. R. (1963). Tables for statisticians. Barnes and Noble Publication, New York.

Barrett, C. B., Reardon, T., & Webb, P. (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy, 26*(4), 315-331. doi: http://dx.doi.org/10.1016/S0306-9192(01)00014-8

Bates, B. C., Kundzewicz, Z. W., Wu, S., & Palutikof, J. P. E. (2008). Climate Change and Water. Retrieved Technical Paper

Bhandari, H., Pandey, S., Sharan, R., Naik, D., Hirway, I., S.K. Taunk, S. K., & Sastri, A. S. R. A. S. (2007). Economic costs of drought and rice farmers' drought-coping mechanisms in eastern India In B. H. Pandey S, Hardy B, (Ed.), *Economic costs of drought and rice farmers' coping mechanisms: a cross-country comparative analysis* (pp. 43-112). Los Baños (Philippines): International Rice Research Institute (IRRI).

Bhatti, S. S., Khattak, M. U. K., & Roohi, R. (2008). *Planning water resource management in Pishin-Lora river basin of Balochistan using GIS/RS techniques.* Paper presented at the Advances in Space Technologies, 2008. ICAST 2008. 2nd International Conference on.

Campbell, D., Barker, D., & McGregor, D. (2011). Dealing with drought: Small farmers and environmental hazards in southern St. Elizabeth, Jamaica. *Applied Geography, 31*(1), 146-158. doi: http://dx.doi.org/10.1016/j.apgeog.2010.03.007

Cooper, P. J. M., Dimes, J., Rao, K. P. C., Shapiro, B., Shiferaw, B., & Twomlow, S. (2008). Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to future climate change? *Agriculture, Ecosystems & Environment, 126*(1–2), 24-35. doi: http://dx.doi.org/10.1016/j.agee.2008.01.007

Dagel, K. C. (1997). Defining drought in marginal areas: The role of perception. *The Professional Geographer, 49*(2), 192-202. doi: 10.1111/0033-0124.00069

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change, 19*(2), 248-255. doi: http://dx.doi.org/10.1016/j.gloenvcha.2009.01.002

FAO/WFP. (2002a). Non food assessment of drought: Balochistan and Sindh provinces.

Gommes, R., & Petrassi, F. (1994). Rainfall variability and drought in Sub-Saharan Africa since 1960. Retrieved Agro-meteorology Series Working Paper 9

Government of Balochistan (GoB). (2007). Provincial disaster risk management plan, Balochistan disaster management authority government of Balochistan.

Habiba, U., Shaw, R., & Takeuchi, Y. (2012). Farmer's perception and adaptation practices to cope with drought: Perspectives from Northwestern Bangladesh. *International Journal of Disaster Risk Reduction, 1*(0), 72-84. doi: http://dx.doi.org/10.1016/j.ijdrr.2012.05.004

Hagman, G. (1984). Prevention better than cure. A report on human and natural disasters in the third world. Swedish Red Cross, Stockholm.

Harrower, S., & Hoddinott, J. (2004). Consumption smoothing and vulnerability Retrieved Food Consumption and Nutrition Division (FCND) Discussion Paper 175

International Research Institute (IRI) for Climate and Society. (2001). The drought and humanitarian crisis in central and southwest Asia: a climate perspective. Retrieved Special Report no. 01-11

Islam, M., Ahmad, S., & Afzal, M. (2004). *Drought in Balochistan of Pakistan: prospects and management.* Paper presented at the Proceedings of the International Congress on Yak, Chengdu, Sichuan, P.R. China.

Jodha. (1981). Role of credit in farmer's adjustments against risk in arid and semi-arid tropical areas of India. *Economic and Political Weekly, 26*, 1696-1709.

Kogan, F. N. (1995). Droughts of the late 1980s in the United States as derived from NOAA polar-orbiting satellite data. *Bull. Am. Meteorol. Soc., 76*(5), 655-668.

Kuhl, J. (2002). *Risk-coping strategies by agricultural households in developing countries: a taxonomy. Manuscript. Institute of Economics, University of Copenhagen and UNEP Collaborating Center on Energy and Environment, Denmark. Roskilde (Denmark): The University of Copenhagen*.

Lazo, J., & Tapay, N. (1999). Social correlates of rainfed rice farmers' mechanisms to cope with drought. *Philipp. Agric. Sci., 82*(2), 190-199.

Morduch, J. (2005). Consumption smoothing across space: testing theories of risk-sharing in the ICRISAT study region of south India. In Dercon S (Ed.), *Insurance against poverty. Oxford (UK): Oxford University Press* (pp. 38-56).

Nellemann, C., MacDevette M, Manders T, Eickhout B, Svihus B, Prins, A., & Kaltenborn, B. (2009). The environmental food crisis – The environment's role in averting future food crises. Retrieved A UNEP rapid response assessment

Obasi, G. (1994). WMO's role in the International Decade for Natural Disaster Reduction. *Bull. Amer. Meteor. Soc., 75*, 1655-1661. doi: http://dx.doi.org/10.1175/1520-0477(1994)075<1655:WRITID>2.0.CO;2

Osbahr, H., Twyman, C., Neil Adger, W., & Thomas, D. S. G. (2008). Effective livelihood adaptation to climate change disturbance: Scale dimensions of practice in Mozambique. *Geoforum, 39*(6), 1951-1964. doi: http://dx.doi.org/10.1016/j.geoforum.2008.07.010

Paul, B. K. (1998). Coping mechanisms practised by drought victims (1994/5) in North Bengal, Bangladesh. *Applied Geography, 18*(4), 355-373. doi: http://dx.doi.org/10.1016/S0143-6228(98)00026-5

Qureshi, A. S., & Mujeeb, A. (2004). Analysis of drought coping strategies in Balochistan and Sindh provinces of Pakistan. Retrieved Working Paper 86

Rosenzweig, M. R., & Wolpin, K. I. (1993). Credit Market Constraints, Consumption Smoothing, and the Accumulation of Durable Production Assets in Low-Income Countries: Investments in Bullocks in India. *Journal of Political Economy, 101*(2), 223-244. doi: 10.2307/2138818

Shafiq, M., & Kakar, M. A. (2007). Effects of drought on livestock sector in Balochistan province of Pakistan *International journal of Agriculture & Biology, 9*(4), 657-665.

Shah, D., & Shah, A. (2005). Migration in remote tribal areas: evidence from southwestern Madhya Pradesh. *Indian J. Agric. Econ., 60*(2), 184-204.

Stern, P. C. (1999). Making climatic force casts matter. Washington D.C. National Research Council. National Academic Press

Townsend, R. M. (1994). Risk and Insurance in Village India. *Econometrica, 62*(3), 539-591. doi: 10.2307/2951659

UNDP. (2001). Drought severity in Balochistan, Pakistan. Geographic information system, area development program Balochistan.

Water Resources Research Institute (WRRI). (2001). Drought relief program. A study conducted for the development of criteria for ranking of drought affected districts to assign priority for allocation of resources.