



*Review Article*

## **Climate Change and Livelihood Issues: Some Empirical Evidences**

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### **Abstract**

*Climate Change has now being acceptable and perceptible phenomena amongst people residing in rural areas. One of the greatest impacts is disruption of livelihoods, especially of rural communities because they have large dependency upon climate sensitive natural resources for their livelihood. In the present study, four villages from two tehsils of Sikar District, Rajasthan have been studied to ascertain the livelihood vulnerabilities of households. The study is based upon indicator approach and the vulnerability has been calculated following the IPCC Third Assessment Report's considerations about vulnerability. The villages and the households have been selected through random sampling technique and a questionnaire was administered amongst the selected household to find out various socio-economic parameters. Data collected have been analyzed using Principal Component analysis, by assigning weights to each indicator, which were further aggregated in to exposure, sensitivity and adaptive capacity indices. Livelihood vulnerability index has been calculated for the villages and tehsils. Adaptation Options being followed by households have also been studied. Focus group discussions were also carried out in the communities and the perceptions gathered were compiled. The empirical findings have been analyzed and the level of vulnerability between two tehsils has been compared. The results have been discussed and suggestions have been given for wider policy implications.*

**Key words:** Climate Change, Livelihood, Indicator approach, Vulnerability, Adaptation.

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### **Introduction**

Climate Change process a new type of challenge for population residing in rural areas, as it is disrupting the livelihoods of people which are mainly dependent upon climatic sensitive natural resources. (MoE&F, 2012) The need of adaptations to the changes in Climate is not new phenomena and human beings are not powerless victims in response to changes and risks (Scoones et al. 1996; Christoplos, et al. 2001; Roncoli, et al. 2001).

In the present study, two Sub divisions of the District Sikar, Rajasthan also known as

“Tehsils” have been chosen to ascertain livelihood vulnerabilities of households. The tehsils studied included Ramgarh Shekhawati which is northern part of the district having sandy terrains whereas the second tehsil is Neem ka Thana which forms the eastern part of the district having hilly terrain of Aravalli ranges. The district has high recurrence of droughts with a frequency of once in five years. (Rathore 2004). The concept of vulnerability has been published in context of climate change by authors. ( Adger ,1999; Kelly & Adger, 1999; Olmos, 2001; Brooks ,2003;

& O'Brien et al., 2004). The concept is now considered as "multidimensional" incorporating various economic, social, institutional, biological and geophysical factors (Khajuria & Ravindranath, 2012). The study adopts definition given by IPCC Third Assessment Report which defines it as "The degree to which a system is susceptible to or unable to cope with adverse effects of Climate Change including Climate variability and extremes. Vulnerability is a function of the Character, magnitude, and rate of Climate Variation to which a system is exposed, its severability, and its adaptive capacity" (McCarthy, 2001). The issues impacting livelihood and its challenges have been presented through a composite Livelihood Vulnerability index which indicates the level of threats and susceptibility which households experience in era of climate change. The depiction through livelihood vulnerability index aims to present an integrated approach about vulnerability, integrating social vulnerability with the biophysical dimensions of climate change to give a comprehensive picture of Vulnerability (Nelson et al., 2010 b; Gbetibous & Ringler, 2009; Cutter, 1996). The Indicator based approach has been followed where a number of social, economic and climatic parameters have been aggregated into a Livelihood Vulnerability Index as earlier explored by various authors for indexing vulnerability at national and district level. (O'Brien, et al., 2004; Hahn, et al., 2009; Toufique, et al., 2014; Rama Rao, et al., 2016).

Four indicators have been selected under exposure which included, rainfall variance, land degradation, illness due to water quality and food insufficiency period.

Another component of vulnerability is Sensitivity that can be considered as "the degree to which a system is affected or modified by an internal or external disturbances or set of disturbances" (Gallop, 2006, pp 295). Indicators selected to study sensitivity included, income share from climatic dependent and independent parameters, loss of crops and livestock, liability of debt, and travelling distance for access of drinking water.

Adaptive Capacity can be understood as inherent capabilities of society or people for adjusting to expected or actual climatic variability or it could be an ability to cope up with climate change impacts (O'Brien et al., 2004). Communities' access to various resources determines the adaptive capacity which may help in responding various threats and exposure (Khajuria & Ravindranath, 2012). Sustainable Livelihood framework, which has been used to analyze adaptive capacity (DIFD, 1999; Ellis, 2000), is based upon entitlement approach propounded by Amartya Sen (Sen, 1981). Five livelihood capitals and their indicators have been cautiously chosen under physical, financial, human, natural and social capitals (Piya et al., 2015; Maiti et al., 2015). In physical capital category indicators included livestock units, accessibility to cattle/fodder camps, information gadgets and possession of irrigated land. Under financial capital they included income, asset value, access to financial services and market. Literacy rate, dependency ratio, child malnutrition and access to agriculture extension services were included in human category. Under natural capital, the indicators were cropping intensity, inverse of

diversification ratio, agro forestry and clashes for water resources whereas under social capital, assistance from friends/NGOs, migration, self help group membership and investment in social gift were selected for framing various questions for primary household survey.

Two villages from each tehsil were selected through simple random sampling method. These villages were Dhandhan & Rookansar from tehsil Ramgarh Shekhawati and Dareeba & Chala from Neem Ka Thana tehsil.

A total of 69 households were selected using random stratified sampling method from four villages for collecting data through a semi structured questionnaire.

The data was standardized as it was in different units, thus bringing them in to

Where 'I' various component indices, 'a' is the loading from the first component of PCA, 'o' is the observed indicator value, 'm' is the mean and 'sd' is the standard deviation within the indicators.

$$LVI = (E_i + S_i) - AC_i$$

Where 'E<sub>i</sub>' is exposure index, 'S<sub>i</sub>' is sensitivity index and 'AC<sub>i</sub>' is adaptive capacity index.

Adaptation to Climate Change can be understood as adjustment sets carried out for countering the environmental changes. These may occur within biological system naturally and in social systems to some extent. (Gallopini 2006; Nelson et al. 2007). Adaptation is understood within the Climate Change literature as "adjustment is natural or human system in response to

comparable ranges. (Nelson, et al., 2010b; Gbetibouo & Ringler, 2009; Vincent, 2004). Weighted method was followed and the indicators were assigned weights using Principle Component Analysis (PCA), as earlier carried out in various studies (Filmer & Pritchett, 2001; Piya et al., 2015; Maiti *et al.*, 2015). The exposure and sensitivity indices were constructed by running PCA for the selected indicators. The adaptive capacity index was calculated by running stepwise PCA. In the first step, indicators under various capitals was run to calculate sub component indices, which were used as input for running the second step PCA to calculate aggregate adaptive capacity index. The formula used to calculate various indices in this analysis is as under

$$I_j = \sum_{i=1}^k a_j \left[ \frac{o_{ji} - m_i}{sd_i} \right]$$

The Livelihood Vulnerability Index has been calculated adopting the IPCC TAR concept that Vulnerability is function of Exposure, sensitivity and adaptive capacity, thus the following formula has been used.

actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC 2001, P. 982). The details of adaptation options were collected through questionnaire and during focus group discussions, the results have been analyzed and discussed below.

### Results and Analysis

The results obtained from the study have been tabulated for the two tehsils and four villages. The mean value of Livelihood Vulnerability Index and its sub indices are as under:

**Table 1. Mean values of Livelihood Vulnerabilities Index and its sub indices**

Tehsils	Exposure index	Sensitivity index	Adaptive Capacity index	Livelihood Vulnerability Index
Ramgarh Shekhawati	1.50	0.04	0.03	1.51
Neem Ka Thana	0.61	-0.14	0.13	0.34

The results depicts that the Livelihood vulnerability of Tehsil Ramgarh Shekhawati is very high (LVI 1.51) due to high level of rainfall variation in the tehsils. Less and erratic rainfall leading to droughts, which has caused higher land degradation .

The ground water quality has also been affected due to low recharge and as it the main source of drinking water , the number of cases reported about illness due to drinking water is quite high.

The food availability trend is also decreasing due to overall impact on agriculture production, hence the overall exposure index (EI= 1.50) for the households residing in the tehsil Ramgarh Shekhawati is very high. The Exposure Index of tehsil Neem ka Thana is lower because the variability of rainfall is less and the average rainfall is more in the tehsil which leads to less number of drought years. The other parameters of exposure are related to rainfall hence they are lower as compared to Ramgarh Shekhawati , hence the mean exposure index is low (EI= 0.61)The sensitivity index is also high for the tehsil Ramgarh

Shekhawati (SI= 0.04) as compared to Neem ka Thana (SI= -0.14) , which can again be attributed to high variance in rainfall which leads to larger percentage loss of crops and livestock ,larger dependence upon agriculture and allied activities and scarcity of water. The adaptive capacity of Ramgarh shekhawati tehsil is low (AC=0.03) as it has lower possession of various assets under different capitals which includes less irrigated lands, livestock units ,agriculture assets and information gadgets.

The lower educational attainments, high dependency ratio, lower access to financial services and markets are also some important factors which contribute in lower adaptive capacity. The adaptive capacity of tehsil Neem Ka Thana is higher (AC= 0.13) as the contributing factors are better than the other tehsil. The mean Livelihood Vulnerability index of tehsil Neem ka Thana (LVI= 0.34) is lower as compared to other , which is due to higher access of households to the assets under various capitals and lesser variation in rainfall. The villages studied under the tehsils have also been compiled below

**Table 2. Mean values of Livelihood Vulnerabilities Index and its sub indices**

Villages	Exposure index	Sensitivity index	Adaptive Capacity index	Livelihood Vulnerability Index
Dhandhan	1.44	-0.01	0.07	1.36
Dareeba	0.72	-0.18	0.1	0.44
Chala	0.53	-0.11	0.16	0.26

The result shows that there is a variation of various indices within the tehsils at village levels. The Dhandhan village in Ramgarh shekhawati is having low vulnerability than the village Rookansar, as there people have developed facilities for rain water harvesting which gives some stabilization in agriculture production and solves the problem of drinking water to a certain extent. The Dareeba village in Neem Ka Thana tehsil has a hilly terrain, the average is being presented in form of frequency table below

holding size is less and there is large scarcity of water which leads to more vulnerability as compared to Chala village which has partly sandy terrain and the households have larger land holding as well as they have diversified their livelihood into wage based activities like labour in nearby brick kilns.

The various adaptation options being adopted by the households

**Table - 3 : Frequency of Households opting for Various Adaptations**

Adaptation Options	Tehsil Ramgarh Shekhawati		Tehsil Neem Ka Thana	
	YES (In %)	NO (In %)	YES (In %)	NO (In %)
Diversification of Crops to synchronize with the moisture availability	97.0	3.0	83.3	16.7
Change the timing of sowing crops/ double sowing	97.0	3.0	83.3	16.7
Soil conservation	57.6	42.4	19.4	80.6
Use of water conservation measures.	33.3	66.7	27.8	72.2
Use Improved seed/ HYV / Short duration/ Drought Resistant Varieties	72.7	27.3	77.8	22.2
Propagation of agro forestry	90.9	9.1	61.1	38.9
Use of climate information prior to sowing	69.7	30.3	47.2	52.8
Cash loan from formal institutions - commercial bank, co-operative society/ grameen bank	45.5	54.5	33.3	66.7
Cash loan through SHGs/ micro-finance	21.2	78.8	8.3	91.7
Cash loan from friends/ neighbor/ money lender/ crop merchant	48.5	51.5	58.3	41.7
Sell of agricultural assets (e.g. land, animal, harvest in advance and farming equipment etc)	72.7	27.3	66.7	33.3
Sell of non-agricultural assets (e.g. jewelry, house and home appliances etc)	21.2	78.8	52.8	47.2
Seasonal migration of any members of the household	45.5	54.5	66.7	33.3
Worked more, if already working	78.8	21.2	100.0	0.0
Reduce food consumption	45.5	54.5	58.3	41.7
Spent savings/ Mortgage house or land	78.8	21.2	86.1	13.9
Employed as daily wage labour (e.g. MNREGS ,DDP or other Govt .schemes work)	51.5	48.5	69.4	30.6
Diversifying livestock	66.7	33.3	25.0	75.0
Different welfare activities and alternate employment (e.g.MNREGS, DDP, FWP, PDS, PMGSY, RGEY etc.)	57.6	42.4	66.7	33.3

The adaptation options that are common in both the tehsils include diversification of

crops and change in sowing time with the rainfall as the agriculture practiced is



mainly rainfed. The other options are varying in both the tehsils. Alternate employment, seasonal migration, additional work and cash loans are higher in Nem ka thana whereas conservation of natural resources, usage of climate information, loan from institutional agencies and livestock diversification is being adopted by larger number of households.

Thus from the above study it can be concluded that the adaptive capacity of the households needs to be augmented especially in term of rainwater harvesting by building both traditional and modern structures to store rain water. The alternate livelihoods needs to be explored which can be sustainable and can give stable income to households even during the climate extreme events. Community led planning and risk assessment is the key solution for evolving definite long term adaptation options suitable for reducing livelihood vulnerability to climate change.

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