

SUBJECT III
RISKS IN AGRICULTURE AND COPING WITH VULNERABILITY
INCLUDING VULNERABLE OR DISASTER PRONE REGIONS

**Vulnerability of Tribal Rural Households in India: Measuring
the Current Status, Risks of Climate Shocks and Impact of
Potential Interventions for Improving Rural Livelihoods**

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ABSTRACT

The present study has estimated the household vulnerability indices by using the primary data collected from 684 tribal rural households from 10 villages in Jharkhand. Majority of the tribal rural households fall in medium to high vulnerability categories necessitating the urgency of income enhancement and livelihood improvement interventions in tribal areas. The climate change in the form of declining rainfall had adverse implications as additional 15 per cent of the households pertaining to medium vulnerability category fell into the most vulnerable category. Though efforts to improve the area under irrigation as well as farm incomes brought some improvement in the situation, the impact was not as widespread as is demanded by the situation. Various development interventions aimed at increasing farm as well as non-farm income, generating employment, improving education and encouraging productive investments benefited between one-fourth and one-third of the tribal households. The combination of all such interventions had a larger impact as it benefited more than half of the tribal households to jump from high to medium level or from medium to low level of vulnerability. The study points to the need for a comprehensive strategy to improve incomes and rural livelihood with a combination of interventions. Such a strategy will bring larger socio-economic impacts through synergies.

Keywords: Vulnerability index, Tribals, Climate shocks, Rural livelihood.

JEL: D81, Q12, Q18, Q25

I

INTRODUCTION

Vulnerability has gained considerable significance from the last three decades with the works of Jodha (1988) looking at the minority view of the poverty debate and that of Chambers (1995) on 'Voice of the Poor'. Chambers (2013) explored people's own words and concepts of wellbeing and ill-being, people's priorities, their experience of institutions and attitudes towards them as well as gender relations. Vulnerability refers to the state of susceptibility to unprecedented risks arising out of multiple factors at play and has also been explained by the phrase 'living on the edge', it provides a graphic image of the livelihood scenario wherein a household is

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sustaining with the bare minimum in all aspects. Chambers (1989) explained that 'Vulnerability means not lack or want but exposure and defencelessness'. This definition points to the external side of exposure to shocks, stress and risks and an internal side of defencelessness due to lack of means to cope with such exposures. Moser (1998) changed the focus and emphasis of Chamber's definition as he highlighted that 'Analysing vulnerability involves identifying not only the threat but also the resilience or responsiveness in exploiting opportunities and in resisting or recovering from the negative effects of a changing environment. The means of resistance are the assets and entitlements that individuals, households, or communities can mobilise and manage in the face of hardships. Vulnerability is therefore closely linked to asset ownership.

The Human Development Report argues that vulnerability is influenced considerably by the human capabilities, social background, fallacies in the policies and due to inadequate social institutions. As per the World Bank, vulnerability refers to the relationship between poverty, risk and efforts to manage risks which therefore is cumulatively known as "Social Risk Management (SRM)". The SRM perspective addresses how vulnerable households are helped in better risk management and becoming less susceptible to resultant welfare losses (Holzmann and Jorgansen, 1999). Furthermore, Clark *et al.* (2000) define vulnerability "as the risk of adverse outcomes to receptors or exposure units (human group, ecosystems and communities) in the face of relevant changes in climate, other environmental variables and social conditions."

Most recent definitions of vulnerability combine the impacts of internal and external defencelessness. "The underlying causes of vulnerability are economic, demographic and political processes that affect the assignment and distribution of resources among different groups of people" (Cardona, 2004). Vulnerability is correlated with the level of development and results from physical exposure, socio-economic fragility and lack of resilience. By not thoroughly analysing the structural causes of vulnerability, the focus is shifted from the root causes of the problem. Thus, in order to deal with vulnerability better, it is important to place an increased emphasis on people's endowment and link these to the causes of vulnerability. Also, policy makers and academicians share common view point regarding the fact that the dynamic nature of vulnerability needs special attention so that appropriate actions can be devised for mitigating the worst consequences.

Apart from vulnerability, the concept of resilience which is considered reciprocal of vulnerability, captures preparedness of the individuals for future by nurturing coping measures (de Leon and Carlos, 2006; Briguglio *et al.*, 2009). Birkmann *et al.* (2010) summarise resilience as '...capability of a system to maintain its basic functions and structures in a time of shocks and perturbations'. However, the system may also entail an individual or a household. Accounting for resilience has further expanded the horizon of vulnerability as it is supposed to consist of a set of conditions with an adverse impact on capability of people to prepare for and

withstand disasters (Lewis, 1999). These sets of conditions have been explicitly related to individual characteristics which are determined by the interplay of socio-economic, political and environmental circumstances as well as the structures (such as class, gender, age etc.) of population.

Any workable definition of vulnerability should encompass resistance, resilience and uncertainty. Resistance is dependent upon the endowment levels of an individual, a household or a community. Resilience is the ability to cope with the shock. Uncertainty is determined by the types of risks to which households are exposed. Risk in this context can be defined as the expectation of future physical or economic losses (Alwang *et al.*, 2001; Clarke, 1999; Cardonna, 2004, Heitzmann *et al.*, 2002). The existence of risks has different effects on populations with an adverse impact on their well-being. It not only results into the creation of additional risks and uncertainty, but also induces risk averse behaviour among the entities forcing them to invest in low risk and low return activities. It is therefore vital to stress upon various internal and external risks to which a household is usually exposed. The seminal World Development Report (WDR) of 2000/2001 categorises these risks into natural, health, social, economic, political and environmental risks (World Bank, 2000). To understand how risks converge and make a household vulnerable is hence important.

Many studies have outlined the role of risk in designing and implementing social policy (Holzmann, 2001; Holzmann and Jorgensen, 2001; Heitzmann *et al.*, 2002). The nature and magnitude of risks and the extent of risk-management mechanisms adopted by a household in a given environment play central role in the analysis of vulnerability. Hence, vulnerability assessment is both desirable and necessary. There are three major arguments in favour of the need for assessing vulnerability. One, it helps in designing effective anti-poverty interventions by examining not only the currently poor groups but also those ones who are likely to be poor in future. Such a dynamic approach ensures that the poverty and hence vulnerability does not transmit from one generation to another. Two, exposure to some risks may bring significantly high reduction in incomes. In the absence of sufficient assets or insurance to smoothen consumption, such shocks may lead to irreversible losses, such as distress sale of productive assets, reduced nutrient intake, or interruption of education that permanently reduces human capital, locking their victims in perpetual poverty (Jacoby and Skoufias, 1997). When people lack the means to smoothen consumption in the face of variable incomes, they are often trapped in poverty as they are trapped in less productive and less remunerative attempts to ward off the irreversible shocks (Morduch, 1994; Barrett, 1999). Third, vulnerability is an intrinsic aspect of well-being. That exposure to risk and uncertainty about the future adversely affects current wellbeing, is one of the central tenets of the basic economic theory of human behaviour, embodied in the assumption that individuals and households are risk averse. And as the World Development Report 2000/2001 on Attacking Poverty documents, this presumption is echoed by findings from worldwide consultations that indicate that risk and uncertainty are a central preoccupation of the poor.

II

APPROACHES TO VULNERABILITY

The review of literature points towards various approaches to examine vulnerability such as, (i) poverty dynamic approach, (ii) asset based approach, (iii) sustainable livelihood approach, (iv) food-security approach and (v) environmental approach.

Poverty dynamic approach: Under this approach, poverty is used as a benchmark to categorise an entity as vulnerable. Hence, vulnerability is measured as probability of falling below the poverty threshold over a given period of time. Vulnerability and poverty share a two-way relationship, with poverty stricken household being more vulnerable than those lying above the poverty line. Almost all vulnerable households are living near or below the poverty line. This approach measures the propensity of a household to suffer significant welfare shocks and experience fall in the level of living standards.

Asset-based approach: The vulnerability is examined through the ownership of income and other welfare generating assets such as land, man power, machinery, buildings, livestock, etc. The households with larger asset base are considered less vulnerable to welfare losses associated with risky events (Moser and Holland, 1997). Investments in the assets tend to reduce vulnerability by improving risk management and generating additional income from these assets. The advantage of asset-based approach is that it expands vulnerability even to those households who, despite not being consumption poor, are vulnerable due to their investment poverty as their asset base declines over time due to their inability to generate sufficient surpluses for future investments in assets (Reardon and Vosti, 1995). These vulnerable sections could have been easily ignored by the poverty dynamic approach.

Sustainable livelihood approach: Under this approach, vulnerability is viewed as the imbalance between the sensitivity and resilience of a livelihood system (Davies, 1996). While sensitivity is reflected by a combination of risk and response, resilience implies reduced exposure, effective and necessary preparedness to withstand the shock. As a result, low sensitivity/high resilience systems are considered less vulnerable and low resilience/high sensitivity systems as more vulnerable. The use of high yielding seeds, drought resistant or less water intensive seeds, making up for appropriate erratic water requirements are important mechanisms to reduce vulnerability by building better resilience.

Food security approach: The food security approach views vulnerability as inability to have physical and/or economic access to sufficient food to meet dietary needs for a productive and healthy life (World Bank, 1986). Vulnerability arises due to the combined effect of the exposure to risk and inability of an individual/household to cope with the risk and recover from a shock or deterioration of current status (Maxwell *et al.*, 2000). Significant efforts have been made under the food security approach to predict the vulnerability on the basis of easily measurable indicators.

Barrett (1999) extends the concept of food security to look beyond outcomes and incorporates intra-household dynamics, the role of assets, how behaviour affects exposure and response, the separate role of risk, and the importance of irreversibility and threshold effects.

More recently, a strand of literature has emerged that combines the livelihoods and environmental literature and defines vulnerability as exposure of individuals or groups to livelihood stress as a result of an environmental change (Ahmed and Lipton, 1999). Projections have been made with respect to expected negative impacts of global warming and associated climatic and ecological changes such as less rainfall, flooding from rising tides due to melting polar ice, etc. (Dinar *et al.*, 1998). The focus tends to be on risks, with less attention to risk responses. There is also an extensive literature on measuring household vulnerability in developing countries (Kochar, 1999; Dercon and Krishnan, 2000; Chaudhuri *et al.*, 2002; McCulloch and Calandrino, 2003; Ligon and Schechter, 2003; Gaiha and Imai, 2009; Jha *et al.*, 2010; Kurosaki, 2010). However, most of these studies do not address vulnerability, risk exposure and coping strategies in an integrated manner. An integrated assessment has the potential to address vulnerability and its ill-effects in a more comprehensive manner with wider positive implications.

III

MEASUREMENT AND DETERMINANTS OF HOUSEHOLD VULNERABILITY

Despite differences in defining vulnerability, selecting variables and selecting methods to measure vulnerability, there is a general consensus on it being a complex and challenging task (Luers *et al.*, 2003). The econometric methods have focused largely on measurement of vulnerability as expected poverty (VEP), vulnerability as low expected utility (VEU) and vulnerability as uninsured exposure to risk (VER). While VEP and VEU measure the ex-ante probability of a household's future consumption of falling below a given minimum due to current or past shocks, VER measures ex-post welfare loss due to shocks. The most commonly cited shocks are climatic, economic, political, social, legal, crime and health conditions (Hoddinott and Quisumbing, 2003). The disadvantages of the VEP method is that estimates across a single cross-section require an assumption that the cross-sectional variability captures temporal variability, whereas the weakness of the VEU method is that it is difficult to account for an individual's risk preference, given that individuals are ill-informed about their preferences especially those related to uncertain events (Kanbur, 1987). The limitation of VER method is the absence of panel data, it is typically impossible to measure the impact of shocks in the absence of panel data as ex-ante and ex-post consumption and income data are generally not included in cross-sectional data sets.

The other method to measure vulnerability is based on developing a range of indicators and selecting most significant among them through expert judgement,

principal component analysis, or correlation with past disaster events. The selected indicators may be used at the local, national, regional or global scales. The indicator approaches are important in monitoring trends and exploring conceptual frameworks. However, this approach is constrained by being subjective in the selection of variables and their relative weights, the availability of data at various scales, and the difficulty of testing or validating the different metrics (Luers, 2005). Recently, the household vulnerability index (HVI) is developed to measure vulnerability. The HVI categorises a household by assessing external vulnerability that is induced by shocks and internal vulnerability of such a household to withstand shocks, then, classifies the household as coping, acute, or in an emergency situation depending on the household's ability to cope. The HVI is estimated with the data on a selected number of variables and a statistical score is calculated for each household indicating its level of vulnerability (Sibanda *et al.*, 2008).

The household vulnerability at any point of time depends upon two aspects; endowment or the resource base and exposure to risks. Those who are vulnerable to transitory poverty suffer primarily from exposure to adverse shocks. Also, the exposure to risk determines the level of vulnerability of a household. A household may have high level of exposure due to high probability of climate, agriculture, income shocks etc. It may also have limited coping capacity to maintain its well-being in the face of adverse livelihood shocks. The chronic or structural vulnerability, however, emerges out of the lack of endowments. Davies (1996) defined structurally vulnerable households as those exhibiting underlying characteristics that make them vulnerable (such as headship, age, households with old and infirm members). In other words, the structurally or chronically poor are those who are both exposed to adverse shocks and have limited long-term income generating capacity. Chronic exposure to risks is crucially important source of vulnerability. A household is more likely to be exposed to adverse shocks if it, (i) has low levels of human and physical capital, (ii) suffers from disabilities, (iii) has lower asset base, (iv) has poor or no network for support, (v) lies in communities with limited livelihood prospects and, (vi) lies in adverse agro-climatic conditions and limited natural resource settings. These are some of intermesh links which act as a cobweb and trap the households. The policy interventions, therefore, must aim at pulling the vulnerable households out of this trap with an increase in their overall well-being.

Philip and Rayhan (2004) outlined various factors contributing to vulnerability such as low levels of education, gender inequality, fragile and hazardous location, and lack of access to resources and services, lack of access to information and knowledge and disintegration of social patterns. The factors such as land holding size, fertiliser use, access to non-farm income sources, household size, number of workers in the family, per capita income, adult literacy, livestock ownership, remittances, education of household head, skill and trainings were also identified as significant determinants of vulnerability (Omamo, 1998; Christiaensen and Subbarao, 2005; Dirway, 2010; Inayatullah *et al.*, 2012; Nkondze *et al.*, 2013). While higher

education, larger land size, higher input use, higher income, access to other sources of income, smaller family size, more number of workers in the family, amount of remittances, higher education, access to information have negative relationship with the vulnerability by bringing resilience, the other factors such as locational disadvantages, gender inequality, lack of access to resources, etc., lead to a higher level of vulnerability. The importance of an each individual determinant of vulnerability is expected to vary across societies and locations.

IV

VULNERABILITY OF TRIBAL HOUSEHOLDS IN INDIA: A CASE OF JHARKHAND

Jharkhand, the 28th Indian state, is best known for its rich mineral resources. It is spread across 79, 714 km², which is 2.4 cent of country's geographical area with a total population of 2.69crores. Jharkhand is among those seven states (Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Rajasthan, Uttar Pradesh, and Uttarakhand) where approximately 1.3crores poor breathe (World Bank Group, 2016) and the majority of them reside in rural areas. Despite more than three-fourth of the population living in rural areas in Jharkhand, agriculture contributed to less than 15 per cent of the gross state domestic product in 2011-12. Topography, climate, soil, and demographics are the major factors which render agriculture a highly challenging and least productive task. Rainfall and weather conditions are the key deciding factors in productivity and adaptability of crops in a given region. The state is privileged to receive a good amount of rainfall but its temporal and spatial distribution is irregular. The situation is further worsened by the fact that more than half of the rain water gets washed away through surface runoff.

A significant feature is the dominance of paddy in the farming system with approximately 70 per cent of the arable area during *kharif* being covered under rice in the state. A large portion of this area remains fallow during *rabi* season translating into the cropping intensity of 115 percent as against the national average of 137 percent. An added trait of agrarian economy is the dominance of marginal and small farmers. More than 84 percent of landholdings are small and marginal in nature with an operational area of less than 2 ha. Even the marginal holdings, with less than 1 ha of the area, account for as high as 68 per cent of the total landholdings. The socio-economic situation of all those dependent on marginalised agriculture sector can be easily gauged from the fact that more than 46 per cent of the rural population lives below the poverty line with a significant proportion living just above the poverty line (Singh *et al.*, 2012). As tribal population constitutes more than 26 per cent of Jharkhand's total population, their situation is even more vulnerable as they always rank at the bottom in terms of most of the indicators of growth and development.

The present study aims to assess the vulnerability of tribal households with the help of primary data collected from 684 tribal households in 10 villages of Ranchi district in Jharkhand. The entire population in these villages was tribal and was largely dependent on agriculture for their livelihood. The selected villages were part

of the Sustainable Agriculture and Farmers' Livelihood (SAFAL) Programme where a number of interventions focused on resource conservation, agricultural growth and income enhancement were being carried out since 2015. The baseline data for the study pertain to the year 2014-15 and collected in 2015, followed by the six-monthly follow up surveys from all these household still January, 2017.

The present study is aimed at (i) developing a household level vulnerability index for tribal households in the selected villages, (ii) classifying the households into different levels of vulnerability, (iii) exploring impact of climate shocks on vulnerability of tribal households, (iv) examine the impact SAFAL interventions on vulnerability and (v) develop future scenarios of vulnerability on the basis of some potential livelihood interventions. The study has attempted to integrate asset-based approach with the environmental approach to look at the current levels of vulnerability, the impact of climate shocks and expected outcomes of development interventions in reducing household vulnerability of rural households.

Database and Methodology

The data were collected through personal interviews on various socio- economic variables such as family size, age, education, farm size, arable land, irrigation, crops grown, crop production and productivity, income from various sources, etc. Information was also collected on various development interventions and their impact in terms of change in arable land, productivity, income and employment. Finally, household level vulnerability index was derived by combining the following six indicators which appeared to be the most relevant for assessing vulnerability. The details of the selected variable, their measurement and the expected relationship with vulnerability are explained briefly in Table 1. The variables with positive expected

TABLE 1. BRIEF DESCRIPTION OF THE SELECTED VARIABLES AND THEIR EXPECTED RELATIONSHIP WITH HOUSEHOLD VULNERABILITY IN JHARKHAND

Selected variables (1)	Values (2)	Expected relationship with vulnerability (3)	Measurement (4)
Household income	Rs./annum	(-)	It is obtained by adding income from all the farm and non-farm sources
Livestock index	Number	(-)	$C*a+G*d+H*f+B*q+P*s+D*m+O*n$ (where, C=cattle (cow and buffalo), a=0.5, G=Goat, d=0.1, H=Hen, f=0.1, B=Bull, q=0.5, P=Pig, s=0.1, D=Duck, m=0.1, O=other livestock, n=0.1)
Arable land	Acres	(-)	Area under crop cultivation. It is a small proportion of total land available with the household.
Education of household head	Years	(-)	Total number of years spent by household head gaining education
Household size	Number	(+)	Total members of the household
Worker participation ratio	Number	(-)	Ratio of workers to the household size. It varies between 0 and 1.

relationship with vulnerability reflect that any increase in the value of the variable will lead to the increase in household vulnerability. A rise in the value of variable with negative sign will lead the reduction in household vulnerability.

To ensure compatibility; all the variables were normalised/standardised. The standardisation was achieved by using equations (1) and (2), based on the selected variable and its hypothesised relationship with vulnerability. The equation used for this conversion is adapted from that used in the Human Development Index to calculate the life expectancy index, which is the ratio of difference between actual life expectancy and a pre-selected minimum, and the range of pre-determined maximum and minimum life expectancy (UNDP, 2007).

$$X_i = \frac{x - \text{Min}(x)}{\text{Max}(x) - \text{Min}(x)} \quad \dots(1)$$

where Min(x) and Max(x) are respectively the minima and maxima of (X₁, X₂, X_n). When the values of X_i are negatively related to the vulnerability, the standardisation is achieved by using equation (2)

$$X_i = \frac{\text{Max}(x) - x}{\text{Max}(x) - \text{Min}(x)} \quad \dots(2)$$

From formulas above we have obtained normalised of y_{id} which vary from zero to one. From the matrix of scaled values, Y = ((X index)) we constructed a measure of vulnerability for different households in the study area as follows:

$$\bar{y}_d = w_1X_1 + w_2X_2 + \dots + w_mX_m \quad \dots(3)$$

where the w's (0 < w < 1 and w₁ + w₂ + w_m = 1) are weights which reflects the relative importance of the individual indicators.

It is assumed that the weights vary inversely as the variation in the respective indicators of development. More, specifically, we assume:

$$w_i = \frac{k}{\sqrt{\text{var}(y_i)}} \quad \dots(4)$$

$$\text{Where } k = \left[\sum_{i=1}^m \frac{1}{\sqrt{\text{var}(y_i)}} \right]^{-1} \quad \dots(5)$$

The weights were obtained for overall vulnerability and were multiplied with the standardised values to obtain final index values. The HVI is designed to assist policymakers, development organisations with a pragmatic tool to understand the demographics, social characteristics as well as physiological limits constraining the growth of the study area.

Socio-Economic Profile and Estimates of Vulnerability of Tribal Households

The terrain in the selected tribal villages is highly undulating as the land is divided into three types of relief; upland, midland and lowland. Most of the upland, commonly known as “*taand*” by locals, is covered by forests, rocks and stones. Upland soils are highly depleted of organic matter as well as nutrients and are easily prone to gully erosion. Any kind of anthropogenic vegetation is hard to find in *taand*. Below upland, is the midland called “*bari*”, with some elevation and level. Such a landscape does not allow standing of water on its surface, but benevolence of soil moisture enables some kind of vegetation. Crops entailing less water are grown on these slopes. Farmers in *kharif* season manage to produce some paddy in *bari*. Midland is followed by the low land, locally called “*doan*”, which is least affected by erosion problem as it is properly supported by crops. Most of this land remains under crop cultivation during *kharif* season.

In the 10 tribal villages under study, all these types of plateaus were extant. Of the total area of approximately 1390 acres, paddy is being grown on less than 13 per cent area and majority of the area remained fallow owing to the scarcity of water for irrigation. Almost 78 per cent of the area was under *taand*, while *bari* covered around 9 per cent. Since the territory favouring crop production in these villages is limited, food security and livelihood is under serious threat rendering majority of rural households vulnerable.

TABLE 2. DISTRIBUTION OF LAND, ITS CHARACTERISTICS AND SUITABLE CROPS FOR TRIBAL VILLAGES IN JHARKHAND

Type of land (1)	Total size of land (acre) (2)	Characteristics of land (3)	Crops grown (4)
<i>Taand</i>	1083 (77.9)	Forests, rocks and stones, prone to high run offs.	Feasibility limits only to oilseeds and maize production.
<i>Bari</i>	121 (8.7)	Low moisture and somewhat fertile	Favouring the production of vegetables, maize and pulses.
<i>Doan</i>	186 (13.4)	High moisture and highly fertile	Enabling the cultivation of paddy and wheat
Grand total	1390 (100.0)		

Note: Figures in parentheses are percentages of the grand total. There is almost no cultivation on *taand* and only some part of the *bari* is cultivated due to lack of irrigation water.

Despite abundant rains, poor distribution of rains, poor adoption of improved seeds, low input use and traditional farming practices have resulted into considerably lower levels of food production and productivity. The average productivity of paddy, maize and wheat in Jharkhand was only 1133kg/acre, 725 kg/acre and 778 kg/acre as compared to the all-India average productivity of 1477 kg/acre, 1026 kg/acre and 1247 kg/acre, respectively in 2012-13 (Government of India 2015; NABARD, 2015). The tribal villages under study in Jharkhand showed even lower levels of productivity

of paddy, maize and wheat at 906 kg/acre, 327 kg/acre and 467 kg/acre, respectively. The productivity of pulses in these villages is also significantly lower than the state averages. Lower crop productivity adversely affects the food security of tribal population. The climate change is adding to the production risk by adversely affecting the crop productivity. The changing weather conditions and erratic rainfall had serious repercussions on yield of different crops. It is evident from the productivity of paddy which was almost half (623 kg/acre) in the drought year of 2010-11 as compared to 1279 kg/acre during the normal year of 2011-12 (NABARD, 2015). In a similar manner, rising temperature during winters can reduce the wheat yields by almost one-third (Wadood and Kumari, 2009). As agriculture is the mainstay of tribal rural population, very low levels of crop productivity render them highly vulnerable as it has direct impact on the total household income.

There is a critical relationship between vulnerability and asset ownership of rural households (Moser, 1998). The land holding and livestock ownership are two important such assets, which have a direct impact on household vulnerability. In addition to that, access to multiple income sources and number of workers in the family affect the household income and hence vulnerability. Sen (1981) in his entitlement approach, has classified land and labour as ownership endowments having direct impact on vulnerability. A brief description of some assets and other socio-economic features of tribal households in Jharkhand point towards relatively higher levels of household vulnerability (Table 3).

TABLE 3. SOCIO-ECONOMIC PROFILE OF TRIBAL HOUSEHOLDS IN JHARKHAND

Category of household (1)	Number of household (2)	Average size of arable land (acre) (3)	Per capita income (Rs./annum) (4)	Share of agricultural income (per cent) (5)	Livestock index (No.) (6)	Household size (No.) (7)	Work participation ratio (8)
Marginal farmer (< 2.5 acre)	569 (83.2)	1.0	9071	35	2.2	5.5	0.66
Small farmer (2.5-5 acre)	93 (13.6)	3.3	9503	41	2.7	5.8	0.59
Medium and large farmer (>5 acre)	22 (3.2)	7.7	8936	44	2.7	6.3	0.54
Overall	684 (100.0)	1.5	9127	39	2.3	5.5	0.68

Note: Figures in parentheses are percentage of the total number of households.

The average size of arable land of a tribal household was very small at 1.5 acre, which is almost half the average size of operational holding in Jharkhand as well as in India (Government of India, 2015). Almost 97 per cent of the land holdings are marginal and small, with the share of marginal holdings more than 83 per cent. Very small size of cultivated land, coupled with low levels of crop productivity renders these holdings economically unviable. Poor economic situation of these tribal households can be gauged from very low levels of per capita income which amounted to Rs. 9127 per annum, less than one-fifth of the average per capita income in

Jharkhand (Rs. 49278 per capita per annum) and less than 15 per cent of the national per capita income in 2012-13 (NABARD, 2015). Extremely low level of income of tribals in Jharkhand is making them resort to multiple income sources as their income from agriculture accounted for only 39 per cent of the total household income. Owing to poor incomes, these households relied on wage income, livestock and other non-farm activities. Relatively high work participation ratio of 0.68 amongst tribal rural households might be an indication of distress owing to lower incomes, compelling more family members to work to supplement their income.

All the above factors interact with each other to determine the overall vulnerability of these households. The vulnerability index for 684 tribal households was estimated and these households were then classified into low, medium and high vulnerability households. The vulnerability classification under the above three categories was carried out by examining the average vulnerability and the distribution of values of vulnerability index for the tribal households. The three classes were determined by using the confidence intervals at 95 per cent level of confidence (mean \pm (2 standard deviations)). The households with low vulnerability indicated that their ability to cope with future shocks. Those with medium level of vulnerability were assumed to be suffering with relatively poor situation of socio-economic indicators and needed some urgent assistance to move out of such situation. Households showing high levels of vulnerability are perhaps not able to recover unless benefited with the best possible interventions of income enhancement and socio-economic upliftment. Owing to smaller arable land holdings, low productivity, low household income and larger family size, about 53 per cent of the tribal households were found in high vulnerability and 43 per cent in medium vulnerability categories (Table 4). It points to the fact that more than 96 per cent of the tribal rural households were witnessing such levels of vulnerability that there was need for serious interventions to improve their livelihood.

TABLE 4. VULNERABILITY STATUS OF THE TRIBAL HOUSEHOLDS IN JHARKHAND

Vulnerability status (1)	Value of vulnerability index (2)	Number of households (3)
Low	Below 0.648	28 (4)
Medium	0.648 to 0.756	291 (43)
High	0.756 and above	365 (53)
Total		684 (100.0)

Note: Figures in parentheses represent %age of total number of households.

There seems to be a negative relationship between the size of operational holding and the index of vulnerability (coefficient of correlation = -0.41), though does not appear to be high. It indicates that there are multiple factors adding to the overall vulnerability of tribal households in Jharkhand. It is thus pertinent to throw light on

other important socio-economic factors across different levels of vulnerability. The average size of operational holding for the most vulnerable tribal rural households was 1.1 acre, followed by 1.8 acre and 5.0 acre for medium and low vulnerability households, respectively (Table 5). The holding size for the least vulnerable households was almost 5 times than that of the most vulnerable households. The average annual household income varied from Rs. 43783 to Rs. 92965 for these categories. There was an inverse relationship between the extent of vulnerability and average annual income of the tribal households. The least vulnerable household was earning more than double the annual income of the most vulnerable household and per capita income was more than three times. Investing in livestock assets is another important activity of the tribal households to safeguard themselves against the income shocks arising out of crop production activities. It is visible from the number of livestock owned by these households. While highly vulnerable tribal households owned only 1.9 livestock units, the number was as high as 4.2 for the lowly vulnerable households. The differences in arable land, annual household income and ownership of livestock units were almost similar for high and medium vulnerability households. A larger family size was an indicator of relatively higher vulnerability as it was resulting in lower per capita income and also higher dependency ratio translating into lesser number of earning members. The family size for the high, medium and low vulnerability tribal households was 6.3, 4.7 and 3.6, respectively. The respective worker participation ratio was also 0.59, 0.76 and 0.85. Further, the education level of the household head was merely 1.5 years for the high vulnerability households, 4.4 years for the medium vulnerability households and 5.6 years for the low vulnerability households.

TABLE 5. FACTORS AFFECTING VULNERABILITY ACROSS VARIOUS VULNERABILITY CLASSES AMONGST TRIBAL HOUSEHOLDS IN JHARKHAND

Particulars (1)	High vulnerability (2)	Medium vulnerability (3)	Low vulnerability (4)	Overall (5)
Operational area (acre)	1.1	1.8	4.2	1.5
Annual household income (Rs.)	43783	54730	92965	50454
Per capita income (Rs./annum)	6897	11676	26030	9127
Livestock ownership (No.)	1.9	2.6	4.2	2.3
Family size (No.)	6.3	4.7	3.6	5.5
Work participation ratio	0.59	0.76	0.85	0.68
Education of household head (years)	1.5	4.4	5.6	2.9

Climate Shocks and Household Vulnerability

The impact of climate change can be broadly visualised in terms of decline in rainfall, especially in the monsoon season and rise in temperature during winters. The decline in rainfall leads to early or mid-season drought in Jharkhand. It reduces the area under cultivation and also brings significant reduction in paddy yields. In a similar manner, rise in temperature during winters causes significant reduction in

wheat yields. In order to assess the impact of climate shocks on the vulnerability of tribal households, we have assumed that decline in rain will cause 20 per cent reduction in arable land along with 20 per cent reduction in food productivity during the *kharif* season. Together, the combined impact of decline in cultivated area and food productivity was estimated to bring reduction in farm income by 36 per cent on an average. The vulnerability indices were estimated for the above climate shock situation by changing the arable area and agricultural income of each household and were compared with the original indices to see the impact.

The results are presented in Table 6. As the area under wheat was almost negligible (0.05 acre) in the study area, we did not estimate the impact of rising temperature on wheat productivity and hence on household level vulnerability in the present study. The decline in rainfall was found to have worsened the vulnerability situation of the tribal households in Jharkhand. Due to decline in the cultivated area and also decline in productivity owing to reduced rainfall, while all the households witnessed an increase in the value of vulnerability index, 118 tribal households (about 17 per cent of total) moved to the next higher level of vulnerability with more than 100 households experiencing a change from medium to high vulnerability. Majority of these households shifted from medium to high levels of vulnerability. The climate shock resulted into more than two-third of the tribal households slipping into the most vulnerable category, while previously the proportion was about half. These results point to the fact that major corrective steps are required to address the issue of vulnerability among tribal rural households in particular and rural households in general in Jharkhand. The climate shocks will further worsen the situation and there is urgent need for policy interventions to mitigate the impacts of climate change in the short-run and explore the long-term adaptation options.

TABLE 6. CHANGE IN VULNERABILITY OF TRIBAL HOUSEHOLDS DUE TO CLIMATE SHOCK IN JHARKHAND

Level of vulnerability (1)	<i>(No. of tribal households)</i>	
	Existing situation (2)	Climate shock situation (3)
Low	28 (4)	12 (2)
Medium	291 (43)	205 (30)
High	365 (53)	467 (68)
Shift from low to medium vulnerability		16 (2)
Shift from medium to high vulnerability		102 (15)
Total number of households experiencing shifting in vulnerability status		118 (17)

Note: Figures in parentheses are per cent of total households.

Sustainable Livelihood Interventions and their Impact on Household Vulnerability

The Centers for International Projects Trust (CIPT) in collaboration with Birsa Agricultural University (BAU), undertook Sustainable Agriculture and Farmers' Livelihood (SAFAL) activities in 10 sampled villages in Jharkhand since 2015. The SAFAL program aims to increase access to irrigation water through low-cost water harvesting structures (*dobhas*), encouraging improved varieties of foodgrains (especially paddy), increasing productivity through improved seeds, other inputs and production practices, increasing cropping intensity by increasing cultivated area in *kharif* and *rabi* season, encouraging high value crops through more efficient value chains, capacity building of the farming communities and encouraging entrepreneurial activities amongst the tribals, especially women. During the period 2015-17, a limited number of interventions were completed such as improved access to water, increase in cultivated area and significant increase in area under BAU recommended varieties of paddy namely *Naveen* and *Lalaat*. On an average, these interventions brought 30 per cent increase in arable land area and about 45 per cent increase in rice productivity. Also, the farm income was estimated to have increased by around 30 per cent due to SAFAL interventions during a span of two years, 2015-2017. The household vulnerability indices were estimated by considering the impact of SAFAL interventions on cultivated area and household incomes, while other components of the index were kept unchanged. The results have been presented in Table 7.

TABLE 7. CHANGE IN VULNERABILITY OF TRIBAL HOUSEHOLDS DUE TO SAFAL INTERVENTIONS IN JHARKHAND

Level of vulnerability (1)	<i>(No. of tribal households)</i>	
	Existing situation (2)	SAFAL interventions (3)
Low	28 (4)	60 (9)
Medium	291 (43)	362 (53)
High	365 (53)	262 (38)
Shift from high to medium vulnerability		103 (15)
Shift from medium to low vulnerability		32 (5)
Total number of households experiencing shifting in vulnerability status		135 (20)

Note: Figures in parentheses are per cent of total households.

While there was a reduction in the index values for all the households almost one-fifth (about 135) tribal households could shift to relatively lower level of vulnerability. As a result of sustainability interventions the proportion of high vulnerability households reduced considerably from 53 per cent to 38 per cent, while that of medium vulnerability households increased from 43 per cent to 53 per cent.

The number of least vulnerable households more than doubled with their proportion increasing from 4 per cent to 9 per cent due to sustainable livelihood activities in these tribal villages. Though there was a positive impact of these interventions, there is an obvious need for a more comprehensive strategy to bring significant reduction in vulnerability of tribal households. Enhancing agricultural production, productivity and hence farm incomes may alone not bring these tribal households out of the clutches of extreme vulnerability.

The strategy which can bring significant results may consist of increasing farm as well as non-farm incomes, increasing investments in livestock assets, increasing education and skill development, reducing dependency ratio through employment generation for tribal people, etc. In order to examine the impact of such interventions, we have estimated the household vulnerability indices under different scenarios. The details of these scenarios along with the assumptions have been presented in Table 8.

TABLE 8. ASSUMPTIONS UNDER DIFFERENT SCENARIOS FOR ESTIMATING HOUSEHOLD VULNERABILITY

Scenario name (1)	Assumptions (2)
Employment generation	10 per cent increase in work participation ratio of the households. The maximum of the ratio was kept at 1.
Income enhancement	Increasing farm and non-farm income by 20 per cent over SAFAL intervention
Education improvement	Increasing schooling level of each household by 2 years
Livestock investments	Increasing livestock asset of each household by one unit
Combined scenario	Assumptions of all the above scenarios were combined together, i.e., 10 per cent increase in worker participation ratio, 20 per cent increase in household income over SAFAL, increasing education by 2 years and increasing livestock assets by one unit.

Based on the above assumptions, the vulnerability indices were estimated for each scenario and the distribution of tribal household under each category has been presented in Table 9. Generation of additional employment opportunities and resulting increase in worker participation (by about 10 per cent) will lead to the improvement in vulnerability status of about one-fourth tribal households (182 tribal households). The proportion of households falling in highly vulnerable category declined by about 20 percentage points when compared to the current situation. It points to the need for even more increase in the employment opportunities. Also, relatively lesser improvement in vulnerability situation due to employment point to the distress nature of employment opportunities in the rural areas and for tribal population. Generation of more remunerative employment opportunities will help in larger improvement rather than merely increasing the employment.

In the income enhancement scenario, efforts to enhance the farm and non-farm income by around 20 per cent will bring almost similar benefits as witnessed in the employment generation scenario. About 26 per cent tribal households are expected to witness a change in their vulnerability status, though all the households experience a decline in the vulnerability score. The proportion of highly vulnerable households

TABLE 9. VULNERABILITY SITUATION OF TRIBAL HOUSEHOLDS UNDER DIFFERENT SCENARIOS IN JHARKHAND

Level of vulnerability/ scenario (1)	Existing situation (2)	Employment generation (3)	Income enhancement (4)	Education improvement (5)	Livestock investments (6)	Combined (7)
Low	28 (4)	71 (10)	71 (10)	69 (10)	74 (11)	126 (18)
Medium	291 (43)	384 (56)	387 (57)	405 (59)	413 (60)	459 (67)
High	365 (53)	234 (34)	226 (33)	210 (31)	197 (29)	99 (15)
Shift from high to medium vulnerability		139 (20)	131 (19)	155 (23)	168 (25)	266 (39)
Shift from medium to low vulnerability		43 (6)	33 (5)	41 (6)	46 (7)	98 (14)
Total number of households experiencing shifting in vulnerability status		182 (26)	164 (24)	196 (29)	214 (32)	364 (53)

Note: Figures in parentheses are per cent of total households.

declined from 53 per cent to almost one-third with majority of them shifting from high to medium vulnerability category. It also indicates that focus on non-farm incomes along with farm incomes will have a greater impact rather than focusing on enhancing farm incomes alone as the impact is higher when compared to the SAFAL intervention, where only agricultural incomes went up. Improving education scenario will have even greater impact as improvement in education of household head by 2 years will improve the vulnerability status of 196 tribal households (29 per cent of the total). Under this scenario, the proportion of high vulnerable tribal households declined further to 31 per cent. Increased investments in livestock assets indicated improvement in vulnerability status of about 32 per cent with the proportion of high vulnerability households declining further to 29 per cent.

A further analysis of the scenarios reveals that income and livelihood interventions undertaken in isolation had a positive but limited impact on vulnerability of rural households. Hence, a combined scenario was also developed assuming all the individual interventions are implemented together and the required results are achieved. As result of the combinations of interventions, more than half of the tribal households shifted to relatively lower level of vulnerability. While, 39 per cent households shifted from high to medium vulnerability, another 14 per cent moved from medium to high vulnerability category. The number of highly vulnerable households declined from 365 to only 99, which is a substantial achievement. The number of least vulnerable households became more than four times with their proportion in the total households reaching as high as 18 per cent from the current level of just four per cent. The combined intervention scenario is likely to have significantly larger impact than the interventions undertaken in isolation.

V

CONCLUSIONS AND POLICY IMPLICATIONS

Assessment of vulnerability becomes essential as it can help in designing effective anti-poverty measures through its dynamic approach, addressing the issue of irreversible losses through consumption and income smoothening and facilitating action for human wellbeing. Vulnerability has been assessed separately through various approaches analysing human poverty, asset ownership, livelihood sustainability, food security and environment. However, a more comprehensive strategy for assessment and mitigation is the integration of more than one approach. The present study has made an attempt to assess household vulnerability by combining the asset-based approach with environmental approach. The major objective of the study is to estimate the current levels of vulnerability for tribal households in India and to study the impact of climate shocks as well as of various income enhancement and livelihood improvement interventions on household vulnerability.

The study identified six important variables determining household vulnerability such as household income, livestock ownership, arable land, education of household head, household size and work force participation. The study was based on the primary data collected from 684 tribal households in 10 villages of Ranchi district in Jharkhand. More than half of the tribal rural households were found highly vulnerable and almost 96 per cent were witnessing medium to high vulnerability with urgent need for policy interventions to improve income and livelihood of these households. Declining rainfall as a result of climate change in Jharkhand further worsened the vulnerability situation with additional 15 per cent tribal households shifting from medium to high vulnerability category. While, sustainable livelihood interventions aimed at increasing irrigation and farm incomes improved the situation, the impact was not as large to address the problem completely. Various scenarios aimed at bringing significant reduction in household vulnerability among tribal rural households were developed. These scenarios aimed at enhancing farm as well as non-farm incomes, generating employment, increasing livestock investments, improving work participation rates and improving education. The impact of such interventions varied a lot when implemented in isolation with 26 to 32 per cent of the tribal households experiencing a positive shift in their vulnerability status. On the other hand, the combined intervention scenario, where most of the income enhancement and livelihood improvement interventions were carried out simultaneously were found to have benefited the largest proportion of these tribal households with more than half of them witnessing a change in their vulnerability status (reducing from higher to lower vulnerability).

The results of the study point to the fact that there is a serious need to address the issue of vulnerability of tribal households. Almost all the tribal rural households suffer from such levels of vulnerability that need immediate attention of the policy

makers. It is worth mentioning that usual improvements of indicators such as income, education, employment and productive investments will not bring the desired outcomes to pull all these households from the clutches of severe vulnerability. Focusing alone on the agricultural incomes will also not help. Also, most of the development efforts will not bear any significant fruit in isolation. There is a need to draw a comprehensive strategy aimed at improving all the major indicators of vulnerability and household poverty. Efforts to improve income, employment, education and investments should be taken together, which will help in bringing larger socio-economic impacts through synergies.

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