VULNERABILITY AND LIVELIHOOD RESILIENCE IN THE FACE OF NATURAL DISASTER: A CRITICAL CONCEPTUAL REVIEW

SARKER, M. N. I.¹ – CAO, Q.^{1,2} – WU, M.^{1*} – HOSSIN, M. A.³ – ALAM, G. M. M.⁴ – SHOUSE, R. C.¹

¹School of Public Administration, Sichuan University, Chengdu 610065, China

²School of Economics and Management, Hubei MinZu University, Enshi 445000, China

³Department of Information Management and E-commerce, University of Electronic Science and Technology of China, Chengdu, China

⁴Faculty of Agricultural Economics and Rural Development, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh

> *Corresponding author e-mail: wuminhelen@163.com

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Abstract. The concepts of vulnerability and resilience are gaining popularity in the development literature but still lack conceptual integration with the theory and practices of livelihood dynamics. However, the livelihood system of a community is a key element of the social system which may frequently be disrupted by the ecological, financial, natural and human-made vulnerability. Therefore, the purpose of this study is to clarify the concept of vulnerability and resilience in the perspective of livelihoods in a climate vulnerable context. It also addresses the methodological gaps through translation of theory from existing literature. This study argues that vulnerability and livelihood resilience are inversely related. It recommends some indicators and pillars for a better understanding of the vulnerability and livelihood resilience drawing from assorted literature through analysing the concept from various dimensions. The study will be helpful in understanding the livelihood dynamics and its assessment in the perspective of vulnerability and resilience.

Keywords: environmental management, security, climate change, adaptive capacity, environmental risk

Introduction

Vulnerability of people to possible natural hazards was impossible to measure before 1990s due to a lack of data availability, appropriate scales, and appropriate measurement approaches. Though according to Janssen (2006), the word 'vulnerability' appeared about 939 times in 2286 publications of disaster literatures in the last 30 years. Vulnerability to natural disasters is a combined effect of nature, environment, society, financial condition and community sensitivity. It is characterized by the susceptibility to be victimized or disrupted by natural disasters. Natural disasters, particularly climate change is a global concern and a daunting challenge for humanity since time immemorial. Natural disasters affect the livelihood of people of developing countries lacking in resources the most. So, natural disaster is one of the major causes of vulnerability (Dyakov, 2013; Garamvölgyi, 2013; Jamali et al., 2018; Sarker et al., 2019). The devastation of natural disasters occur in ways such as gradually changing average temperature, humidity and other environmental factors, increasing annual and seasonal climatic conditions, gradually increasing the frequency of hazardous events and the speed at which catastrophe factors are changing (Tompkins and Adger, 2004; IPCC, 2014; Omotoso et al., 2018; Nistor et al., 2018; Akhtar et al., 2019).

Vulnerability is the ability of people, organization, and societies to withstand the adverse effects of stressors (Ajibade et al., 2013; Lee, 2014; Hoa, 2019; Terin, 2019). Most of the cases, the socio-ecological vulnerability of the people is the same across the globe. People usually faces three vulnerability components viz. exposure, sensitivity and adaptive capacity (Cutter et al., 2003; Fatemi et al., 2017). Comprehensive vulnerability analysis requires a specific context for better understanding. Vulnerability analysis should be done to find out the root causes and provide a suggestion for tackling adverse effect. Resilience is a concept which has been applied to research and practice in every possible field from science to sociology, nursing (Ho et al., 2012), medicine (Garcia-Dia et al., 2013), psychology, business and public administration. It is a process of "bounce back" or "returning to form" (Weldegebriel and Amphune, 2017). Livelihood resilience is the ability of an individual, group, or community to bounce back to anticipating livelihood challenges, reducing the effect of vulnerabilities, recovering effects from past and present vulnerabilities, and thriving even in a difficult livelihood environment (Gwimbi, 2009). This study is going to assess the status of livelihood resilience of riverine island dwellers and recommend some measures for improving their livelihood resilience.

The word 'resilience' originates from Latin word *resilio* that means 'to jump back' (Manyena, 2006). Walker and Salt (2012) have claimed that 'resilience' originated from ecological research where Holling (1973) sought to differentiate between an ecological system that persists in a condition of equilibrium or stability, and response of dynamic systems when they are stressed and move from this equilibrium. A resiliency perspective is an understanding of a system's adaptive capacity. For livelihood systems, the four pillars of this perspective relate to activities and processes allowing for effectively (a) *anticipating* livelihood challenges and potential for surprises (b) *minimizing* the impact of present vulnerabilities (c) *recovering* from the impact of past as well as present vulnerabilities and (d) *thriving* from a complex livelihood situation (Gwimbi, 2009).

Livelihood resilience is a top policy concept in development context research which emerging from various disciplines (Tanner et al., 2015). It actually focuses the ability of a community to bounce back to normal condition i.e. previous conditions after suffering shocks. Resilience is a process which tackles a wide range of shocks, vulnerability, and stress like vulnerable livelihood, food insecurity, social protection, disasters and social conflicts (Zebrowski, 2013). United Nations (2013) has already declared resilience as an important agenda for working as part of an integrated and comprehensive approach to assessing and addressing factors that undermine communities' and countries' resilience, including climate risk, environmental sustainability and social inequalities or exclusion. Natural disaster particularly climate change is a global concern and worst challenges for humanity from the ancient period. The main effect of natural disasters is on the livelihood of the resource poor people of developing countries.

Some studies have already been done on resilience in the psychology literature, climate change literature, engineering literature and social sciences (Dyakov, 2013; Garamvölgyi, 2013; Jamali et al., 2018; Alam et al., 2018; Sarker et al., 2019). Most of them focus on ecological analysis and few of them explain clearly about the concept of vulnerability and resilience in the perspective of a society which resulted to fill the connection with livelihood dynamics. Therefore, this study attempts to fill the research gap by addressing this issue through an extensive review of the literature. This study also intends to add the methodological implication for understanding and measuring the livelihood vulnerability of a community with the clarification of the concept. It also provides a new lens of the suitability and superiority of resilient livelihood thinking over sustainable livelihood framework (SLF)

by exploring the weakness of SLF and adding solution for achieving livelihood resilience in a disaster vulnerability context. Though the term "resilience" is gaining popularity in the literature irrespective of the disciplines and livelihood research, the meaningful integration of the concept through proper translation from theories to action is really challenging. The concept of vulnerability and resilience is focused on the mainstream literatures such as climate change (Adger, 1999; Alam et al., 2018); disaster management (Shah et al., 2018; Adger, 2005), urban management (Sarker et al., 2019), nursing and engineering management (Fox-Lent and Linkov, 2018). But some researchers used the concepts for social-ecological system literature (Chaffin and Scown, 2018; Adger, 2005). The present study focuses the concept in the perspective of the socio-ecological system which is a better fit to livelihood system.

The rest of the paper is organized as section 2 deals with the methodology, section 3 describes the result of the study, section 4 deals with discussion focusing resilience and resilience concept emphasizing livelihood through developing a conceptual framework and final section concludes the article.

Methodology

Research design

A systematic literature review has been conducted for obtaining research objectives. An extensive desk literature review has been done for obtaining recent literature (from 2005 to 2018). Concept analysis has been done to clarify the resilience concept and validate the concept through filed data. A case study (as part of the author's PhD study) also has been done to validate the conceptual framework through assessing the vulnerability of disaster-prone community.

Search strategy

This study emphasizes the resilience concept in the multidisciplinary aspects. An extensive literature search has been done on some renowned databases like web of science, engineering village, and Scopus databases by using keywords such as "resilience, resilient, vulnerability, capacity" (*Appendix A*).

Inclusion criteria

The literature search is guided by two criteria; first, the study must focus on vulnerability and resilience; and second, livelihood is the main concern of the study. Livelihood resilience focused and peer reviewed articles have been considered for the time from 2005 to 2018 which focuses on human population. The focal points of the study are to identify the important definitive research on vulnerability and livelihood resilience, and the trend of the modification and integration of the concept and meaning of resilience to other discipline and its potential implication to the society.

Exclusion criteria

This study excludes the journal articles which have no full text, duplication and published in other languages than English. It also excludes the articles in which content does not cover the concept of resilience and disaster vulnerability context.

Review results

Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines has been followed in a systematic literature review (Moher et al., 2009). The review search has been done by following several steps; first, 575 documents are identified with 19 from references (*Fig. 1*). After removing the duplicates, 254 documents have been selected by abstract screening. Then 116 documents have been excluded due to lack of full text, irrelevant, not focusing on livelihood resilience. Finally, 29 documents have been selected from journal articles, books, book chapters, and working papers (*Appendix B*). The checklist of the Reporting of Observational Studies in Epidemiology (STROBE) is also followed for qualitative document selection (Vandenbroucke et al., 2007). This review has been conducted from December 2018 to January 2019. A conceptual model has been developed for livelihood resilience.



Figure 1. PRISMA selection for qualitative study

Discussion

The findings of this study have been presented into two following sub-sections; the first section deals with vulnerability and second section deals with livelihood resilience.

Vulnerability

The concept of vulnerability

The major characteristics of vulnerability are its dynamic nature that influences people's social and biophysical processes (IPCC, 2014). Significant attention is needed from the researchers and policymakers to develop successful adaptation strategies. Citizens of developing countries are highly vulnerable due to low income and dependency on agriculture (UNDP, 2008). These burdens should spark exploration of potential adaptive capacities for resource poor communities. People's susceptibility to the impact vulnerability of natural hazards are increasing to almost all spheres of life like social physical, human, financial, and natural dimensions. Though the effect of

natural hazards may be occasional, seasonal or year-round, the extent of exposure varies across communities.

Rural livelihood is highly dependent on climatic variability as its dependence on agriculture. Livelihood vulnerability means the susceptibility of livelihood system of stressors. Since the livelihood system of a community comprises natural, human, social, physical and financial capitals that mean it solely depends on the socio-ecological system. According to DasGupta and Shaw (2015), rural livelihood is adversely affected by the effect of climate change. Abid et al. (2016) mention that rural livelihood is dependent on a complex system of institutional, biophysical, financial and political condition of the community. Livelihood vulnerability actually focuses the exposure, sensitivity as well as adaptive capacity of an individual's livelihood or a community's livelihood in the face of natural disasters.

Dimensions of vulnerability

The major three components of livelihood vulnerability are exposure, sensitivity and adaptive capacity (*Fig.* 2). Exposure addresses the extent of a system facing varying climate conditions. It generally focuses the condition of an individual or community during facing variable climatic situations. It shows the frequency, and extent of loss in terms of livelihood capitals. Sensitivity means the degree of a system which addresses how sensitive to the variable climatic conditions. It generally focuses the reaction of an individual or community during facing changing climatic situations. It also shows the frequency, and sensitiveness in terms of livelihood capitals. Adaptive capacity is the ability of a system to withstand against the stressors and shocks. It emphasizes the ability of an individual or a society to tackle or control the situation which occurs during natural hazards.



Figure 2. The major elements of vulnerability in a socio-ecological system

Vulnerability of the people of developing countries is almost similar all over the world such as flooding, riverbank erosion, drought, storm, cyclone, crop and livestock diseases infestation. Paavola (2008) conducted a study on livelihood vulnerability of Tanzanian farmers and reported that agricultural farming-based livelihood is highly vulnerable to climatic variability. Livelihood system is varied from community to community such as livelihood of the people of rural Burkin Faso is solely dependent crop cultivation, livestock and agroforestry and they suffer from seasonal food

insecurity due to climatic variability (Addisu et al., 2016). Jacobi conducted a study on the livelihood of the fish farming community in Kenya and reported that climatic variability was the main drivers of vulnerability to the community. Beckford and Rhiney (2016) assess the vulnerability of a community living in north eastern St Vincent and concluded that the main driver of poverty was livelihood vulnerability caused by environmental variability and globalization. Climate change is one of the main drivers of livelihood vulnerability of the people of coastal areas especially natural resources dependent people. Chinwendu et al. (2017) conducted a study on household vulnerability and adaptation to climate change in Kaduna river basin in Nigeria and reported that livelihood vulnerability was varied from village to village of riverbank community due to varies of sensitivity to risk, uncertainty and limited access to natural resources and institutional capacity. Antwi et al. (2015) assessed the community vulnerability of a flood prone community in Ghana and mentioned that climate induced disasters make the people vulnerable in terms of socio-ecological, financial and political aspects.

Natural disasters are the outcome of interaction among hazard and stake, living and non-living and fixed and moving elements which causes human, economic, environmental, socio-political losses and cultural crisis in people's livelihood. Most of the rural communities have faced vulnerabilities in terms of various livelihood capitals such as social, political, financial and natural assets due to dynamic changes of environment in Zimbabwe (Nyamwanza, 2012). Wilson (2014) conducted a study on livelihood vulnerability and politics of adaptation in Alaska and reported that subsistence livelihood of the people was highly vulnerable due to climate change impact which could be minimized through developing context specific adaptation strategies. Literature across the world shows that changing climate is the main driver of livelihood vulnerability which affects almost all aspects of human life.

Livelihood resilience

The concept of livelihood resilience

Livelihood is a way of living which is comprised of the capabilities, assets, and activities. Livelihood resilience is the ability of a people or a community to sustain and retain livelihood opportunities in a stress situation which caused by the disturbances of social-ecological system, political system, and financial reasons. Resilience is a set of behaviors that stimulate social transformation and empower a group of people or social system (Earvolino-Ramirez, 2007; Gaillard, 2010; Jorgenson et al., 2010; Scholz et al., 2012). Livelihood resilience integrates livelihood system with resilience in a way where people are the main actors in the adaptation practices. The environmental factors are responsible for hampering the livelihood system of resource poor and vulnerable people to conduct their daily life (Adger, 1999). It thus requires an in-depth investigation of how climatic factors influence the livelihoods of people. Though sustainable livelihood framework is developed for the use of international agencies for poverty alleviation through improving livelihood assets, it adds a new dimension for livelihood research especially for the livelihoods which associated with the vulnerability, shocks, and stress of social and ecological systems (Vogel et al., 2007; Zebrowski, 2013). Importantly, people are the central concern of livelihood thinking where ecological factors, social and political factors, market, technology and resources are the associated factors related to livelihood (Panthi et al., 2016).

Livelihood resilience however, stimulates the capacities of an individual, community or administrative system to respond to the challenges, risks, stressors and disturbances. It also enables people to perceive the risks and uncertainties of social-ecological systems and to take anticipatory actions to tackle the adverse situation. An ideal resilience system requires natural resources, information and access to physical, economic and logistic assets for developing the system against the disturbances of the environment. Livelihood resilience also integrates social networks with human rights for resilience thinking. Both human rights and social network are essential elements of social system to develop the capacity of the system against any adverse situation.

Livelihood resilience thinking from sustainable livelihood framework

The present study borrows the concept of ecological resilience for livelihood inquiry for better explanation of livelihood resilience in the disaster vulnerability context. The other concept of resilience is indirectly related to livelihood system because of its relation to the changing climate, stress and shocks as well as physical infrastructure, social and economic system and institutional responses. Since ecological system is completely different from livelihood system, this study considers all related dimensions of social and ecological systems for better integration of livelihood inquiry to resilience. A sustainable livelihood approach is followed to assess the livelihood pattern which consists of the analysis in the context of people's livelihood. This approach confirms Sen's (1981) classic focus entitlement, Long's (1984) action oriented approach, and Chambers and Conway's (1992) seminal paper on sustainable livelihood. Sustainable livelihood approach is a well-accepted approach which has emerged in 1990s for assessing the livelihood system and strategies in the face of natural disasters and vulnerability of rural people. According to sustainable livelihood approach (following Chambers and Conway, 1992; Scoones, 1998), livelihood is a set of physical and social assets, and actions for living as well as it can be sustainable in such a condition when it is able to cope with and retain from risk, uncertainty and stress through enhancing capabilities and without hampering the natural resources.

The sustainable livelihood approach considers demographic, socio-economic, political and ecological context of people's life and access to social, economic, physical, natural and human capitals as well as institutional aspects for ensuring people's access and control over assets. Various scholars developed some analytical framework by using the diagrammatic checklist developed by Scoones (1998) such as vulnerability framework by Moser (1998), capitals and capability framework of Bebbington (1999) and micro-policy analytical framework by Ellis (2000). Using the principles of sustainable livelihood framework, some renowned organization already developed their operational SLF such as Cooperative for Assistance and Relief Everywhere (CARE), Department for International Development (DFID), Oxfam and the United Nations Development Program (UNDP). Since various organization developed their livelihood analysis framework in the light of SLF, this study only considers SLF for guiding own research direction.

There is an increasing trend of using the sustainable livelihood framework in assessing vulnerability, risk, uncertainty and livelihood literatures (for example, Can et al., 2013; Amos, et al., 2015; Addisu et al., 2016; Alam, 2016; Bhuiyan et al., 2017) all over the world. Sustainable livelihood framework (SLF) is a basis of rural vulnerability studies irrespective of the country (for example Li et al., 2018; Pandey et al., 2017). Theoretically, the sustainable livelihood framework (SLF) is developed to deal with

condition where the poor perform as 'strategic managers' in transferring the livelihoods outcomes, through a set of livelihood activities in accordance with the entitlements and access to resources, as decided by the conditions of institutional contexts (Moser, 1998). The sustainable frameworks point to assets as central concern which is mainly affected by the environmental stressors. Livelihood strategies and institutional process are the driver for transforming the vulnerable context to sustainable livelihood. Livelihood strategies are the strategies taken by the people for maintaining their livelihood and institutional process is responsible for translating the assets and strategies into action for making desirable and sustainable changes in people's livelihood. The major livelihood strategies of rural people are agricultural practices, diversification of livelihood, and migration (Ellis, 2008).

The SLF approach may be explained in three ways; first, framework for short-term livelihood trajectories; second, a way of development activities; and third, outline of overall development. In the livelihood related literature, the SLF was possibly envisioned as the earlier; as "a diagram to organize ideas into manageable categories, to identify entry points and critical processes, and assist with prioritizing catalysts for change that can improve people's livelihoods" (Ellis, 2000).

Strength of sustainable livelihood framework

Vulnerability assessment requires understanding of the SLF in terms of its strengths and weakness for building a concrete method of assessment (Pandey et al., 2017). Due to its strength, it is well accepted all over the world for livelihood assessment. The main strengths of SLF are focusing people-centeredness, people's capabilities and holisticness. First, SLF is people-centered approach which focuses people's realities, strengths and compromises to others. It emphasizes local complexities and realities for analyzing the issues in a better way. Second, SLF analyzes people's capabilities and strengths which is necessary for overcoming risk, uncertainty and livelihood insecurity (Ekblom, 2012). Third, SLF is a holistic in nature in terms of its recognition to multiple strategies, actors and outcomes where people's livelihood is connected. So, it is applicable to assess the dynamics of livelihood vulnerability of char dwellers in Bangladesh. Sustainable livelihood framework has broad aspects of inquiry covering vulnerability, shocks, risks, assets, institutional response, strategies of livelihood and outcomes which may be a toolkit for livelihood analysis. According to Clark and Carney (2008), SLF is a key analytical tool to assess and understand various aspects of the livelihood of people.

Weakness of sustainable livelihood framework

Though SLF is well accepted by various scholar but it is still criticized due to ignoring or avoiding some important issues. The main limitation of SLF is its inability to address the social, political, and institutional aspects (Scoones, 2009). It actually avoids focusing the role of structures, acting process, and institutions rather emphasizing assets and activities of household though the assets are not neutral due to its inclusion and exclusion nature (Antwi et al., 2015). SLF generally assess the livelihood status at household level which is a key to local context but less concentration to connect with national and global level. Livelihood vulnerability analysis requires an emphasize on a connection with institutional levels for better integration with the institutional capital irrespective of micro or macro level

perspectives. An importance on institutional process and political economy focusing structural forces is necessary to assess the dynamic of rural livelihoods and resilience (Scoones, 2009) but present form of SLF cannot meet this issue. Besides the term "sustainable," a core term of SLF, has not been properly focused in terms of variable local context (Bhattacharjee and Behera, 2018).

SLF cannot provide the answers to some quires such as 'sustainable to what and for whom' whose reality to be addressed? (Chambers and Conway, 1992) which are very much important in dynamic vulnerability context. According to Longley and Maxwell (2013), SLF is very much developed and applicable only for reducing poverty in relatively stable context. One of the major weak points of SLF is how to address sustainability in the dynamic vulnerability context where livelihood assets are recurrently hampered with environmental factors. SLF is basically outcome-based approach which cannot address the related process and capacities. It focuses only on short-term dynamics rather than long term which reduce the ability to address the dynamic vulnerability context of livelihood.

From sustainable livelihoods to resilient livelihoods thinking

This study attempts to develop a framework for addressing the weakness of SLF and assess the dynamic context of vulnerability and livelihood through including elements of adaptive, absorptive and transformative capacity. Resilience thinking is the advanced option of livelihood vulnerability assessment following SLF but addressing all weakness of SFL. This study adopted SLF for operationalization of the perspective of resiliency using the useful idea from SLF for better understanding the dynamic vulnerable context. The transformation from sustainable livelihood to resilient livelihood is summarized and presented in *Table 1*.

Sustainable livelihoods thinking	Resilient livelihoods thinking		
Sustainability	Resiliency by adaptive, absorptive and transformative capacity		
Assets	Institutions and assets		
Linking household and geographical/spatial scales	Linking institution, community, household and temporal scales		
Coping and short-term dynamics	Both coping and adapting – however focusing more on long-term adaptation dynamics		
Outcome-oriented	Process-oriented		

Table 1. Summarizing main aspects on shifts from sustainable to resilient livelihoods thinking (Source: adapted after Nyamwanza, 2012)

It is well established that the core ideas of sustainable livelihood framework form the central position of the analysis of dynamic vulnerability context. In this study, resilient livelihood thinking is focused on using the useful ideas from sustainable livelihoods for better understanding the dynamics of changing vulnerability context. The resiliency perspective as advanced in this work builds on the strengths of this thinking, blending it with new ideas in taking livelihoods. Ideas from Scoones's (1998) 'diagrammatic checklist' and Ellis's (2000) livelihoods framework were used in the adapted framework to guide analysis. This is because while showing general interrelationships and

connections, these scholars' presentations provide room for re-arranging ideas and infusing new ones as they seem less rigidly formulated to show particular linear or contextual patterns. *Table 1* summarizes the major aspects vis-à-vis shifts from sustainable livelihoods to resilient livelihood thinking as raised in various discussions in this work so far.

The conceptual framework (*Fig. 3*) has been developed by following 'diagrammatic checklist' of Scoones (1998), livelihood framework of Ellis (2000) and livelihood framework for resilience of Nyamwanza (2012). This selection is due to the flexibility of their framework to include element, re-arranging ideas and developing new one for context specific livelihood analysis. The conceptual framework focuses vulnerability context (flood, drought, riverbank erosion, cyclones, shocks, and risks), livelihood assets (human, natural, social, physical and financial assets), institutions (household, community, sub-national, and national level), adaptive strategies (livelihood strategies), various capacities (adaptive, absorptive, and transformative capacity) and outcome related livelihood.



Figure 3. Adapted livelihood framework for resilience (Source: adapted after Scoones, 1998; Ellis, 2000; Nyamwanza, 2012)

The framework will be applicable to analyze the vulnerability of any community especially who are facing the adverse of climate change. It will help to interpret the factors responsible for livelihood vulnerability, and the positive effect of policy measures and livelihood assets to overcome the vulnerable condition. It also provides the direction of how government institution can solve and improve the vulnerability context and which level is most suitable for government intervention. This framework might be useful for its adaptation strategies for improving livelihood condition in a vulnerability context. It also focuses how resilience capacities developed and work in a vulnerable livelihood context for obtaining a self-motivation, strong social network and ability to live with uncertainty.

Conclusion

The concept of livelihood resilience is relatively new in natural disaster vulnerability context. This study attempts to clarify the livelihood resilience concept from the perspective of climate change vulnerability and natural disasters. It analyzes the resilience concept by focusing on various dimensions of vulnerability and resilience. It also integrates the livelihood system to the resilience concept successfully through analyzing more related existing literature of the renowned databases. This study reveals that vulnerability is a function of exposure, sensitivity and adaptive capacity of a system in which exposure and sensitivity are positively related to vulnerability while adaptive capacity is negatively related. Similarly, livelihood resilience is a function of the adaptive, absorptive and transformative capacity of livelihood system which enables people to sustain and retain livelihood opportunities in stress events caused by natural disasters. Livelihood capitals (e.g. social, natural, human, physical and financial capital) help to enhance the capacity of the people in the face of climate change vulnerability. This study also interprets the development of resilient livelihood thinking from traditional sustainable livelihood framework which is suffering from various weaknesses. This study argues that livelihood resilience is more advanced and suitable approach to address disaster related vulnerability issues. This study further argues that resilience livelihood framework and related indicators will help to assess the vulnerability of a socio-ecological system and to take proper measure to improve livelihood resilience of any vulnerable people, group or community. The study suggests conducting in-depth empirical study on livelihood resilience assessment in the natural disaster prone vulnerability context using specific indicators developed in this study for future research.

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APPENDIX

Appendix A

The following search strategies have been followed

Web of science:	TS = (resilien* AND vul)
Engineering village:	resilience AND vulnerability > climate change > disaster
Scopus:	(TITLE-ABS-KEY (resilience AND vulnerability)) AND (livelihood AND resilience) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "ip") OR LIMIT-TO (DOCTYPE , "bk")) AND (LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (LANGUAGE , "English"))

Appendix B

The following articles have been selected for the systematic literature review due to more relevancy

Sl no.	Researcher	Title	Method	Sources/journal
1	Adger (1999)	Social Vulnerability to Climate Change and Extremes in Coastal Vietnam	Quantitative	World Development
2	Kleine et al. (2003)	Resilience to natural hazards: How useful is this concept?	Critical review	Environmental Hazards
3	Adger (2005)	Social-Ecological Resilience to Coastal Disasters	Quantitative	Science
4	Adger (2006)	Vulnerability	Quantitative	Global Environmental Change
5	Thomalla et al. (2006)	Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation	Quantitative	Disasters
6	Earvolino-Ramirez (2007)	Resilience: A Concept Analysis	Critical review	Nursing Forum
7	Vogel et al. (2007)	Linking vulnerability, adaptation, and resilience science to practice: Pathways, players, and partnerships	Quantitative	Global Environmental Change
8	Paavola (2008)	Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania	Quantitative	Environmental Science Policy
9	Gwimbi (2009)	Linking rural community livelihoods to resilience building in flood risk reduction in Zimbabwe	Quantitative	Jamba: Journal of Disaster Risk Studies
10	Alinovi et al. (2010)	Measuring Household Resilience to Food Insecurity: Application to Palestinian Households	Quantitative	Agricultural Survey Methods
11	Gaillard (2010)	Vulnerability, capacity and resilience: Perspectives for climate and development policy	Quantitative	Journal of International Development
12	Jorgenson et al. (2010)	Resilience and vulnerability of permafrost to climate change	Quantitative	Canadian Journal of Forest Research
13	Scholz et al. (2012)	Risk, vulnerability, robustness, and resilience from a decision-theoretic perspective	Quantitative	Journal of Risk Research
14	Can et al. (2013)	Application of Livelihood Vulnerability Index to Assess Risks from Flood Vulnerability and Climate Variability— A Case Study in the Mekong Delta of Vietnam	Quantitative	Journal of Environmental Science and Engineering

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15	Ekblom (2012)	Livelihood Security, Vulnerability and Resilience: A Historical Analysis of Chibuene, Southern Mozambique	Critical review	Ambio
16	Zebrowski (2013)	The nature of resilience	Critical review	Resilience
17	Ajibade et al. (2013)	Urban flooding in Lagos, Nigeria: Patterns of vulnerability and resilience among women	Quantitative	Global Environmental Change
18	Fatemi et al. (2017)	Social vulnerability indicators in disasters: Findings from a systematic review	Qualitative	International Journal of Disaster Risk Reduction
19	Abid et al. (2016)	Climate change vulnerability, adaptation and risk perceptions at farm level in Punjab, Pakistan	Quantitative	Science of The Total Environment
20	Tanner et al. (2015)	Livelihood resilience in the face of climate change	Critical review	Nature Climate Change
21	Lee (2014)	Social vulnerability indicators as a sustainable planning tool	Quantitative	Environmental Impact Assessment Review
22	Pandey et al. (2017)	Sustainable livelihood framework-based indicators for assessing climate change vulnerability and adaptation for Himalayan communities	Quantitative	Ecological Indicators
23	Panthi et al. (2016)	Livelihood vulnerability approach to assessing climate change impacts on mixed agro-livestock smallholders around the Gandaki River Basin in Nepal	Quantitative	Regional Environmental Change
24	Shaw et al. (2016)	Building Community Resiliency	Quantitative	Urban Disasters and Resilience in Asia
25	Weldegebriel and Amphune (2017)	Livelihood resilience in the face of recurring floods: an empirical evidence from Northwest Ethiopia	Quantitative	Geoenvironmental Disasters,
26	Bhuiyan et al. (2017)	Exploring impacts and livelihood vulnerability of riverbank erosion hazard among rural household along the river Padma of Bangladesh	Quantitative	Environmental Systems Research
27	Alam et al. (2018)	How do climate change and associated hazards impact on the resilience of riparian rural communities in Bangladesh? Policy implications for livelihood development	Quantitative	Environmental Science and Policy
28	Chaffin and Scown (2018)	Social-ecological resilience and geomorphic systems	Quantitative	Geomorphology
29	Bhattacharjee and Behera (2018)	Determinants of household vulnerability and adaptation to floods: Empirical evidence from the Indian State of West Bengal	Quantitative	International Journal of Disaster Risk Reduction