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Climate Change and Drought: Impact of Food Insecurity on Gender Based Vulnerability in District Tharparkar

MANZOOR HUSSAIN MEMON, NAVEED AAMIR, and NADEEM AHMED

Climate change has now become a reality that has intensified the sufferings of people living in arid ecosystems. Decrease in rainfall, rise in temperature and increase in the frequency of extreme events are some of the changes observed in the semi-arid desert of district Tharparkar. For thousands of years, people of Tharparkar are coping with drought and aridity of the land by using indigenous knowledge. However, global changes in the climatic pattern and deterioration of social and economic conditions have pushed the inhabitants of this arid region into extreme vulnerable situation. This paper investigates the link between climate-induced natural disasters, particularly drought, from the perspective of changing climate patterns which have resulted in food insecurity and water scarcity. The paper analyses the rainfall pattern in the last 38 years—dividing it into two periods i.e. from 1975-1994 and 1995-2014. The findings of the paper have challenged the prevailing notions about aridity and rainfall patterns in Tharparkar district. The research found that there is an increase in average annual precipitation in the district with erratic patterns. Thus, the nature of drought in the district has changed from its historic pattern of less or no rainfall to more but erratic rainfall that is more threatening to livelihoods of the people that in turn have multiplier effect on water and food insecurity. In particularly, women are more vulnerable in the absence of social security and lack of basic necessities for their survival amidst drought. For instance, traditionally the burden of managing water resources falls on women, which leads to an increased work load during the time of drought and also water scarcity.

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INTRODUCTION

Drought is that natural calamity that has an exceptional detrimental impact on human survival. In terms of the number of affected people by drought, Wilhite (2000b) ranked it first among natural hazards. It develops slowly and does not affect the valuable infrastructure, such as homes, buildings, etc. According to UNCCD (United Nations Convention to Combat Desertification), drought is "the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems."

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Pakistan is one of the least studied countries in terms of socio-economic impacts of climate change—particularly in the context of drought. From the context of drought, the existing literature elsewhere in the world is also found scarce. It is therefore important to identify the impact of climate change in drought prone areas, and the potential influence on the socio-economic indicators of the associated communities. Thar Desert is one of the largest subtropical deserts situated in the northwest of the Indian sub-continent. The ecology of Tharparkar region is characterised by high temperature, low and erratic precipitation, scarcity of water and presence of soluble salt in the soil. Due to long spells of dry weather with little or no rainfall in the region, people have experienced perpetual droughts for longer periods.

The challenge is to identify the climate variability and potential impacts on people and other inhabitants in the drought areas. District Tharparkar, which covers more than 30 percent of the arid zone of Sindh province, has studied to understand the challenges posed by frequent climate induced droughts. The research will explore the patterns of drought with coping and adaptation mechanisms of the local population. However, the research will also examine the changes in the drought pattern due to climate variability with changes (if any) in the coping/adaptation mechanisms. Following subsidiary research questions will also be investigated to analyse the difference between past droughts (30 years before) and present droughts.

(a) Whether the changes in the climate have changed the drought patterns?
(b) How changes in drought pattern have impacted the livelihood resources and quality of life of the local people?
(c) What is the gender differential impact of climate induced drought?
(d) How effective are the indigenous/conventional coping and adaptation measures?

This paper outlined an introduction and a brief background on the study area, followed by a conceptual and theoretical framework. Following this, the section explains the methodological framework of the data collection and analysis. Subsequent section establishes the climate challenges, faced in the study area as well as the changes observed in the drought patterns,instigating higher gender and social vulnerability of the people. Finally, epilogue summarises the key findings of the study with some policy recommendations to cope with the increasing challenges associated with the climate change, food insecurity and water scarcity in the changing drought context.

CONCEPTUAL/THEORETICAL FRAMEWORK

Classification of a hazard as drought and partial drought was first defined by Meteorological Glossary, printed and published by Her Majesty's stationary office, London in 1972.[1] Figure 1 explains the three classifications/stages of drought i.e. meteorological, hydrological and agriculture droughts. The current classifications are:

(1) ***Meteorological Drought,*** normally region specific, can be defined exclusively on the basis of the degree of dryness (often in comparison to normal or

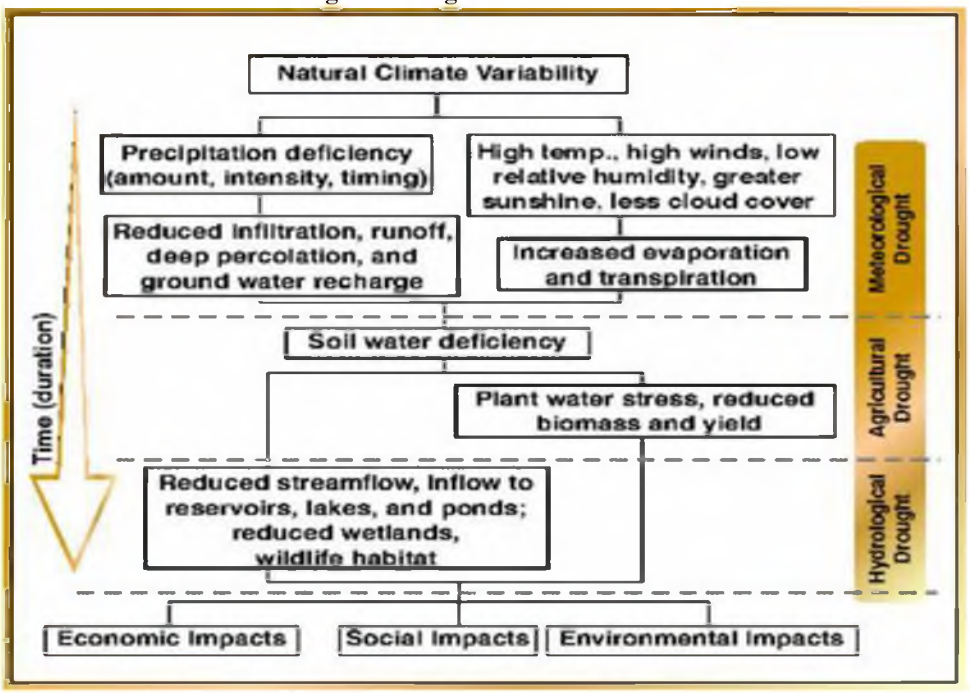
[1]Chaudhry, *et al*., History's Worst Drought Prevailed over Pakistan, Pakistan Meteorological Department, Government of Pakistan.

average amount) and the duration of the dry period. It is explained on the basis of the rainfall frequency and intensity in a particular area.

(2) ***Hydrological drought*** causes a sharp decline in the levels of underground aquifers and has a worst impact on human activities and natural ecosystem. Reduction in surface and sub-surface water supplies thus leads to a lack of water availability for human consumption, livestock and other specific water demands.

(3) ***Agricultural drought*** refers to requirements of crops with regard to water in different periods of cultivation. It is related to differences between actual and potential evapo-transpiration and soil water deficit, are crop-specific, dependent on the timings of rain and dry periods relative to crop cycles etc.

Fig. 1. Drought Characteristics



Source: Pakistan Meteorological Department.

Agricultural droughts can occur in the absence of meteorological drought while hydrological drought is linked to meteorological drought. Depending on the ecology, livelihood characteristics, economic base and socio-economic indicators, the spillover effect of the agriculture drought may lead to ecological, environmental, pastoral, economic and socio-economic drought, thus making the people of the specific region more vulnerable. In Tharparkar, the livelihood of the people is primarily dependent on agriculture, livestock and manual labour in other cities. Geophysical aspects of district Tharparkar features various ecological zones that have varied rainfall patterns, vegetation cover, soil quality, underground water level, temperature and topography. Based on different characteristics, the district Tharparkar is divided into seven ecological zones that

are termed in local language as 'Dhat', 'Kha'ur', 'Kantho and Parker', 'Muhrano', 'Samroti', 'Vango' and 'Vat'.[2] Ecological zones are one of the criteria for sampling of villages for primary data collection.

In Sindh province, over the past 20 to 30 years climate change has caused extreme weather events. The frequency and severity of natural disasters such as floods and droughts have increased manifold. The brunt of natural disasters and climate change has fallen on the poorest of the poor. People with low socio-economic status tend to have limited access to monetary and non-monetary resources, are more often renters, have less or no education and inadequate health facilities are more likely to be dependent on public social services [Krokstad (2004), Gulbrandsen and Andersen (2006)]. A higher percentage of population living below the poverty line in the province thus is socially and economically marginalised with higher level of vulnerability to the impact of climate change, impacts manifested in the form of natural disasters.

The Hyogo Framework for Action 2005-2015 underlines the fact that the impacts of disasters on social, economic and environmental conditions should be examined through indicators to assess the vulnerability. The importance of institutions in determining vulnerability to climate change was illustrated in 1991-92 when an 'apocalyptic' drought in southern Africa caused grain yields in ten states to drop 56 percent below normal year and 17 to 20 million people were exposed to starvation [Green (1993)]. Despite the high magnitude of the problem, a combination of national and international policy helped avert diseases and death in countries with functioning governments [Evan, *et al.* (2010)]. Therefore, understanding whether livelihoods are vulnerable to climate change also involves assessing the institutions that are working in society that allows for a collective response to the problem.

The link between climate change and inequality is intense and problematic. Adger and Kelly (2001) have explored direct and indirect causal links between inequality and vulnerability by looking at the patterns of resource allocation and pooling of risk at communal level. They explain that "inequality affects vulnerability directly through constraining the options of households and individuals when faced with external shock; and indirectly through its links to poverty and other factors". Watts (1991) and Davis (1996) have shown that in agricultural societies, both income and wealth are important in coping strategies under conditions of drought. The ownership of land or property, savings, livestock and other fungible assets are critical sources of coping strategies. In the absence of income and disposable capital assets and increasing inequality over time, climate change impacts on vulnerability will further deteriorate the coping capacity of the community/individuals. One of the major causes that enhance vulnerability at community level is the increasing inequality and higher incidence of poverty. Poverty marginalises a large section of the population by putting a barrier (nepotism, corruption) on acquiring benefits from social protection measures. Higher incidence of poverty for longer period produces acute vulnerability. Yamin, *et al.* (2005) explains that "although vulnerability is not defined as poverty, but today poverty is yesterday's unaddressed vulnerability". Further, recurrent droughts are also associated with higher levels of vulnerability to

[2]Mohammad Ali Shaikh, "Water Scarcity in Tharparkar", Seventh International Water Technology Conference Cairo, April 2013.

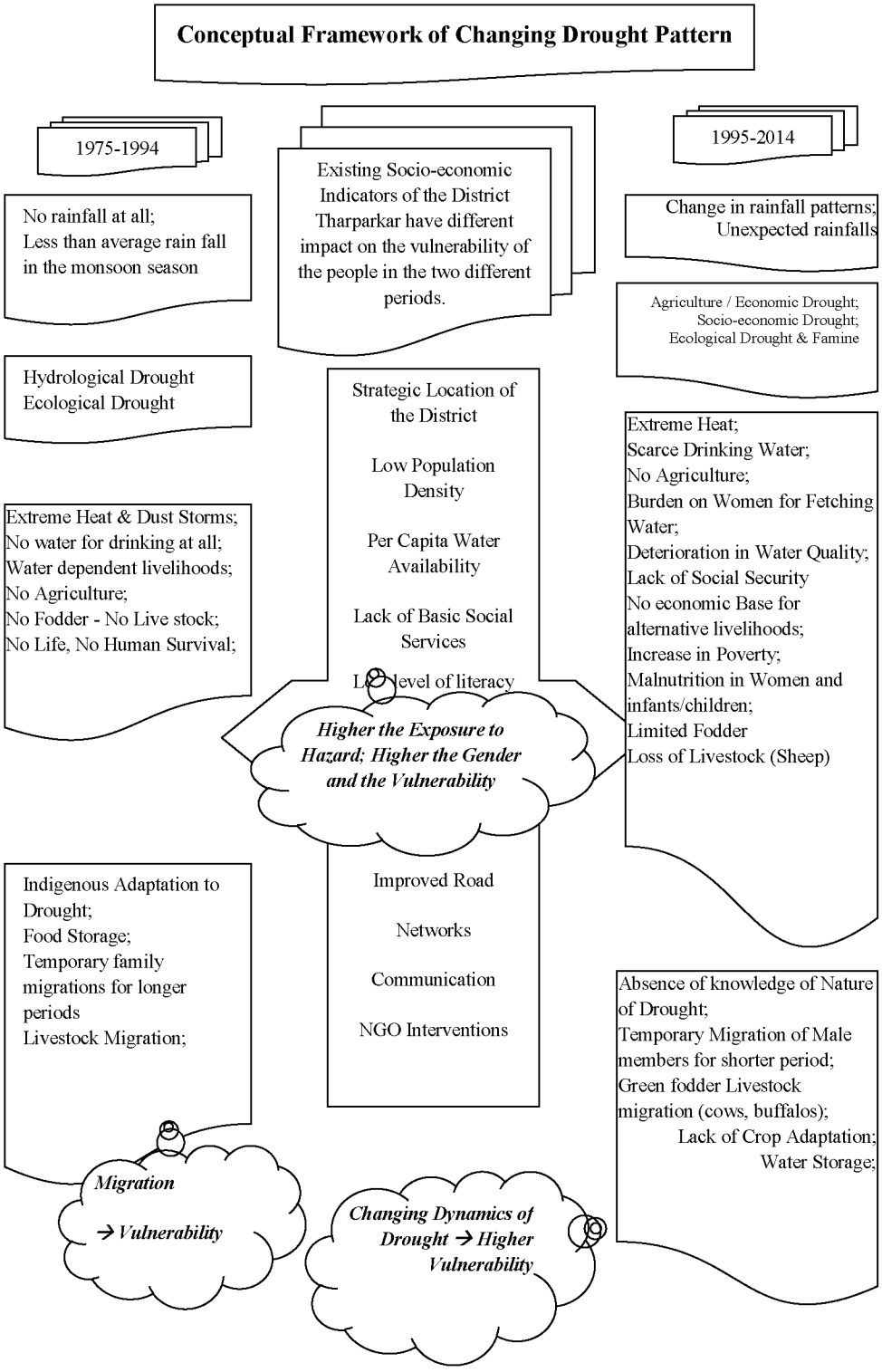
poverty [Donald (2008)]. Dercon, *et al*. (2005) in a study sampled Ethiopian villages found drought as a major disaster amongst others that have impacts on the per capita consumption. According to the key findings of the study, individuals experiencing drought have lower per capita consumption by about 20 percent.

The term 'gender' is a socially constructed phenomenon that defines different roles, identities and attitudes of men and women. Over time, these roles, identities and attitudes shape distinct characteristics of men and women in a society. Many believed that climate change is an unchanging fact for all but has varied impacts, particularly for those who are poor and marginalised [Lambrou and Piana (2006)].

The conceptualisation of climate change impact on gender cannot ignore the existing poverty and inequalities in communities. The analysis of poverty should be broadened to include issues of access, ownership and socio-cultural barriers. For instance, studies have shown that men did not avail health services out of fear of their community that if seen, will be considered as weak or needing support [Esplen (2006)]. Similarly, men are less likely to seek help for stress and mental health issues than women [Masika (2002)]. These attitudes and behaviours demand more specific contextual based climate change adaptation strategies for men and women. John and Kinsey (2000), examine the impact of rainfall shock on adult health in the rural Zimbabwe, have also found that women as compared to men, are adversely affected by drought. They further added that all women are not equally affected by disaster, as apparently poverty is the major cause of their low resilience to shocks.

It is a known fact that women in developing countries as well as in Least Developed Countries (LDCs) have the lowest social status in terms of economic and social empowerment. A vast majority of women are illiterate, poor, marginalised, deprived and have poor health [Mitchell, *et al*. (2007)]. In rural communities, the role of women is critical in organising life at household level. Women not only work as the unpaid family worker in agriculture and other occupations but also hold care-giving responsibilities for children, elderly people and physically or mentally impaired household members [Enarson (2000)]. In addition to this, women are expected to prepare food, fetch water for drinking and make arrangements for garbage disposal. These varied responsibilities of women make them vulnerable to the differential impacts of climate change.

A model/framework has been developed, to systematically investigate the changing dynamics of drought pattern in district Tharparkar. The model explains the impact of climate change on the drought condition and how such drought conditions together with existing deplorable socio-economic conditions affect food insecurity and water scarcity. The analysis is conducted from the viewpoint of vulnerability of the communities with specific focus on gender in the existing social context. The model also explains the transformations and changes in practices, followed by changing drought dynamics and patterns. In addition, it also explores how changing drought pattern is affecting the indigenous knowledge that in turn is hindering the adaptation capabilities of the people. For the analysis of the changing drought pattern, the rainfall pattern of the last 38 years is brought into focus—dividing it into two periods i.e. from 1975-1994 and 1995-2014.


Conceptual Framework of Changing Drought Pattern
1975-1994
No rainfall at all;
Less than average rain fall in the monsoon season
Hydrological Drought
Ecological Drought
Extreme Heat & Dust Storms;
No water for drinking at all;
Water dependent livelihoods;
No Agriculture;
No Fodder - No Live stock;
No Life, No Human Survival;
Indigenous Adaptation to Drought;
Food Storage;
Temporary family migrations for longer periods
Livestock Migration;
Migration → Vulnerability
Existing Socio-economic Indicators of the District Tharparkar have different impact on the vulnerability of the people in the two different periods.
Strategic Location of the District
Low Population Density
Per Capita Water Availability
Lack of Basic Social Services
Low level of literacy
Higher the Exposure to Hazard; Higher the Gender and the Vulnerability
Improved Road Networks
Communication
NGO Interventions
Changing Dynamics of Drought → Higher Vulnerability
1995-2014
Change in rainfall patterns;
Unexpected rainfalls
Agriculture / Economic Drought;
Socio-economic Drought;
Ecological Drought & Famine
Extreme Heat;
Scarce Drinking Water;
No Agriculture;
Burden on Women for Fetching Water;
Deterioration in Water Quality;
Lack of Social Security
No economic Base for alternative livelihoods;
Increase in Poverty;
Malnutrition in Women and infants/children;
Limited Fodder
Loss of Livestock (Sheep)
Absence of knowledge of Nature of Drought;
Temporary Migration of Male members for shorter period;
Green fodder Livestock migration (cows, buffalos);
Lack of Crop Adaptation;
Water Storage;

METHODOLOGICAL FRAMEWORK

The methodological framework of this paper is based on both qualitative and quantitative techniques. The research methodology includes primary data collection from the field that started with the preliminary understanding of community and farmer's perception dialogues. The key data collection tools were multi-group shared learning dialogues (SLDs) with stakeholders, key informant interviews (KIIs), followed by the primary data collection (both qualitative and quantitative) through a community and household survey questionnaire and focus group discussions (FGDs) in the selected sample villages.

A two-stage stratified random sample selection process was adopted to enumerate households and communities. Selection of villages was based on the following criterion:

(a) For comparative analysis, sample villages are divided into categories i.e. villages located in drought effected area and villages located in non/less drought effected area;
(b) For the representation of all ecological zones of Tharparkar district, at least 2 villages were selected from seven ecological zones;
(c) The sampling of selection of villages was also based on the representation of the five Talukas (sub-division of district) of District Tharparkar. At least 2 villages were selected from each Taluka;
(d) Village selection criterion has at least 50 households and less than 200 households;
(e) Based on all of the above criteria, an appropriate number of rural circles' (PSUs: Primary Sampling Units) list was prepared for each tier (ecological zones, Taluka), randomly selected with the help of statistical software.
(f) Following the criteria of Pakistan Bureau of Statistics, sample PSUs were selected with Probability Proportional to Size (PPS) method of sampling technique.
(g) At the second stage, 20 households (SSUs: Secondary Sampling Units) were targeted from each village. Households were selected by systematic sampling procedure with a random start.

Based on the data collected through various instruments, Vulnerability and Capacity Index (VCI)[3] is constructed at community and household levels. The VCI is a simple tool that informed development practitioners and policy makers about the relative level of vulnerability at community and household levels of the disaster and climate risk regions. The VCI defines and quantifies appropriate criteria, related to material (income, education), institutional (infrastructure, social capital) and attitudinal (sense of empowerment) vulnerability, and can be used to measure differential vulnerability at the household and community level in both rural and urban areas.

The methodology also includes validating primary data with available secondary data of some key variables, such as level of literacy, household size, dependency ratios and poverty incidences, etc. Secondary Data Collection was conducted by reviewing published data at district level from various sources including public documents.

[3]Mustafa, Ahmed, Saroch, and Bell (2011) Pinning Down Vulnerability: From Narratives to Numbers. Disasters 35, 62–86.

Relevant publications from the Sindh Bureau of Statistics, Planning and Development Department, Government of Sindh were also collected. These publications provide district-wise data on various socio-economic variables. Data from Pakistan Meteorological Department on climate variability has also been collected to establish a link and to understand climate variability in the district. Climatic data is based on monthly and yearly averages on temperatures, humidity and rainfall. Monthly data for the period of 40 years i.e. from 1975 to 2014 was collected and analysed. To examine the impact of climate change on rainfall pattern and dynamics of drought, the data was divided into two periods: from 1975-1994 taken as less or no impact of climate change, designated as 1st period and high impact of climate change as 2nd period, taken from 1995 to 2014.

VALIDATING CLIMATE VARIABILITY

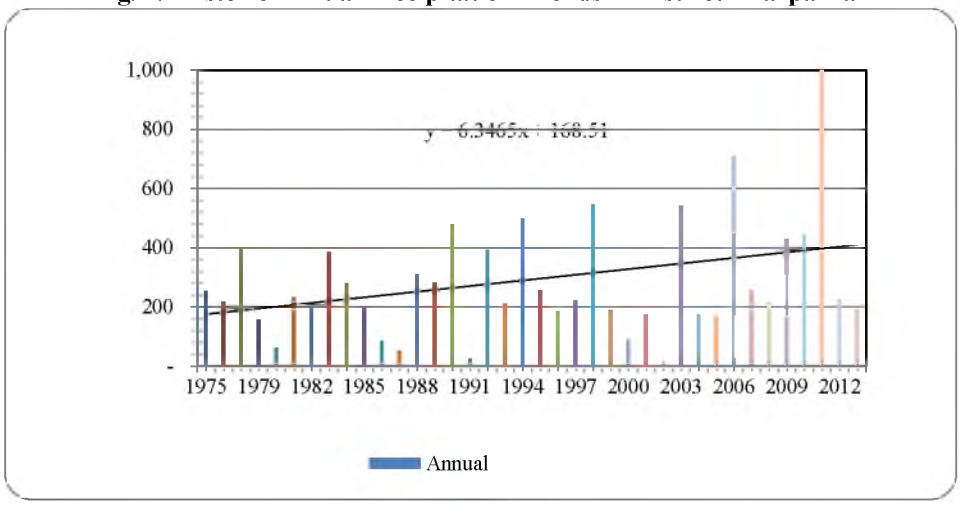
Climate change is a relatively new phenomenon that is not adequately understood in the context of its impact on particular events and disasters. However, there is a strong relationship between the disasters and global warming. The existing literature validated that climatic patterns have changed in some parts of the world and its impact on the population is severe in terms of livelihood loss and water and food insecurity. Similarly, the research on climate data of district Tharparkar has highlighted some key trends over the last 40 years.

According to Pakistan Meteorological Department (March, 2014)"... ... ... *Monsoon rainfall (June-Sep) is the main source of water for Tharparkar region in which 87% of annual rainfall is observed. This rainfall influences the livelihood of the people. Deficit in monsoon rainfall causes a lot of impacts on agro-socio-economic pattern of that area."* [4]

Rainfall patterns and scale of rainfall in the historical framework can be divided in to two main parameters: the intensity and the frequency. Rainfall patterns are far more important among the other climatic variables while assessing the drought patterns. In district Tharparkar, the amount of rainfall varies each year, and historically the monsoon season is spread to four months from June to September each year. Considering the livelihood dependency of rainfall, the mature rain in the first 2 to 3 months i.e. June to August is more important and its frequency of 4 to 5 times is crucial for life in Tharparkar. By analysing the rainfall pattern, it can be concluded that the average annual precipitation over the last 40 years has shown an increasing trend ($y=6.3465x+168.51$) of 6.35mm per annum. As exhibited in Figure 2, the increasing trend is more pronounced in post-1995 period. There was a substantially greater inter-annual variability in the amount of rainfall in Tharparkar district. The year 2002 was the extreme dry year in the 40 years history, while year 2011 was the extreme wet year, with the precipitation level crossing 1000 millimetre (mm) that was first time in the known history of Tharparkar. Having no fresh water from canal system or natural streams, the livelihood of people in the district is solely dependent on monsoon rainfall. Agriculture and livestock are the main economic means of livelihood, and both depend on the amount of rainfall which is now seemingly more erratic and irregular.

[4]Pakistan Meteorological Department, "Meteorological report for Tharparkar", Report No. Dr-4(43)/2011-12/, March 2014.

Fig. 2. Historic Annual Precipitation Trends in District Tharparkar

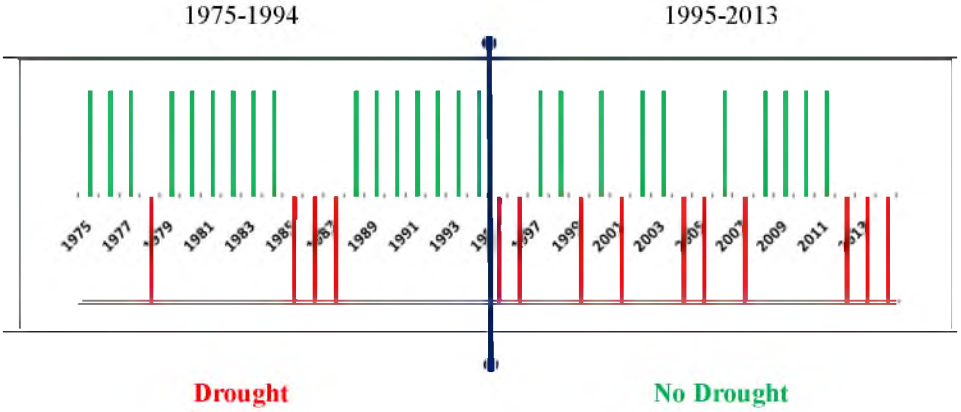


Data Source:
Pakistan Meteorological Department, Government of Pakistan;
District Development Statistics (Various Issues)

Historical normal rainfall is defined as the average annual precipitation between the above mentioned specified time period (Pakistan Meteorological Department) and drought, is defined as the situation where rainfall is lower than the normal. Normal rainfall is estimated for the monsoon season as between 175mm and 200mm and normal annual guide ranges from 200mm to 250mm.[5]

Since 1968, the region has been officially declared 15 times a natural calamity hit area by drought. The recent declaration of drought was the last two years i.e. 2013 and 2014. As appears from Figure 3, occurrence of droughts has been relatively frequent during the last two decades.

Fig. 3. Incidence of Drought in Tharparkar (1968-2014)

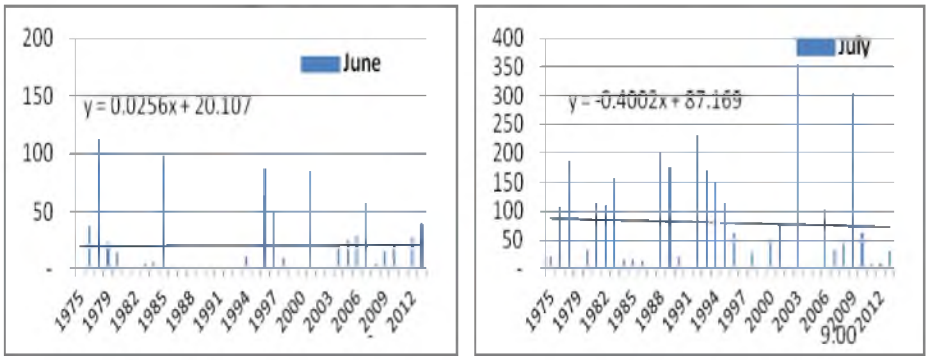


Source: Sindh Relief Department (2012).

[5]Author's calculation; Pakistan Meteorological Department, "Meteorological report for Tharparkar", No.Dr-4(43)/2011-12/, March 2014.

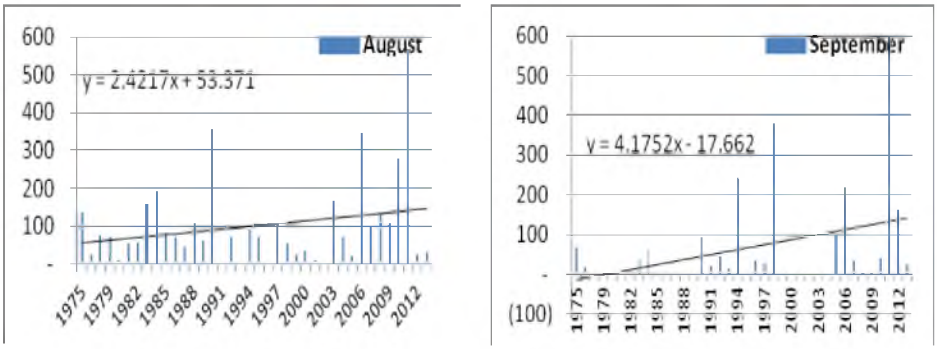
Ironically, district Tharparkar has faced frequent droughts in the last one decade despite having substantial increase in precipitation. A detail investigation is needed to explore the rainfall pattern, particularly in the monsoon period and how the higher frequency and intensity of rainfall impacted the livelihood sources in other periods. Since 2006, the annual rainfall in the district was found to be within the range of normal rainfall guide.

Fig. 4. Change in Monsoon Pattern



The change in the monsoon pattern can also be observed in Figure 4 and Figure 5, by examining the existing rainfall model during the months of June, July, August and September. Increasing rainfall trend is more pronounced in the month of August and September, vis-à-vis June and July. A decline in precipitation is observed in the peak monsoon season i.e. July (*minus [-] 0.4002*) and relatively no change in the month of June (*0.0256*). Average precipitation has decreased in the month of July from an average of 84.32mm in the 1st period (1975-1994) to 67.38mm during 2nd period (1995-2013).

Fig. 5. Change in Monsoon Pattern



By analysing the late seasonal and off-peak monsoon rainfall pattern, it has been revealed that frequency and volume of rainfall increased in the 2nd period. The rate of increase was as higher as 4.17mm per annum in the month of September, with an exceptional highest ever rainfall of over 1300 mm in any month that was not witnessed in the history of Tharparkar.

Table 1

Non-Seasonal, High Rainfall Incidence

1975-1994	No Incidence of Non-seasonal Rainfall
October 1995	60mm
October 1998	52.4mm
May 1999	128.2 mm
October 2004	82.90mm
September 2011	778 mm
October 2013	49mm

Source: Pakistan Meteorological Department, Government of Pakistan; District Development Statistics (Various Issues).

'April to May' and 'October to November' are the climate transition periods.[6] Normally there are no substantial rainfalls in the transition periods. However, during the last two decades there have been some noteworthy observations explaining the climate change uncertainties (Table 1). In 1999, the month of May has experienced high precipitation of 128.2mm that was highest ever precipitation in the month of May in district Tharparkar. The previous average was recorded as 26.10 in year the 1982 for the same month. The increased precipitation was mainly because of the worst cyclone in the entire coastal region of Sindh that burst into heavy rains in the area and surroundings.

While in the month of October, average precipitation recorded an increase from 4.58mm during 1975-1994 to 15.78mm during the post-1995 period. There were almost three incidences of rainfall above normal precipitation in the month of October in the 2nd period. The highest precipitation was recorded at 82.90mm in 2004, *vis-à-vis* highest previous record of 25.65mm in 1975. Detailed month wise averages and maximum rainfall indicators are provided in the annexure.

FACTORS THAT AGGRAVATE THE GENDER AND SOCIAL VULNERABILITY

The following discussion highlights the factors and drivers that aggravate the existing gender and social vulnerability in the area. While such factors and drivers have existed historically in the region; however, their impacts in the two periods are considerably different. In the context of model, it is important to examine that whether the existing socio-economic factors further aggravate the gender and social vulnerability in the high climate change impact period (1995-2014), as compared to the 1st period (1975-1994).

According to Pakistan Meteorological Department (March, 2014), *"In the wake of recent disaster confronting Tharparkar district, the analysed meteorological data depicts that current disaster may be termed as "socio-economic disaster" rather than simply drought because seasonal and annual rainfall was moderately below the climatic averages. The disaster may have occurred due to moderately below average rains, coupled with some epidemic and weak socio-economic settings of the area. …… Deficit in monsoon rainfall causes a lot of impacts on agro-socio-economic pattern of that area."*[7]

[6]Chahudary, Sheikh, Bari, 'History's Worst Drought Conditions Prevailed Over Pakistan', Pakistan Meteorological Department, Government of Pakistan.

[7]Pakistan Meteorological Department, "Meteorological report for Tharparkar", Report No.Dr-4(43)/2011-12/, March 2014.

Dependency Ratio, Employment and Education Profile

According to the District Census Report 1998, average household size in Tharparkar was 5.6. The average household size of selected villages is 1.1 higher than the district average. The number of dependents for every 100 working age (15-59 years) persons is 113. The ratio is well above the national average that is 97 [SPDC (2012-13)]. Higher dependency ratios indicate an economic and social burden on the working age population and on the economy, as an economically non-active population requires additional resources and support systems.

As far as food insecurity is concerned, the entire Tharparkar region is agro-based. Due to lack of industrial base and fragile economic conditions, over the years the livelihood opportunities are not diversified and depend completely on water availability for agriculture and livestock. Out of the total employed men, 42.7 percent are associated with the agriculture sector, followed by 16.9 percent as self-employed. A significant feature of the female labour force is the prevalence of unpaid family contributors who work without pay in cash or kind. In the case of Tharparkar, 72 percent of employed women participate in labour force as unpaid family helpers. They usually work in agriculture sector. This trend is counter-productive as women play a specific role in farming activities but their contribution is not recognised. A sizeable proportion of female labour force is self-employed. They are mostly engaged in home-based work.

The continuous droughts in the last decade have forced people to search alternative livelihood source for survival. With high illiteracy and no skills, they are working as unskilled labour within as well as outside district. Years have passed and the conditions of the local communities have not shown any improvement. Their deplorable situation is the outcome of twin factors; they are suffering due to natural calamities, but the man-made hazards are further aggravating their miseries.

The overall literacy rate in the selected communities is 31.4 percent, which is well below the literacy rate of 38.6 percent in Sindh [PSLM (2012-13)]. Huge gender gap exists in the literacy, as 44.4 percent of the adult males are reported to be literate as compared to 17.2 percent of literate females. The enrolment ratios for boys and girls depicted an alarming state, as only 47.4 percent of boys and 30.7 percent of girls are enrolled at primary level. Secondary schools are either not available or not at an accessible distance from villages—a fact that restricts a large percentage of grade 5 girls to move into the next class. Socio-cultural taboos also impede girls from going outside villages for education.

Incidence of Poverty

Poverty incidence at household level is estimated from per capita consumption expenditures. The estimation of poverty incidence from household data is conducted, by using the poverty line of Rs 1,928 per adult equivalent per month from Jamal (2013) study. The estimates show a very high incidence of poverty in the sample villages as 54.4 percent of people are living below the poverty line (Table 2). The mean VCI score of poor households was 68 in comparison with mean VCI score of 63 in non-poor that reflected a strong correlation between poverty incidence and vulnerability. As discussed and revealed earlier, the high dependency ratio further aggravates the vulnerability of the households below poverty line.

Table 2

Poverty Incidence and Vulnerability

Category	MHHs	FHHs	Total	VCI
Below Poverty Line	148	19	167	68
	54.4%	54.3%	54.4%	
Non-Poor	124	16	140	63
	45.6%	45.7%	45.6%	

Source: SPDC Household Survey, 2014.

The poverty index of Sindh province has shown a higher poverty incidence in rural areas as compared to urban areas. This is mainly due to the dual nature of the province's economy[8] and problems with the development priorities and resources allocation. District Tharparkar is the only district in Sindh province that is fairly above in the 'low human development' category. According to Human Development Indices (HDI), District Tharparkar has improved slightly from HDI 0.3317 in 1998 to HDI 0.3137 in 2005. However, there has been a decline of 1 percent per annum in the HDI of District Tharparkar.[9] According to rural poverty indices, 28.4 percent of the rural population of the district lives below the poverty line.[10]

The socio-economic profile substantiated *a priori* assumption of a higher level of social vulnerability in the selected sample households because economic and social indicators of Tharparkar have not improved much over the last two decades. In the overall ranking of the most deprived districts in Sindh, District Tharparkar had been ranked highest in the deprivation index among all other districts of the province [Jamal (2003)]. The incidence of multi-dimensional poverty in the district is also high at 93.3 [Jamal (2012a)]. About 55 percent of the population is deprived in terms of selected indicators i.e. education, health, housing services and economic base [Jamal (2012)]. The deplorable social indicators i.e., large household size, poor literacy level, inadequate infrastructure, with poor access to education and health facilities reflect upon the higher level of poverty and deprivation in the district [Rehman (2013)].

Inadequate and poor social service delivery has also compounded the existing level of vulnerabilities that may or may not be temporal in nature. The discussion on socio-economic profiles of the selected villages helps in the conceptualisation of the broad contours of an analytical framework of a social vulnerability assessment. It also identifies those stressors of the human system that are closely linked with the sources and drivers of social vulnerability.

Empirical Test Validating Poverty and Inequality in District Tharparkar

An independent sample t-test was also conducted to compare VCI scores at household level (VCIHH) for both poor and non-poor households. T-test of equality of

[8]Social Policy and Development Centre, "Combating Poverty: Is Growth Sufficient?", Social Development in Pakistan, Annual Review 2004, p. 59.

[9]Haroon Jamal and Amir Jahan Khan, "Trends in Regional Human Development Indices", Research Report No. 73, Social Policy and Development Centre (2007).

[10]Haroon Jamal, "In Search of Poverty Predictions: The Case of Urban and Rural Pakistan", Research Report No. 59, Social Policy and Development Centre (2004), p. 20.

mean between VCIHH and CPLINE (consumption based poverty line) suggests that there is a significant statistical difference in mean values between two groups. The result implies that households that fall in the category of non-poor that have statistically significant lower vulnerability in comparison with household above the poverty line. In the case of district Tharparkar, these results pointed out low level of household consumption because the economic base of the district is extremely weak. Social vulnerability in district Tharparkar has largely stemmed from inaccessibility to water, perpetual disasters, particularly drought, absence of public social service delivery, poor governance, absence of social capital, lack of adaptive capacity and fragile economic base. An independent sample t-test highlighted the fact that poverty has an effect on household vulnerability. Households having higher incidence of poverty have a higher level of social vulnerability (see Table 3).

Table 3

Independent Sample Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
VCIHHN Thar VCI HH all	Equal variances assumed	.884	.348	3.52	305	.001	4.183	1.189	1.843	6.522
	Equal variances not assumed			3.48	280.83	.001	4.183	1.201	1.818	6.548

In the district of Tharparkar, there is a statistically significant correlation between VCIHH and consumption poverty at household level. The result shows that 0.197 value share 3.88 percent of the variability in VCI. It also implies that poverty at household level cannot fully explain the household vulnerability (see Table 4).

Table 4

Correlation between VCI and Consumption Poverty at Household Level

		VCIHH Thar VCI HH	cpline consumption poverty line
VCIHH Thar VCI HH	Pearson Correlation	1	-.197**
	Sig. (2-tailed)		.001
	N	307	307
cpline consumption poverty line	Pearson Correlation	-.197**	1
	Sig. (2-tailed)	.001	
	N	307	307

**Correlation is significant at the 0.01 level (2-tailed).

Vulnerability and Capacity Index

From the sample of 307 households and community survey in 15 villages, VCI is calculated at household and village levels respectively. As discussed earlier, the architecture of VCI encompasses quantitative and qualitative aspects of social vulnerability, by assigning a value (positive or negative) to each characteristic of household or village in three broad categories of material, institutional and attitudinal vulnerability. From the community VCI it is revealed that higher the exposure to hazard by a community, higher is the vulnerability of that community.

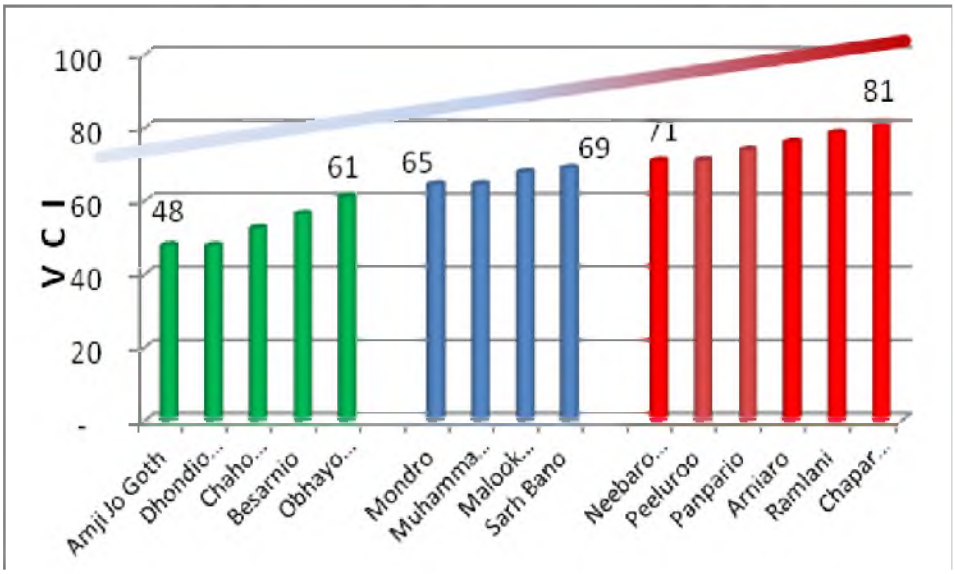
Table 5

Categorisation of VCI Scores

Vulnerability	Lower Limit of VCI Score	Upper Limit of VCI Score	No. of Villages	Number of Households	Percentage of Households
Low	48	61	5	103	33.5%
Moderate	65	69	4	97	31.5%
High	71	81	6	107	35.0%
Total	-	-	15	307	100.0

Source: SPDC Household and Community Survey, 2014.

Fig. 6. Vulnerability Scores of Selected Villages



Source: SPDC Household Survey, 2014.

Based on the VCI scores of community and household, categorisation (Table 5), five villages fall in the low vulnerable category, four in the moderate category and six villages are categorised as highly vulnerable. The categorisation revealed the significant differentials among the selected villages, based on their exposure to hazards and material and institutional vulnerability. The lower and upper limit of average mean values determined the category of each village from its village mean score as exhibited in Table

5. From the sample of 307 villages, the households are almost equally distributed in each vulnerable category with a slight higher percentage of households in high vulnerable category. Figure 5 shows the vulnerability scores of all selected villages, which range from 48 to 81. There appears to be an increasing trend of VCI score with increase in physical exposure to hazard. Also there is no overlap in all the three categories indicating a distinct difference amongst the categories. The most vulnerable group comprises 40 percent of the sample, about 6 villages.

In contrast to differentials, similarity in several factors is also observed in almost all the villages, which tend to place them on a higher intercept of vulnerability. For example, there are no collective assets owned by the community in any of the villages. Self help groups are not found in any of the villages. The sense of empowerment was observed to be very low and in most of the villages people do not access local or national leadership except two villages. Similarly, livelihood sources are mostly unstable.

Due to lack of opportunities and prevalence of illiteracy alternative livelihoods have become limited for these communities. Thus, the most common alternate livelihoods are the locals who work on daily wages are unskilled labourers, have unstable income which is a source of a fragile economic system.

Food Insecurity and Water Scarcity: A Social and Gender Context

In the arid and semi-arid regions, the effect of climate change is severe in particular for food insecurity and water scarcity. The monsoon season is characterised by harvesting in the region, feeding of animals with grazing land and recharge of underground aquifers. Normal rainfall in monsoon season allows the living organisms to secure their subsistence level of food for the rest of the year. Thus, monsoon brings back life and hope in the region.

The normal monsoon season is considered very crucial amidst the existing socio-economic conditions, absence of social services delivery and fragile economic base. Historically, the region relied on underground aquifers for drinking purposes that recharge from the monsoon rains. The low intensive and less frequent rains during monsoon season together with the shift in timings affect the groundwater recharge and quality of water due to the presence of soluble salts in the soil.

Changes in the frequency and intensity of rainfall during the monsoon season and an increased precipitation in the off-season bring an uncertain situation of water availability. In such events, the soil water deficiency occurs, thus reducing the biomass and yield. Water deficiency in the soil reduces water quantity in underground aquifers as well as affecting its quality. Table 6 exhibits changes observed by the respondents of household survey. Overall 67 percent of the respondents reported an increase in the depth of the underground aquifer while 89 percent mentioned reduction in the livestock grazing fields due to erratic and irregular soil and land erosion. Reduction in the number of water zones was mentioned by 48 percent men and 73 percent women. Since the collection of water is the responsibility of women, at water-scarce times the burden of managing water resources falls on women, which leads to an increased work load.

Table 6

Observed Changes Due to Drought

Variables	Changes	Male	Female
Underground Aquifers	Lowering	63.5%	70.4%
Livestock Grazing Fields	Decreases	93.5%	85.7%
Number of Water Zones	Decreases	48.4%	72.6%
Herbs/Plants/Bushes	Decreases	70.8%	50.2%

Source: SPDC Household Survey, 2014.

Women are more vulnerable to water scarcity and deteriorated quality amidst uncertainties during the 2nd period. In the current drought phenomenon, only men in the family are forced to migrate towards major towns and cities particularly in search of livelihoods for the survival of their families. They opt for migration towards greener areas, where they also receive relatively better social services and sustainable livelihoods. Women, children and elders are left behind to face difficulties of life particularly water scarcity and famine.

Table 7

Drinking Water Quality

Variables	Yes (%)
Sweet	23.5
Mixed	33.8
Bitter	42.7

Source: SPDC Household Survey, 2014.

Sweet water is scarce throughout the district except in ecological zones of '*vat'*, *'vango'*, *'kantho* and *parkar'*. It was reported in most sites that the depth of the underground aquifers has increased over the years that has affected the quality of ground water. In particular, the women, children and elders are more vulnerable in the context as they have to live in such harsh conditions where drinking water is not fit for human consumption. Table 7 reveals that, more than 75 percent of households in the sample have no access to sweet water. They have to rely on the available water which is not suitable for human consumption. A very few percentage of households can afford to purchase sweet water for drinking. This indicates that the lack of access to safe drinking water has increased the vulnerability of women, children and elders as they have no alternative choice except to use mixed and bitter water. Male member of the family have a choice to migrate from the area to other areas for earning purpose.

According to the report by National Disaster Management Authority (NDMA) in 2012:

> "*Like other countries, In Pakistan women have limited access to resources; little awareness of their rights, limited mobility with little exposure to environments outside their community or at times even the household, low levels of literacy and few life skills. This makes women highly vulnerable in periods of disaster where even greater challenges are faced in accessing basic resources. Stakeholders agree that to reduce the vulnerability of women and children in times of disaster,*

greater efforts must be made to understand the nature of barriers they confront and investment allocated to address these."[11]

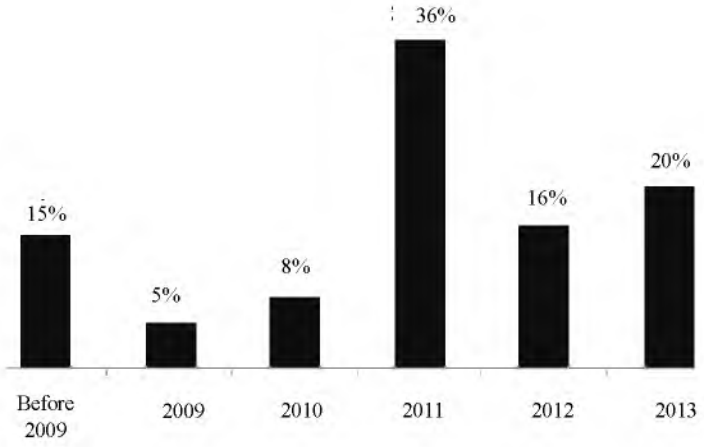
Life in the desert is harsh and difficult. In extreme cases droughts lead to famine, when crops have failed to grow. Recurring droughts increase the burden on women to manage food shortages and for men this means obtaining additional income from non-agricultural sources.[12]

Table 8

The Incidence of Starvation

Households ever experienced starvation	47%
Average number starvations in life **(male)**	7
Average number starvations in life **(female)**	13

Percentage Distribution of Households that have ever Experienced Starvation



The persistent drought conditions have resulted in severe food insecurity. Lack of livelihood options have plunged people into a state of hunger as they had no access to food and potable water. The field survey reveals that 47 percent of the households have experienced starvation[13] in their life (Table 8). On average, a household experienced over 11 times of starvation in the span of the last 30/40 years. Both men and women reported starvation experiences. However, the average starvation in women is almost twice as those in men. This reflects the cultural norms where women sacrifice their nutrition requirements for the entire family. As exhibited in Table 8, women experienced starvation 13 times in their life as compared to 7 times by men. Of the total households,

[11]National Disaster Management Authority, Government of Pakistan, "Disaster Risk Management Needs Report 2012", June 2012.

[12]Sibyl nelson and Yianna Lambrou, "Gender Dimensions, Climate Change, and Food Security of Farmers in Andhra Pradesh, India.. Gender and Climate Change: An Introduction", Edited by Irene Dankelman, Earthscan 2010.

[13]Starvation is defined as a no food for 24 hour.

40 percent reported at least 5 starvations and 20 percent reported at least 10 starvations in their life. The incidence of starvation is comparatively high during the last five years (2009-2013). People were asked to mention the year of most recent starvation. As shown in Table 8, out of all households that have ever faced starvation, 85 percent reported that their most recent experience was during the last five years.[14]

The mean vulnerability score of those who have experienced starvation is higher at 67 (141 households) as compared to mean VCI score of 63 for household who did not experience any starvation (166 households) in their life. Similarly, households in which women experience starvation are more vulnerable (mean VCI 69) as compared to households where only men reported the experience of starvation (mean VCI score 64). Further, household where women experienced starvation either singly or jointly with men are also more vulnerable with mean VCI score of 68. Starvation incidence is high in households below poverty line that is 87 percent, while they have monthly income less than or equal to Rs 16,666 with relatively high dependency ratios.

Coping and Adaptation Practices

Coping and adaptation practices in the last 10–20 years have changed considerably due to climate variability. During the last 10–20 years, respondents were unable to distinguish the changing characteristics of climate with the precise recognition and understanding of potential drought in the region. Migrations to barrage areas are still in practice. However, participants of FDGs mentioned that migration of the whole family has reduced. Mostly male members of the family migrate in search of livelihood while women, children and elders are left behind to face a difficult life, owing to water scarcity and limited availability of fodder for livestock. This may be one of the major reasons behind the high incidence of starvation in women as mentioned earlier. As shown in Table 9, current practice of temporary migration was reported by about 40 percent of household as compared to 59 percent in the past. The practice of storing food as coping mechanism has increased substantively from 33 percent to about 48 percent of households. However, the quantity of food available for storage was reported to be lower than the subsistent level. As stated by a female respondent: "*the practice of storing grain was a method of coping with drought, but we are unable to store enough due to decrease in yield and an increased frequency of disasters.*"

Table 9

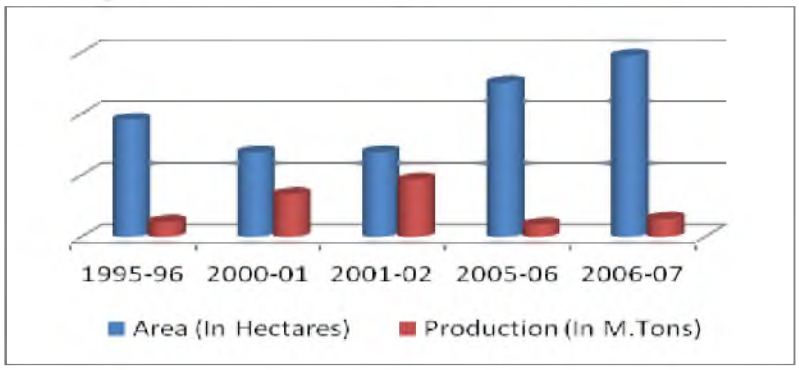
Coping and Adaptation and Coping Practices

Variables	Current	30 Years Back
Food Storage	47.5%	33%
Temporary Migration	39.9%	58.8%
Store Water	-	-
Change of Livelihood	10.9%	4.9%

Source: SPDC Household Survey, 2014.

[14]These responses should be taken with the caution that they are based on memory recall. People generally tend to remember their recent experiences more accurately.

Fig. 7. Area and Productivity of Millet in Selected Years



Source: Development Statistics of Sindh (Various Issues).

Agriculture in the district is entirely rain fed, depending on monsoon rains. In order to achieve the optimum growth, various crops have particular temperature requirement, moisture and nutrient during their growth cycle. If the moisture availability falls below the optimum amount during the growth cycle, the growth of crop will be impaired and yields reduced.[15] The main crops of the district are millet and guar (cluster bean), which are sown immediately after the first spell of mature rain. The agriculture cycle requires at least three to four spells of normal rainfall with an interval of 10-15 days. During the last 10 years, there are significant production losses due to irregular and erratic pattern of rainfall. As depicted in Figure 7, there has been decline in the productivity in 1995-96, 2005-06 and 2006-07, despite the fact that there was normal rainfall in terms of the amount but was erratic and irregular. The unpredictable rains normally vary within frequency and intensity in terms of area and time [Shaikh (2013)]. Lack of knowledge and absence of government support through agriculture extension department were cited as major reasons for inability of farmers to shift to other crops or change the cropping pattern.

Livestock activities are also changed owing to limited availability of fodder in the district. According to a respondent, horses were a common sight in the desert, but due to the loss of fodder, they are not seen anymore. Communities preferred to have more sheep and goats while donkeys have also received importance because of increased water scarcity and fast depletion of water zones. However, such practices are subjective in the wake of less resilience to diseases amidst available fodder and grazing lands. The donkeys are mostly used for carrying water from far flung areas. Green fodder livestock like cow and buffaloes are found in very small numbers particularly in areas which are canal irrigated or have better access to water resources. It is found from data that in 1970 ratio of cows to goats and sheep was 1:1 and district Tharparkar was declared as main cattle region of Pakistan, but it turned to 1:6 in 1998 amidst increase in water scarcity.[16] Analysing the primary data of sample communities, the ratio of cow to goats and sheep comes out as 1:8.

[15]Chahudary, Sheikh, Bari, 'History's Worst Drought Conditions Prevailed Over Pakistan', Pakistan Meteorological Department, Government of Pakistan.

[16] Ibid.

CONCLUSION

Climate change has now become a reality and arid ecosystems will be amongst the major sufferers. Decrease in rainfall, increase in temperature and increased incidences of extreme events are some of the changes expected in arid zones of district Tharparkar. For thousands of years, people of Tharparkar region have been living with their indigenous knowledge, combating the problems arising from the lack of natural resources and provision of facilities. But over the years global changes in the climatic pattern parallel with the over powering nature of social and economic factors have pushed the inhabitants of this arid region into a more vulnerable situation.

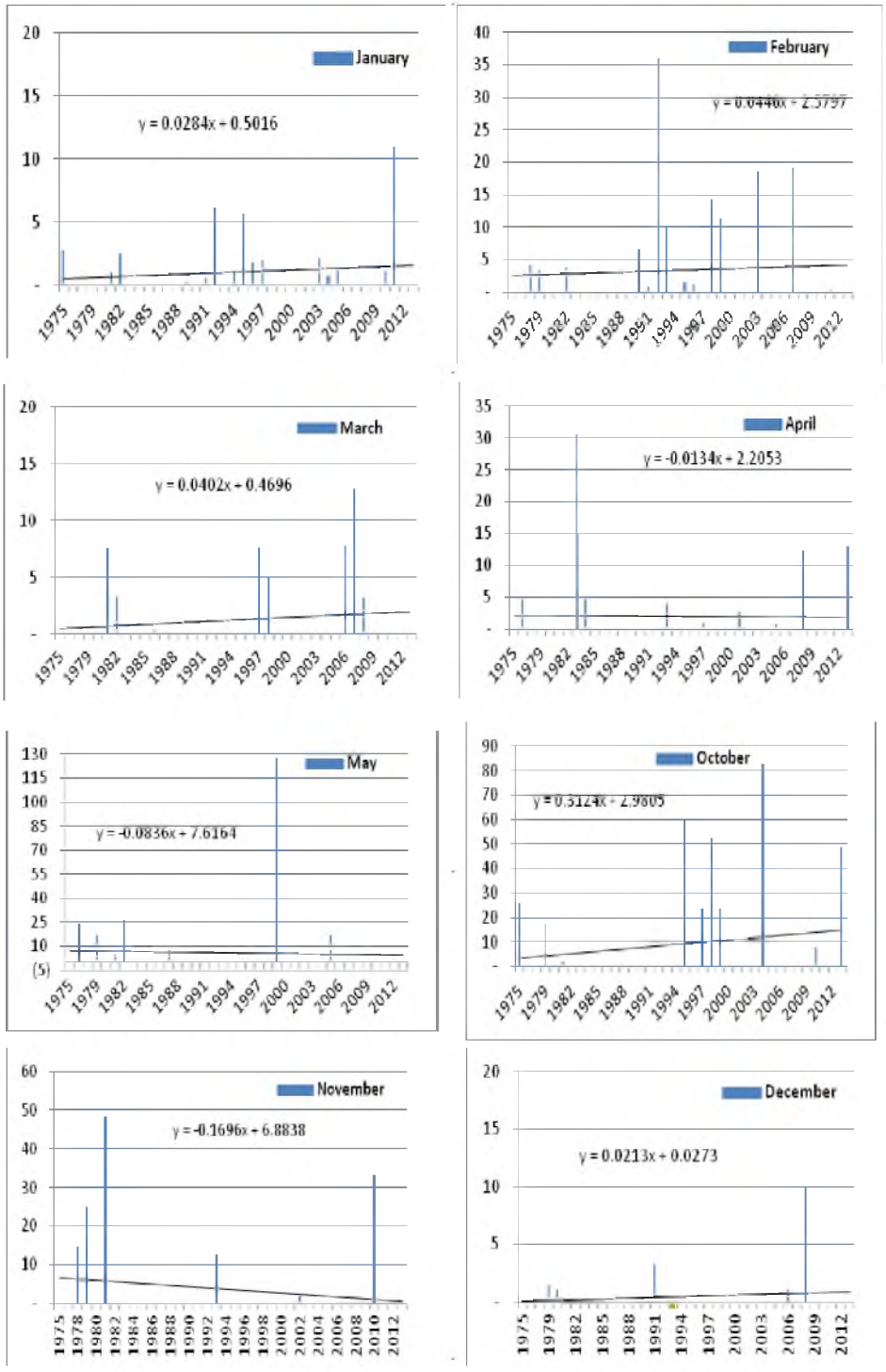
In the last two decades, changes in drought patterns instigated the higher level of the vulnerability in the people. Unlike historical droughts, the recurrent recent drought dragged the life of majority of people in the region to below subsistence level. Besides the change in climatic patterns, the other reason behind their vulnerability is the absence of industrial base that makes the economic base of the region fragile. Thus reduces the income generating opportunities of the district, negatively affects the food security and increases the incidence of poverty of the district. With increase in demographic pressure and inability of the government to provide economic opportunities and support the industrious potential of the population, the livelihood of the region will continue to be at risk. The availability of water and food would have been a minor issue if people have high purchasing power and adequate and diversified sources of livelihood.

There is need to impart and enhance knowledge and understanding of hazards and climate changes in both men and women for more effective coping and adaptation strategies. Water is the main source of miseries of the people, as beside other chronic challenges, it is responsible for water borne diseases in the region. Ironically, women and children are mainly affected. The disjointed circumstances aggravate the vulnerability of the families, particularly the women because of their socially constructed roles and prominence in the society. Women have to bear the disproportionate burden and face hardship of life. Despite cumbersome responsibilities women radiate strength and is evident from their experience of starvation which is almost double than the entire family members. However, this results in high malnutrition in women leading to high maternal mortality rates. Further, the low birth weights result in high infant mortality rates in the district.

The underdevelopment of the entire Tharparkar region is another aspect aggravating the vulnerability and can be explained by malicious behaviour of the authorities. Lack of provision of basic infrastructure, poor communication network, pathetic health and education facilities and non-provision of clean drinking water are the key vulnerability factors. Thus the prevailing issues and the intense human sufferings will continue if provincial government chose to continue with its ad-hoc and disconcerted approach. Serious efforts are also needed to stop the corruption / pilferage and address the issue properly as an issue of a climate change—which would require serious technical inputs, a comprehensive strategy, envisaging short and long term of action; a gender lens; and an effective coordination between relevant government departments. Water availability being the main source of suffering, the provincial government must start by maintaining the existing wells and ponds and conversion of brackish water into sweet water with the help of technology. In the long term, a diversion of excessive water via outfall drains in the region would help in recharge of the ground water. Also a long run economic and development strategy would assist in improving the living standards and eliminate the economic disparity of the people of the Tharparkar district.

ANNEX A

MONTHLY RAINFALL TRENDS - SELECTED MONTHS (IN MILLIMETER)



ANNEX B

Monthly Rainfall Averages

Month	1975-1994				1995-2013			
	Average	Median	Max	Min	Average	Median	Max	Min
January	0.96	-	6.20	-	1.35	-	11.00	-
February	3.08	-	36.00	-	3.49	-	19.20	-
March	0.53	-	7.50	-	1.92	-	12.80	-
April	2.11	-	30.60	-	1.56	-	13.00	-
May	3.86	-	26.10	-	7.71	-	128.20	-
June	14.60	-	112.20	-	25.07	18.80	87.20	-
July	84.32	34.10	231.80	-	67.64	32.60	354.30	-
August	92.69	73.30	356.10	-	113.24	69.80	562.80	-
September	35.14	13.70	241.20	-	95.94	26.20	778.1	-
October	4.58	-	25.65	-	15.78	-	82.90	-
November	4. 80	-	48.60	-	1.85	-	33.20	-
December	0.28	-	3.30	-	0.58	-	10.00	-
Total	249.1	255.3	499.1	24.6	336.1	221.0	1361.3	4.6

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