RURAL HOUSEHOLD LIVELIHOOD VULNERABILITY AND MITIGATION STRATEGIES - NEED FOR A GOVERNMENT INTERVENTION

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1.   Introduction

Sustainable development report (2017) has observed that globally the natural and economic shocks have caused a loss of 250 billion to 300 billion US dollars a year. Also, the vulnerability to shocks is found to be high in developing and under-developed countries (SDG 2017). In those regions, rural households are particularly more vulnerable to shocks in those regions (Alpízar 2007, Dercon 2005). The most common household shocks are an income earner's illness or death, business failure, dwelling demolition, theft, drought, farmlands destruction due to fire or flood, long spells of unemployment, and price hikes for farm inputs and food stuffs (Mba et al. 2018). The studies have also observed that the risks\shocks are vicious in nature and they may hinder the household's capacity to recover and push them towards vulnerability (Bankoff and Hilhorst 2013; Daramola et al. 2016). These observations bring to light an important possibility that the vulnerability factors could be both contagious and cumulative in its effect. Understanding the transmission mechanism and breaking the vicious cycle assumes importance in this context. There are different approaches to studying the vicious propagations of vulnerability. One of the channels through which this vulnerability propagation finds expression is the mitigation strategy response. An immediate response of the individual household to vulnerability that disrupts the livelihood is to adopt different coping strategies that may include increasing the labour force participation rate, selling livestock, receiving loan at an exorbitant interest rate, and diversifying income. There are capacity limits for the households, and there are elements of complementarities among different strategies, and so not all mitigation strategies adopted or available to a particular household would be successful in mitigating the shocks in the long term (Raut 2021). Poor have very little choice in respect to adopting a mitigation strategy from a broad range; certain mitigation strategies are not feasible and certain others lead to unintended consequences. This in turn forces household to adopt poor or irrational strategies to cope with the risk or shock. These spontaneous, myopic, flawed and poorly thought-out strategies

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may bring immediate relief to vulnerable conditions for the short term, but they increase the probability of falling into extreme vulnerability in the future. Studies have observed that the government intervention might serve to address the problem of myopic strategies (Lodge and Wegrich 2014). This study intent to understand the type of livelihood risks the rural households face and the possible mitigation responses adopted by them. Among the different coping strategies, the study identifies the mitigation strategies that may be myopic in its intent. Further, this study finds out the exact dimension of vulnerability in which the myopic mitigation strategies are adopted. This paper uses the systematic literature review as a methodology. The current study has five sections. The first section explains the background of the study, scope, and objectives; the second section contains a brief discussion on methodology of PRISMA for the analysis of systematic review and meta-analysis; the third section discusses results of systematic review and meta-analysis; and the final section concludes the study.

II. PRISMA Methodology for systematic literature review an d Meta-analysis

The study used the PRISMA methodology to perform an impartial and systematic review of the literature. PRISMA is an acronym that stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses, which is used to guide systematic reviews and meta-analyses (Bigonnesse et al. 2018). PRISMA provides guidelines in which the reviewing, finding, analyzing, and abstracting of papers can be done rigorously. This method enables a systematic, complete, and unbiased review of the literature on the particular research topic. The process of extracting data/studies in the method PRISMA consists of four stages, namely: identification of articles in a database by applying appropriate search terms/key words that are related to the research; screening of all identified articles from the databases using the titles and abstracts; and selecting and reviewing full-text articles that are eligible.

Resource (Data Source)

In order to collect data, the study used 10 popular databases. In particular, two of these databases, namely Scopus and Web of Science (WoS), provide advanced inbuilt features for search filtering, which help to perform comprehensive and effective searching. Other databases, such as SAGE, Science Direct, Oxford Journals, SpringerLink, Emerald Insight, JStor, Wiley Online Library, and TaylorFrancis, assisted in the process of retrieving all eligible studies for the comprehensive review analysis.

Eligibility and exclusion criteria

The present study employed adequate eligibility criteria, such as (i) obtaining only journal articles because they are more complete and contain more viable and reliable

documentation (Bar-Ilan 2010; Montesi & Mackenzie 2008); and case studies, on the other hand, depict contemporaneous events in a real-world setting (Yin, 1994); (ii) retrieving only English-language publications in order to smoothen the literature quest and analysis; and (iii) considering those articles that emphasize the discussion of livelihood vulnerability and coping/adaptation strategies among rural households. Table 1 shows these feasible criteria.

Table: 1 Inclusion and exclusion criterion used for the studies

Criterion	Eligibility	Exclusion
Type of Literature	Journal Articles and Case Studies	Chapter in Book, Review Articles, Conference Proceedings
Language	English	Other than English
Study's primary emphasis	Livelihood vulnerability and coping/adapting strategies	Other than Coping/adaptation and livelihood vulnerability

Source: Table created by author

Note: Adopted from Syahid et al. 2021

Systematic review literature criteria

Employing multiple databases is often advised by researchers and information professionals to retrieve relevant articles on a selective topic to perform a systematic review (Bramer et al. 2017). To conduct a systematic review, the present study used 10 databases. The process of searching for articles took place from March 28th, 2022, to April 8th, 2022. Inclusion of various databases would help to eliminate the risk of bias. The technique starts with the selection of a search keyword that relevant to the study objective.

Table: 2 Number of studies identified by databases and keywords used

Journal database	Keywords used	Number of Identified results
Web of Science	((Coping OR cope OR adapt*) AND (livelihood vulnerability) AND (rural household)	229
Scopus		279
Taylor Francis	(Topic) - (Economics /Social Sciences/Arts and humanities/ agricultural economics /Agricultural climate change/ Environmental management/ Environmental economics/ Labour economics /Environmental Sciences/ Environmental Studies/ Development Studies / Public Environmental Occupational Health / Agriculture Multidisciplinary)	837
Science direct		3349
SAGE		32
SpringerLink		785
Emerald Insight		874
Oxford Journals		415
Jstor		547
Wiley Online Library		2250
Total		9,597

Source: Table created by author

Table 2 represents that a total of 9,597 studies were obtained from 10 databases. From the 9,597 studies 995 duplicates studies were recognized and eliminated during this stage. Out of 8602 studies further 8174 were removed at the stage of screening because of the absence of those keywords in the title and abstracts that included in the eligibility criteria. Further, Taking 428 complete studies the process run on to the eligibility stage right after completing the screening phase. After reviewing all of the articles, Seventy four (74) studies were shortlisted for systematic review because they were thoroughly centered on the study's objective. The entire procedure is depicted through the PRISMA flow diagram in the Figure 1.

Figure: 1 PRISMA's four stage flow diagram for the study data extraction and analysis
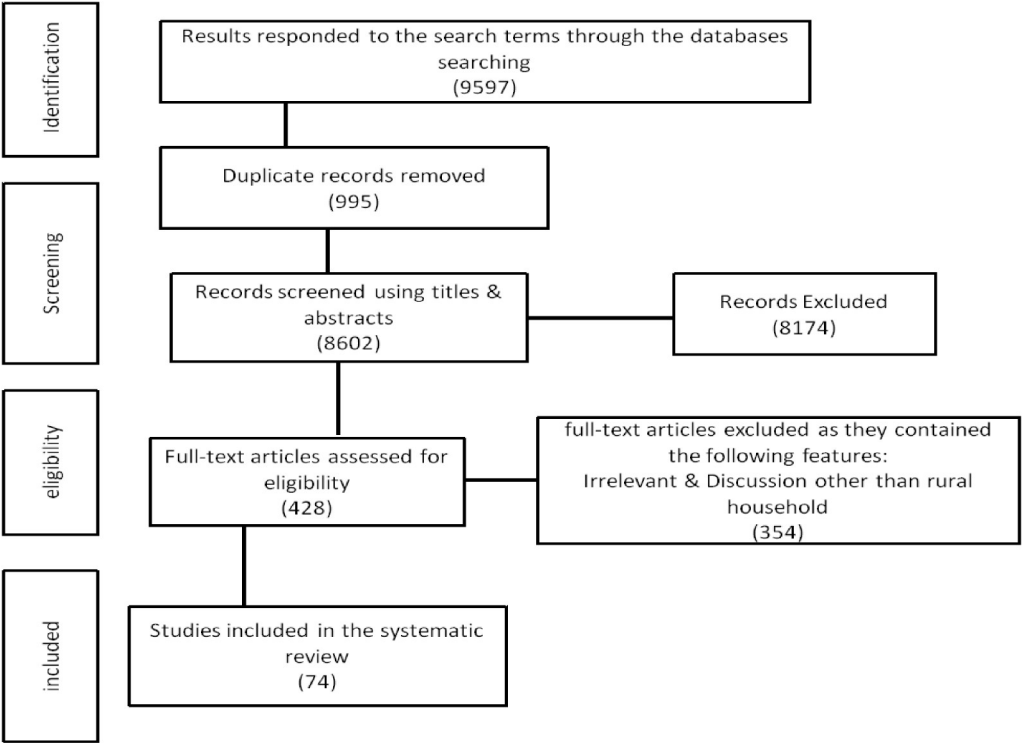
Source: Figure created by author

Note: Adopted from Moher et al. (2009)

Systematic literature review methodology

Presenting summary to the each included study, indicators of livelihood vulnerability in the terms of four capitals, the risk/shock mitigation strategies, the interaction among the each livelihood vulnerability indictor and mitigation strategies are summarized.

Meta regression methodology

Meta regression uses regression analysis to summarise research findings from multiple studies while controlling for the effects of available covariates on an outcome variable. There are two types of meta-regression models in the literature, namely, random effects and fixed effects models. One of the important factors that determine the type of model to be specified for the analysis is the heterogeneity among the studies. If there is no heterogeneity, it implies that there is no systematic differences among studies and the differences are only due to sampling error. The fixed effects meta-regression model is most appropriate in this context. On the other hand, if the studies are heterogonous, additional sources of variance also need to be accounted. The random effects meta-regression models are found to be more appropriate in this context. In comparison, the fixed effect regression model does not allow for within study variation, while the random effect model allows for within and between studies variations. Although heterogeneity can be tested using standard practices, it is often subject to a problem of selective inference (Benjamini 2020). It is also observed that the heterogeneity test lacks statistical power. Therefore, many studies prefer a random effect model as it is more robust in practice (Thompson and Higgins 2002).

The relationship between the household livelihood vulnerability risk/shock and the mitigation strategy could be assessed in Multinomial Logistic Regression Model (MLM) framework as both the variables are essentially nominal in nature. The risk or shock phenomenon is a multinomial variable with 4 categories. Each study in this analysis reported only one household livelihood vulnerability risk/shock factor; and therefore risk is unique and exclusive. But on the other hand, the mitigation strategies in response to household vulnerability risks were not unique and exclusive. The studies have reported multiple mitigation strategies for a single vulnerability shock. In order to capture all possible mitigation strategies the strategy of using multiple dichotomous dummy variables for each non-exclusive mitigation categories is used. Conceptually, the mitigation strategy, in strict sense, is a dependent variable in this context. However, in this study the objective is to find out the significance relationship, neither the direction nor extent of relationship is relevant here. Therefore, considering the mitigation strategy as dependent variable would not make any differences in this regression model. Based on these considerations, the Multinomial Logistic Regression Mixed Effects Model is formulated.

Table: 3 Categories of risk/shock mitigation management strategies adopted in the included studies

Behavior based strategies	Assistance based strategies	Asset based strategies	Adaptation strategies
-Do nothing -Consumption total Buy less or low-priced food Decline in spending on other essential non-food items -Occupational changes Member/s of household migrate for employment Adults increases their work hours or trying to find additional work Household starts a business Engaging and switching to non-farm activities -Child changes Withdrawing children's from school and sending them to work	- Assistance total From neighbor, relative or friend From the government From local NGO/ religious organization -Borrowing total From bank or savings group From a money lender From a relative, friend or neighbor	-Selling household assets -Selling livestock, -Crop/food stock -Selling jewelry -Selling/rented out land -Using savings -Insurance	-Crop diversification -Livestock diversification -Income diversification -livelihood diversification -Change farm location -Change is planting dates -Plant early maturing crops - water conservation - use of herbicides, insecticides, and chemical fertilisers. - Soil conservation and irrigation techniques -Planting trees -Use of drought resistant crops - Use of improved seeds -Mulching -Inter cropping -Planting horticulture and vegetables

Source: Adopted from Knight et al. 2015

III. a. Results and discussions of the systematic literature analysis and Meta-analysis

This section contains an analysis and discussion of systematic review of articles in terms of themes, study description, dimension of livelihood vulnerabilities and mitigation/ adaptation strategies.

Tabulation presentation of data (see annex A) depicts an overview of all included studies' characteristics that consist of the author and year of publication, livelihood vulnerability indicator, vulnerability dimensions, risk/shock mitigation/adaptation strategies, setting, study year, method of collecting data, sample size. The range of years of publication included studies from 1998 to 2022, whereas, majority of the studies were published in 2021. Most studies covered the context of natural shock/risk vulnerability. Furthermore, majority of the studies concerning vulnerability and mitigation/adaptation strategies were done in the Asian and African regions. The range of study years observed in the review is from 1960 to 2019. Interview and questionnaire methods of data collections were observed in the scenario of vulnerability and mitigation/adaptation strategies. The all included studies have used qualitative research design, primary data, household as a sample unit, and the range of the sample size is observed from 30 units to 20325 units in this systematic

literature review.

Table 4: Number of studies by the dimensions of risk/shock reported

Risk/shock	Frequency	%
Natural	54	73.0
Financial	6	8.10
Human	12	16.20
Physical	2	2.70
Total	74	100

Source: Table created by Author

Table 5: Frequency cross-tabulation of studies, in respect to mitigation strategies and risk/shock dimension reported

	Mitigation				Total
	Behavior	Assistance	Asset	Adaptation	125
Natural	46(36.8%)	21(16.8%)	30(24.0%)	28(22.4%)	
Human	9(34.61%)	7(26.92%)	8(30.76%)	2(7.69%)	26
Financial	2(20.0%)	6(60.0%)	2(20.0%)	0(0.0%)	10
Physical	1(25.0%)	2(50.0%)	0(0.0%)	1(25.0%)	04
Total	58	36	40	31	165

Source: Table created by Author

Table 4 shows the current study encounters rural household's livelihood vulnerability in four dimensions: natural capital, human capital, financial capital, and physical capital. Form the all included studies, the majority of the studies 54 (73%) found risk/shock in natural capital. Risk/shock was detected respecting human capital in 12 (16.2%) studies, financial capital in 6 (8.1%), and physical capital in 2 (2.7%).

Table 5 shows that in response to natural capital risk/shock behavior based mitigation strategies were observed 46 (36.8%) studies, asset based strategies were observed in 30 (24%) studies followed by adaptation strategies with 28 (22.4). Further, assistance based strategies were observed in 21 (16.8%) studies. In response to human capital risk/shock behavior based strategies were observed in 9 (34.61%) studies. In 8 (30.76%) studies, asset based strategies were observed, assistance based strategies observed in 7 (26.92%) studies and adaptation strategies were observed in 2 (7.69%). In financial capital risk assistance based strategies were observed in 6 (60%) studies, behavior and asset based

studies were observed in 2 (20%) studies each. For the financial capital shock none of the studies observed adaptation strategy. Physical risk/shock was observed in minimum number of studies. For the physical capital shock/risk, assistance based strategies were adopted in 2 (50%) studies, behavior based and adaptation strategies were observed in 1(25%) studies each. No asset based strategies were observed to physical based risk/shock. Furthermore, this table also shows that shows the mitigation strategies that were adopted in response to different risk/shock scenarios. Risk response strategies were broadly categorized as behavior-based, assistance-based, asset-based, and adaptation-based. Each included study indicates multiple risk/shock management strategies that Households were found to adopt. Therefore the count in respect to the prevalence of strategies exceeds the total number of included studies. In particular, behavior-based strategies were seen in 58 (35.15%) research, assets-based strategies in 40 (24.24%), assistance-based strategies in 36 (21.82%), and adaptive methods in 31 (18.79%) studies.

Range of risk management strategies used by the rural households

In order counter the risk/shock the households are using various management strategies. In the current study the risk/shock management strategies are divided into 4 categories namely behavior based strategies, assistance based strategies, asset based strategies and adaptation based strategies. The extent of usage and adaptation of these strategies in various included studies are discussed below.

Behavior based mitigation strategies

In order to defend the livelihood from risk/ shock the behavior based mitigation strategy is found to be a most adopted strategy among rural households. This strategy consist reduction of food consumption, purchasing cheaper/low price food, reducing non-food expenses, switching and engaging form farm activities to non-firm activities, selecting business as a main occupation, increasing working hours, migration, do noting and dropping children from formal education and sending them to work/child labor. The studies of Ansah et al. 2021; Bhowmik et al. 2021; Gebre et al. 2021; Mamoudou & Mughal 2021; Oskorouchi &Poza 2021; Shankeel & Shazli 2021; Hossain et al. 2020; Senakpon et al. 2020; Shanabhoga et al. 2020; Rahman & Gain 2020; Aniah et al. 2019; Lawlor et al. 2019; Mawejje 2019; Daramola et al. 2016; Gentle & Maraseni 2012; Zheng&Byg 2014; Pritchard et al.2017; Paul & Routray 2010; Pauline et al. 2017; Abbas et al. 2018; Hanke & Barkamnn 2017; Shimelis & Bogale 2007; Knight et al. 2015 observed the reduction in food consumption and quality by cutting the meals served, purchasing low/cheaper food in many studies , Similarly reducing non-food expenses also found as a mitigation strategy in these studies namely, Lawlor et al. 2019; Daramola et al. 2016; Knight et al. 2015. On the other hand

households are observed occupational changes as coping strategies many studies particularly households switching/engaging from farm to non-farm activities is observed in Abdullahi et al. 2022; Ansah et at. 2021; Hossain et al. 2020; Kuang et al. 2020; Lone et al. 2020; Amfo & Ali 2020; Ferdushi et al. 2019; Lawlor et al. 2019; Akinyemi 2017; Alam et al. 2017; Tesfaye & Seifu 2016 ; Choudri et al. 2013; Bui & Do 2012; Jha et al. 2007. Some of the studies i.e. Abdullahi et al. 2022; Lawlor et al. 2019; Alam et al. 2017; Knight etc al. 2015; Chen et al. 2012 have observed that the household prefer to adopt business as a main source of livelihood security or to counter the risk/shock.

Household's behavior attitude to secure their livelihood makes them to a little ignorant towards their health which in term households are found to increase working hours as a mitigation strategy (Hussain et al.2020; Rahman & Gain 2020; Lawlor et al. 2019; Kgosikama et al. 2018; Knight et al. 2015; Tran 2015). Furthermore, many households are found to adopt migration as mitigation strategy (Aravalath & Kasim 2021; Asante et al. 2021; Bhowmik et al. 2021; Nepal et al. 2021; Shankeel & Shazli 2021; Hussain et al.2020; Shanabhoga et al. 2020; Aniah et al. 2019; Ferdushi et al. 2019; Alam et al. 2017; Pauline et al. 2017; Kubik & Maurel 2016; Bylander 2015; Iqbal & Roy 2015; Knight et al.2015; Zheng&Byg 2014; Gentle & Maraseni 2012; Sudmeier et al. 2012; Mwinjaka et al. 2010; Paul & Routray 2010; Jha et al. 2007; Takasaki et al. 2004; Nabarro et al. 1989). Households are also observed to be not responding (do nothing) to risk/shock and prefer to be ignorant (Lawlor et al. 2019; Knight et al. 2015; Tran 2015). Households even use some poor mitigation strategies, drop out their children form schools and send them to work/child labor (Shankeel & Shazli 2021; Nguyen et al. 2020; Rahman & Gain 2020; Shahzad et al. 2019; Abbas et al. 2018; Pauline et al. 2017; Knight et al. 2015; Gentle & Maraseni 2012).

Assistance based mitigation strategies

Assistance based coping strategies consist Assistance total: From neighbor, relative or friend, from the government, from local NGOs/religious organization. And on the other hand, Borrowing total: From bank or savings group, From a money lender, From a relative, friend or neighbor. The studies Daramola et. al. 2016; Bhowmik et al.2021; Pritchard et al.2017; Oskorouchi &Poza 2021; Patnaik & Narayanan 2015; Lawlor et al. 2019; Mawejje 2019; Senakpon et al. 2020; Gebre et al. 2021; Knight et al. 2015; Ansah et al. 2021; Kuang et al. 2020; Tran 2015; Nguyen et al. 2020 have observed assistance from neighbor/ relatives/friends. And asset from government (Ansah et al. 2021; Aravalath & Kasim 2021; Bhowmik et al. 2021; Lawlor et al. 2019; Pritchard et al. 2017; Kolawole et al. 2016; Knight et al. 2015; Sudmeier et al. 2012; Shimelis & Bogale 2007) and assistance from NGOs/ religious organization (Ansah et at. 2021; Aravalath & Kasim 2021; Hanke & Barkamnn

2017; Pritchard et al. 2017; Knight et al. 2015; Iqbal & Roy 2015; Patnaik & Narayanan 2015; Knight et al. 2015; Sudmeier et al. 2012).

Borrowing from bank/saving group (Aravalath & Kasim 2021; Oskorouchi &Poza 2021; Raut 2021; Shanabhoga et al. 2020; Rahman & Gain 2020; Hussain et al. 2020; Hossain et al. 2020; Nguyen et al. 2020; Mawejje 2019; Abraham 2018; Khandker & Koolwal 2018; Hanke & Barkamnn 2017; Patnaik & Narayanan 2015; Knight et al. 2015; Tran 2015; Shimelis & Bogale 2007). Borrowing from money lender (Batung et al. 2022; Aravalath & Kasim 2021; Hossain et al. 2020; Senakpon et al. 2020; Shahzad et al. 2019; Mawejje 2019; Knight et al. 2015; Tran 2015; Paul & Routray 2010; Nabarro et al. 1989). Borrowing from a relative/friend/neighbor (Aravalath & Kasim 2021; Hossain et al. 2020; Rahman & Gain 2020; Senakpon et al. 2020; Mawejje 2019; Knight et al. 2015; Tran 2015; Zheng&Byg 2014; Nabarro et al. 1989). In assistance based, borrowing food on credit is observed mitigation strategy, borrowing food on credit form friends/relatives (Shankeel & Shazli 2021; Gebre et al. 2021) from trader (Shankeel & Shazli 2021) and money lender (Nabarro et al. 1989). Borrowing from NGO (Rahman & Gain 2020; Hossain et al. 2020; Bhowmik et al. 2021).

Asset Based mitigation strategies

Asset-Based coping strategies consists selling household assets, selling livestock, crop/food stock, selling jewelry, selling/rented out land, using savings, insurance. However, in particular selling households assets adopted as a mitigation strategy (Oskorouchi &Poza 2021; Raut 2021; Hussain et al. 2020; Lone et al. 2020; Mayanja et al. 2020; Nguyen et al. 2020; Aniah et al. 2019; Janzen & Carter 2019; Mawejje 2019; Hanke & Barkamnn 2017; Pauline et al. 2017; Jiao & Moinuddin 2016; Patnaik & Narayanan 2015; Knight et al. 2015; Tran 2015). Selling livestock (Hossain et al. 2020; Zheng&Byg 2014; Lone et al. 2020; Paul & Routray 2010; Pauline et al. 2017; Abbas et al. 2018; Shahzad et al. 2019; Patnaik & Narayanan 2015; Nabarro et al. 1989; Shimelis & Bogale 2007). Crop/ food stock (Knight et al. 2015; Anderson et al. 2018; Tran 2015; Takasaki et al. 2004; Pauline et al. 2017; Anderson et al. 2018; Tran 2015). Selling jewelry (Hossain et al. 2020; Abbas et al. 2018). Selling/ rented out land (Lone et al. 2020; Patnaik & Narayanan 2015, Shahzad et al. 2019; Tran 2015; Pauline et al. 2017; Abbas et al. 2018; Jha et al. 2007), Using savings (Hussain et al. 2020; Janzen & Carter 2019; Shahzad et al. 2019; Jiao & Moinuddin 2016; Knight et al. 2015; Tran 2015; Abbas et al. 2018; Chen et al. 2012), Insurance (Lone et al. 2020; Janzen & Carter 2019; Thang & Van 2019; Knight et al. 2015; Mwinjaka et al. 2010; Jha et al. 2007; Takasaki et al. 2004)

Adaptation strategies

Adaptation strategies consists of Crop diversification, Livestock diversification, Income diversification, livelihood diversification, Change farm location, Change is planting dates, Plant early maturing crops, water conservation, Use of chemical fertilizer, pesticides & insecticides, Soil conservation techniques and irrigation, Planting trees, Use of drought resistant crops, Use of improved seeds, Mulching, Inter cropping, Planting horticulture and vegetables. Whereas, Crop diversification is adopted as risk management strategy (Asante et al. 2021; Sudmeier et al. 2012; Shanabhoga et al. 2020; Mwinjaka et al. 2010; Akinyemi 2017; Amfo & Ali 2020; Choudri et al. 2013; Tesfaye & Seifu 2016; Lone et al. 2020; Vincent et al. 2015; Tibesigwa et al. 2015; Kuang et al. 2020; Jha et al. 2007). Live stock diversification (Amfo & Ali 2020; Tibesigwa et al. 2015), Income diversification (Amfo & Ali 2020; Shahzad et al. 2019), Agrochemical application (Asante et al. 2021; Kuang et al. 2020; Kgosikama et al. 2018; Ullah et al. 2017; Choudri et al. 2013), Irrigation (Asante et al. 2021; Kgosikama et al. 2018; Choudri et al. 2013; Lone et al. 2020; Tessema et al. 2013; Jiao & Moinuddin 2016; Jha et al. 2007), Inter cropping (Amfo & Ali 2020; Mubira et al. 2018; Lone et al. 2020; Vincent et al. 2015), Change planting dates (Lone et al. 2020; Aniah et al. 2019; Kgosikama et al. 2018; Alam et al. 2017; Eludoyin et al. 2017; Rahut&Ali et al. 2017; Tesfaye & Seifu 2016; Kolawole et al. 2016; Vincent et al. 2015; Choudri et al. 2013), Planting early maturing crops (Eludoyin et al. 2017; Vincent et al. 2015), Using of drought resistance (Aniah et al. 2019; Akinyemi 2017; Rahut&Ali et al. 2017; Jiao & Moinuddin 2016; Choudri et al. 2013), Change crop type/variety (Mekonnen et al. 2021; Hussain et al. 2020; Kuang et al. 2020; Shahzad et al. 2019; Kgosikama et al. 2018; Tesfaye & Seifu 2016;Alam et al. 2017; Choudri et al. 2013; Ullah et al. 2017; Mwinjaka et al. 2010), Changing location (Mwinjaka et al. 2010; Vincent et al. 2015), Water harvesting and conservation (Kuang et al. 2020; Lone et al. 2020; Mubira et al. 2018; Opare 2018; Jiao & Moinuddin 2016; Tesfaye & Seifu 2016; Vincent et al. 2015; Choudri et al. 2013; Tessema et al. 2013; Jha et al. 2007), Implementation of soil conservation technique (Lone et al. 2020; Aniah et al. 2019; Kgosikama et al. 2018; Tesfaye & Seifu 2016; Choudri et al. 2013; Jha et al. 2007), Planting trees (Alam et al. 2017; Rahut&Ali et al. 2017; Ullah et al. 2017; Tessema et al. 2013), Horticulture and vegetable cultivation (Lone et al. 2020; Alam et al. 2017; Jha et al. 2007), Change cropping pattern (Gentle & Maraseni 2012; Ullah et al. 2017; Hussain et al. 2020; Mayanja et al. 2020; Lone et al. 2020), Conversation agriculture practice (Tesfaye & Seifu 2016; Vincent et al. 2015; Shahzad et al. 2019), Use improved seed (Abdullahi et al. 2022; Ullah et al. 2017), Organic fertilizer (Choudri et al. 2013), Mulching (Mubira et al. 2018), Use of indigenous knowledge (Aniah et al. 2019)

III.b. Discussion of meta-regression results

The relationship between households livelihood risk and mitigation strategies adopted may be represented as Mixed Effects Multinomial Logistic Regression Model (MLM) specified below;

$$Z_i = D_{i1}\beta_1 + D_{i2}\beta_2 + D_{i3}\beta_3 + D_{i4}\beta_4 + \psi_i + \epsilon_{ij}, \text{ with } \psi_i \sim N_3(\mu_i, \Phi_i), \text{ and } \epsilon_{ij} \sim N_3(0, \Sigma).$$

The random effect term, $?_i$ is a 3-dimensional vector added to account for the heterogeneity; ? is 3 x 3 error covariance matrix and $?_i$'s are 3 - dimensional vectors.

If the number of possible categories in the outcome variable is 4 then the Multinomial Logit Model (MLM) would have 3 equations. Hence, outcome variable with MLM may be defined as

$$Z_i{}^T = \left[\log\left(\frac{P_{i2}}{P_{i1}}\right), \log\left(\frac{P_{i3}}{P_{i1}}\right), \log\left(\frac{P_{i4}}{P_{i1}}\right) \right]$$

Here, P_{ij} is the probability ith study concerned with risk/shock in jth capital. Now, P_{i1} = $P(Y_{ij}= 1 \mid X_{ij})$; P_{i2} = $P(Y_{ij}= 2 \mid X_{ij})$; P_{i3} = $P(Y_{ij}= 3 \mid X_{ij})$ and P_{i4} = $P(Y_{ij}= 4 \mid X_{ij})$. In this model, P_{i1} is considered the base category probability.

Further,

Yij = 1   if ith study concerned with Natural capital

    = 2   if ith study concerned with Physical capital

    = 3   if ith study concerned with Financial capital

    = 4   if ith study concerned with Human capital

Di1 = 1   if ith study reported Behavior based mitigation strategy.

    = 0 otherwise

Di2 = 1   if ith study reported with Assistance based mitigation strategy.

    = 0 otherwise

Di3 = 1   if ith study reported with Asset based mitigation strategy.

    = 0   otherwise

Di4 = 1   if ith study reported with adaptation strategy.

    = 0   otherwise

An R package, Mclogit is used to estimate this Mixed Effects MLM. The results for the same are presented in Table 6. The model intent to study the relationship between the individual strategies and the risk faced. Hence, the model is run without the intercept. Though the model is run without the intercept, the idiosyncratic effects, which are captured in the mean of random effects error term, would be reported as intercept term.

Table 6: Results of Mixed effects multinomial logistic regression for relationship between household livelihood risk and mitigation strategies by different dimensions of risk/shock

Mitigation Strategies	1. Physical/Natural	2. Financial/Natural	3. Human/Natural
Behavior Based	-75.388 (15089.203)	-38.868 (9859.704)	-1.643* (0.897)
Assistance Based	56.862 (11472.750)	37.623 (9859.704)	0.822 (0.920)
Asset Based	-18.464 (7416.533)	-1.305 (1.520)	-0.081 (0.785)
Adaptation	17.487 (5658.624)	-18.047 (8458.569)	-1.980* (1.053)
Constant	-37.176 (9631.491)	-16.839 (7639.072)	0.350 (1.109)
Significance:	* = p < 0.1	n=74	

Source: Table created by Author

Table 6 presents the results of mixed effects multinomial logistic regression analysis that intent to explore the association between household livelihood risk and the corresponding mitigation strategies in the studies. On the whole the model is observed to be significant in respect to risk in human capital, while the model is insignificant for physical and financial capital model. In the Human Capital Model, the households are observed to adopt all the strategies. Only Adaptation and behavior based strategies found to be significant in the context of risk/shock in human capital. It also found that the models were insignificant in respect to risk/shock in physical and financial capital. In this study the human capital risks consist indicators i.e. food insecurity/shortage and health risks. In order to manage these risks the household observed to adopt behavioral based mitigation strategies mainly reducing size and frequency of meals (Sani & Kemaw 2019; Shankeel & Shazli 2021; Shimelis & Bogale 2007; Gebre et al.2021; Knight etc al. 2015) and other behavior based strategy namely, occupational changes transfer/engage to non-farm activity to mange human capital risk (Nabarro et al. 1989; Shimelis & Bogale 2007). On the other hand the Adaptation strategies like crop- livestock diversification, observed potential coping strategy among households (Tibesigwa et al.2015) and other adaptation strategies like diversifying livelihood activities, changing agricultural practices are adopted by the households (Mayanja et al. 2020).

Discussion

On the basis of systematic review and meta-analysis, this study has made an attempt to fulfill its objectives. In this process, the study identified various components of livelihood vulnerability risks (see annex A) in the context of depletion of livelihood capital. In particular, natural capital risk, human capital risk, financial capital risk, and physical capital risk. Similarly, on the other hand, in order to manage these risks and secure their livelihood, the risk management strategies are used, which are categorised into four groups, namely, behavior-based, assistance-based, asset-based, and adaptation risk management strategies. Studies have observed the natural capital risk in 54 studies and also found natural capital vulnerability risk as the most dominant and physical capital risk as the least dominant compared to others dimensions of vulnerability. In particular, human capital risk was observed in 12 studies, physical capital risk was identified in 6 studies, and physical capital risk was observed in 2 studies. Similarly, on the whole, the study found behavioral-based mitigation strategies as the most commonly used strategies and adaptation as the least commonly used to protect livelihood. In detail, behavior-based strategies were observed in 58 studies; asset-based strategies were identified in 40 studies; assistance-based strategies were observed in 36 studies; and adaptation risk management strategies in 31.

Furthermore, out of these four categories of risk/shock management strategies, a total of 3 strategies, namely, behavior-based, assistant-based, and asset-based, consist mostly of mitigation strategies, and the remaining one, which is an adaptation strategy, consists of ex--ante strategies. Furthermore, these 3 mitigation strategies are consist myopic strategies, which further lead to extreme vulnerability in the future.

The majority of myopic strategies were observed in respond to natural capital risk. The behavior-based strategy takes first place as a strategy to mitigate natural risk, which consists of a large number of myopic strategies such as: doing nothing, Buy less or low-priced food, reduce the spending on other health expenses, adults increases their work hours or trying to find additional work, engaging in unfamiliar work including non-farm activities, withdrawing children's from school and sending them to work has been placed first to mitigate the natural risk, followed by an asset-based strategy that includes bounded rational activities such as selling household assets, selling livestock, crop, or food stock, selling jewelry, selling or renting out land. And in third place, assistance-based strategies are observed where the myopic strategies including taking loans from money lenders at high interest rates. In response to human capital risk, the behavioral-based strategy took first place, followed by asset and third-assistance. In the case of financial capital risk, the assistance-based strategy took first place, followed by behaviour and asset-based strategies

equally. In response to physical capital risk, an assistance-based mitigation strategy took first place, followed by a behavior-based one. Behavior based mitigation strategy is observed as most common strategy used by rural household compared to other strategies in the study.

The results of mixed effect multinomial logistic regression have indicated that the rural households are found statistically significant to adopt behavioral and adaptation based risk management strategies in order to deal with human capital risk. Furthermore, the myopic mitigation strategies have been found high in behavior based mitigation strategy compare to other strategies and null in adaptation based strategy. Since the study found the rural household are more sensitive to human capital risk where they are adopting various types of myopic mitigation strategy which in turn increase the vulnerability further rather than reduce it. Hence, the government intervention is highly needed to address the human capital risk and its mitigation strategies compare to the rest.

Moreover, the adaptation strategies are more expensive in nature compared to the mitigation strategies. Since rural households are also attracted to employing myopic/ irrational strategies in order to get immediate relief. And they are observed to use behavior-based mitigation strategies, which consist of more myopic strategies in this study and this could trap the rural households, particularly poor households, into the vicious cycle of vulnerability and poverty. Therefore, government intervention is needed to address the rural household's livelihood vulnerability risks and their strategies, which are myopic in nature. Since the selection of strategies is behavioral in nature, the study suggests or encourages government intervention in the form of nudge-related policies (choice architecture policies) which consist, framing, nudging, default choice, restricted choice, and mandatory choice.

IV. Conclusion

Natural and economic shocks have been causing huge global losses. Shocks tend to create disproportionate problems in rural areas in developing countries. Every shock has an impact on a household. Some shocks have a perpetual impact and others do not. The perpetuating vicious propagation of vulnerability is often due to myopic mitigation strategies adopted by poor families. The paper intends to study the possible myopic coping strategies that perpetuate the vulnerability and identify the dimension in which the shocks occur and the associated corresponding mitigation strategies. The study used systematic literature review and meta-analysis using PRISMA methodology, where 74 studies were identified from 10 databases. The study found different shocks/risks that affected the livelihood of the rural household. Furthermore, the results of mixed effect multinomial logistic regression have indicated that the rural households are found statistically significant to adopt behavioral

and adaptation risk management strategies in order to deal with human capital risk. In addition the study also identified myopic strategies in at least three categories of risk management strategies. These myopic strategies are adopted often in response to all dimensions of risks/shocks. The study has suggested that government intervention is required to prevent the perpetuation of vulnerability.

(The huge references data base used by the authors is available with them. They are not reproduced here for want of space and they can be contacted for further details . ED)

ANNEXURE

ANNEX A. Overview of the Study characteristics of the studies included

	Study Ref	Vulnerability by livelihood capitals	Vulnerability dimension	Risk/shock management strategies	Study Setting	Study Year	The method of obtaining data	Sample Size
1.	Asante et al. (2021)	Natural capital	Drought, unpredictable rainfall pattern, high temperature, strong wind, flood	Behavior based, Other	Ghana	2019	Questionnaire	121
2.	Sudmeier et al. (2012)	Natural capital	Landslides	Behavior based, assistance based, other	Nepal	2010	Questionnaire	26
3.	Shanabhoga et al. (2020)	Natural capital	high temperature	Behavior based, Assistance based, Asset based, Other	India	2018 - 19	Questionnaire	90
4.	Mwinjaka et al. (2010)	Natural capital	Drought	Behavior based, Asset based, Other	India	2008	Interview	160
5.	Opare (2018)	Natural capital	decline in water supply	Other	Ghana	2007-08	Interview	49
6.	Rahman & Gain (2020)	Natural capital	River bank erosion	Behavior based, Assistance based	Bangladesh	2017-19	Interview	434
7.	Daramola et. al. (2016)	Natural capital	flood & windstorm	Behavior based, Assistance based, Asset based	Nigeria	2009-13	Questionnaire	1116
8.	Kgosikama et al. (2018)	Natural capital	Drought	Other	Botswana	2014	Questionnaire	91
9.	Raut (2021)	Natural capital	Earthquake	Behavior based, Asset based, Assistance based	Nepal	2013-16	Questionnaire	281
10.	Bui & Do (2012)	Natural capital	increase in temperature, flood & landslides	Behavior based	Vietnam	2017	Questionnaire	290
11.	Alam et al. (2017)	Natural capital	drought, river bank erosion, flood & cyclone	Behavior based, Asset based, Other	Bangladesh	2014	Questionnaire	380
12.	Akinyemi (2017)	Natural capital	reduction in rainfall, increase in temperature and drought frequency	Behavior based, Asset based, Other	Botswana	2015	Questionnaire	137
13.	Amfo & Ali (2020)	Natural capital	pests and diseases, drought, insufficient rainfall and declining in soil fertility	Behavior based, Other	Ghana	2018	Questionnaire	400
14.	Mekonnen et al. (2021)	Natural capital	poor rainfall, severe erosion and increasing temperature	Asset based, Other	Ethiopia	2017-16	Questionnaire	185
15.	Hossain et al. (2020)	Natural capital	Flood	Behavior based, Asset based, Assistance based	Bangladesh	2017	Questionnaire	175

No.	Author (Year)	Capital	Hazard	Adaptation type	Country	Year	Method	Sample
16.	Gentle & Maraseni (2012)	Natural capital	low precipitation, low pre-monsoon and winter rainfall, temperature increase, drought, decline water sources	Behavior based, Asset based, Other	Nepal	2010	Questionnaire	485
17.	Choudri et al. (2013)	Natural capital	shortening of rainfall and increased Drought frequency	Behavior based, Other	Oman	2011	Questionnaire	40
18.	Iqbal & Roy (2015)	Natural capital	flood, cyclone and drought	Behavior based	Bangladesh	1991 & 2001	Questionnaire	177
19.	Eludoyin et al. (2017)	Natural capital	abnormal rainfall & temperature	Other	Nigeria	2013	Interview	210
20.	Mubira et al. (2018)	Natural capital	abnormal rainfall and temperature	Other	Uganda	2011	Interview	120
21.	Kolawole et al. (2016)	Natural capital	drought, heavy rainfall & flood	Behavior based, Other	Botswana	2011	Questionnaire	592
22.	Tesfaye & Seifu (2016)	Natural capital	temperature change, dry weather, declining precipitation, change in rainfall pattern	Behavior based, Other	Ethiopia	NA	Questionnaire	296
23.	Abdullahi et al. (2022)	Natural capital	Drought	Behavior based, Asset based, Other	Nigeria	2018	Interview	263
24.	Rahut & Ali et al. (2017)	Natural capital	variation in temperature, rainfall pattern and wind	Behavior based, Other	Pakistan	2015	Questionnaire	500
25.	Zheng & Byg (2014)	Natural capital	Drought, hail storm (2)	Behavior based, Assistance based, Asset based	China	2012	Interview	162
26.	Kinsey et al.(1998)	Natural capital	Drought	Asset based	Zimbabwe	1998	Questionnaire	400
27.	Bylander (2015)	Natural capital	Flood & varied rainfall	Behavior based	Cambodia	2009-10	Interview	89
28.	Bhowmik et al.(2021)	Natural capital	Flood & cyclone	Behavior based, Assistance based	Bangladesh	2019	Interview	104
29.	Pritchard et al.(2017)	Natural capital	Drought and crop failure	Behavior based, Asset based, Assistance based	Zimbabwe	2002 & 2008	Interview	141

30.	Lone et al. (2020)	Natural capital	temperature, flood and drought	Behavior based, Asset based, Other	India	2018	Questionnaire	266
31.	Vincent et al.(2015)	Natural capital	lower rainfall and high temperature	Behavior based, Other	Southern Africa	2011	Interview	200
32.	Paul & Routray (2010)	Natural capital	Flood	Behavior based, Asset based, Assistance based	Bangladesh	2005	Interview	94
33.	Oskorouchi &Poza (2021)	Natural capital	Flood	Behavior based, Asset based, Assistance based	Afghanistan	2011-12	Questionnaire	20325
34.	Aravalath & Kasim (2021)	Natural capital	Flood	Behavior based, Assistance based, Asset	India	2018	Interview	240
35.	Nepal et al.(2021)	Natural capital	Drought	Behavior based	Nepal	2017	Questionnaire	100
36.	Patnaik & Narayanan(2015)	Natural capital	Drought	Behavior based, Asset based, Assistance based	India	2008	Questionnaire	120
37.	Ferdushi et al. (2019)	Natural capital	Flood	Behavior based, Other	Bangladesh	2017	Interview	378
38.	Chen et al. (2012)	Natural capital	Earthquake	Behavior based	China	2012-13	Questionnaire	108
39.	Takasaki et al. (2004)	Natural capital	Flood	Behavior based, Asset based	Amazonia	1993	Questionnaire	95
40.	Pauline et al. (2017)	Natural capital	Rainfall variability	Behavior based, Asset based, Assistance based	Tanzania	1960-12	Questionnaire	90
41.	Aniah et al. (2019)	Natural capital	Ecological changes and Drought	Behavior based, Asset based, Other	Ghana	2015	Questionnaire	150
42.	Abbas et al. (2018)	Natural capital	Flood	Behavior based, Asset based, Assistance based	Pakistan	2013	Questionnaire	250
43.	Ullah et al. (2017)	Natural capital	Crop diseases, drought, flood, increasing temperature	Other	Pakistan	2010	Questionnaire	116
44.	Tessema et al. (2013)	Natural capital	Temperature and precipitation	Other	Ethiopia	2012	Interview	110

#	Author (year)	Capital	Shock/Stressor	Coping strategies	Country	Year	Method	Sample
45.	Shahzad et al. (2019)	Natural capital	Landslides, floods, dry period and erratic rainfall	Behavior based, Asset based, Assistance based, Other	Pakistan	2015-16	Interview	200
46.	Kubik & Maurel (2016)	Natural capital	Drought and temperature	Behavior based	Tanzania	2008-09	Questionnaire	3265
47.	Hussain et al.(2020)	Natural capital	Food and drought	Behavior based, Asset based, Assistance based, Other	Pakistan	2014	Questionnaire	273
48.	Mamoudou & Mughal (2021)	Natural capital	Drought	Behavior based, Asset based	Mauritania	2008 & 2014-15	Questionnaire	1885 & 936
49.	Janzen & Carter (2019)	Natural capital	Drought	Behavior based, Asset based	Kenya	2009 & 2011	Questionnaire	637
50.	Thang & Van (2019)	Human capital	Health shocks	Asset based	Vietnam	2010 & 2012	Questionnaire	2045
51.	Lawlor et al. (2019)	Human capital	Food shocks	Behavior based, Assistance based	Zambia	2010 & 2012	Questionnaire	4817
52.	Batung et al.(2022)	Financial capital	Financial access	Assistance based	Ghana	2019	Questionnaire	1100
53.	Abraham (2018)	Financial capital	Financial access	Assistance based, Asset based	Nigeria	2011	Questionnaire	320
54.	Mawejje (2019)	Financial capital	Financial access	Behavior based, Asset based, Assistance based	Uganda	2012	Questionnaire	4032
55.	Khandker & Koolwal (2018)	Financial capital	Financial access	Assistance based	Bangladesh	1991-11	Questionnaire	2600
56.	Hanke & Barkamnn (2017)	Natural capital	Drought	Behavior based, Asset based, Assistance based	Madagascar	2013-14	Questionnaire	150
57.	Bylander & Hamilton (2015)	Financial capital	Financial access	Behavior based, Assistance based	Cambodia	2009	Questionnaire	11974
58.	Jiao & Moinuddin (2016)	Natural capital	Drought and flood (2)	Behavior based, Asset based, Other	Laos	2011	Questionnaire	271
59.	Shillabeer (2008)	Financial capital	Financial constrains	Assistance based	Bangladesh	2005	Interview	55
60.	Sani & Kemaw (2019)	Human capital	Food insecurity	Behavior based, Asset based	Ethiopia	2017	Interview	276

61.	Shankeel & Shazli (2021)	Human capital	Food insecurity	Behavior based, Assistance based, Asset based	India	2014	Questionnaire	240
62.	Nabarro et al. (1989)	Human capital	Food insecurity	Behavior based, Asset based, Assistance based	Nepal	1979-80	Interview	200
63.	Shimelis & Bogale (2007)	Human capital	Food insecurity	Behavior based, Asset based, Assistance based	Ethiopia	2003 & 2004	Questionnaire	115
64.	Senakpon et al.(2020)	Human capital	Food insecurity	Behavior based, Assistance based	Nigeria	2010-11 & 2012-13	Questionnaire	5858
65.	Gebre et al.(2021)	Human capital	Food insecurity	Behavior based, Assistance based	Ethiopia	2013	Interview	1402
66.	Knight etc al.(2015)	Human capital	Health shock	Behavior based, Asset based, Assistance based	South Africa	2010-12	Questionnaire	1958
67.	Mayanja et al. (2020)	Human capital	Food insecurity	Behavior based, Asset based, Other	Uganda	2013	Interview	195
68.	Anderson et al.(2018)	Human capital	Food insecurity	Asset based	Malawi	2011-13	Questionnaire	7207
69.	Tibesigwa et al.(2015)	Human capital	Food insecurity	Other	South Africa	2008	Questionnaire	1128
70.	Kuang et al. (2020)	Physical capital	Assets	Behavior based, Assistance based, Other	China	2017	Interview	224
71.	Arun et al.(2013)	Physical capital	Assets	Assistance based	India	2005-07	Interview	165
72.	Jha et al. (2007)	Natural capital	Temperature and precipitation	Behavior based, Asset based, Other	India	2015	Questionnaire	735
73.	Tran (2015)	Natural capital	Drought, flood (2)	Behavior based, Asset based, Assistance based	Vietnam	2007-10	Questionnaire	2000
74.	Nguyen et al.(2020)	Natural capital	Drought & health shock	Behavior based, Asset based, Assistance based	Cambodia	2013-14	Questionnaire	567

Source: Table created by author