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Research Article

GENDERED LIVELIHOOD VULNERABILITY IN THE FACE OF RISING DROUGHT: A STUDY OF FARMERS IN BANKURA, WEST BENGAL, INDIA

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ABSTRACT

This study has attempted to investigate the nature and magnitude of livelihood vulnerability of farmers in the Bankura region, West Bangal, India, across gender on the occasion of rising frequency of drought. A multistage purposive random sampling technique was used to select study sites and collect farm-level data of 250 farmer households across gender using a well-structured and pre-tested schedule. The findings revealed that female-headed households are comparatively more exposed to changing climate of increasing frequency of drought than are the male headed households. Due to the lack of basic amenities and economic resources, the livelihood vulnerability score was significantly higher for female-headed households. Therefore, to improve the income security of the said susceptible households' measures like identifying and providing them with innovative, practical and gender sensitive methods so as to reduce the extent and dimensions of livelihood vulnerability, are prominent measures which would help in developing livelihood resilience for this 'at risk' part within the farmer community.

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1. Climate Change: An Introduction

Climate change is one of the most vital global environmental challenges facing humanity with implications on food production, freshwater supply, health, etc. According to the latest scientific estimation, the earth's climate system has palpably changed on both global and regional scales since the preindustrial era. Further evidence reveal that most of the warming (of 0.1°C per decade) observed over the last 50 years, is ascribable to human activities This conspicuous increase is anticipated to have stern impacts on the global hydrological system, ecosystems, sea level, crop production and associated processes. The visual signs of climate change are higher temperatures, more droughts, changing rainfall pattern, melting glacier and subsequently rising sea level. The impact would be particularly harsh in the tropical areas, which mainly consist of developing countries, including India. As the reality of climate change

becomes accepted by the scientific community, it is critical to understand its impact on the ground, particularly the lives populace dependent on agriculture and natural resources for sustenance.

2. Climate Change and Gender

Climate change poses numerous risks to agricultural communities. Vulnerability is a concept often employed in the context of climate change to identify risks that address current and projected impacts. However, the term vulnerability can be situated in a broader social context, driven by factors such as land tenure and access, livelihood diversification, and employment, which singles out traditionally backward, discriminated, highly exposed section of the society, i.e., women. Women are highly vulnerable with the least resources, tenure rights, low literacy, and the least freedom to participate in mainstream adaptation strategies. The following points highlight gender vulnerability in the farm sector:(i) women are more disadvantaged as cultivators as they tend to own and farm in smaller plots, work longer hours, or limit farming to food crops, (ii) extreme climate swings in disaster-prone agrarian communities mostly subject women to forced migration, increased discrimination, resource poverty owing to selling off landed poverty and subsequently food insecurity (unfccc, 2023).

In the situation of climate change, it is likely to have greater negative impact on women in backward regions in particular, as the personal income they can control is often more limited than that of men. With the above background, this study evaluates gender- environment perspective of climate change in agriculture and their vulnerability.

However, among all the visible manifestations of climate change, this study will focus on drought and its effect on farmers since in contrast to other extreme events such as floods, which are typically confined to small regions and well-defined temporal intervals, droughts are difficult to identify in time and space, affecting wide areas over long periods of time.(Chandra A. et.al., 2017).

3. Rationale for Choosing Study Area as West Bengal

West Bengal is predominantly an agrarian state. In majority of its districts than 70 per cent of land area is used in growing crops (Census of India, 2011). According to Agricultural Census, 2011-12, 84 percent of the operated area belongs to small and marginal farmers and the average size of the farmland holding is 0.77 ha (as in Ghosh, 2011). However, West Bengal also comes to be most climatically vulnerable states of India. As many as 15 districts in West Bengal, which are home to nearly 72 million people, are exposed to intense climate variability events such as cyclones, floods, and droughts, according to (CEEW) in 2021. Districts like Howrah, Kolkata, North 24 Parganas, Paschim Medinipur, and South 24 Parganas are cynosures for cyclones, which have increased five-fold in the state between 1970 and 2019.

Apart from cyclones and floods, West Bengal has also recorded a two-fold increase in droughts in the last ten years. Its intense drought centers include Bankura, Ganjalghati, Hirbandh, and Purulia. Once irregular in occurrences, droughts (or drought-like conditions) now have affected more than 40 per cent of the state's districts in recent decades. According to the CEEW, even flood-prone areas like Bankura and Purulia have witnessed a shift towards drought instances in the past decade (ceew.in).

4. Bankura

Given the above discussion, Bankura district has been selected as the study area for carrying out the survey on rising drought and its effect. A brief overview of Bankura is given below.

Bankura is located in the western part of the state. It is also included in the area known as "Rarh" in Bengal. Bankura district is situated at 23.25°N 87.07°E. The western part of the district has poor, ferruginous soil and hard beds of laterite. In the eastern part lies the wide expanse of green fields more fertile in nature. The economy of Bankura district is characterized by an overwhelming agro-economic base and low urbanization. Agriculture is the primary occupation with average land size available per cultivator is around 0.41 ha. Around 66 percent of the rural population is engaged in various forms of agricultural labour occupation whereas 32 percent of the rural workforce derives livelihood from self-employment in farming (Census, 2011). While Bankura district is usually susceptible to drought, in the past decade it has experienced particular rise in frequency of drought condition which is an evident effect of climate variability, viz-a-viz., climate change (Bankura District Statistical Handbook, 2014). Therefore, agricultural population of Bankura has largely shifted to mono-cropping and the cropping pattern is skewed heavily towards paddy cultivation. In 2006, the Ministry of Panchayati Raj marked Bankura as one of the country's 250 most backward districts and had been receiving funds from the Backward Regions Grant Fund Programme (BRGF) for some time (Ministry of Panchayati Raj, 2015).

5. Methodology

5a. Research Methodology

A multi-Stage sampling technique was used to select study sites and farmer households. After selecting Bankura as the study district (because of the afore-mentioned reasons), attempt was made to select the block. In Bankura drought is a regular feature in the North-West part of the district which reflects the true over-all climatologically picture of the district. The blocks located in the region cover Chhatna, Saltora, Gangajalghati, Barjora, Bankura-I, Bankura-II, Mejia, Indpur, Hirbandh and Ranibandh. Therefore a thorough consultation was done with district headquarter Agriculture, Natural Resources and Statistical Department who have the comprehensive knowledge about the climate-edaphic conditions by blocks of Bankura. Indpur Block was decided as the study block on their prominent suggestion based on time series data on recorded pattern of rainfall, soil characteristics and cropping pattern. At the next stage, one village, namely Indpur is finally picked up which resonates the district's arid climatic conditions well as was underpinned by the Agricultural Development Officer (ADO) at Block Office of the State Government of West Bengal. It was where the field work was eventually carried out. Indpur village became a definite choice more so because besides confronting persistent drought, it was characterized by higher concentration of female owner cultivators relative to other villages located in the block as per data provided by the Block Statistical Department, which would enable help better capture vulnerability of female in relation to male farmers in this mentioned condition of chronic aridness.

To understand farmers' perception on climate change across gender, farming households were first categorized into male and female. For this purpose, list of cultivators was obtained

from gram panchayat separately for male and female. In Indpur 125 farmers were female and the entire group was surveyed for the fulfillment of the objective. Here it is imperative to mention that in India, as per the information collected in Agriculture Census 2015-16, about as low as 11.72 percent of the total operated area in the country is operated by female operational farm holders (Ministry of Agriculture & Farmers Welfare, 2021). Therefore, the study area, characterized by small number of female farm holders, is no exception. For comparative analysis a matching number of male farmers were picked up to carry out the primary survey (125). Random Sampling Method was adopted in this regard. The total sample size of the study comes to be 250.The survey data relates to the agricultural year 2021-22 (July-June).

5b. Estimation Method

The focal point of this study was to amalgamate gender sensitive indicators, and to develop a Livelihood Vulnerability Index (LVI) separately for male and female that could be applicable at any scale, be it national, state, region, district, village, and even at the household level. The LVI by gender helps to spot out the most vulnerable members' group of society and analyze vulnerability within the community. The data (indicators) collected through field survey were categorized into three sub-components of exposure, sensitivity, and adaptive capacity under the two distinct groups, namely, male and female. The indicators chosen were representative of a stepwise method for understanding climate change impacts, development linkages, and the economic, social, and environmental dimensions linked to vulnerability of male and female cultivators. The indicator-based approach in a specific set or combination used to measure the vulnerability by computing indices. Before combining indicators to measure vulnerability across gender, the indicators were first normalized to scale of zero (0) and one (1) using equation (1 and 2) and if the indicator has a positive relationship with targeted indices, such as exposure, sensitivity, and adaptive capacity, then equation (1) was employed:

$$Index = \frac{K_i - K_{min}}{K_{max} - K_{min}} \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where K_i is the original sub-component for the community ***i***and $K_{min}$and $K_{max}$are minimum and maximum values, respectively. For each sub-component, the vulnerability was determined using survey data.

After each component was standardized to scale noted above, the mean of each sub-component was estimated by using equation 2 to calculate the value of each major component.

$$K_h = \frac{\sum_{I=1}^{n} Index\ \text{Ki}}{n} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

Where, K_h is one of the three components of the community h, exposure (EXP), sensitivity (SENS) and Adaptive capacity (ADP), index k_i represents the sub-component indexed by i, that make up for each major component, and n is the number of sub-components in each major component.

Once the values for exposure, sensitivity and adaptive capacity were calculated, the three contributing factors (exposure, sensitivity and adoptive capacity) were combined using equation (3) to obtain potential livelihood vulnerability index (PLVI).

$$PLVI_d = (E_d) - (A_d) * S_d \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

We have scaled the PLVI based on the results obtained from the vulnerability index score, i.e., -1 (least vulnerable) to 1 (most vulnerable) (Singh and Singh, 2019).

Like stated earlier, each of the above-mentioned indices has been calculated separately for male and female farmers in strive to understand the livelihood vulnerability of farmers in drought at gender disaggregated level.

6. Selection of Rational Indicators

It is a primary task to first select a suitable indicator, without which the computed results cannot be generalized or compared. Therefore, after substantial literature review, this study identifies some of the key indicators for the three dimensions, namely, exposure, sensitivity and adaptive capacity.

Exposure refers to strain caused by changes in frequency, intensity/magnitude, duration, and nature of climate stress.

Sensitivity is the degree to which the system is affected either adversely or beneficially, by climate-related stimuli. It measures the ability of a system to respond to climate change impact, which is comprehended by both socio-economic and ecological situations and identifies the level at which environmental stress is likely to influence a cohort.

Adaptive capacity refers to the ability of a system to minimize the adverse consequences of moderate to extreme potential damages from the climate variability.

All the three contributing factors (exposure, sensitivity and adoptive capacity) were eventually combined to get inference about potential livelihood vulnerability index (PLVI) of the farm operators through gender in the study area. The selected rational indicators for calculation of livelihood vulnerability index, shortlisted on the basis of the review of Literature and pilot surey, have been explicitly discussed below.

Table 1. Selected rational indicators for livelihood vulnerability index Component Indicators

Exposure

1. HHs perceive that rainfall has declined (in %)
2. HHs observe that summer days become hotter (in %)
3. HHs perceive that frequencies of droughts have increased (in %)
4. HHs perceive that water level continuously has declined (in %)

Sensitivity

1. HHs unable to access LPG for cooking purposes (in %)
2. HHs cannot access hand-pump (untreated) water for drinking (in %)
3. HHs depends on government sources for irrigation (in %)
4. HHs using free government medical facilities (in %)
5. HHs do not have toilet facility (in %)
6. HHs do not have all seasonal or pukka house (in %)
7. HHs belong to Below Poverty Line classification (in %)
8. Head of household does not attained school (in %)

Adaptive Capacity

1. HHs changing their cropping pattern (in %)
2. HHs planning to switch to non-farm activities (in %)
3. HHs Kisan Call Centre (in %)
4. HHs started conservation of water bodies and soil to mitigate climate variability (in %)
5. HHs having secured their crop through crop insurance (in %)
6. HHs have expanded storage capacity to procure agriculture products (in %)
7. HHs have taken help of extension services on climate change combating (in %)
8. HHs growing more than one crop (multiple cropping) (in %)

(Source: Field survey data, 2021. Note: HHs indicates households)

7. Results and Discussion

7a. Incidence and Frequency of Drought in Bankura

Even after 69 years of independence Bankura district is characterized by poor socio economic condition and less cropping intensity (Goswami, 2021). During normal years this district receives an annual rainfall of 1400 mm with 'the month of July receiving the maximum shower compared to rest of the months of the entire year'.

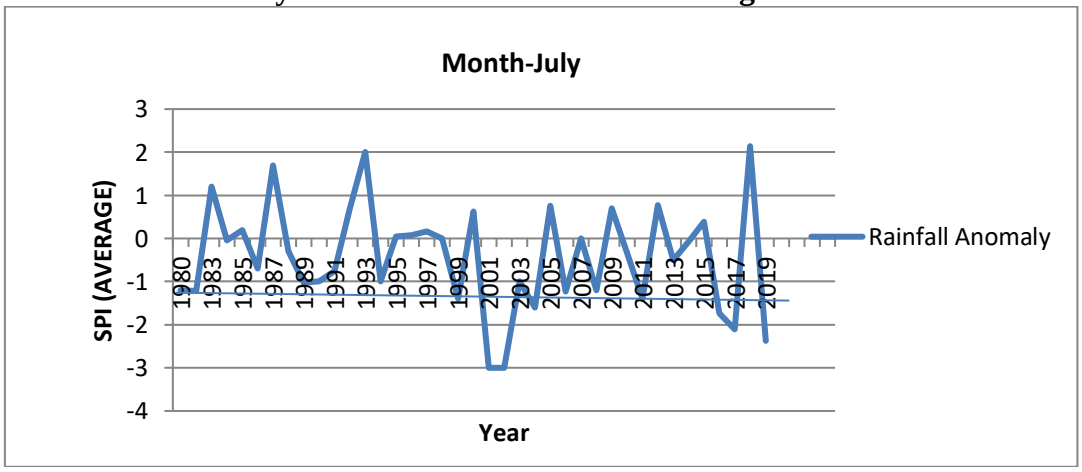
7b. Drought Analysis (SPI)

Drought index has been constructed for the study area in order to measure drought. SPI has been used to quantify the amount of precipitation deficiency. The Standardized Precipitation Index (SPI) expresses the actual rainfall as standardized departure from rainfall probability distribution function (Lei et al., 2003; Hazra et.al., 2017). SPI is calculated using the formula-

$$= \frac{\text{Actual rainfall-Normal Rainfall}}{\text{Normal Rainfall}} \times 100$$

The Normal Rainfall is the long-term average of the Actual Rainfall. The SPI value varies between -2 and 2.

Figure 1: Rainfall Anomaly in Bankura District of West Bengal



Source: Meteorological Data of Bankura, GoWB, 2021 as in Goswami, 2021

Figure 1 unveils high degree of anomaly in rainfall received in Bankura over the years with a progressive rise in the frequency of drought post 2000. While between 1980 and 2000 there has been 1 moderate drought year, 5 severe drought years and 1 extreme drought year, the longest and most intensive droughts have been recorded since 2000-01 particularly severe in the years 2001, 2005, 2009, 2010 and 2011 while the moderate drought years being 2016, 2017, 2019. Complacently, 2007 and 2012 were predominantly humid (Indpur Gram Panchayat, 2021).

7c. Socio-Economic Overview of the Sample Respondents

Coming to socio-economic profile, sample households in the study area reflects the greater degree of backwardness of female-headed households than that of male-headed households, irrespective of the fact that all the farmers interviewed, belonged to small and marginal land category. While the female cultivators did not have average operational land size more than 0.90 acre, the male farmer households were found to be privileged in this regard land holding 1.65 acre. though they too remained in the small farmer classification.

Demographic composition and dependency ratio of a household are crucial components which should be taken note of because they give insight to earning potential of a family and level of economic burden ought to be borne by the working members in feeding unemployed mouths. In the study areas it was noted that de jure female farmers not only had marginal land holding but also these households were characterized by no seasonal migration and high dependency ratio of more than two times the working members' size. This indicates precarious economic situation of such single mother female headed households. In contrast, with regard to male farmer households the family size was not only big, but more male members were also part of active work force with incidence of migration taking place in the household as well, all of which vividly underpins relatively better economic prospect of the family (Primary Survey, 2021-22).

7d. Results of Index Calculation

Table 1a: Gender-Wise Indicators for Exposure Index of Farmers Households

Indices	Bankura	
	Indpur	
	M	F
Rainfall Decline	0.76	0.92
Hotter Summer	0.93	0.93
Frequency of Drought Increased	0.95	0.97
Decline in Water level	0.91	0.92
Exposure Index	0.87	0.94

Source: Field Survey, 2021-22

Table 1b: Gender-Wise Indicators for Sensitivity Index of Farmers Households

Indices	Bankura	
	Indpur Panchayat	
	M	F
Lack of Clear Energy Cooking Source	0.78	0.91
Lack of Private Drinking Water Source	0.59	0.84
Irrigation Dependence on Government Source	0.58	0.72

Free Medical Facilities	0.63	0.71
Lack of Sanitation Facility	0.44	0.79
Poor Nature of House	0.48	0.77
Below Poverty Line	0.53	0.84
No Electricity Access	0.48	0.61
Illiteracy	0.54	0.83
Sensitivity Index	0.65	0.78

Source: Field Survey, 2021-22

Table 1c: Gender-Wise Indicators for Adaptive Capacity Index of Farmers Households

Indices	Bankura	
	Indpur	
	M	F
Cropping Pattern Change	0.077	0.021
Switching to Non Farm Activities	0.178	0.099
Information Technology	0.171	0.063
Conservation of Water Bodies	0.18	0.067
Crop Insurance	0.098	0.077
Expansion of Storage Capacities	0.34	0.21
Extension Services	0.072	0.038
Multi Cropping System	0.22	0.083
Adoptive Capacity Index	0.25	0.09

Source: Field Survey, 2021-22

Table 1d: Gender-Wise Livelihood Vulnerability Index of Farmers Households

Indices	Bankura	
	Indpur	
	M	F
Exposure Index	0.89	0.94
Sensitivity Index	0.64	0.78
Adoptive Capacity Index	0.26	0.09
Livelihood Vulnerability Index	0.55	0.67

Source: Field Survey, 2021-22

a. Exposure Index (EI)

Exposure to changing climate has a great impact on the livelihoods of the sample households, discussed earlier. The calculated exposure index revealed that female-headed households found themselves to be more exposed to climate variability such as rainfall decline, hotter summer days rising frequency of droughts than the male counterparts (see Table 1a) as the said climatic challenges had twin negative repercussions on their livelihood which manifested by form of loss of their crops and fell more heavily on women than men, as understood from the perception studies of the cultivator folks across gender.

b. Sensitivity Index (SI)

Higher persistence of poverty, wide variations in access to basic amenities and greater dependence on natural resources for survival formed some of the principal factors making sample farmers sensitive to changing climate, as suggested by Table 1b. The computed sensitivity indices show that female cultivator households were more sensitive relative to male

gender. The present study findings reveal since lion's share of female led famer households belonged to BPL category, more than 90 percent of such households had to take resort to forest resources for cooking in face of inability to purchase LPG. In addendum, more than 75 percent consumed untreated water extracted through community water supply owing to fund crunch to set up private water sources such as handpumps. Wood source for cooking causes lung related chronic diseases like asthma, bronchitis. Untreated drinking water, coupled with wood burnt smoke, not only increases sensitivity to climate change but also perceptibly raise medical expenditure. Also, more than 70 percent of female-headed households in Indpur depended for irrigation on government. Further, most of the female headed households were not in a position to avail private medical services due to higher medical costs. Similarly, lack of other basic amenities, like sanitation, access to electricity, and high level of illiteracy played important contributory role in augmenting sensitivity of the women farmer households to climate change in comparison to male. This highlights that vulnerability in the region has multidimensional and multifunctional layers and also is gender-sensitive/specific.

c. Adaptive Capacity Index (ADI)

An incentive to adopt is usually a measure to minimize risks from crop failure and maximize net profits attainable. Adaptation strategies encompass individual responses at micro-level to safeguard their livelihoods from climatic shocks. Farmers generally make rational choices from a set of adaptation strategies in form of agricultural practices and technologies available in their region. Upon looking deeper into differentiated adaptive capacity among the sample households (see Table 1c), it is observable that less than 5 percent female-headed farmer households have diversified cultivation in favour of less drought-prone crops, such as pulses and oilseeds, unlike male. Besides that, due to strict rural hierarchy and social insecurity, widowed females had restricted physical mobility and therefore could not afford to travel long distances away from home in search of non-farm employment opportunities like their male colleagues. As a consequence, only 8-10 percent female-headed households were noted to be engaged in non-farm activities outside native. Inequality is also found with regard to the information access on various farm issues of climate change owing to wide level illiteracy and concomitantly poor degree of awareness specific to female. Similarly, with regard to other adoptive strategies, as well, women found themselves in precarious state. Inadequate financial resources of the spouseless female agriculturalist folks acted as hindrance towards taking up new adoptive measures which involved fund investment. Therefore, taking up rain-water conservation measures in a meaningful manner or expanding crop store capacity perceptibly, despite vivid understanding of the need, came to be difficult for them. Illiteracy and subsequently lack of confidence further barred the female land operators from seeking gender specific extension services in order to develop right knowledge about balanced use of fertilizers in lieu to reap optimum benefits in the progressively drying climato-edaphic conditions. As a result, the yield in their plots got grossly more negatively affected than men who had greater access to extension by virtue of better political connection with local self government. Coming to crop insurance, a safeguard in case of crop failure, firstly more than 65 percent of the women cultivators in the surveyed region were waiting for successful completion of the legal process entailed in name conversion of the land after death of their husbands. As a result, they were not eligible to seek government led crop insurance schemes

at all. While, for those who already had land in their name, official complexities and prolonged strenuous process inhibited these single women from getting themselves enrolled for crop insurance. In other words, with respect to adoption of coping strategies as well, women remained significantly behind the male gender.

d. Livelihood Vulnerability Index (LVI)

The relative strength and interaction of exposure, sensitivity, and adaptive capacity indices determine the level of vulnerability of the farmers across gender in the particular study area (Table 1d). Indices of exposure for Indpur, Bankura indicated that female-headed households are highly exposed to drought. In addition, sensitivity indices showed that surveyed female led farm households are equally sensitive as they have conspicuously lower adaptive capacity to deal with the aridness than that of male-headed households owing to perceptible socio-economic hindrances. In totality, livelihoods of female-headed households are potentially vulnerable to said form of climate variability than that of male cultivators in the study drought-prone district of Bankura (female lagging behind male by 12 (index) points).

8. Conclusion and Policy Recommendations

The study has attempted to investigate the nature, magnitude of livelihood vulnerability of the farmers by gender in the Bankura region of West Bengal, a leading agricultural state of India significantly prone to drought. Therefore, the sample farmers are extremely exposed to the said climate change. The decline in rainfall with subsequent fall in water table coupled with increase in temperatures (farmers' perception) are adding to layer of biophysical vulnerability in the system and consequently summing up precariousness to the livelihood of the cultivators across gender. Farmers adopted several adaptation strategies to overcome the current environmental crisis. However, low basic amenities (sensitivity), poor financial resources, and high level of illiteracy came up to be formidable barriers to protecting agriculture and subsequently livelihood. The woes of the female headed farmers were significantly higher than the male counterparts given their poorer socio-economic condition vividly indicating their higher degree of vulnerability over the men.

Based on the present study findings, this study has suggested region and issue-specific policy interventions. Firstly, since the water table is continuously declining, and thus creating a water scarcity even during monsoon season therefore there is an urgent need to scale up water conservation procedure through construction of rain-water harvesting structures. Rural Self Government should come forward and take necessary steps in constructing more such structures in this region using surplus labours to make irrigation water available at cheaper cost and thereby reduce vulnerability of the farmers' livelihood across gender. Using rural development schemes 100 Percent Government Sponsored Scheme like MGNREGS (Mahatma Gandhi National Rural Employment Guarantee Scheme) in this regard can be of particular relevance because the said Scheme has important provision of constructing water harvesting structures covered under it with zero personal cost on the part of farmers.. Next, less water consuming and early maturing varieties should be introduced through agricultural extension cells of the state government which would not only render higher farm productivity but also reduce input cost. Lastly, this study suggests that there is a need for gender-specific policy interventions to build a socioeconomic and demographical infrastructure as a mainstream

climate policy. Some suggestions in this regard include- (a) Gender oriented extension services to be provided to the women so that despite wide-spread illiteracy they have thorough knowledge about drought resistant varieties and the balanced dosage of inputs required to be used at farm level during drought conditions so as to optimize farm productivity-profitability; (b) in de jure female farmer households, 67 percent of the widowed single women grieved that despite death of their husband they were struggling to get the land plots converted in their names which is barring them from taking advantage of different government schemes to get subsidized loans which could enable them to adopt state-of-the-art technology in their agriculture and subsequently improve their livelihood besides contributing to food security. In view of this plight, it become an imperative responsibility of the government to ensure and expedite the process of official name transfer of the land so that within short span of the husband's death declaration the land becomes in the name of the wife and they can smoothly carry out the food production of cash crunch (c) women, including, marginalized communities must be involved in the design and implementation of climate response actions at Union and State Government level to ensure the equal sharing of benefits.

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