

# Assessing the costs of droughts in rural India: a comparison of economic and non-economic loss and damage

Chandra Sekhar Bahinipati\*

Department of Humanities and Social Sciences, Indian Institute of Technology Tirupati, Tirupati 517 506, India

Drought, recognized as one of the major disasters, negatively affects India's agrarian economy, and in turn, farmers' well-being. Households incur both economic and non-economic loss and damage. The latter is most often unnoticed and unaddressed although it is expected to be quite significant in developing nations. Understanding and assessing loss and damage are the prime objectives of the Warsaw International Mechanism. While numerous studies have emerged to estimate the impact on crop production, income, on-farm employment and financial status, there are only limited studies with respect to assessing loss and damage to intangible resources and the total cost of a drought in particular. By interviewing drought-affected farmers in the Kutch district of Gujarat state, this study aims to understand the perception of farmers and to estimate total economic value and non-economic loss and damage. A contingent valuation method was employed. In sum, two major findings emerged: (i) intensity of economic loss and damage is perceived as relatively high as compared to non-economic loss and damage, although the reverse was expected, and (ii) the average total economic value of a drought was INR 8303, and the mean value of non-economic loss and damage was INR 4831. This study reveals that households give lower value to intangible losses that occurs over a period than the immediate tangible loss and damage which directly affect their total wealth. Given this, community-level adaptations to minimize non-economic loss and damage are less likely to be formulated. From the policy perspective, this study strongly advocates the evaluation of intangible costs, so that upcoming state action plans, disaster management plans and ex-post assessment reports could be tailored accordingly for minimizing these risks.

**Keywords:** Agrarian economy, drought, non-economic loss and damage, rural areas.

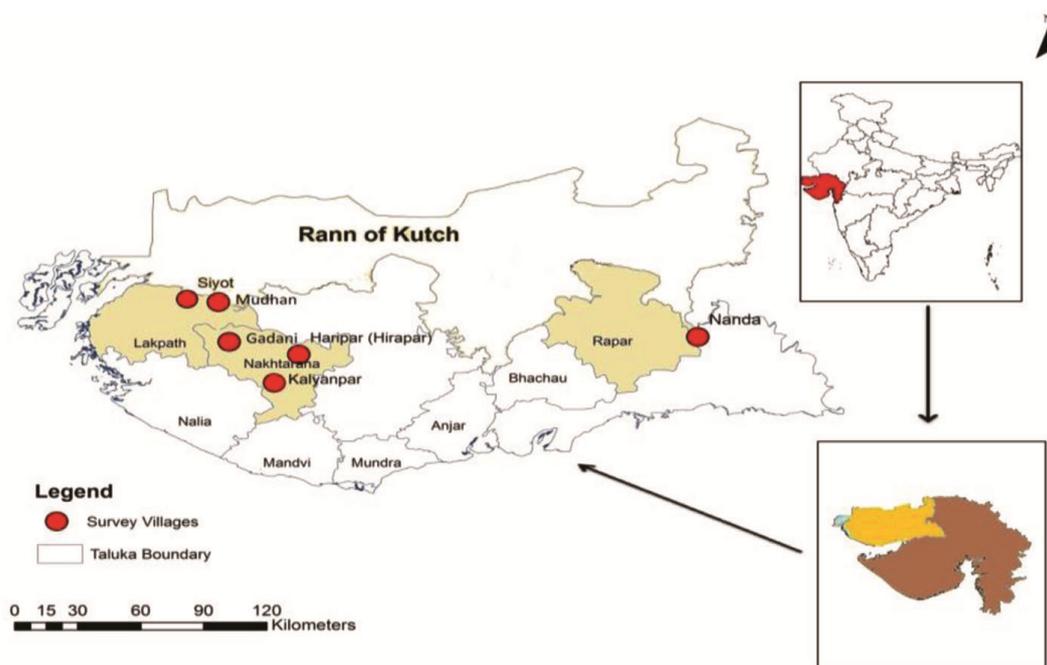
ESTIMATING loss and damage (L&D) is always a prime concern for policy makers, researchers and practitioners<sup>1</sup>. This reveals the resilience capacity of an entity, so that transformative and curative measures could be undertaken

accordingly; while former avoids risk at ex-ante, the latter insures ex-post consumption smoothing<sup>2</sup>. It aims to evaluate, mostly in monetary terms, the cost of a disaster on society, economy and environment<sup>3</sup>. Though an official definition is yet to be released, it is usually referred to as residual impacts from climatic extremes given the available mitigation and adaptation mechanisms<sup>4</sup>. Indeed, it has received significant momentum in recent years in the international climate negotiation under the United Nations Framework Convention on Climate Change (UNFCCC)<sup>5,6</sup>.

L&D is categorized into three types, viz. avoidable, unavoided and unavoidable<sup>2</sup>. Avoidable and unavailed damages could be mitigated through planned adaptation options, but can no longer extenuate unavoidable damages<sup>5</sup>. The unmitigated L&D is grouped into two types: economic and non-economic costs. The goods and services sold in the market are part and parcel of the former. There is no market for goods and services belonging to the latter (e.g. loss of cultural heritage, traditional knowledge, biodiversity, human mobility, etc.) and therefore, their pecuniary value cannot be evaluated directly<sup>7</sup>. The reported economic L&D (ELD) in absolute terms is relatively high in the developed nations. However, a higher figure is observed for the developing nations when it is reported as a percentage of the gross domestic product (GDP)<sup>7</sup>. On the other hand, the non-economic L&D (NELD) is expected to be significant in the developing nations<sup>6</sup>, but there is a dearth of empirical estimations. As of now, the state government agencies in India (e.g. Special Relief Commissioner, State Disaster Management Authority, etc.) are performing ex-post L&D assessment immediately after a disaster<sup>8</sup>. Recently, a detailed L&D estimation was carried out for rapid disasters like cyclonic storms (for example, Fani cyclone occurred in 2019 that badly hits the state of Odisha<sup>9</sup>) and floods, however, it is lacking in the case of slow-onset disasters such as droughts, sea-level rise, salinization, etc. Further, a few studies have also calculated ex-ante and ex-post L&D<sup>4,8,10,11</sup>. Nonetheless, there is still no clarity in definition and methods<sup>12</sup>.

Nations like India are home to a series of natural disasters such as cyclonic storms, floods, droughts, etc.<sup>13</sup> Therefore, efforts have been made in recent years to

\*e-mail: csbahinipati@iittp.ac.in



**Figure 1.** Location map of the survey villages in Kutch District, Gujarat, India. Source: Prepared by the author based on the maps collected from different sources. Note: This map is not to scale and may not depict authentic boundaries.

generate a disaster database for effective risk management. So far it consists of a few direct ELD indicators (e.g. crop loss, damage to public and private property, etc.) and even fewer number of NELD indicators (e.g. human casualties and people affected). Moreover, mostly two L&D indicators are being reported in the disaster assessment reports followed by a drought, viz. affected people/households and damage to cultivated area where there is more than 50% crop loss. A few studies have evaluated the impact of drought on crop production, income, food security, malnutrition, on-farm employment, financial status, etc.<sup>14–17</sup>. Even though previous studies have highlighted several NELD indicators with respect to droughts, for instance, farmer suicide, conflict for water, declining groundwater level, loss of biodiversity, psychosocial stress, forest degradation, water quality deterioration, damage to wildlife and fish habitat, etc.<sup>15</sup>, these are hardly captured in the assessment reports because of difficulties in conceptualizing, accounting and monetization<sup>18–20</sup>. The L&D discourse is still focusing on potential economic costs, monetary compensation and burden-sharing<sup>21</sup>. However, both slow-onset disasters and NELD have received attention in the recent past COP (conference of parties) meetings<sup>5</sup>.

Not accounting for ELD and NELD adequately could lead to underestimated L&D values and does not fully reflect a community's resilience capacity<sup>19</sup>. One of the objectives of the WIM (Warsaw International Mechanism on L&D) is to conduct a comprehensive risk management, including assessment, reduction, transfer and retention, to enhance the resilience capacity of an entity<sup>5</sup>.

Valuation of ELD and NELD is vital from the policy perspective. The NELD costs from a drought are anticipated to be high, especially in the context of developing nations, and, in fact, there is no direct method to estimate them. Recently, a few studies have been carried out on NELD assessment in Bangladesh and Japan with respect to cyclones and typhoons<sup>22,23</sup>. With regard to India, the empirical estimation of total cost of a disaster is limited, droughts in particular. Based on a survey of drought-affected households in Gujarat (Figure 1), the present study aims to assess farmers' perception on economic and non-economic risks, and willingness to pay (WTP) to address these risks. In doing this, the onus was to analyse households' perception towards NELD compared to ELD. Further, the WTP values were used to estimate the possible cost of a disaster.

### Impact of droughts in India

Droughts frequently occur in India to wreak havoc in many parts of the country, particularly in the central northeast and west central<sup>24</sup>. According to Mishra *et al.*<sup>25</sup>, seven major drought periods have occurred in India during 1870–2016, viz. 1876–82, 1895–1900, 1908–24, 1937–45, 1982–90, 1997–2004 and 2011–15. Table 1 shows the frequency of drought events during the last two centuries. Within the study period, a larger number of drought events occurred between 1976 and 2000, i.e. around 11 drought years. On an average, approximately 5–6 drought events have occurred during each study

**Table 1.** Reported drought events in India (1801–2012)<sup>26,27</sup>

Period	Drought years	No. of years
1801–25	1801, 1804, 1806, 1812, 1819, 1825	6
1826–50	1832, 1833, 1837	3
1851–75	1853, 1860, 1862, 1866, 1868, 1873	6
1876–1900	1877, 1883, 1891, 1897, 1899	5
1901–25	1901, 1904, 1905, 1907, 1911, 1918, 1920	7
1926–1950	1939, 1941	2
1951–75	1951, 1965, 1966, 1971, 1972, 1974	6
1976–2000	1977, 1978, 1979, 1982, 1983, 1985, 1987, 1988, 1992, 1999, 2000	11
2001–2012	2002, 2009, 2012	3
1801–2012		49

**Table 2.** Reported loss and damage (L&D) due to droughts in India since 1950 (ref. 27)

Year	Location (state, region or district)	Human casualties	People affected (million)	Reported L&D (million US\$)
1964	Rajasthan, Centre	NA	0.5	NA
1964	Mysuru	NA	166	NA
1972	Central India	NA	100	50
1973	Central India	NA	100	NA
1983	Kerala, Tamil Nadu, Rajasthan	NA	100	NA
1987	Gujarat, Rajasthan, Odisha, Madhya Pradesh, Andhra Pradesh, Maharashtra and four Union Territories	300	300	NA
1987	Odisha	110	NA	NA
1993	Bihar, Odisha, Andhra Pradesh, Maharashtra, Gujarat, Madhya Pradesh, Uttar Pradesh and Karnataka	NA	1.18	NA
2000	Gujarat, Rajasthan, Madhya Pradesh, Odisha, Andhra Pradesh and Maharashtra	NA	90	588
2001	New Delhi, Rajasthan, Gujarat, Odisha	20	NA	NA
2002	Uttar Pradesh, Madhya Pradesh, Rajasthan, Punjab, Haryana, Delhi, Karnataka, Kerala, Nagaland, Odisha, Chhattisgarh, Himachal Pradesh, Gujarat, Maharashtra, Andhra Pradesh and Tamil Nadu	NA	300	910.72

Note: NA, not available.

interval, i.e. around 25 years. Moreover, it was observed as being more frequent in some states like Gujarat, Rajasthan, Uttar Pradesh, Tamil Nadu, Jammu and Kashmir, and Telangana. In these states, drought occurred in 2–3 year intervals<sup>26</sup>. Table 2 describes the reported L&D due to various droughts in India, however, this is not a comprehensive list. The affected states from drought in the year 2000 were Gujarat, Rajasthan, Madhya Pradesh, Odisha, Andhra Pradesh and Maharashtra, and, in total, the economic loss was US\$ 588 million. Moreover, around 16 states encountered drought in 2002, and the total economic loss was US\$ 910.72 million (Table 2)<sup>27</sup>.

## Study area

Gujarat is geographically located in western India (Figure 1), and surrounded by arid and semi-arid regions. Although the state is known for industry-led economic growth, agriculture and allied activities are providing

livelihood opportunities to a majority of rural households, i.e. 50% of the total labour force as of the 2011 census<sup>28</sup>. Only around half of the net sown area was irrigated as of 2010–11, indicating that the same portion of land is still rainfed<sup>28</sup>. The amount of rainfall largely varied across the agro-climatic regions and was between 250 and 1500 mm. In fact, monsoon season receives 90% of the rainfall<sup>29</sup>. Drought is considered as a regular shock<sup>14</sup>, and an increasing trend in the foreseeable future is anticipated<sup>24</sup>. For example, around 15 drought years occurred between 1978 and 2016, of which, three have been in the current decade, viz. 2012, 2014 and 2016 and, most often, more than 50% of the state's total area was affected<sup>14</sup>. In 2016, around 18 districts had rainfall deficit ranging from 20% to 56% (according to the India Meteorological Department (IMD) classification, this could be a moderate or severe drought), and as a consequence, around 623 and 527 villages were fully and partially affected respectively<sup>30</sup>. Among the agro-climatic zones, Kutch district experiences a high rainfall variation, and in fact, receives rainfall during 18 days in a year<sup>29</sup>. Several studies have

found that drought weakens yield, depleting groundwater, increasing land degradation and desertification, and in sum, affecting the well-being of rural farmers to a large extent<sup>14,16,31</sup>. This reflects the lack of coping strategies to withstand drought.

We have chosen Kutch district for a household survey since it has been experiencing prolonged droughts in consecutive years<sup>14,31</sup>. For instance, there were 82 drought years in Saurashtra and Kutch regions between 1895 and 2005 (ref. 32) and, particularly in Kutch, one drought year in every cycle of three to four years<sup>33</sup>. This district is located in western Gujarat (Figure 1), and is viewed as an island since its south and west are covered by sea and east and north by the Ranns (salt marshlands). A meagre portion of the total area is cultivable, i.e. around 14% during 2007–08 (ref. 28). Rainfed agriculture (e.g. only 28% of the cultivated area was under irrigation as of 2007–08)<sup>28</sup> and animal husbandry accommodate a large number of households. The major crops grown in this district are pearl millet, green gram, castor, groundnut, cotton, wheat and moth bean. In comparison to other districts, less amount of rainfall is received by Kutch district; mean rainfall is 340 mm and coefficient of variation is 60% (ref. 28). Groundwater is the main source of irrigation, and, it is declining over the years because of erratic rainfall patterns and over-extraction. The district has a large number of small and large industries, and five ports. A major earthquake hit the district in 2001, which caused massive devastation to both public and private property and killed about 12,216 people<sup>34</sup>.

Within this district, around six drought-prone villages – Siyot, Nanda, Haripar, Gadani, Mudhan and Kalyanpar – were randomly selected for a household survey (Figure 1). Between 20 and 40 households were surveyed from each village by adopting a simple random sampling approach. In sum, information was collected from 186 farm households during November–December 2016. A structured questionnaire was designed for the household survey, which includes household characteristics, agriculture, L&D from droughts that occurred post-2010, and households' preference for drought-proofing options, i.e. in terms of WTP.

## Empirical method

The total economic value (TEV) consists of both ELD and NELD; in some instances, it is difficult to distinguish between them. For instance, NELD invariable includes L&D to ecosystem services, while food and fibre obtained from this are components of market economy<sup>20</sup>. As NELD cannot be evaluated directly, this study has adopted the CV (contingent valuation) technique to estimate NELD as well as TEV<sup>35</sup>. Moreover, there are two major challenges to calculate NELD, viz. incommensura-

bility and context-dependent. The former refers to the absence of a common unit to measure the non-economic goods and services on the same scale, and the latter indicates the values are different from person to person<sup>36</sup>. As mentioned earlier, the study villages had experienced three droughts in the current decade. The study-specific indicators associated with ELD and NELD were identified through focus group discussions (FGDs). The indicators, namely crop loss, land desertification, loss of livestock, impact on assets and amenities and extra irrigation cost are part of ELD. Psycho-social stress, human mobility, dropout of children from school, lack of community social cohesion for accessing water for agricultural purposes and drinking, damage to biodiversity and declining groundwater level represent NELD<sup>6</sup>. In order to estimate ELD, the respondents were directly asked to reveal L&D value for each indicator from the last two droughts, i.e. 2014 and 2016. We did not collect information for 2012, as there could be a possibility of recall bias. In addition, intensities of ELD and NELD were gathered in Likert scale.

Constructing a proxy market for every NELD indicators is not justifiable to carry out quick post-disaster need assessment. Thus, we considered two risk management options: e.g. (i) land and water management, and (ii) insurance and compensation, and developed hypothetical markets for these measures. Surveyed farmers were first informed about the potential benefits of these options, and thereafter, their preferences for each mechanism were collected, i.e. in terms of WTP. This was considered as proxy for calculating cost of a disaster, and perhaps, could indicate the intensity of drought in a particular location. The land and water management options directly reduce the impact of droughts on crop yield and groundwater depletion, and therefore, both ELD and NELD costs could be minimized; it could possibly reflect the TEV of a drought. The insurance and compensation option assists the affected farmers to smoothen consumption and reduce possible impact on the NELD indicators like psycho-social stress, suicide, migration, school dropout of children, etc. Hence, it is assumed as a proxy for NELD costs. However, it should be noted that it could not mitigate some of the NELD indicators such as groundwater depletion, crop diversification, etc. In sum, this study has designed three scenarios: status quo, land and water management, and insurance and compensation. In the case of second scenario, the farmers were briefed about several land and water management options which the government can undertake in the near future. The possible activities, for example, could be construction/reconstruction of dams and village ponds, providing water through Narmada canal irrigation, soil health cards, agricultural extension support for zero tillage, land laser levelling, micro-irrigation, etc. For the third scenario, farmers were assured to minimize the basis risk entangled with present index-based agricultural insurance.

**Results and discussion**

*Socio-economic profile*

Table 3 shows socioeconomic characteristics of the surveyed households. During the survey, it was found that 15% of the households belonged to below poverty line (BPL). With regard to operational land holding, marginal and small contributed 31%, whereas the share of medium was 64%. Around two-third of households were living in concrete house. It was also observed that a low percentage of households had access to agro-advisory services and soil health cards. Agro-meteorological information was found to be positively influencing the behaviour of farmers to undertake farm-level adaptation options. Optimal doses of fertilizers and suitable cropping pattern information were provided to the farmers through soil health cards; this is considered to be the first step towards sustainable farming<sup>37</sup>. Recently, the central government launched a flagship financial instrument to reduce moderate to extreme risks associated with weather variability, known as Pradhan Mantri Fasal Bima Yojana (PMFBY). Around 59% of the total farmers have opted for this. In fact, three-fourth of households purchase crop-insurance regularly. Loanee farmers are by default insuring the loan amount through crop-insurance and the loan amount could be waived followed by a disaster year. Non-loanee farmers, in contrast, can voluntarily purchase insurance from any agricultural insurance company. A large percentage of farmers have frequently consulted agricultural extension experts (i.e. 84%) and 68% of total farmers visit Krushi Mahostav to seek advice from agriculture experts, e.g. agrarian festival (in 2005, the Government of Gujarat had inducted this, and the onus is to enhance adoption of technologies in the agriculture sector)<sup>38</sup>. Through agricultural extension and Krushi Mahostav, farmers receive

information associated with agronomic, agro-climatic and various agricultural technologies from both sources<sup>38</sup>.

*Households' vulnerability to droughts*

In India, households are experiencing various idiosyncratic and covariate risks and shocks. As there is no perfect insurance, particularly in the developing nations, both the above negatively affect the well-being of households – the nature of impact could be short and long term<sup>39</sup>. In the context of the present study, the respondents were asked about the number of droughts that have hit them in the last five years, and their perception about frequency and intensity of droughts (Table 4). All the sample households were affected by droughts in the recent years. Among them, around 17% of the total households were affected by all the drought events that occurred in the current decade. While 41% of the farmers experienced two drought events, the remaining 42% felt the impact of only one drought. With respect to farmer's perception on the frequency and intensity of the droughts, around 95% observed an increasing trend. Similarly, Udmale *et al.*<sup>15</sup> observed that a majority of farmers in Maharashtra perceived increasing droughts in the recent years.

Drought affects the society in several ways. A few FGDs were organized with the stakeholders to list the major L&D indicators under two categories – ELD and NELD. The reported ELD indicators, for instance, are L&D to agricultural crops, loss of livestock, loss of agricultural wage and top-up expenditure on irrigation (i.e. investment required for further digging of tubewells, digging of a new tubewell, addition of extra column pipes and purchase of a new pump set with higher HP). The

**Table 3.** Socio-economic characteristics of surveyed households

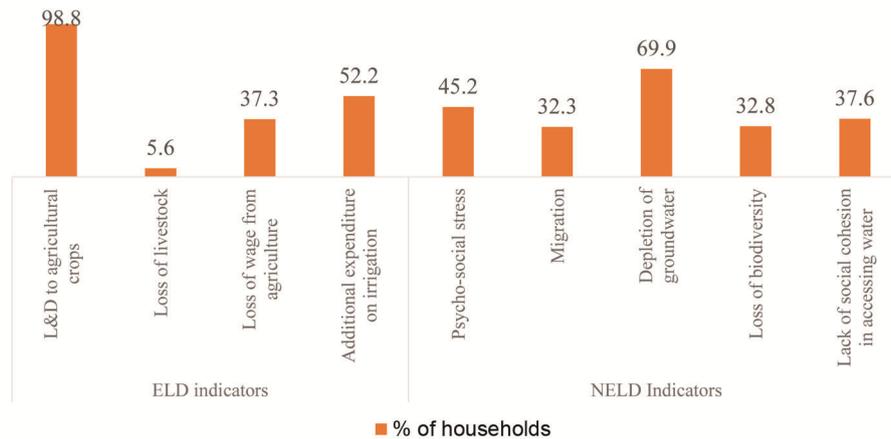
Indicators	Total (% of households)
Below poverty line (BPL)	15.05
Operational land holding	
Marginal and small	31.18
Medium	63.98
Large	4.84
Type of house	
Concrete	72.04
Access to agricultural institutions	
Crop insurance	73.12
Pradhan Mantri Fasal Bima Yojana (PMFBY)	59.14
Agricultural extension	84.41
Information from Krushi Mahostav	67.74
Agro-advisory services	15.05
Soil health card	3.23

Source: Household Survey, 2016.

**Table 4.** Frequency and intensity of drought

Indicators	Percentage of households
Affected by droughts (last 5 years)	
At least one drought	100
Drought occurred three times	17.20
Drought occurred two times	40.86
Drought occurred once	41.94
Perception of the households about frequency and intensity of droughts	
Frequency	
Increase	96.24
Decline	1.61
No change	2.15
Intensity	
Increase	95.16
Decline	1.61
No change	3.23

Source: Household Survey, 2016.



**Figure 2.** Percentage of households reporting economic and non-economic loss and damages (L&D). Source: Author's figure (Household survey, 2016).

drought directly affects crop yield and groundwater level, as has been observed in numerous studies<sup>15</sup>. As expected, the option loss of agricultural crops was mentioned by all the surveyed farmers (99%). Nearly half of the households (i.e. 52%) have borne additional expenditure on irrigation to mitigate unavoids damage to agricultural crops. Agriculture is the main source of occupation in the selected villages which creates employment opportunities, and, consequently, around 37% of the farm households were affected by the lack of on-farm employment opportunities.

The reported major NELD indicators are psycho-social stress, migration, declining groundwater level, loss of biodiversity and lack of social cohesion in accessing water (Figure 2). Among these, loss of biodiversity and depletion of groundwater are material NELD, while psycho-social stress, migration and lack of community cohesion in accessing water are non-material NELD. An indicator such as depletion of groundwater is reported by a majority of households (70%). It is obvious because the lack of rainfall during the droughts leads to a low level of groundwater recharge. To overcome this, the Government of Gujarat has undertaken several supply and demand-driven mechanisms, viz. the Sardar Sarovar Project, river-linking and inter-basin transfer of water, Sardar Patel participatory Water Conservation Scheme, micro-irrigation system and Jyotigram Yojana<sup>40</sup>. A recent study by Bahinipati and Viswanathan<sup>41</sup> observe that pecuniary benefits provided by the government of Gujarat have increased adoption of micro-irrigation technologies in the water scarce regions of the state. Given that there are unavoidable damages from a disaster due to lack of a perfect insurance, the affected entities, in general, encounter financial hardship, which fosters psycho-social stress among the households. Around 45% of the total households, for example, reported psycho-social stress, while three-fourths of the households had access to crop insurance (Table 3). Most of the households in Kutch district

depend on water from the Sardar Sarovar Canal for drinking and irrigation purposes. Particularly in the drought years, community-level conflicts amplify with respect to the distribution of water for agriculture and drinking purposes within and among the villages. Roy and Hirway<sup>14</sup> observed shortage of drinking water during a drought year in Gujarat. In many instances, women in the villages have to travel long distances to collect water, which leads to lesser availability of time for other employment opportunities, increase in dropout of children from school and also negative impact on health<sup>16</sup>. A recent study observed that households spent an average 5 h to collect water in Gujarat<sup>16</sup>. Further, groundwater level is declining at a much faster pace in the drought prone regions of the state<sup>14</sup>. An indicator such as lack of social cohesion in accessing water was reported by 38% of the total households. Due to lack of jobs in the rural economy and financial hardships followed by a drought, either the entire household or a few members seasonally migrate to urban regions in search of jobs. In the study villages, one-third of the households were generally found to migrate following a drought year. In rural India, the main causes for migration are lucrative job opportunities in other regions, lack of jobs, forced migration followed by shocks, etc.<sup>42</sup>. This study specifically asked about forced migration. Further, loss of biodiversity was outlined by 33% of the sample households. Almost similar findings were observed by Udmale *et al.*<sup>15</sup> in the case of droughts in Maharashtra.

### *Loss and damage from droughts*

The surveyed households were asked to report intensity of ELD and NELD. Drought affected more households in 2016 (87%) in comparison to 2014 (72%) (Figure 3). In this study, I compared the intensity of ELD and NELD from droughts that occurred in 2014 and 2016 (Figures 4

and 5). With reference to ELD from the 2014 drought, 19% of the farmers perceived that the impact was ‘very high’ and ‘high’ (Figure 4). ‘Moderate’ impact was reported by two-thirds of the households (63%) while 18% reported low intensity. With reference to NELD, around half of the surveyed households (49%) reported a ‘moderate’ impact, while the impact was ‘low’ for 42% (Figure 4). In comparison to the previous drought, nearly twice the percentage of the households reported that the intensity of ELD from the 2016 drought was ‘very high’ and ‘high’ (37%) (Figure 5). The views were moderate for 47% and low for 14%. Similarly, 68% respondents perceived moderate intensity of drought, and the low impact was reported by 17%. The remaining 14% reported the impact as very high and high (Figure 5). In between both the droughts, farmers reported relatively high impact during the 2016 drought. While comparing the perception of farmers about the intensity of ELD and NELD, more number of farmers perceived the intensity of ELD to be higher in comparison to NELD (Figures 4 and 5). In fact, it is anticipated that households in the developing countries are likely to come across more in terms of NELD compared to ELD. Such finding does not roll out the hypothesis of high NELD impact in the developing nations, but it is clear that the respondents are giving low values to the NELD indicators. Households could have followed a hyperbolic discounting approach, where the immediate losses (i.e. ELD) are discounted more than the losses occurring over time (NELD). The other reasons could be that people may have given more weight to the tangible

loss which directly affects their total wealth. Behavioural economics foundation pronounced it as an endowment effect<sup>43</sup>.

Figure 6 shows an average of the value of ELD indicators. On an average, the damages to agricultural crops due to droughts in 2014 and 2016 were INR 7234/ha and INR 12,601/ha respectively. Apart from the impact on crops, there is high likelihood of declining groundwater level during the drought year, and, consequently, farmers are undertaking several additional measures for irrigation, such as either digging the existing wells or a new well, adding additional column pipes, increasing horse power of pumpsets, purchasing water through the informal market, etc. As a result, farmers end up with a large expenditure on irrigation, e.g. on an average of INR 54,613 and 24,567 in 2014 and 2016 respectively. This varies with respect to time of occurrence of a drought in a particular season. The average losses in agricultural wage, and livestock in 2016 were INR 2296 and 2440 respectively. The corresponding figures were INR 1565 and 822 during the 2014 drought. From this we can say that farmers are mainly incurring major loss in crop production and shouldering additional expenditure on irrigation.

As pointed out earlier, it is not possible to follow a similar approach adopted for ELD indicators to estimate NELD costs. The respondents stated their WTP for drought-proofing measures (i.e. land and water management, and insurance and compensation) (Table 5). Around 97% of farmers were willing to contribute towards risk management options. While a similar percentage of

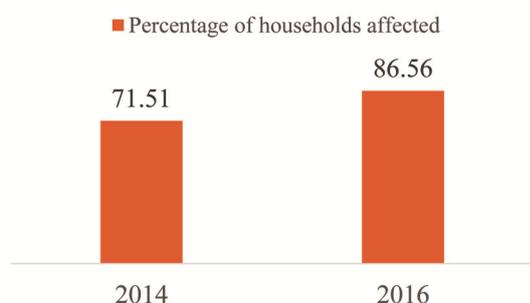


Figure 3. Percentage of households affected by droughts during 2014 and 2016. Source: Household Survey, 2016.

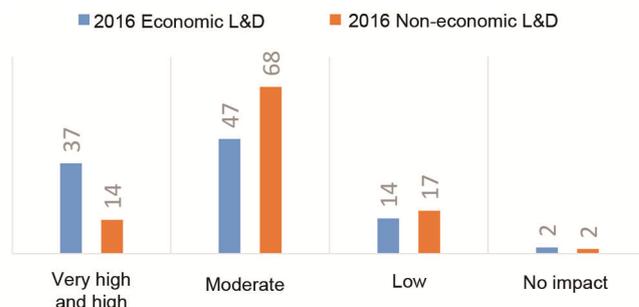


Figure 5. Intensity of L&D from droughts in 2016. Source: Household Survey, 2016. The values are reported in percentage.

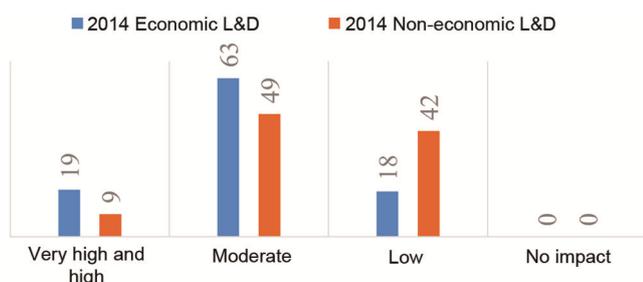


Figure 4. Intensity of L&D from droughts in 2014. Source: Household Survey, 2016. The values are reported in percentage.

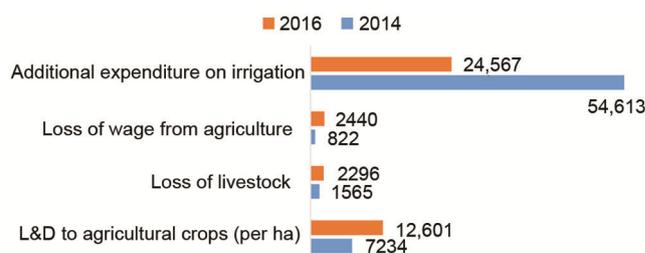
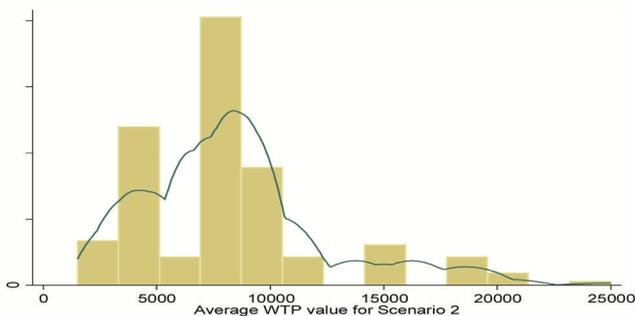


Figure 6. Average estimates of ELD indicators among households. Source: Household Survey, 2016. The values are reported in INR.

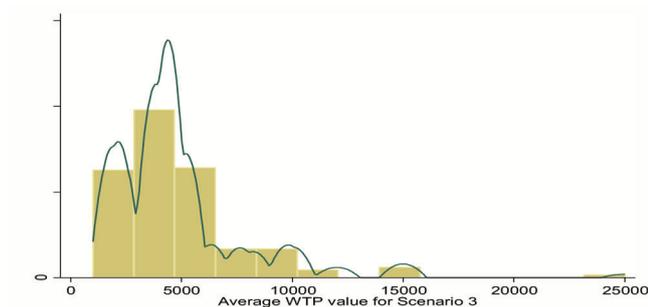
**Table 5.** Drought-proofing options

Options	Total	Minimum	Maximum
Percentage of households – willingness to pay (WTP)			
Drought-proofing measures	96.77	–	–
Land and water management	96.77	–	–
Insurance and compensation	95.16		
Average WTP (INR)			
Land and water management	8303 (4131)	1500	25,000
Insurance and compensation	4831 (3177)	1000	25,000

Note: Figures in parentheses indicate standard deviation. Source: Household Survey, 2016.



**Figure 7.** Frequency of average willingness to pay (WTP) value for scenario 2. Source: Household Survey, 2016.



**Figure 8.** Frequency of average WTP value for scenario 3. Source: Household survey, 2016.

farmers were willing to pay for scenario 2, a marginally lower percentage of respondents were interested to bid for scenario 3, i.e. 95%. Based on the reported WTP value, the mean value was estimated as INR 8303 for scenario 2 (i.e. land and water management), which could reflect the TEV of a drought. Further, the average value for scenario 3 (insurance and compensation) was INR 4831. This indicates that the present available incremental and transformative measures are not able to fully mitigate the impacts. Figures 7 and 8 show the distribution of WTP values for scenarios 2 and 3. It is found that the distribution is more negatively skewed in the case of scenario 3 compared to scenario 2. This reveals that a large number of farmers were reluctant to go for a higher bid in case of scenario 3 because, based on their own experiences and reference point, they believed that there is a

lesser likelihood of getting full compensation against the insured amount. This could have happened due to basis risk, i.e. difference between losses calculated by the insurance company and actual loss experienced by the farmers.

### Conclusion and policy implications

The well-being of households is, in general, negatively affected by catastrophic shocks, and the developing nations and the small island nations have, in particular, borne the larger impact of these<sup>7</sup>. Recurrent droughts are the major challenge in rural India, resulting in that destruction of crops, reduction of income and a negative impact on various intangible resources. There are two types of costs, viz. economic and non-economic. The latter is mostly unnoticed and unaddressed by policy though it is likely to be quite significant in the developing nations<sup>18,20</sup>. Moreover, understanding and assessing L&D, NELD in particular, one of the prime objectives of WIM. The present study, thus, aims to compare farmers' perception on the intensity of ELD and NELD, and also calculate TEV and NELD costs of a drought.

Based on empirical analysis, the following findings emerge. Drought events affect all the respondents, and the increasing frequency and intensity of droughts has been observed by 95% of the total households. Everyone reported L&D to agricultural crops in the aftermath of a drought. In monetary terms, the drought in 2014 cost on an average INR 7234 to each household. In the case of the drought in 2016, it was estimated as INR 12,601 per household. The next major loss – 52% of the total households – was reported as additional expenditure on irrigation. However, the monetary value was quite high, for instance, on an average the additional amount spend by farmers was INR 54,513 and 24,567 in 2014 and 2016 respectively. Among the NELD indicators, declining groundwater level and psycho-social stress were reported by percentage of households. However, households give lesser weightage to NELD compared to ELD, and endowment effect and hyperbolic discounting approach could have played a major role. It is, therefore, expected that individual and community level adaptation

measures to mitigate NELD are less likely to be formulated. In sum, a drought costs a household around INR 8035, and the average NELD is estimated as INR 4597. This indicates the failure of available coping strategies at household, community and institutional levels.

Thus, the present study emphasizes on the estimation of NELD as it is in general unnoticed and unaddressed. Climate negotiators, in fact, are mostly focusing on compensating the affected entities. Given this we should emphasize the inclusion of NELD in the estimation of total cost of a disaster which may assist the developing nations to take better decisions and design policies for effective and efficient risk management. In particular, following the recommendations of WIM, both the central and state governments must also integrate NELD into the climate change and development planning process. This study urges policy makers to give due consideration to NELD indicators in the Second State Action Plan on Climate Change which is on the way, the National Disaster Risk Management Plans in the country and ex-post L&D assessment. Further, there is also requirement of generating data on climate change and drought, especially at the district level, so that effective drought management plans could be designed.

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