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Vulnerability to food insecurity in rural India: A decomposition exercise[1]

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Abstract

Myopic nature of food security policies has overlooked the focus on the vulnerable sections of the population. This paper is the first attempt to measure vulnerability to food insecurity using expected utility approach. We provide a decomposition of vulnerability into its sources mainly poverty, aggregate, idiosyncratic and unexplained risk factors; (iii) analyze the role of the growing influence of the level of urbanization; and (iv) map the success of food security program like the Public Distribution System in regions vulnerable in terms of food security. Our key finding is that poverty and idiosyncratic risks are found to be the main components rendering households vulnerable. As expected higher income lower the impact of different shocks. Price of staple food items significantly lowers the consumption of a diverse diet. States with poor PDS performance are more vulnerable. Households with a steady source of income and those with higher work participation rate are less prone to shocks. Higher level of urbanization significantly lowers the extent of vulnerability to food insecurity.

1. Motivation

Food security programs should be forward looking and dynamic in nature. It should not only focus on those who are currently food insecure but also on those who are vulnerable and hold a high chance of plunging into the food insecure zone in future (Bogale, 2012).This should be of prime concern to policy makers as vulnerability to food insecurity of households or individuals negates the success of different safety net programs. Vulnerability in the context of food insecurity can be defined as the 'probability of an acute decline in food access, or consumption, often with reference to some critical value that defines levels of human well-being' (WFP, 2002).[i] It is a result of the interaction of economic, political and social conditions. It has two dimensions: (i) exposure to risks; and (ii) susceptibility or coping ability to manage risks (Guha-Khasnobis et al., 2007; Naudé, et al., 2009).

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Households whose level of welfare is above that of the deprived (identified based on the consumption of a minimum basket of goods, comprises expenditure on food, education, health, housing, transportation, etc.) at present might experience a sudden shock. This shock may be economic in nature due to job loss, catastrophic health expenditure in the form of sudden illness or death of any member in the family, weather related shocks which might affect crop production of farmers, sudden loss or reduced profits incurred by small enterprises or those who are self-employed, etc. These households comprise the set of vulnerable or the newly formed deprived. Now the challenge is how to a priori identify the set of vulnerable households. A major handicap in policy making is that the government resorts to static measures to identify the set of beneficiaries who are deprived and those who are not, with respect to certain basic minimum needs. These measures being static in nature do not provide an estimate of the additional expenditure that the government needs to incur to provide for the needs of the additional beneficiaries. For example, food security programs designed on the basis of these measures (identification of the beneficiaries) will not address the needs of the newly formed deprived. [2]It is expected that food security policies are not myopic but forward looking in nature. Policies should be designed such that households are permanently lifted out of the zone of vulnerability to food insecurity.

Limited studies have explored vulnerability to food insecurity which is mainly a rural phenomenon (Scaramozzino, 2006; Bogale, 2012).The main limitation for the same is the lack of a comprehensive large scale panel data survey. Even at the regional level there are no surveys conducted by local governments to devise localized policies. As identified in Klasen and Waibel (2013), specialized surveys are required to address the issues better. There has been no acceptable and agreed upon methodology for measuring vulnerability which has been another major constraint (Dilley & Boudreau, 2001; Bogale, 2012).

[2]We assume that the poor are food insecure. However, those above the poverty line may or may not be food secure. These households were not eligible for any benefits whether in cash or kind (eligible for food grains from PDS, wages from NREGA, etc.) in the earlier period along with the poor. However, in this period these households are the new poor as defined in the literature due to the sudden shocks. This incurs an additional expenditure on the government as policy makers now need to make provision for these newly formed poor.

Vulnerability reduces capabilities and choices, and human resilience to sustain further shocks (UNDP, 2014). If vulnerable households are not protected then the attainment of the Sustainable Development Goals (SDG) hunger target will not be successful (Grimm et al., 2013). India was lagging behind in attaining the Millennium Development Goals (MDG) 2015 hunger target of reducing the proportion of those malnourished. If vulnerable households are not protected then it would delay the progress even further. Social protection strategies were the new initiatives in this context aimed to assist the 'new poor' and the vulnerable households (Adato et al. 2004).

This paper contributes to the food security literature by identifying households vulnerable to food insecurity based on expected utility measures, understanding their food security and socio-economic and demographic profiles from 2005 to 2012. The methodology developed is useful for developing countries where panel data sets are not available, and draws on the measures of vulnerability conceptualized by Ligon and Scheeter (2003). We decompose the impact of different shocks and estimate the magnitude and the corresponding impact on rendering them vulnerable. Vulnerable households adopt different coping strategies. The first strategy is to reduce household food consumption. This also has an adverse impact on the health and nutritional status of household members, and especially on infants and children. Thus, analyzing the food security profile of these vulnerable households is very crucial for policy makers.

It is well identified in the literature that the focus of food security policies should not only be on calorie intake but consumption of a diverse diet (Ruel, 2002). Consumption of a diverse diet ensures the intake of different nutrients, and thus prevention of a plethora of diseases (Johns and Sthapit, 2004; FAO, 2012). It is necessary to avoid the triple burden of malnutrition - simultaneous presence of under-nutrition, obesity and micronutrient deficiency diseases (Gómez et al., 2013). However, contrary to recommendations, developing countries generally focus on calorie or cereal intake with minimal focus on the consumption of a diverse diet. This is a prime reason why developing countries suffer from persistent nutritional deprivation (Ruel 2002; Pinstrup-Andersen, 2009).[3]

We fill the gap in the literature by: (i) conceptualizing vulnerability to food insecurity based on the existing measures of vulnerability to poverty in the Indian context given the lack of panel data; (ii) provide a decomposition of vulnerability into its sources mainlypoverty, aggregate, idiosyncratic and unexplained risk factors; (iii) analyze the role of the growing influence of the level of urbanization; and (iv) map the success of food security program like the Public Distribution System in regions vulnerable in terms of food security, and identify policy implications of the same. Our key finding is that poverty and idiosyncratic risks are found to be the main components rendering households vulnerable. As expected higher income lower the impact of different shocks. Price of staple food items significantly lowers the consumption of a diverse diet. Households with a steady source of income and those with higher work participation rate are less prone to shocks. Higher level of urbanization significantly lowers the extent of vulnerability to food insecurity.

2. Methodology

The concept of vulnerability is generally applied to the measurement of poverty. Studies have examined methods of measuring vulnerability to poverty, and discussed related aspects over time (Pritchett et al., 2000; Baulch&Hoddinott, 2000; Chaudhuri et al. 2002; Kamanou&Morduch, 2002; Calvo&Dercon, 2007).Zhang and Wan (2009) provide a comprehensive overview of the literature. Glewwe and Hall (1998) define vulnerability as a dynamic concept, which is attributed to a macroeconomic shock, and distinguish between policy-induced and market-induced vulnerability. Kühl (2003) defines vulnerability to poverty as the propensity of a household to suffer a shock the magnitude of which lowers its level to that below a socially acceptable norm. Pritchett et al. (2000) and Mansuri and Healy (2001) estimate the probability of a household

[3]The definition of food security encompasses the entire process from production of food grains, to consumption to final nutritional outcomes. However, in this paper we focus primarily on the consumption and output dimension of food security measured in terms of dietary diversity.

experiencing at least one or repeated periods of poverty in future. Chaudhuri*et al.* (2002) defines vulnerability to poverty as the probability that the household will become or remain poor in future. To summarize, poverty is a static concept, and that of vulnerability to poverty is a dynamic one.[ii]

Expected utility framework[iii]

We measure the extent of vulnerability using the expected utility framework as developed by Ligon and Schechter (2003).[iv]To the best of our knowledge Bogale (2012) is the only study till date that has examined vulnerability to food insecurity using this approach in the context of Ethiopia.The model assumes two situations with respect to the consumption profile of a household: (i) The risk-averse household is certain that expected consumption in period t+1 (where t denotes the current period) will be just below the threshold for deprivation, so that the probability of vulnerability is one; and (ii) the expected mean value of consumption is unchanged. There is an equal probability that the household's consumption is just above the poverty line (above the mean), and just below the mean value. Since the household is risk averse it will prefer a certain level of consumption in the first case, though vulnerability is lower in the second case.[v]

In this approach, vulnerability is defined as the difference between utility derived from some level of certainty-equivalent consumption, at and above which the household is not considered vulnerable. This certainty-equivalent level of consumption is the same as defining a threshold level for food security. Consumption c_i for the i^{th} individual/household has different distributions in different states of the world. The measure is given as follows:

$$V^i = U^i(z) - EU^i(c^i) \qquad (1)$$

U_i is a weakly concave strictly increasing function, and z is the poverty line. Equation (1) can be rewritten as:

$$V^i = \left[U^i(z) - U^i\left(Ec^i\right)\right] + \left[U^i\left(Ec^i\right) - EU^i\left(c^i\right)\right] \qquad (2)$$

The first term is a measure of poverty with respect to the difference in utility evaluated at z and c for a concave function. The second term measures the risk that the household faces. The latter can be decomposed into aggregate or covariate, and idiosyncratic risk, where $E(c_i|x_t)$ is an expected value of food consumption conditional on a vector of covariant variables, x_t. The vector of aggregate variables i denoted by $\overline{x_t}$ and $x_t^i$is the set of idiosyncratic variables. It is assumed that $E(c_{it}|\overline{x_t}, x_{it}) = \alpha^i + \eta_t + x\beta$. Aggregating across households, an estimate of aggregate vulnerability is obtained as follows:

$$V^i = \left[U^i(z) - U^i\left(Ec^i\ \right)\right] + \left\{U^i\left(Ec^i\ \right) - EU^i[E(c^i\ |\overline{x}\ ]\right\} + \{EU^i[E\left(c_t^i|\overline{x_t}\right] - EU^i\left(c_t^i\right)] \quad (3)$$

This is a static function, and for estimation purposes time series variation needs to be considered. Consumption expenditure is measured with error. To correct for the same the idiosyncratic risk component is further decomposed into: (i) risk arising due to k observed time-varying household characteristics; and (ii) risk arising due to unobserved factors which lead to measurement error in consumption. Let consumption measured with error be represented by $\widetilde{c_t^i}$. Then, $\widetilde{c_t^i}=c_t^i + \varepsilon_t^i$, where ε_t^i is the error term following the properties that $E(c_t^i|\overline{x_t}, x_t^i) = E(\widetilde{c_t^i}|\overline{x_t}, x_t^i)$. This implies that measurement error will only have an impact on unexplained risk. Thus, the decomposition function is of the form:

$$V^i =$$

$$\left[U^i(Ec) - U^i\left(Ec_t^i\right)\right] + \left\{U^i\left(Ec_t^i\right) - EU^i[E(c_t^i|\overline{x_t}]\right\} + \{EU^i[E\left(c_t^i|\overline{x_t}\right] - EU^i\left[E\left(c_t^i|\overline{x_t}\ , x_t^i\right)\right]\} +$$

$$[EU^i\left[E\left(c_t^i|\overline{x_t}, x_t^i\right)\right] - EU^i\left(c_t^i\right)] \qquad (4)$$

This decomposition allows an assessment of whether vulnerability is a result of factors underlying poverty or of aggregate and idiosyncratic shocks, and the inability to cope with them.[vi] There are two limitations to this approach. First, the results may differ depending on the form of the utility function assumed. The second limitation is that the measurement is with respect to utility. Figure 1 provides an illustrative evidence of the same. The model assumes a concave welfare function such that the marginal utility of consumption is decreasing with an increase in the level of consumption. In the event of an uncertain event, expected utility $EU^i(c^i)$ is obtained from an expected consumption level of Ec^i. Next the household can face two situations in future: (i) low consumption denoted by c_L; and (ii) high consumption denoted by c_H. However, a certain level of consumption (Ec^i) would provide a higher level of utility $U^i(Ec^i)$ at point D on the curve. Now given poverty line z, vulnerability is the distance FC, which can be decomposed into poverty (FD) and risk (DC). Ligon and Schechter (2003) assume a particular form of the utility function:

$$\mathrm{U(c)} = \frac{c^{1-\gamma}}{1-\gamma} \quad (5)$$

where γ denotes household sensitivity to risk and inequality. This is an iso-elastic utility function, which exhibits decreasing absolute risk aversion and constant relative risk aversion.[vii] γ takes a value of two for our analysis purposes. Thus, the empirical specification for panel data regression is as follows:

$$\widetilde{c_t^i} = \alpha^i + \eta_t + x_t^{i'}\beta + v_t^i \quad (6)$$

The explanatory variables included in the model are: MPCE (a dummy variable is defined for classifying households into different categories based on consumption expenditure), social group (scheduled caste, scheduled tribe, other backward class, and others), religion (Hindu, Muslim, Christian, Others), household type (for rural areas: self-employed in non-agriculture, agricultural labour, other labour, self-employed in agriculture and others), marital status (never married, currently married, widowed and divorces/separated), education (not literate, primary, middle, higher secondary, diploma, graduate and post-graduate), number of household members in the age group 15-24, 25-34,35-44,45-59 and 60 and above, size of land possessed by households and gender). Land possessed is categorized as follows: less than 0.001, 0.001 - 0.004, more than 0.004 - 0.40, more than 0.40 - 1, more than 1 - 2.0, more than 2.0 - 4.0, and greater than 4.0 hectares (for rural India only). All characteristics are at the household head level. Standard errors are clustered at the FSU level.

Estimation of quality-adjusted prices

NSS provides detailed information on the quantity and value of 142 food items. Unit values are computed for each food item by dividing total expenditure by quantity consumed and expressed in Rs/kilogram. These unadjusted unit values give biased estimates as they do not control for quality and demographic characteristics, and are not a true representation of market prices. Unit values suffer from measurement error, quality changes and the impact of household composition on MPCE (Majumdar et al., 2012). Prais and Houthakker (1955) discuss quality effects, which leads to a difference between raw unit value and prices. Quality-adjusted unit values need to be computed to reduce the bias. Certain food items bought in the urban areas are generally of superior quality than those consumed in rural areas. Also households in rural areas have a higher proportion of consumption from home produce than in urban areas. We compute the same using the procedure followed in Majumdar et al. (2012) controlling for both quality, demographic and income related factors. The empirical specification is as follows:

$$v_i^{hsjd} - \left(v_i^{sjd}\right)_{median} =$$
$$\alpha_i D_s + \beta_i D_j + \gamma_i \sum_j \sum_d D_j D_d + \varphi_i x^{hsjd} + \omega_i f_i^{hsjd} + \sum_m b_i Z_{im}^{hsjd} + \varepsilon_i^{hsjd} (7)$$

where v_i^{hsjd} is the unit value paid by household h for food item i in state j, district d and sector s,$(v_i^{sjd})_{median}$ is the median unit value for the i^{th} food item in the district in which the household lives, x is monthly per capita food expenditure, f is the proportion of meals that is consumed outside by the members of the household, Z_{im} is household characteristics (household details of age, gender, household size, number of adult males and females in the household), and D_s,D_j and D_d are the dummies for the sector, state and district respectively. Inclusion of x, f and Z_{im} in the model controls for income and demographic factors, which affects household consumption expenditure. The district-wise quality-adjusted price for each food item p_i is obtained by adding the residual obtained after estimating the model as specified in equation (9) to the district's median value for that particular food item. The residual contains the unexplained factors not incorporated in the model, and thus a measure of the quality difference, which is unexplained by the explanatory variables. This residual when added to the raw unit value corrects for the differences in quality across different districts. This procedure is based on Hoang (2009) with a slight modification as in Majumdar et al. (2012) that median unit values are used in place of mean unit values. Those observations, which are more than 1.5 times the interquartile range are identified as outliers, are eliminated. Quality-adjusted unit values for the following food groups are considered-rice, wheat, and pulses & pulse products, by aggregating over food items belonging to the respective food groups. From the economic perspective, diet diversity is important to lower prices by reducing the demand for a particular set of food items.

Measurement of Dietary Diversity

We use the Entropy Index as a measure of dietary diversity as prevalent in the literature (Karamba et al., 2011; Nguyen and Winters, 2011; and Sharma and Chandrasekhar, 2016).It is defined as:

$$Entropy\ Index\ (E) = -\sum_{i=1}^{n} w_i ln(w)_i (8)$$

The range of E is (0, ln n).[viii] The higher the value of the index, greater is the diversity in food consumption. We compute the Entropy Index based on the share of expenditure on different food items/ groups.

3. Data

Nationally representative household consumption expenditure survey conducted by the National Sample Survey Organization (NSSO) in July 2004 - June 2005, July 2009 - June 2010 and July 2011- June 2012 across rural India is used for analysis purposes. A stratified multi-stage design was used for the survey. The first stage units (FSUs) comprise the 2001 Census villages in the rural sector and Urban Frame Survey (UFS) blocks in the urban sector. The ultimate stage units (USU) were the households in both the sectors. Within each district of a State/UT two basic strata were formed: (i) rural stratum comprising all rural areas of the district, and (ii) urban stratum comprising all urban areas of the district. The sample size for rural India is 79,298, 59,097 and 59,683 households respectively.

The NSS collects information on various demographic and socio-economic characteristics. The survey also collects detailed information on expenditure (in rupees), quantity consumed and source of purchase for the main food groups: cereal, cereal substitutes, pulses & pulse products, milk & milk products, sugar, salt, edible oil, egg, fish & meat, vegetables, fruits (fresh and dry), spices, and beverages. The recall period for edible oil, egg, fish & meat, vegetables, fruits, spices, beverages and processed foods was seven days and for other food items was 30 days. Quantities for food items were collected in kilograms except for a few items like milk (liters), eggs, lemon, banana, pineapple, coconut and orange in units, ice-cream and other milk products in rupees and for spices in grams. Appropriate conversion of food items to kilograms was done wherever possible as in Majumdar et al (2012).[ix]

4. Discussion

Household level panel data surveys are not conducted in India, which is most appropriate to measure the level and extent of vulnerability. Given data limitations another option is to track a particular cohort based on age or state-regions over time. Districts are tracked across states over three rounds of the survey.[x] Consumption data is normalized so that comparison of utility values (measured in utils) is possible. The component $U^i(Ec)$ is the mean value of food consumption across districts over the past three rounds. $U^i(Ec_t^i)$ is the time-varying mean food consumption computed for different years. $EU^i[E(c_t^i|\overline{x_t}]$ is obtained by estimating the restricted least squares regression where the time-invariant characteristics considered are household type, social group, religion, gender, and level of urbanization.[xi]

Rapid urbanization has a growing influence on both the demand and supply side issues of food security (Sattherthwaite et al., 2010). The pressing demand for a large variety of food products with a decline in the number of food producers leads to rising food prices, and reduce intake of vital nutrients. Rural populations are at a higher risk than the urban ones primarily due to lower levels of income, seasonal employment, poor storage and transportation facilities, lower availability, etc. This motivates to analyze the influence of growing levels of urbanization on vulnerability. The level of urbanization is an estimate of the proportion of the district's population living in urban and peripheral urban areas of the district. While the share of urban population in every district is available as part of Census of India data, the size of population living in peripheral urban areas is not available as part of the official statistics given the dichotomous definition of what is rural and urban. Literally, the term peripheral urban, refers to an area around a city or town, and is conceptually rural in nature. Estimates of the size of the peripheral urban area have been generated by geographers and for India they are available as part of the India e-geopolis data set.[xii]

All analysis is conducted at the household level across rounds and state districts. Panel data regression is conducted using fixed effects model.[xiii] The estimated normalized food consumption is averaged at the district level for the three rounds the survey was conducted. Computation of $EU^i\left[E\left(c_t^i\middle|\overline{x_t}, x_t^i\right]\right\}$ again requires estimation of fixed effects model with the inclusion of time varying characteristics like monthly per capita consumption expenditure (MPCE), level of education, marital status, size of land possessed, and the quality-adjusted unit value of staple food items like rice and wheat. State-region level effects are adjusted for in the regression model. Equation 5 is estimated using the fixed effects model.

Table 2 provides the components of vulnerability to food consumption. Poverty is the main determining component of vulnerability for Indian households. Idiosyncratic risks play a dominant role in increasing vulnerability. Idiosyncratic risk arises due to income shocks, incidence of unemployment, etc. Aggregate risks are supposed to be the same across all households. However, the level of welfare of poor households are affected less by this component. This is supported by the fact that determinants of vulnerability and poverty are the same, and have opposite signs as that of aggregate risk. Given the dominant role played by idiosyncratic shocks we can conclude that than state-region or village or community level characteristics, household level shocks not captured by the model play a significant role in determining the level of vulnerability.

Higher work participation rate[xiv] leads to a lowering of the level of risk faced by the household. With an increase in the price of staple food items like rice and wheat the chances of being vulnerable rises. Compared to those who do not have any fixed source of income in the rural sector, those who are self-employed in agriculture or non-agriculture, and laborers are better off with respect to the level of food consumption expenditure. This is also reiterated by the fact that those in higher income groups are better off than those with lower levels of income. Female headed households are more susceptible to shocks than their male counterparts. Women in developing countries undertake vulnerable employment[xv] more than their male counterparts. With an increase in the level of urbanization in a state-region there is a reduction in the extent of vulnerability. Urbanization leads to more job opportunities, and helps households diversify their source of income.

Estimates of vulnerability are robust as compared to estimates of poverty. Decomposition of vulnerability into its different risk factors will help policy makers identify which component to lay greater emphasis on. This will facilitate to adopt cost-effective solutions. Table 3 provides a graphical overview of diet diversity profiles along with the level of vulnerability. Overall, the best performing are the southern states of Karnataka, Tamil Nadu and Gujarat. Households in West Bengal, Rajasthan, and Madhya Pradesh are the most susceptible to shocks according to the estimates of vulnerability. More number of state-regions show improvement over time as evident from the pictorial representation (Figures 2 (a) – 4 (b)).[xvi]Overall, there is an improvement in the status of vulnerability of households. Dietary diversity also improves over time. Southern and eastern states perform better with respect to dietary diversity. Northern states exhibit low levels of diet diversity. Poverty is a major risk component of vulnerability. Thus, it is expected that poor households will exhibit a similar food security profile (as measured by dietary diversity) as that of vulnerable households. As compared to 2004-05 the amount of purchase of food grains from PDS and share of consumption from PDS to total food grains consumed remained at almost the same level in 2011-12. This implies that overall at the all India level there was an increase and extent of the level of vulnerability commensurate with the increase in the depth of poverty and inequality, and an indication that food security programs have had a minimal role to play to reducing vulnerability.

Gujarat was one of the states with a fall in consumption from PDS, and also vulnerable to shocks. Increase in the states of Karnataka, Madhya Pradesh, Rajasthan and Tamil Nadu was half of that in the poorer and more vulnerable regions of Assam, Bihar and Orissa. This is commensurate with the fact that the eastern states perform worse with respect to food insecurity, and despite the increase in consumption from PDS there is not much impact on the reduction in the level of vulnerability. Reduction in the rates of malnourished is observed but remains high along with the states which can withstand high levels of shock. Our empirical estimation corroborates this. One limitation of the above methodology is that households may adopt an income smoothing approach not due to risks faced, but by choice. This might happen in case the household's income is not insured. In such a case income poverty is due to the uninsured component of risk (Ligon, 2010). This can be improved upon by using the methodology developed by Elbers and Gunning (2003). It is a stochastic dynamic model with simulation of household income under different situations. However, it would strictly require household level panel data. More information needs to be collected on the type of shock, impacts, type of risk and coping strategies adopted. For example coping strategies could include: (i) Dietary change: Changing the diet and buying less expensive and less preferred food items, limit the portion of meals or reducing the number of meals taken; (ii) Food seeking: Borrow food or money to increase the amount of food available in the short-term; (iii) Household structure: Decrease the number of people to be fed in the short-term; earning members and growing children are fed more; and (iv) Rationing: Decreasing consumption of street food (Maxwell et al., 1999).

5. Concluding remarks

Lack of household level panel data for India is a major hindrance for analyzing vulnerability at the household level. Hence, given the data limitations, state-region level conclusions can be drawn. This paper provides new evidence on vulnerability to food insecurity using the expected utility approach. It is found that poverty is a major component of vulnerability along with idiosyncratic risks. Income and type of occupation (primarily jobs with a steady flow of income) determine the resilience of households to shocks. Price of staple food items determines the extent of consumption of a diverse diet. Based on these indicators of food access the policy prescription would be to devise a mix of cash vs in-kind transfers. Urbanization also improves food access via a positive impact on raising the level of income, and accessibility to a varied range of food items.

High growth and income generating programs may not always reduce vulnerabilities. A mix of safety net and social protection strategies are important for improving resistance and resilience of households. They play an important role in reducing horizontal inequalities, and thus reducing discrimination in society. Vulnerabilities are faced across the entire life cycle, and a different set of policies like unemployment insurance and pension schemes are required (Malik, 2014). Policies in India should attempt to look beyond that of poverty, and focus on vulnerability and risk assessment, and its major contributing factors. This is all the more required in the context of food and nutrition policies. Good nutrition is important for sustainable development. A mix of both universal and localized policies is required. A combination of the salient features of micro-finance, health, insurance and work related programs need to be imbibed in the social protection strategies for the poor. Future studies should look into these aspects.

ENDNOTES

[i] See León and Carlos (2006) on different dimensions and definitions of vulnerability and how it has evolved over time.

[ii]The most widely used measure of poverty is the Foster-Greer-Thorbecke (FGT) Index defined as follows: $\mathrm{FGT}_\alpha = \frac{1}{N}\sum_{i=1}^{H}(\frac{z-y_i}{z})^\alpha$; where α is the parameter of poverty aversion, N is the total population, z is the poverty line, H is the total number of people below the poverty line, y_i is the income of the ith individual (Foster et al.,1984). However, poverty measures are not suitable for measuring the extent of vulnerability.

[iii]Celidoni (2013a) provides a comprehensive summary of the existing measures of vulnerability to poverty.

[iv] Methods 1 and 2 are not considered as results can be improved by using a panel, and not a cross-section data. Methods 3 and 4, which provide more robust results, cannot be adopted due to data limitations. This is because no prior information is available on the probability of the occurrence of a certain event say crop loss or drought.

[v] Aggregation of household preferences has minimal impact on the measures of vulnerability as discussed in Calvo and Dercon (2007). It is similar to the aggregation of income at the household level to that at the region level. Using the methodology outlined in Calvo and Dercon (2007) would give different results when information on aggregate level risks such as climate shocks is available. However, since in our case the only risk factor considered is change in prices, the results will not differ depending on whether the methodology developed by Ligon and Schether (2003) or Calvo and Dercon (2007) is used. Only households with negative vulnerability will be assigned a value of zero in the latter method (Ligon and Schether, 2004).

[vi] Poverty risk can also be decomposed into expected incidence, intensity and expected variability as in Celidoni (2013b), which requires further analysis.

[vii] The utility function assumed by Ligon and Scheter (2003) is an iso-elastic one. Its properties are as follows:

$$\mathrm{U(c)} = \frac{\mathrm{c}^{1-\gamma}}{1-\gamma}\text{, where } \gamma > 0$$

A utility function exhibits Decreasing Absolute Risk Aversion (DARA) if $\frac{\partial A(c)}{\partial c} < 0$, where $A(c) = -\frac{U''}{U'}$ (Mas-Colell et al., 1995).

So, in this case $U'' = \frac{C}{\gamma}$ and $U' = \frac{1}{c^{\gamma}}$.

Hence, relative risk aversion = $cA(c) = \gamma$, is a constant. Thus, it represents Constant Relative Risk Aversion (CRRA).

[ix] The following conversions are used: 1 litre milk=1 kg; 1 egg =58 gms; 10 bananas=1 kg; 1 orange=150 gms; 1 pineapple=1.5 kgs; 1 coconut=1 kg.

[x] District level information is available from 2004-05 onwards. Estimation procedure is based on Deaton (1985) and Ligon and Schechter (2003).

[xi]The National Sample Survey conducted in 2011-12 has additional household types and they are combined together as others category for comparison purposes.

[xii](http://www.ifpindia.org/Built-Up-Areas-in-India-e-GEOPOLIS.html).

[xiii]Hausman test is conducted to test for the fixed vs. random effects model. The estimates are free from cross-sectional dependence, which hold for macro panels with long time-series rather than micro-panels (few years and large number of observations).

[xiv] Work participation rate is the proportion of working members in the household.

[xv] Vulnerable employment rate is defined as the percentage of own-account and unpaid family workers in total employment. In 2013, 60 percent of women were engaged in vulnerable employment as compared to 54 percent men (UN, 2014).

[xvi] For constructing maps, the state-regions are categorized into five quintiles based on the value of the Shannon Index, and the estimated level of vulnerability. Accordingly color codes are used to represent the different quintiles along with the corresponding cut-off values.

REFERENCES

Adato, M., Ahmed, A. U., & Lund, F. (2004). Linking safety nets, social protection, and poverty reduction (No. 12). International Food Policy Research Institute (IFPRI), Washington D.C.

Baulch, B., &Hoddinott, J. (2000).Economic mobility and poverty dynamics in developing countries. *The Journal of Development Studies*, vol. 36(6), pp. 1-24.

Bogale, A. (2012). Vulnerability of smallholder rural households to food insecurity in Eastern Ethiopia. *Food Security*, vol. 4(4), pp. 581-591.

Calvo, C., &Dercon, S. (2007). Risk and Vulnerability to Poverty.In *The Many Dimensions of Poverty* (pp. 215-228). Palgrave Macmillan UK.

Chaudhuri, S., J. Jalan, and A. Suryahadi. (2002). *Assessing household vulnerability to poverty from cross-sectional data: A methodology and estimates from Indonesia*, vol. 102. Discussion paper.

Deaton, A (1985). Panel data from time series of cross-sections.*Journal of econometrics*, vol. 30 (1), pp. 109-126.

Dilley, M., & Boudreau, T. E. (2001).Coming to terms with vulnerability: a critique of the food security definition.*Food Policy*, vol. 26(3), pp. 229-247.

Elbers, Chris, and Jan Willem Gunning.(2003). Vulnerability in a stochastic dynamic model. Tinbergen Institute Discussion Paper TI 2003-070/2.

FAO.(2012).The state of Food Insecurity in the World. Rome

Glewwe, P., & Hall, G. (1998). Are some groups more vulnerable to macroeconomic shocks than others? Hypothesis tests based on panel data from Peru. *Journal of Development Economics*, vol. 56(1), pp. 181-206.

Gómez, M. I., Barrett, C. B., Raney, T., Pinstrup-Andersen, P., Meerman, J., Croppenstedt, A., ...& Thompson, B. (2013). Post-green revolution food systems and the triple burden of malnutrition, *Food Policy*, vol. 42, pp. 129-138.

Grimm, M., Waibel, H., &Klasen, S. (Eds.). (2016). *Vulnerability to Poverty: Theory, measurement and determinants, with case studies from Thailand and Vietnam*. Springer.

Guha-Khasnobis, B., Acharya, S. S., & Davis, B. (Eds.).(2007). *Food insecurity, vulnerability and human rights failure*. Palgrave Macmillan.

Hoang, L. V. (2009). *Estimation of food demand from household survey data in Vietnam* (No. 12).

Johns, T., &Sthapit, B. R. (2004).Biocultural diversity in the sustainability of developing-country food systems, *Food and Nutrition Bulletin*, vol. 25(2), pp. 143-155.

Kamanou, G., &Morduch, J. (2002).Measuring vulnerability to poverty (No. 2002/58).WIDER Discussion Papers, World Institute for Development Economics (UNU-WIDER).

Karamba, W. R., Quiñones, E. J., &Winters, P. (2011). Migration and food consumption patterns in Ghana. *Food Policy*, vol. *36*(1), pp. 41-53.

Kühl, J. J. (2003). Disaggregating household vulnerability–analyzing fluctuations in consumption using a simulation approach. *Copenhagen: Institute of Economics, University of Copenhagen. Unpublished manuscript*.

Klasen, S., and Waibel, H. (2013): Vulnerability to poverty: theory, measurement and determinants, Palgrave Macmillan.

Kumar, K. K., Ramachandran, M., &Viswanathan, B. (2009). What characterises women vulnerable to chronic energy deficiency?. *Social Indicators Research*, vol. *90*(3), pp. 365.

Ligon, E. A. (2010). Measuring risk by looking at changes in inequality: Vulnerability in Ecuador.

Ligon, E. A., & Schechter, L. (2004).Evaluating different approaches to estimating vulnerability.

Ligon, E., & Schechter, L. (2003).Measuring vulnerability. *The Economic Journal*, vol. *113*(486).

Majumder, A., Ray, R., &Sinha, K. (2012).Calculating rural-urban food price differentials from unit values in household expenditure surveys: A comparison with existing methods and a new procedure. *American Journal of Agricultural Economics*, vol. 94(5), pp. 1218-1235.

Mansuri, G., and A. Healy (2001).Vulnerability Prediction in Rural Pakistan, World Bank.Mimeo, Washington, DC.

Naudé, W., Santos-Paulino, A. U., & McGillivray, M. (2009).Measuring vulnerability: An overview and introduction. *Oxford Development Studies*, vol. 37(3), pp. 183-191.

Nguyen, M. C., &Winters, P. (2011). The impact of migration on food consumption patterns: The case of Vietnam. *Food Policy*, vol. *36*(1), pp. 71-87.

Pinstrup-Andersen, P. (2009). Food security: definition and measurement, *Food Security*, vol. 1(1), pp. 5-7.

Prais, S. J., &Houthakker, H. S. (1955). The analysis of family budgets, with an application to two British Surveys conducted in 1937-39 and their detailed results. *The analysis of family budgets, with an application to two British Surveys conducted in 1937-39 and their detailed results*.

Pritchett, L., Suryahadi, A., &Sumarto, S. (2000). *Quantifying vulnerability to poverty: A proposed measure, applied to Indonesia* (No. 2437), World Bank Publications.

Ruel, Marie T., (2002). Is dietary diversity an indicator of food security or dietary quality?, FCND discussion papers 140, International Food Policy Research Institute (IFPRI), Washington D.C.

Satterthwaite, D., McGranahan, G., &Tacoli, C. (2010).Urbanization and its implications for food and farming. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *365*(1554), 2809-2820.

Scaramozzino, P. (2006). Measuring vulnerability to food insecurity. *Agricultural and Development Economics Division of the Food and Agriculture Organization of the United Nations (FAO-ESA).*

Suryanarayana, M. H., & Silva, D. (2007). Is targeting the poor a penalty on the food insecure? Poverty and food insecurity in India. *Journal of Human Development*, vol. *8*(1), pp. 89-107.

Malik, K. (2014). *Human development report 2014: Sustaining human progress: Reducing vulnerabilities and building resilience*. United Nations Development Programme.

Maxwell, D. l, Ahiadeke, C., Levin, C., Armar-Klemesu, M., SawudatuZakariah, and Grace Mary Lamptey (1999).Alternative food-security indicators: revisiting the frequency and severity of 'coping strategies. *Food Policy*, vol. 24(4), pp 411-429.

United Nations Development Programme (UNDP) (2014): Human Development Report 2014, Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience, New York.

United Nations World Food Programme (UNWFP) (2002). Vulnerability Analysis and Mapping, VAM Standard Analytical Framework, Role and objectives of VAM activities to support WFP Food-Oriented. Rome.

Zhang, Y., and Wan, G. (2009).How precisely can we estimate vulnerability to poverty? *Oxford Development Studies*, vol. 37(3), pp. 277-287.

TABLES

Table 1: Descriptive statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
Urbanization	162325	0.200	0.148	0.010	1
Dependency ratio	188055	0.08	0.14	0	1
Household size	188055	4.94	2.43	1	43
Household size squared	188055	30.30	36.07	1	1849
Income					
MPCE: Quartile 1	188054	0.200	0.400	0	1
MPCE: Quartile 2	188054	0.200	0.400	0	1
MPCE: Quartile 3	188054	0.200	0.400	0	1
MPCE: Quartile 4	188054	0.200	0.400	0	1
MPCE: Quartile 5	188054	0.200	0.400	0	1
Employment					
Self-employed in non-agriculture	187948	0.259	0.438	0	1
Agricultural labour	187948	0.177	0.382	0	1
Other labour	187948	0.156	0.363	0	1
Self-employed in agriculture	187948	0.262	0.440	0	1
Others	187948	0.146	0.353	0	1
Social group					
Scheduled Tribes	188024	0.164	0.370	0	1
Scheduled Castes	188024	0.169	0.375	0	1
Other Backward Classes	188024	0.385	0.487	0	1
Others	188024	0.282	0.450	0	1
Gender					
Male	188055	0.892	0.311	0	1
Female	188055	0.108	0.311	0	1
Education					

Not literate	188016	0.324	0.468	0	1
Primary	188016	0.369	0.483	0	1
Middle	188016	0.117	0.321	0	1
Secondary	188016	0.080	0.271	0	1
Higher secondary	188016	0.057	0.231	0	1
Diploma/Graduate/Post-graduate	188016	0.053	0.225	0	1
Land possessed					
Less than 0.001 ha	188055	0.033	0.178	0	1
0.001 ha < Land owned < 0.04 ha	188055	0.055	0.228	0	1
0.04 < Land owned < 0.4 ha	188055	0.446	0.497	0	1
0.4 < Land owned < 1 ha	188055	0.207	0.405	0	1
1 < Land owned < 2 ha	188055	0.121	0.326	0	1
2 < Land owned < 4 ha	188055	0.081	0.273	0	1
Land owned > 4 ha	188055	0.057	0.231	0	1
Quality-adjusted unit value					
Rice	171662	13.27	7.81	-7.39	403.59
Wheat	140690	13.27	12.62	-7.83	314.99
Pulses	72209	26.36	5.29	13.15	39.49
Age					
Age group: Less than 15	188054	0.00	0.04	0	1
Age group:15-24	188054	0.02	0.14	0	1
Age group:25-34	188054	0.16	0.36	0	1
Age group:35-44	188054	0.27	0.45	0	1
Age group:45-59	188054	0.35	0.48	0	1
Age group:60 and above	188054	0.20	0.40	0	1

Table 2: Correlates and components of vulnerability to food consumption

	Vulnerability	Poverty	Aggregate risk	Idiosyncratic risk	Unexplained risk
Average value(in utils)	6.8795*	6.8795	-7.5895	7.0367*	0.5528*
	[-0.6616 14.4206]	[-18.8845 32.6435]	[-134.1985 119.0195]	[-145.7278 159.8012]	[-45.2493 46.3548]
Reference group: Age group:60 and above					
Age group: Less than 15	-18.6544	-18.6544	12.4168	-1.4183	-10.9986
	(23.8522)	(23.8522)	(24.7891)	(26.9167)	(35.2645)
Age group:15-24	-0.8206	-0.8206	2.5287	-4.0948	1.5660
	(3.2625)	(3.2625)	(3.3907)	(3.6817)	(4.8235)
Age group:25-34	-1.1444	-1.1444	1.3722	-2.3329	0.9607
	(1.5196)	(1.5196)	(1.5793)	(1.7148)	(2.2467)
Age group:35-44	-0.0802	-0.0802	0.0949	-1.4615	1.3666
	(1.2249)	(1.2249)	(1.2730)	(1.3822)	(1.8109)
Age group:45-59	-0.6857	-0.6857	1.0866	-1.6820	0.5954
	(1.1148)	(1.1148)	(1.1585)	(1.2580)	(1.6481)
Dependency ratio	3.1920	3.1920	-2.2416	9.2313**	-6.9897
	(3.4794)	(3.4794)	(3.6161)	(3.9264)	(5.1441)
Household size	-1.1911***	-1.1911***	1.2578***	0.0313	-1.2891**
	(0.4392)	(0.4392)	(0.4564)	(0.4956)	(0.6493)

Household size squared	0.0189	0.0189	-0.0176	0.0156	0.0021
	(0.0266)	(0.0266)	(0.0276)	(0.0300)	(0.0393)
Reference group: Education: Higher secondary					
Not literate	-2.0974	-2.0974	3.4732*	-5.4397***	1.9664
	(1.8669)	(1.8669)	(1.9402)	(2.1067)	(2.7601)
Primary	-2.2153	-2.2153	3.2992*	-4.5443**	1.2451
	(1.7808)	(1.7808)	(1.8507)	(2.0096)	(2.6328)
Middle	-1.4240	-1.4240	2.9454	-4.7796**	1.8342
	(1.9391)	(1.9391)	(2.0152)	(2.1882)	(2.8668)
Secondary	-1.0414	-1.0414	2.5198	-1.4586	-1.0612
	(2.0537)	(2.0537)	(2.1344)	(2.3176)	(3.0364)
Diploma/Graduate/Post-graduate	1.8861	1.8861	-0.9739	0.1295	0.8444
	(2.2696)	(2.2696)	(2.3587)	(2.5612)	(3.3555)
Quality-adj. unit value of rice	0.2926***	0.2926***	-0.0778	-0.9683***	1.0461***
	(0.0671)	(0.0671)	(0.0697)	(0.0757)	(0.0992)
Quality-adj. unit value of wheat	0.1253***	0.1253***	-0.1283***	-0.2393***	0.3675***
	(0.0470)	(0.0470)	(0.0488)	(0.0530)	(0.0694)
Reference group: Others					
Self-employed in non-agriculture	-4.6921***	-4.6921***	4.0514***	0.0034	-4.0548**
	(1.3916)	(1.3916)	(1.4463)	(1.5704)	(2.0575)
Agricultural labour	-5.5479***	-5.5479***	5.2680***	-1.3972	-3.8708*
	(1.5325)	(1.5325)	(1.5927)	(1.7294)	(2.2658)

Other labour	-3.6812**	-3.6813**	3.7880**	0.3324	-4.1204*
	(1.5205)	(1.5205)	(1.5802)	(1.7159)	(2.2480)
Self-employed in agriculture	-2.8032*	-2.8032*	2.8703*	0.9410	-3.8113*
	(1.4455)	(1.4455)	(1.5023)	(1.6312)	(2.1371)
Reference group: Social group: Others					
ST	0.3929	0.3929	-0.5524	-2.4179	2.9704
	(1.7162)	(1.7162)	(1.7836)	(1.9366)	(2.5373)
SC	-0.0738	-0.0738	-0.0470	2.1073	-2.0603
	(1.2596)	(1.2596)	(1.3091)	(1.4215)	(1.8623)
OBC	1.1471	1.1471	-1.5880	-2.0372*	3.6252**
	(1.0305)	(1.0305)	(1.0710)	(1.1629)	(1.5236)
Female	5.6764***	5.6764***	-4.8687***	1.3102	3.5586
	(1.6830)	(1.6830)	(1.7491)	(1.8993)	(2.4883)
Reference group: 2011-12					
2009-10	-1.6875	-1.6875	2.2191*	-3.9847***	1.7656
	(1.1578)	(1.1578)	(1.2033)	(1.3065)	(1.7117)
2004-05	-1.7525	-1.7525	4.4228***	-4.9375***	0.5146
	(1.5391)	(1.5391)	(1.5995)	(1.7368)	(2.2755)
Reference group: Reference group: MPCE: Quartile 1					
MPCE: Quartile 2	-1.6984	-1.6984	2.1054	5.9662***	-8.0716***
	(1.3666)	(1.3666)	(1.4203)	(1.5422)	(2.0205)
MPCE: Quartile 3	-2.3181	-2.3181	2.6016	9.5077***	-12.1093***

	(1.5599)	(1.5599)	(1.6212)	(1.7604)	(2.3063)
MPCE: Quartile 4	-4.5641***	-4.5641***	4.7328***	11.4037***	-16.1365***
	(1.7434)	(1.7434)	(1.8119)	(1.9674)	(2.5775)
MPCE: Quartile 5	-8.5330***	-8.5330***	9.0348***	12.8978***	-21.9326***
	(2.0299)	(2.0299)	(2.1096)	(2.2907)	(3.0011)
Urbanization	1.1810	1.1810	11.1819***	63.4734***	-74.6553***
	(3.2721)	(3.2721)	(3.4006)	(3.6925)	(4.8376)
Reference group: 0.4 < Land owned < 1 ha					
Less than 0.001 ha	2.1688	2.1688	-6.0405**	-3.9777	10.0182**
	(2.8431)	(2.8431)	(2.9548)	(3.2084)	(4.2035)
0.001 ha < Land owned < 0.04 ha	1.9104	1.9104	-5.7240**	5.8118**	-0.0878
	(2.3731)	(2.3731)	(2.4663)	(2.6780)	(3.5085)
0.04 < Land owned < 0.4 ha	3.0977	3.0977	-7.0219***	4.1797	2.8422
	(2.4826)	(2.4826)	(2.5802)	(2.8016)	(3.6705)
1 < Land owned < 2 ha	1.1698	1.1698	-5.1158*	2.0712	3.0446
	(2.6206)	(2.6206)	(2.7235)	(2.9573)	(3.8744)
2 < Land owned < 4 ha	0.0461	0.0461	-5.2121*	-1.9835	7.1956*
	(2.7760)	(2.7760)	(2.8850)	(3.1326)	(4.1041)
Land owned > 4 ha	2.2417	2.2417	-9.2321***	3.4374	5.7947
	(2.9756)	(2.9756)	(3.0925)	(3.3579)	(4.3993)
Constant	13.7196*	13.7196*	-12.7225	-1.1222	13.8448

	(7.8344)	(7.8344)	(8.1421)	(8.8409)	(11.5828)
Observations	124,086	124,086	124,086	124,086	124,086
R-squared	0.061	0.061	0.067	0.081	0.068

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3: Dietary diversity profile across vulnerable households

State	State-Region	Dietary diversity 2004-05	Vulnerability 2004-05	Dietary diversity 2009-10	Vulnerability 2009-10	Dietary diversity 2011-12	Vulnerability 2011-12
Punjab	**Northern**						
Punjab	Southern						
Uttaranchal	Uttaranchal						
Haryana	Eastern						
Haryana	Western						
Rajasthan	Western						
Rajasthan	North-Eastern						
Rajasthan	Southern						
Rajasthan	South-Eastern						
Uttar Pradesh	Northern Upper Ganga Plains						
Uttar Pradesh	Central						
Uttar	**Eastern**						

Table 3: Dietary diversity profile across vulnerable households

State	State-	Dietary	Vulnerability	Dietary	Vulnerability	Dietary	Vulnerability
Pradesh							
Uttar Pradesh	Southern						
Bihar	Northern						
Bihar	Central						
Assam	**Plains Eastern**						
Assam	Plains Western						
Assam	Cachar Plain						
West Bengal	Himalayan						
West Bengal	Eastern Plains						
West Bengal	Southern Plains						
West Bengal	**Central Plains**						
Jharkhand	Ranchi						
Orissa	Coastal						
Orissa	**Southern**						

Table 3: Dietary diversity profile across vulnerable households

State	State-	Dietary	Vulnerability	Dietary	Vulnerability	Dietary	Vulnerability
Orissa	Northern						
Chhattisgarh	Northern Chhattisgarh						
Madhya Pradesh	Vindhya						
Madhya Pradesh	Central						
Madhya Pradesh	Malwa						
Madhya Pradesh	South						
Madhya Pradesh	South Western						
Madhya Pradesh	Northern						
Gujarat	South Eastern						
Gujarat	Plains Northern						

Table 3: Dietary diversity profile across vulnerable households

State	State-	Dietary	Vulnerability	Dietary	Vulnerability	Dietary	Vulnerability
Gujarat	Dry areas						
Gujarat	Kachchh						
Gujarat	**Saurashtra**						
Maharashtra	Coastal						
Maharashtra	Inland Western						
Maharashtra	Inland Northern						
Maharashtra	Inland Central						
Maharashtra	**Inland Eastern**						
Maharashtra	**Eastern**						
Andhra Pradesh	Coastal Northern						
Andhra Pradesh	Coastal Southern						
Andhra Pradesh	Inland North						

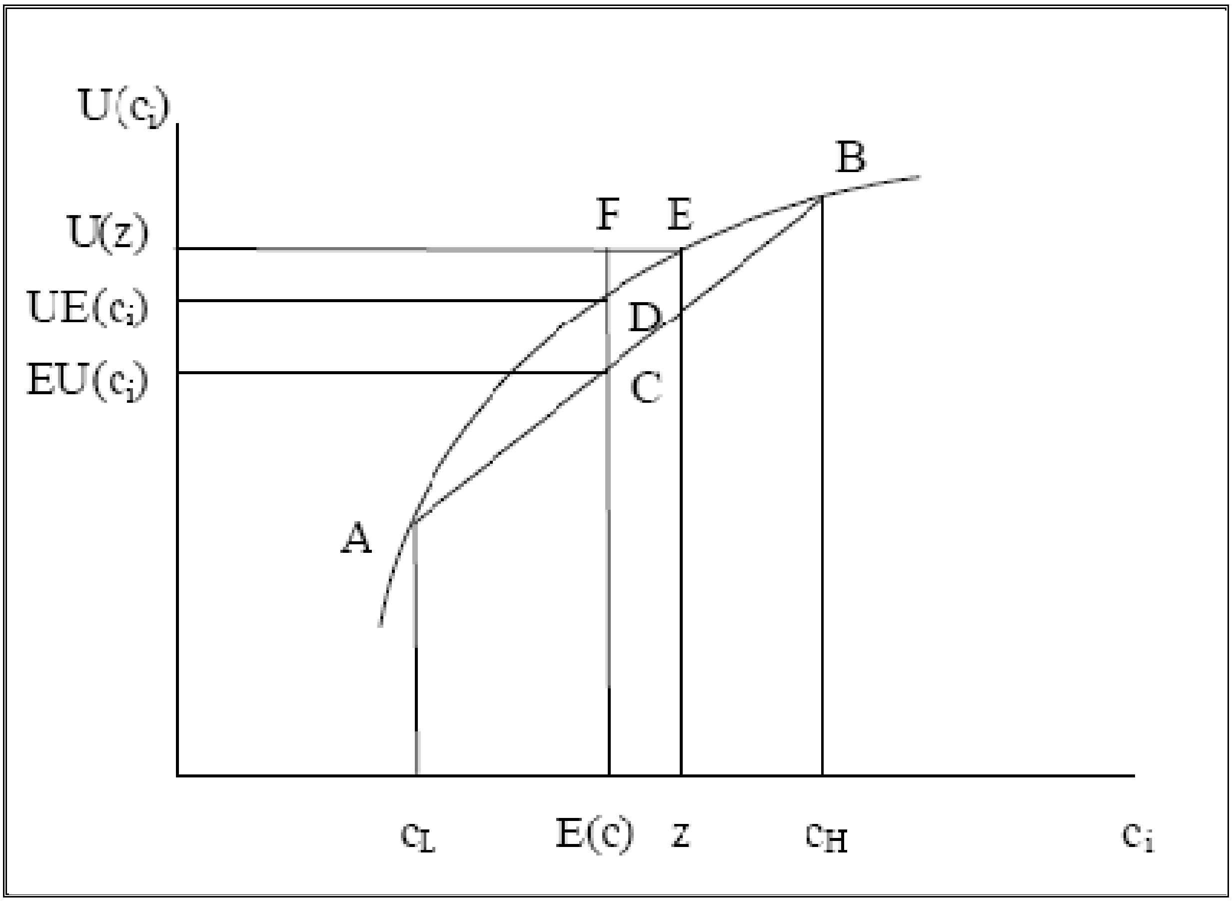
Table 3: Dietary diversity profile across vulnerable households

State	State-Western	Dietary	Vulnerability	Dietary	Vulnerability	Dietary	Vulnerability
Andhra Pradesh	Inland North Eastern						
Karnataka	Coastal and Ghats						
Karnataka	Inland Eastern						
Karnataka	Inland Southern						
Karnataka	Inland Northern						
Kerala	Northern						
Kerala	Southern						
Tamil Nadu	Coastal Northern						
Tamil Nadu	Coastal						
Tamil Nadu	Southern						
Tamil Nadu	Inland						

	Low
	Medium
	High
	Very high

FIGURES

Figure 1: Graphical representation of the decomposition of vulnerability



Source: Adapted from Thorbecke (2004)

Figure 2(a): Spatial map of dietary diversity profile across state-regions of India (2004-05)

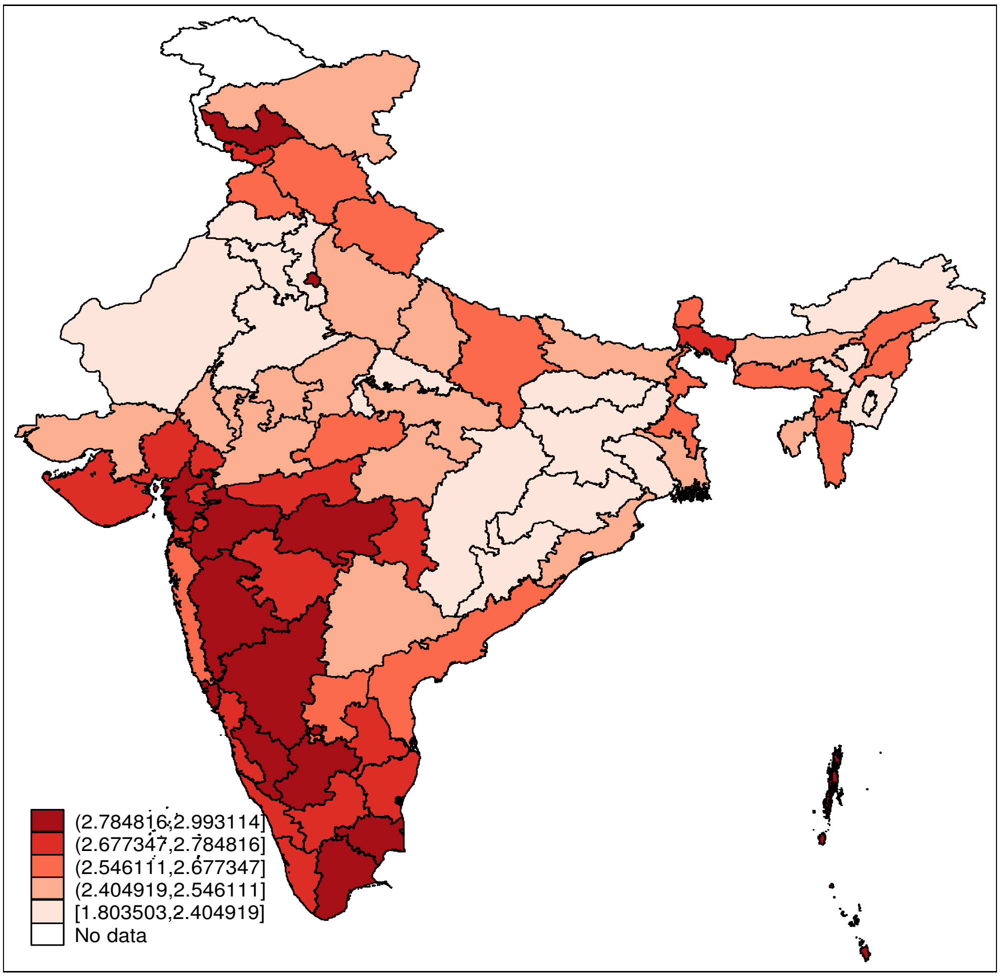


Figure 2(b): Spatial map of the level of vulnerability across state-regions of India (2004-05)

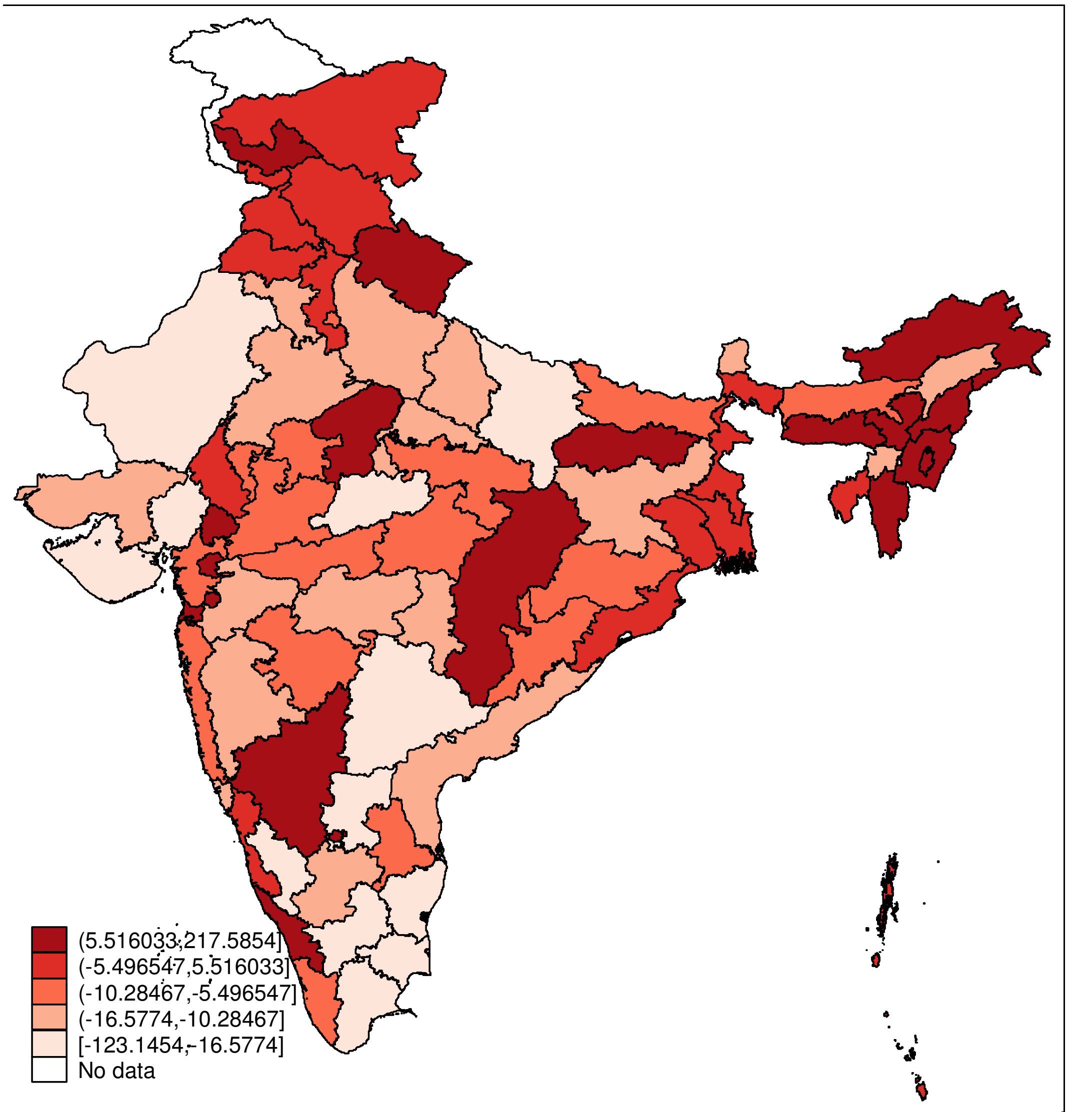


Figure 3(a): Spatial map of dietary diversity profile across state-regions of India (2009-10)

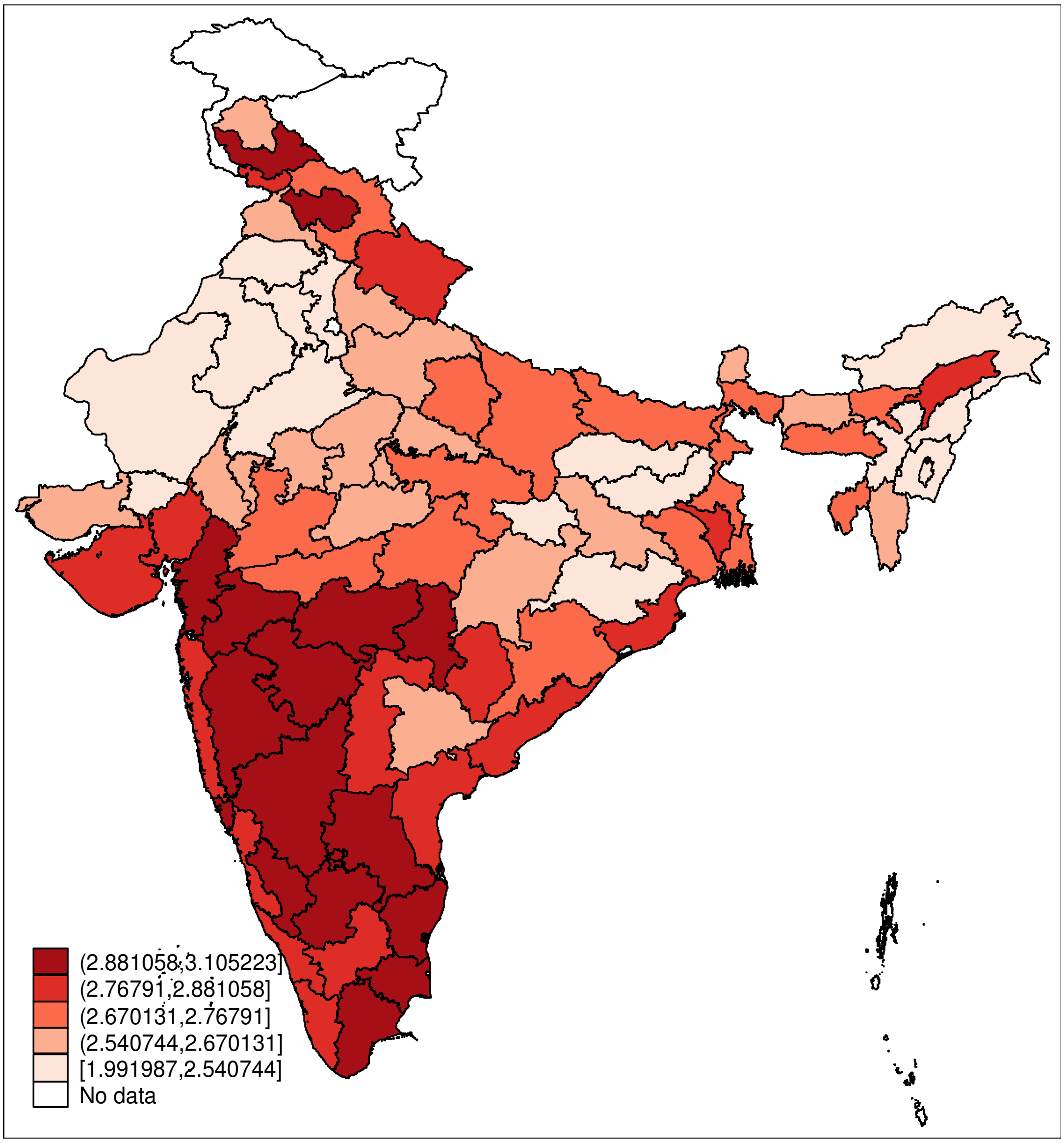


Figure 3(b): Spatial map of level of vulnerability across state-regions of India (2009-10)

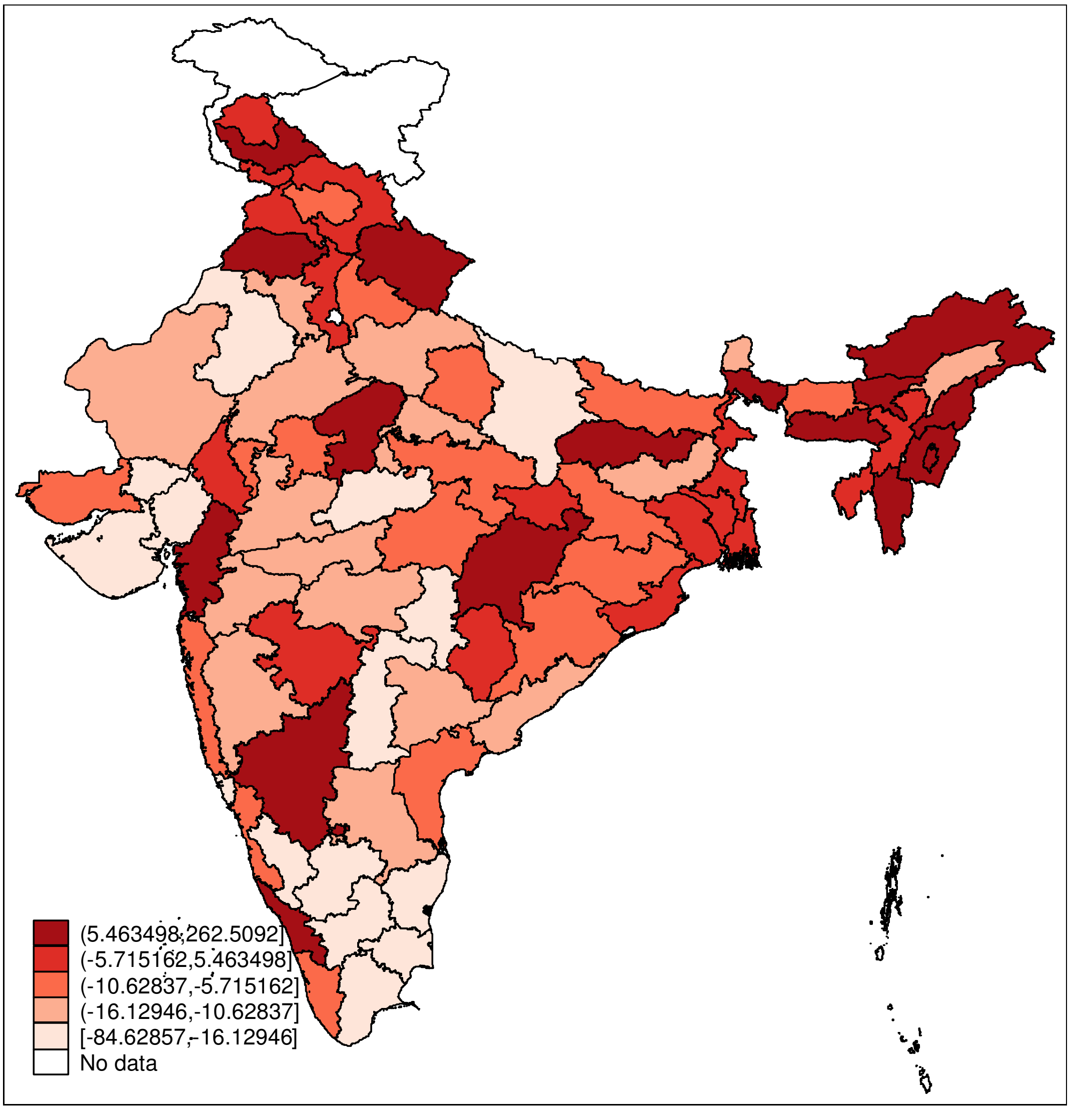


Figure 4 (a): Spatial map of dietary diversity profile across state-regions of India (2011-12)

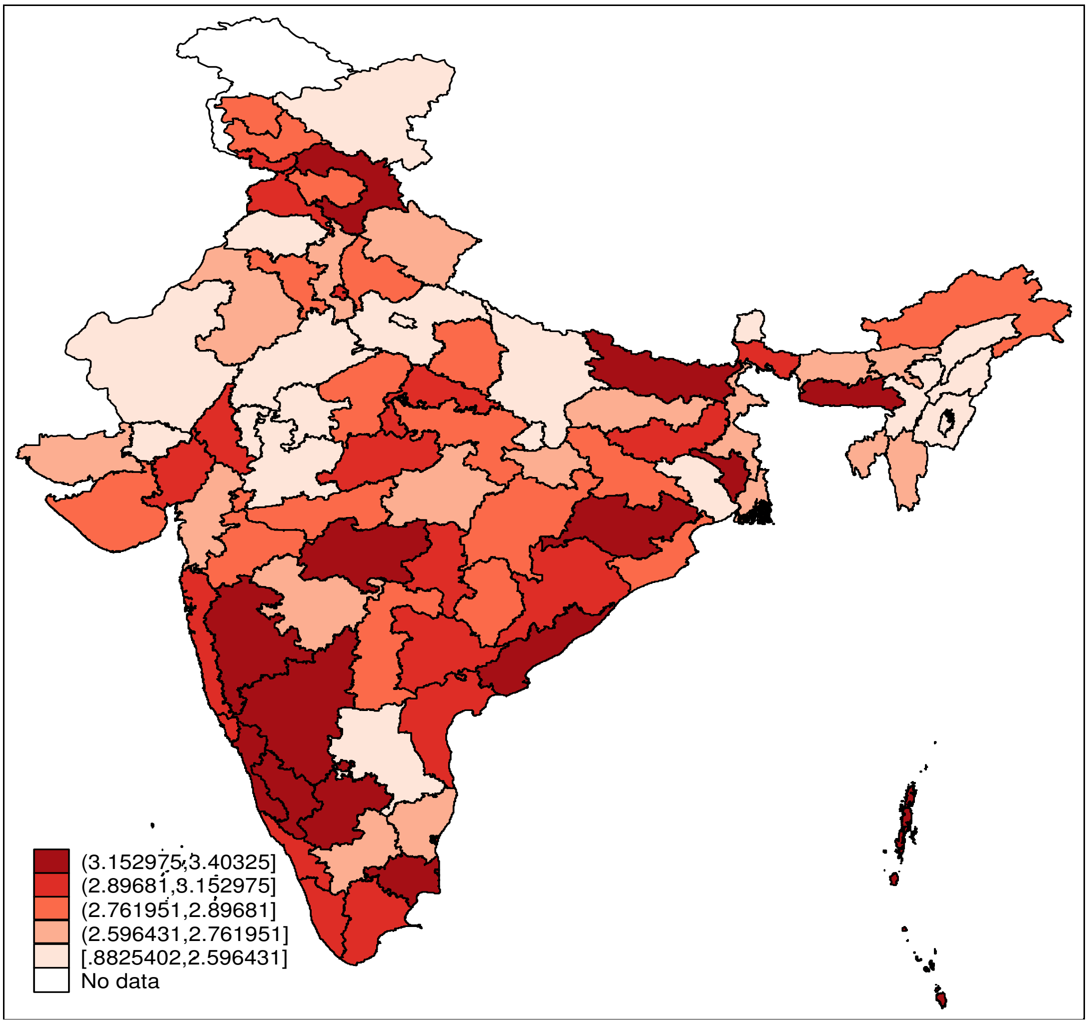


Figure 4(b): Spatial map of the level of vulnerability across state-regions of India (2011-12)