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Supplementary Information of

Vulnerability to climate change and its measurement: A survey

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Table S1. Vulnerability Indices

Name of the index	Author(s) (year)	Source of data	Area of the study	Findings	Drawbacks
Social Vulnerability Index (SoVI)	Cutter et al. (2003)	Secondary. Source: city and county data book for 1994 and 1998 under U.S Census.	3141 counties of United States.	Vulnerability is measured in all the counties and divided into different groups according to their vulnerability scores. Greater value of SoVI is found in the in the southern half of U.S., that is from south Florida to California.	Exposure component is ignored High chances that some important components got left out after the extraction of principal components because of the structure of the data set (Ahsan and Warner, 2014).
Social Vulnerability Index (SVI)	Vincent (2004)	Secondary. Data source: World Bank (2002, 2001), UN (2002), UNAIDS (2002), WHO (2002), ITU (2002), Transparency International.	Countries of Africa.	Nigeria is the highest socially vulnerable, followed by other sub-Saharan countries. No recognizable geographical trend to indicate greater pattern of social vulnerability.	May suffer from the problem of missing data since the data source is secondary. For inter country analysis taking the common variable may not be suitable because the definition and the process of collection of values of variables may differ across the countries.
Vulnerability Index	Deressa et al. (2008)	Secondary. Source: Central Statistical Agency Ethiopia (2006), International Disaster Data Base (1906-2006)	Regions of Ethiopia.	Vulnerability statuses of different regions are explained in a systematic manner. Study also exhibits the probable factors which are affecting the vulnerability of each region separately.	High chances that some important components got left out after the extraction of principal components because of the structure of the data set (Ahsan and Warner, 2014) The analysis of vulnerability starts from the households (Adger, 1999); but the study based on the regional level assessment only.
Livelihood Vulnerability Index (LVI), LVI-IPCC	Hahn et al. (2009)	Primary.	Mabote and Moma Districts of Mozambique	Differences in different heads of vulnerability are seen in the two villages. Differences and extent of vulnerability under different heads of it are presented with the help of diagrams.	Equal weights assigned while aggregating the index values of different contributing factors of vulnerability. however, it is not appropriate to assume that all the components have the equal contribution towards vulnerability.

Livelihood Effect Index (LEI)	Urothody and Larsen (2010)	Primary.	Lete and Kunjo Village Development Committees (DVCs) in lower Mustang of India.	The differences in vulnerability in the two villages are the results of the effects of different factors of vulnerability. Gender of household heads is one of the distinguished factors in it.	May not be suitable if the respondents are not educated enough (Ahsan and Warner; 2014). Thus, for less literate people, the method may not be applicable.
Climate Change Vulnerability Index (CVI)	Pandey and Jha (2012)	Primary.	Pauri Garhwal district of Uttarakhand.	The villages near to the district head quarter are at a better position in terms of vulnerability compared to the villages which are far.	The weights assigned to different subcomponents are sensitive to data
Social Vulnerability Index (SVI)	Ge et al. (2013)	Secondary. Source: Statistical Yearbooks, Socioeconomic Database of China.	The Yangtze River Delta of easternmost China.	Per capita income and regional per capita GDP significantly affecting social vulnerability	Indicator 'exposure' is not present. May be useful only when secondary information is properly available.
Socioeconomic Vulnerability Index (SeVI)	Ahsan and Warner (2014)	Primary.	South-Western coastal areas of Bangladesh	On different grounds of vulnerabilities, such as demographic, economic, social, physical vulnerability, exposure to hazards etc, different areas are vulnerable. From overall result, Maheshwarpur union is found to be the most vulnerable amongst all the regions.	The index presented a direct relation of vulnerability with all the three indicators that is exposure, sensitivity and adaptive capacity. But adaptive capacity is inversely related with vulnerability.
Social Vulnerability	Lee (2014)	Secondary. Sources: National Geographic Information System (NGIS) Taiwan, Taiwan Ministry of Economic Affairs, Water Resources Agency.	Chiayi county of west cost of Taiwan.	Vulnerability of each townships of Chiayi county is measured. Plains and coastal regions of the study area are more vulnerable to flooding.	Probable problem of missing data as the data source is secondary. The values of the items under the indicator are summed without weight assignment.
World Risk Index (WRI)	Welle and Birkmann (2015, 2016)	Secondary. Sources: World Bank, official data	173 countries of the world	Calculates the vulnerability of the countries and rank them accordingly.	Problem of missing data. May not be suitable for region specific studies, if secondary data are not available.

		base of the respective countries.		Results of different heads of vulnerability are also presented in the form of colored mapping.	
Physical Vulnerability to Climate Change Index (PVCCI)	Findoeno et al. (2020)	Secondary.	191 member countries of UN.	Calculates vulnerability to climate change for all 191 countries and rank them according to the vulnerability scores. Developing and least developed counties are having higher vulnerability score than the average.	The index is backed by a strong base of secondary data; say HDI etc. also is useful for country based of state based vulnerability analysis. Method is too technical and may not be applicable in region specific studies in developing nations due to the issue of missing micro level data.
INFORM	EC-DRMKS (2020)	Secondary. Sources: World Bank, official data base of the respective countries.	191 countries	Calculate the vulnerability of all the 191 countries and rank them.	Incomplete availability of data.
Social Vulnerability Index (SVI)	Das et al. (2021)	Secondary. Source: Census of India and Bangladesh Bureau of Statistics from the year 2001 to 2011	Ganges-Brahmaputra-Meghna (GBM) delta of Bangladesh and India.	Region specific differences in vulnerability across different regions of the GBM delta. Cyclone and flooding are found as the most important issue of concern in the GBM delta.	Unavailability of common variable is a serious problem when the national boundary changes.
Household Vulnerability Index (HVI)	Ehsan et al. (2022)	Primary.	Selangor coastline of Malaysia.	Highly exposed to shoreline erosion, The causes of demographic, socio-economic and structural sensitivity and lower level of adaptive capacity of the society are explored.	Associated with the problem of equal weight while adding the component of vulnerability.

Source: authors' own observation.

Table S2: Overview of different methods used by the researchers to study vulnerability to climate change and natural hazards.

Author(s)	Method(s) of analysis	Data sources	Area of study	Findings
Shah et al. (2013)	LVI, LVI-IPCC By Hahn et al (2009)	Primary	Cacandee village of Caroni wetlands and Kernahan/ Cascadoux villages of Nariva wetlands of Canada.	Differences in vulnerability in different heads are found in both the regions. Gender based vulnerability on the basis of the head of households is also studied; on different grounds, both are differently vulnerable.
Toufique and Yunus (2013)	LVI by Hahn et al (2009)	Primary	Coastal districts of Bangladesh	People living closer to coast are more vulnerable. Basic issues are associated with health, loss social networks and climate variability.
Tewari, and Bhowmick (2014)	LVI-IPCC By Hahn et al (2009)	Primary	District of Bhagalpur, Bihar.	Better adaptive capacity in one region has the capacity to reduce the vulnerability to climate change in the respective region.
Panthi et al. (2015)	LVI, LVI-IPCC By Hahn et al (2009)	Primary	Gandaki River Basin, Nepal	Areas which are more exposed to climatic disaster are more vulnerable in nature as these areas are frequently affected by the variability of climatic factors. Water, health, food and social networks are also another major contributing factors of vulnerability.
Alam et al. (2017)	LVI, LVI-IPCC By Hahn et al (2009); CVI by Pandey and Jha (2012	Primary	Nagarpur Upazila of Tangail District and Chauhali Upazila1 of Sirajgonj district of Bangladesh	Vulnerability is affected by the geographical location of the areas. More remote and exposed to hazards make the areas more vulnerable.
Adu et al. (2018)	LVI, LVI-IPCC By Hahn et al (2009)	Primary	Brong-Ahafo region of Ghana	Water scarcity during the dry season is one of the major contributors of vulnerability. Socio-demographic profile is another significant contributor towards the differences in vulnerability in the study region.
Amuzu et al. (2018)	LVI, LVI-IPCC By Hahn et al (2009)	Primary	Coastal Zone (CZ) of The Gambia	Sensitivity to climate variability and climate change and livelihood occupations like fishing or agricultural activities are the main diverse of vulnerability in the different locations of study area.
Mukherjee et al. (2019)	LVI, LVI-IPCC By Hahn et al (2009)	Primary	Sagar Island, Parganas District of India	Flood, saline water intrusion, coastal erosion leads to greater vulnerability in terms of causing loss to agricultural production. Need for enhancement in adaptive capacity.
Dendir and Simane (2019)	LVI, LVI-IPCC By Hahn et al (2009)	Primary	Gurage Zone of Ethiopia	A location specific differences in vulnerability is observed; Lowland zones are more vulnerable than the others. Livelihood diversification has great contribution towards improvement in people's resilience.
Azam et al. (2019)	LVI, LVI-IPCC By Hahn et al (2009)	Primary	Kazipur upazila of Bangladesh	Char communities with greater volume of marginalized households are having a greater extent of vulnerability People are sensitive and exposed to disaster.
Nor Diana et al. (2019)	LVI, LVI-IPCC	Primary	Pahang region, Malaysia	The presence of high exposure and relatively low level of adaptive capacity makes the community more vulnerable.

	By Hahn et al (2009)			
Sarker et al. (2019)	LVI, LVI-IPCC By Hahn et al (2009); CVI by Pandey and Jha (2012)	Primary	Gaibandha district of Bangladesh	Differences in distance from the respective administrative head quarters also affect the differences in vulnerability. places with larger distance from the center have low social capital and possess high vulnerability.
Suryanto and Rahman (2019)	LVI, LVI-IPCC By Hahn et al (2009)	Primary	Sukoharjo and Klaten Regency, Indonesia	The agricultural insurance in one region leads to the reduction of vulnerability in it compared to the other region though in case of other aspects, both areas are similar in nature.
Das et al. (2020)	LVI by Hahn et al (2009)	Primary	Maldah District of West Bengal, India.	People are not having strong adaptive capacity to cope themselves with climate change and hazardous events.
Mavhura and Manyangadze (2021)	SoVI by Cutter et al (2003), Factor Analysis (FA).	Secondary. Data source: the recent census of Zimbabwe	Districts of Zimbabwe.	5 key factors are found to affect social vulnerability such as gender of household head, informal employment, poverty, especially able population and birth rate. Geographical variation of vulnerability across different districts is found.
Jalal et al. (2021)	Vulnerability to Expected Poverty (VEP)	Primary	southern coastal region of Bangladesh	Income vulnerability is significantly related with agriculture related factors like cultivable land, rented and leased out land, type of soil etc; climate influenced factors like salinity and rainfall and socio-demographic factors such as age, education, family size, occupation, dependency ratio, ownership of land, household assets etc.
Endalew (2021)	LVI-IPCC by Hahn et al (2009) VER econometric model.	Primary	South Gondar Zone, Ethiopia	Due to the poor adaptive capacity, backward demographic and socio-economic conditions, rain-fed agriculture is highly vulnerable. Income diversification leads to the lowering of vulnerability. Drought, climate variability are positively related with household's economic vulnerability; livelihood diversification, rural infrastructure, irrigation facilities etc exhibits inverse relation with the same.
Ahmed et al. (2021)	CVI by Pandey and Jha (2012	Primary	Raydas Bari Char, Gaibandha District, Banglades	Flood, river erosion, and drought are the major climate driven risks with serious negative effects on livelihood which are basically based upon agriculture
Samuels et al. (2022)	CVI by Pandey and Jha (2012	Primary	Arid zone of South Africa.	Immediate effect of climate fall on the reduction in water availability leading to adverse effect on livestock and agricultural production; which intern reduces household's income. Adaptive capacity and sensitivity have different effects causing differences in the level of climate vulnerability.
Mazumder et al. (2022)	Logistic Regression (econometric model)	Secondary Data source: American Community Survey (ACS) 2013–2017, National Flood Hazard Layer (NHFL) 2018 and 2014 for Tampa and Houston, respectively	Tampa city of Florida, Huston city of Texas.	The socioeconomic variables have significant contribution towards the flood risks in the study areas. Education, age and income of people are found to be the significant contributors towards people's causality. Ethnic and racial inequalities are also found to be significantly related with exposure component.

Atiglo (2022)	Logistic Regression (econometric model)	Secondary. Data source: Migration and Adaptation (DECCMA) Ghana Survey	Volta Delta of Ghana	The exposure factor, which is associated with climate change is largely influenced by the geographical characteristics. Households are most vulnerable to salinity.
Bouaakkaz et al. (2023)	SoVI by Cutter et al (2003)	General Census of Population and Housing (GCPH) 2014, Morocco.	Souss Basin of southwest Morocco	The areas are mostly divided into three parts based on the extent of emergence of floods in these areas and the findings reveal that people from severe flood affected areas are more vulnerable and there is a serious need for effective policy to be taken to reduce the problem of flood.

Source: authors' own observation.