SEAS (Sustainable Environment Agricultural Science) E-ISSN 2614 – 0934
https://ejournal.warmadewa.ac.id/index.php/seas
Vol. 2, Number 1, April 2018, pages: 01 - 09 http://dx.doi.org/10.22225/seas.2.1.672.1-9

Received: March 20th, 2018 Revised: April 09th, 2018 Accepted: April 23rd, 2018

Remodeling Livelihood Vulnerability Indicators for The Informal Food Microentrepreneurs

Hanilyn A. Hidalgo[1], Michael Cuesta[2]
1 Central Bicol State University of Agriculture, Philippines.
2 Ateneo de Naga University, Philippines

Abstract

The informal sector consists of business enterprises that operate outside legal business frameworks. With the huge contribution of the informal sector in economic development, local authorities regard the sector as partners in local development initiatives. Among the industries in the informal sector, the role of the informal food sector in the food value chain is vital in addressing food security issues in the urban community. However, the absence of social protection in the informal sector makes their livelihood more vulnerable to economic losses. The Livelihood Vulnerability Index (LVI) approach is a practical tool for assessing how vulnerable the sector is and which livelihood component contributes to its vulnerability. Inopportunely, studies on LVI are only centered to farming communities. This paper explores the development of livelihood vulnerability indicators that can be utilized to off-farm enterprises predominantly to the informal food microenterprises. The indicators were sourced from LVI and entrepreneurship studies using the major vulnerability factors such as adaptive capacity, sensitivity, and exposure. The developed livelihood vulnerability indicators quantify the seven livelihood components of the informal food microenterprises such as the demographic profile, social network, livelihood strategies, health security, food security, access to utilities and disaster experience.

Keywords*: remodeling, livelihood vulnerability index, microentrepreneurs.*

Author Correspondence:
Hanilyn A. Hidalgo
[1] Central Bicol State University of Agriculture, Philippines
E-mail: hanilyn77@gmail.com

1. Introduction

The informal economy consists of economic activities that occur outside of formal institutional boundaries but which remain within informal institutional boundaries for large segments of society [1]. The International Conference of Labor Statisticians characterizes the informal sector as units engaged with at least some market products under the operation of low levels of organizational technology, containing no books of accounts to allow separation of production operations from household activities and a distinction between labor and capital and with employment size below a certain level threshold.

However, informal sector workers are not protected by labor laws, policies, or programs of the state [2]. This sector is often characterized by low income per capita and high poverty incidence [3]. The low-earning capacity of this sector may be attributed to a poor educational background and low-skilled workforce [4].

The Food and Agriculture Organization described the informal food sector as those enterprises relating to food production in the urban and peri-urban areas; services such as catering and transport; and the retail sale of fresh or processed products. The informal food sector is regarded as a business sector with low capital investment but highly diversified. The informal food sector covers the activities in the entire food value chain, thus, it becomes a source of income and food security [5].

Climate extremes impinge on people's stream of livelihood. In the event of drought, flood, and typhoon, agriculture and food production industries are severely affected. Since informal food sector directly gets their agricultural supplies and raw materials from the local markets, they become more susceptible to such events [6]. Their occurrences become an obstacle to continuing people's livelihood. Further, the absence of social protection in the informal sector makes their livelihood more vulnerable to economic losses. Thus, this necessitates for the development of livelihood vulnerability indicators to assess means of reducing their vulnerabilities and eventually develop resilient informal food microentrepreneurs in the context of climate extremes. While most studies on livelihood vulnerability are focussed to farming communities, this paper explores on the nature of informality in the business sector and shows how the vulnerability factors can be integrated into the livelihood components of the food microentrepreneurs.

2. Material and Methods

This research is conducted by exploring the literature on livelihood vulnerability by modifying the use of existing Livelihoods Liability Index (LVI) to serve entrepreneurs outside agriculture. From this study, there are measurable indicators of vulnerability and indicators that can identify weak and strong points of informal microenterprises.

Indicators sourced from LVI and entrepreneurial research use key vulnerability factors such as adaptive capacity, sensitivity, and exposure. The livelihood vulnerability indicators developed to quantify the seven livelihood components of informal micro-food enterprises such as demographic profiles, social networks, livelihood strategies, health security, food security, access to utilities and disaster experience.

3. Results and Discussion

3.1 Forces driving informal sector

Statement of Vo and Ly (2014) that during the last two decades from 1995 to 2014, the size of the shadow economy in ASEAN countries has increased. The existing policies at the tax, labor and business rates have had a significant effect on shadow economic growth. The proliferation of the informal sector led to explorations of its continuous existence. According to [8], the opportunity and circumstances that created an informal business are in itself within the context of entrepreneurship. However, in most cases, the informal business sector is mistakenly perceived as a marginal sector with no entrepreneurial angle.

Generally, informal entrepreneurs are necessity-driven rather than opportunity-driven. [9] asserted that not all who engaged in off-the-books transactions are driven by necessity though necessity is a primary motive of an informal business sector. [10] further claimed that in economically depressed communities, informal entrepreneurship is motivated out of necessity. However, in prosperous areas, the informal sector is motivated by opportunity. [11] support his claims that informal sector is prevalent in developing countries where formal employment is insufficient. Because of their status, they find it difficult to purchase service delivery and rent spaces/premises.

In similar studies, [12] argued that entrepreneurship exists out of necessity or choice. Specifically for some women, the driving forces include: earning an income, satisfying an interest in doing business, enforcing flexibility and autonomy, and performing family obligations. Hence, the contention that infor-

mal micro-entrepreneurship is borne out of poverty is fallacious.

Informal business sector exists in all types of economies but [10] revealed that early stage entrepreneurs and the established self-employed are more likely to trade in the informal system and are more likely prevalent in economically depressed than the prosperous rural communities. While their numbers are difficult to measure, the informal entrepreneurs are to some extent greater than the formal businesses in the depressed communities. However, even in rich countries, the informal business sector is likely to exist. In a study of 600 entrepreneurs in Ukraine, about 90 percent operates in an informal business sector and 40 percent claimed that their main and secondary livelihood depends on the informal business sector [9].

Further [13] explore that in developing countries, traditional family-based micro enterprises are generally the source of livelihoods in urban and rural communities. However, they rarely transform into small and medium enterprises because of the inability to improve the business capacity and product quality. The formal education of the entrepreneurs may effect on the performance of the enterprise as value addition is generated along the business process. A more in-depth study was conducted by [1] wherein barriers, motivations and capabilities of the informal entrepreneurs were made through the lens of three separate theories: institutional theory, motivation-related theories from a sociological perspective, and resource allocation theory.

3.2 Urban Informal Food Sector Issues

Claim [14] that the livelihood of street vendors is characterized by high levels of insecurity. According to his study, the informality has brought them to work in long hours with an uncertain market and susceptible to controls. Conscious of their status in the business community, they still chose to stay as informal since their activities are somewhat similar to legal trading. Besides, very little competency is needed with a favorable accessibility to market. While it is the responsibility of the government to protect all sectors, very little attention is given to street selling whose participants are disorganized, hence, less influential. This, then, paved the way to find a room to execute their opportunistic or entrepreneurial activities between the enforcement of regulations and implementation of policies.

The study of [15] noted that the presence of street vendors has become a widespread scenario in communal places. Public space in the urban areas has become an important resource for the informal business sector due to its conduciveness to the market. In fact, in India, the government recognize the role of the street-food vendor in providing food security as mentioned by [16]. The study further claimed that the state can capitalize on the potential of the informal food sector in the delivery and consumption of healthy food by capacitating the informal micro-entrepreneurs in recuperating urban food security.

Aside from income level, a source of livelihood and household size, one factor that affects food security is the residential condition of the household. According to [17] there is a high level of household food insecurity for people residing in slum areas. In order to effectively address food insecurity, government policy must focus on the vulnerabilities of the households of the urban poor.

3.3 Economic Contribution

[18] proved that in Africa, the informal business sector has expanded that it has accounted a significant share in the economy from its total output and employment as a result of increasing globalization.

The challenge for policymakers is to address the obstacles of the informal sector notwithstanding the economic benefits derived from the sector such as generation of jobs. In Thailand, the growing trend of the informal business sector is an indication that the government has not been focussing on this sector as mentioned by [19]. He further claimed that policies that deal with labor welfare protection and productivity are important entry points to manage the sector in the future.

[14] stated that informal economic activities exist due to poor implementation of state policies and regulations. They are not accounted for in the Gross Domestic Product but they are, nevertheless, recognized by the government as the hidden contributor in economic development. This was supported by [20] that in developing countries, the presence of informal sector is normal. The role of micro and small enterprises where informality is common has been recognized to foster growth. In fact, [21] revealed that informal entrepreneurs comprise a large portion of the economy than the formal entrepreneurs. But in actual practice, entrepreneurship does not adhere to the rules all the time. Many informal economic activities were seen as more enterprising and entrepreneurial than the formal ones. In Ukraine, the informal sector serves as the breeding ground for enterprise development. Hence, the hidden enterprise culture in this sector should be given recognition in public policy and be treated separately with the formal enterprise [9].

[21] affirmed that the prevalence of informal sector has brought some policy implications to facilitate formalization of the hidden enterprise sector. Hence, their study suggested policy measures such as simplification of regulatory compliance, the introduction of incentives and amnesties and campaigns for tax morality in response to the growing population of informal entrepreneurship.

Formal education, particularly at the tertiary level, increases the chance of getting into formal entrepreneurship than those without college degrees. The decision to formalize the business is attributable to higher self-confidence, lower business risks and enhanced competencies of the entrepreneur. Tertiary education poses disapproving implications to the informal sector as it reveals the consequences of the activities [22].

The study of [23] expressed four means to address the barriers of the informal entrepreneurship: nurturing a performance-based culture; creating favorable conditions for economic advancement; increasing quality of governance; and enhancing people's resources and abilities. However, [21] stressed that for developing countries, social capital must be strengthened at the outset before any type of reforms or policies is implemented. Accordingly, wiping out the informal business sector may only destroy the enterprise culture while de-regulating them would mean bringing down the level of an enterprise. Hence, the most appropriate option is to smooth the progress of formalization process.

Economic liberalization is favorable to both the formal and informal business sectors while governance level discourages the informal sector and may hinder the growth of entrepreneurial activity in the area [24]. In order to encourage formality, business regulatory policies must be engaging and do not favor any sector [25]. Though, a certain policy approach may not necessarily be applicable to all types of informal entrepreneurship [26].

3.4 Sustainable Livelihood

[27] contend that vulnerability restraints the pursuit towards long-term sustainability. The Sustainable Livelihood Approach (SLA), which was developed by [28] has integrated the factors affecting vulnerability to climate change but to a limited extent. The SLA assesses five kinds of capitals: natural,

social, financial, physical and human to determine the household capacity to absorb and withstand shocks and stresses.

The SLA concept was supported by [29] asserting that the SLA was able to cover other aspects of poverty in an economically, ecologically, and socially sustainable manner. This was further strengthened by [30] when the SLA was used as a substitute measure of poverty. [31] also used the SLA by combining the fuzzy cognitive mapping approach to capture household perception climate change impacts.

Livelihood resiliency studies came along with the SLA concept. [32] adopted the concept of resilience in the context of a structural framework which resulted in three dimensions of resilience: buffer capacity, self-organization, and capacity for learning. Meanwhile, [33] developed the livelihood security model using five components: food, income, life and health, house and property, and water security. The five components have similarities to the Livelihood Vulnerability Index developed by [34] but lacks climate change variability component. A recent study by [35] attempted to formulate a livelihood vulnerability analytical framework incorporating climate change vulnerability factors such as sensitivity and adaptation capacity. The study revealed that the most vulnerable communities are those who are poor and within the vulnerability loops.

3.5 Livelihood Vulnerability

Looking through the lens of a sustainable livelihood approach, a Livelihood Vulnerability Index (LVI) was developed by [34] to determine a detailed analysis of forces affecting household livelihood vulnerability in a particular community. The LVI is a combination of Sustainable Livelihood Analysis (Chambers) and IPCC's three major contributing factors to vulnerability – exposure, sensitivity and adaptive capacity. The LVI with seven major indicators aggregated into IPCC's vulnerability factors was piloted in Mozambique. The utility of LVI has been tested and applied in different socio-ecological settings such as the case of two wetland communities in Trinidad and Tobago. Results of the application provided new variables in minimizing vulnerability to environmental change [36].

In another LVI application in Mekong Delta of Vietnam, the livelihood vulnerability was analyzed in the context of gender. Other confounding variables were seen as an important point in data interpretation [37]**.** [38] further proved the applicability of LVI at agro-ecological system scale at the communities of Choke Mountain in Blue Nile Highlands of Ethiopia. In the agricultural context, LVI was tested in Nepal which is considered as the world's fourth most vulnerable country to climate change. The findings provided site-specific development entry points to minimize the vulnerability of small farmers to climate change. In the Philippines, LVI has not been used in assessing the household livelihood vulnerability, particularly in the sub-community and community levels. A coastal community vulnerability index used by [39] was tested in Baler, Aurora. However, some variables were not accounted for which could further substantiate the vulnerability factors of the households. Climate change vulnerability was also assessed in disaster-prone provinces like Infanta, Quezon but [40] used only three factors of vulnerability – sources of livelihood, loss, and damage, and knowledge and perceptions of people.

In order to fully understand the socioeconomic conditions that contribute to the vulnerability of the poor communities, a detailed vulnerability and adaptive studies at the local level must be conducted as suggested by [41]. While studies in the Philippines which are related to climate change focused on vulnerability and adaptive measures, no study has concentrated on livelihood vulnerability that would quantify the strength of livelihood systems that would include socio-economic conditions and adaptive capac-

ities. More so, no livelihood vulnerability study has been conducted for the informal food sector that seeks to address in building their resiliency amidst natural disaster exposure.

3.6 Proposed LVI Indicators for Informal Food Microentrepreneurs

The LVI developed for the informal food microentrepreneurs was anchored from the study of [34] where the major livelihood components were drawn. The study modified the indicators used by Hahn in each livelihood component that would suit the nature of the food microentrepreneurs. The components used were socio-demographic profile, livelihood strategies, social networks, health security, food security, access to water, access to utilities and disaster experience.

Livelihood Vulnerability Indicators for Informal Food Microentrepreneurs

Vulnerability factor	Component	Indicators	Assumed functional relationship
Adaptive Capacity	Socio-demographic profile	Percentage of dependent people (<15 years and >60 years; and with the disability) Percent of female-headed food businesses Percentage of owners earning below the subsistence level Percent of owners who have not attended college	Higher percentage reflects less capacity to adapt Women have a less adaptive capacity The poor have lower means to adapt Education contributes to increased awareness and adaptive capacity
	Livelihood strategies	Average commodity diversification index Average livelihood diversification index Average skills diversification index Percent of owners with 3 or more years in the same business Percent of owners with sufficient and more than sufficient savings Percentage of owners with multiple suppliers of inputs	Diverse products reduce risks Diverse sources of income increase adaptive capacity More skills increase adaptive factor Years of experience reduces risks Financial literacy reflect a more adaptive capacity Variability of suppliers reduces risk
	Social networks	Percentage of owners with access to credit Percentage of owners who are confident they can borrow after typhoon Percent of owners who availed of any livelihood assistance (past 12 months) Percent of owners who are members of an industry-related organization The average percentage of sales comes from a regular market or 'suki'	Financial access reinforces the adaptive capacity Access to livelihood assistance strengthens adaptive capacity Information sharing and group support increases adaptive capacity External relationships support capacity to adapt
Sensitivity	Health security	Percent of owners with chronic illness Percent of food businesses where the owner had to stop food business operation due to illness Percentage of business owners without health insurance	Illness increases sensitivity Illness impacting the livelihood implying more sensitivity The absence of insurance implies higher sensitivity to disaster
	Food security	Percentage of owners who are food insecure	Food insecurity reflects higher sensitivity
	Access to utilities	Percent of business owners without access to pipeline water supply Percentage of owners without own electricity Percentage of owners without modern fuels or stove Percentage of owners without mobile phones (active numbers)	Utilities contribute to a person's welfare. Water is vital to a person's wellbeing while power and phones are essential means of communication. The higher percentage means more sensitive.

Exposure	Disaster experience	Average number of days of electricity disruption during typhoon	More reflects higher sensitivity.
		Percent of owners that did not receive early warning	Access to info leads to less exposure.
		The average cost of casualty (sickness/ injury) due to typhoon Nina	
		Average number of days of irregular supply inputs due to typhoon Nina	Poor health status means more exposure.
		The average percentage of loss on productive assets	Higher losses mean more exposure
		The average percentage of loss on household assets	
		The average percentage of loss on income	

At the onset of climate extremes, the literature suggests that sustainable livelihood models be adopted to build the resiliency of vulnerable communities and sectors. [28] SLA framework has been used several times in livelihood studies adopting the five asset pentagon which include natural, physical, financial, social and environmental livelihood capitals [29], [30], [31], [32], [33]. The integration of climate change impacts in the SLA framework has led to the development of livelihood vulnerability index. Hahn's LVI has been used, modified and tested in various types of farming communities such as those in Mozambique, Trinidad and Tobago, Vietnam, Ethiopia and Nepal ([37], [38], [39], [42]). The indicators above is a modified version of LVI (Hahn et al) integrating the off-farm enterprise concepts and conditions. It used the resiliency concepts of enterprises that are assumed to affect the vulnerability of their businesses amidst climate change and natural disasters.

4. Conclusion

In the event of extreme weather events, the informal food sector is not spared from business risks. The utilization of the remodeled LVI for informal food sector measures the vulnerabilities of the microenterprises. In assessing livelihood LVI components shall be limited to socio-demographic profile, livelihood strategies, social networks, health, food, utilities, natural disasters and climate variability.

References

[1] Webb, J. W., Bruton, G. D., Tihanyi, L., & Ireland, R. D. (2013). Research on entrepreneurship in the informal economy: Framing a research agenda. *Journal of Business Venturing*, *28*(5), 598–614. https://doi.org/10.1016/j.jbusvent.2012.05.003

[2] Batangan, D. & Batangan, M. T. (2007) Social security needs assessment survey for the informal economy in the Philippines. Final Report on the ILO-SRO Manila Survey Results.

[3] ILO (2012). Statistical update on employment in the informal economy. www.laborst.ilo.org/informal_economy_E.html

[4] Rutkowski et al (2016). Republic of the Philippines Labor Market Review: Employment and Poverty. World Bank Document.

[5] FAO (2007). Promises and challenges of the informal food sector in developing countries.

[6] Jamil, S. (2013) Connecting the Dots: The Urban Informal Sector and Climate Vulnerabilities in Southeast Asian Megacities. NTS Alert no. AL13-01.Available at http://www.rsis.edu.sg/nts/html-newsletter/alert/nts-alert-1301.html.

[7] Vo, D.H. & Ly, T.H. (2014) Measuring the Shadow Economy in the ASEAN Nations: The IMIC Approach. *International Journal of Economics and Finance*; 6(10)Published by Canadian Center of Science and Education

[8] Anderson, A., El-Harbi, S., & Brahem, M. (2013).Enacting entrepreneurship in "informal" businesses.*International Journal of Entrepreneurship and Innovation*, *14*(3), 137–149. https://doi.org/10.5367/ijei.2013.0118

[9] Williams, C., & Round, J. (2007). Entrepreneurship and the Informal Economy :a Study of Ukraine â€™ S Hidden Enterprise Culture. *Journal of Developmental Entrepreneurship*, *12*(1), 119–136. https://doi.org/10.1142/S1084946709001144

[10] Williams, C.C. (2011). Entrepreneurship, the informal economy, and rural communities.*Journal of Enterprising Communities: People and Places in the Global Economy*, *5*(2), 145–157. https://doi.org/10.1108/17506201111131578

[11] Meyer, N., Meyer, D. F., & Molefe, K. (2016). Barriers To Small Informal Business Development and Entrepreneurship: the Case of the Emfuleni Region. *Polish Journal of Management Studies*, *13*(1), 121–133. https://doi.org/10.17512/pjms.2016.13.1.12

[12] Franck, A. K. (2012). Factors motivating women's informal micro-entrepreneurship.*International Journal of Gender and Entrepreneurship*, *4*(1), 65–78. https://doi.org/10.1108/17566261211202981

[13] Mottaleb, K. A., & Sonobe, T. (2013). What determines the performance of small enterprises in developing countries? Evidence from the handloom industry in Bangladesh.*International Journal of Business and Globalisation*, *10*(1), 39–55. https://doi.org/10.1504/IJBG.2013.051802

[14] Boels, D.. (2014). It's better than stealing: informal street selling in Brussels. *International Journal of Sociology and Social Policy*, 34 (9/10), 670-693

[15] Hackenbroch, K., Baumgart, S., & Kreibich, V. (2009). The spatiality of livelihoods: Urban public space as an asset for the livelihoods of the urban poor in Dhaka, Bangladesh. *Erde*, *140*(1), 47–68.

[16] Patel, K., Guenther, D., Wiebe, K., & Seburn, R.A. (2014). Promoting food security and livelihoods for urban poor through the informal sector: a case study of street food vendors in Madurai, Tamil Nadu, India. *Food Security*, *6*(6), 861–878. https://doi.org/10.1007/s12571-014-0391-z

[17] Kimani-Murage, E. W., Schofield, L., Wekesah, F., Mohamed, S., Mberu, B., Ettarh, R., …Ezeh, A. (2014). Vulnerability to Food Insecurity in Urban Slums: Experiences from Nairobi, Kenya. *Journal of Urban Health*, *91*(6), 1098–1113. https://doi.org/10.1007/s11524-014-9894-3

[18] Verick, S. (2006).The Impact of globalization on the informal sector in Africa.*United Nations Economic Commission for Africa (ECA)*, 26. Retrieved from http://www.iza.org/conference_files/worldb2006/verick_s872.pdf

[19] Warunsiri, S. (2011). The role of informal sector in Thailand, *4*, 450–453.

[20] Li, Yue & Rama, M. (2015). Firm Dynamics, Productivity Growth, and Job Creation in Developing Countries: The Role of Micro- and Small Enterprises. *The World Bank Research Observer*, 30(1)

[21] Williams, C.C., & Nadin, S. J. (2012).Tackling entrepreneurship in the informal economy :evaluating the policy options.*Journal of Entrepreneurship and Public Policy*, *1*(2), 111–124. https://doi.org/10.1108/20452101211261408

[22] Jiménez, A., Palmero-Cámara, C., González-Santos, M. J., González-Bernal, J., & Jiménez-Eguizábal, J. A. (2015).The impact of educational levels on formal and informal entrepreneurship.*BRQ Business Research Quarterly*, *18*(3), 204–212. https://doi.org/10.1016/j.brq.2015.02.002

[23] Thai, M. T. T., & Turkina, E. (2014).Macro-level determinants of formal entrepreneurship versus informal entrepreneurship.*Journal of Business Venturing*, *29*(4), 490–510. https://doi.org/10.1016/j.jbusvent.2013.07.005

[24] Dau, L. A., & Cuervo-Cazurra, A. (2014). To formalize or not to formalize: Entrepreneurship and pro-market institutions. *Journal of Business Venturing*, *29*(5), 668–686. https://doi.org/10.1016/j.jbusvent.2014.05.002

[25] Chen, M. A. (2006). Rethinking the informal economy: Linkages with the formal economy and the formal regulatory environment.In *Linking the Formal and Informal Economy: Concepts and Policies*.https://doi.org/10.1093/0199204764.003.0005

[26] Williams, C. C., Nadin, S., & Rodgers, P. (2012).Evaluating competing theories of informal entrepreneurship: some lessons from Ukraine.*International Journal of Entrepreneurial Behaviour& Research*, *18*(5), 528–543.https://doi.org/10.1108/13552551211253919

[27] Kabir et al (2012). Impact of small entrepreneurship on sustainable livelihood assets of rural poor women in Bangladesh. International Journal of Economics and Finance,4(3), 265-280. http://dx.doi.org/10.5539/ijef.v4n3p265

[28] Chambers, R. and Conway, R. (1992). Sustainable rural livelihoods: Practical concepts for the 21st century. IDS discussion paper, No. 296. pp.127-130.

[29] Krantz Lasse (2001), The Sustainable Livelihood Approach to Poverty Reduction An Introduction, Swedish International Development Cooperation Agency

[30] Erenstein, O. (2011) Livelihood Assets as a Multidimensional Inverse Proxy for Poverty: A District-level Analysis of the Indian Indo-Gangetic Plains, Journal of Human Development and Capabilities, 12:2, 283-302, DOI: 10.1080/19452829.2011.571094

[31] Singh, P.K. & Nair, A. (2014) Livelihood vulnerability assessment to climate variability and change using

fuzzy cognitive mapping approach. Climatic Change 127: 475. https://doi.org/10.1007/s10584-014-1275-0

[32] Speranza, C. I., Wiesmann, U., & Rist, S. (2014). An indicator framework for assessing livelihood resilience in the context of social–ecological dynamics. *Global Environmental Change*, *28*, 109-119.

[33] Mutahara, M., Haque, A., Khan, M. S. A., Warner, J. F., & Wester, P. (2016). Development of a sustainable livelihood security model for storm-surge hazard in the coastal areas of Bangladesh. *Stochastic environmental research and risk assessment*, *30*(5), 1301-1315.

[34] Hahn, M.B., Riederer, A.M., Foster, S.O. (2009). The livehood vulnerability indeks: a pragmatic approach to assessing risks from climate variability and change-a case study in Mozambique. Global Environmental Change 19 (1) 74-88

[35] Lin, K. H. E., & Polsky, C. (2016). Indexing livelihood vulnerability to the effects of typhoons in indigenous communities in Taiwan. *The Geographical Journal*, *182*(2), 135-152.

[36] Shah, K. U., Dulal, H. B., Johnson, C., & Baptiste, A. (2013). Understanding livelihood vulnerability to climate change: Applying the livelihood vulnerability index in Trinidad and Tobago. *Geoforum*, *47*, 125–137. https://doi.org/10.1016/j.geoforum.2013.04.004

[37] Can, Nguyen Duy et.al. (2013) Application of LVI to assess risks from flood vulnerability and climate vulnerability: A case study in the Mekong Delta of Vietnam. *Journal of Environmental Science and Ecology*, A2, 476-486.

[38] Simane, B., Zaitchik, B. F., & Foltz, J. D. (2016). Agroecosystem specific climate vulnerability analysis: application of the livelihood vulnerability index to a tropical highland region. *Mitigation and Adaptation Strategies for Global Change*, *21*(1), 39–65. https://doi.org/10.1007/s11027-014-9568-1

[39] Orencio, P. & Fujii, M. (2012) An index to determine the vulnerability of communities in a coastal zone: A case study in Baler, Aurora, Philippines. *Royal Swedish Academy of Sciences*. DOI 10.1007/s13280-012-0331-0.

[40] Acosta et al. (2014). Livelihood adaptation to impacts of extreme events in the Philippines: A decade after the typhoon-induced disasters in Infanta, Quezon Paper presented in the National Conference on Integrated Natural Resources and Environment Management (NC-INREM 2014), Learning Lessons, Sharing Knowledge: Strengthening the Role of INREM in Sustainable Development, held in SEARCA, Los Banos, Laguna on October 16 to 17, 2014.

[41] Cuesta M, Ranola Jr RF. (2008). Current vulnerability of the rice production sector to rainfall variability and extremes in the province of Camarines Sur, Philippines. J ISSAAS 14 (1):67-79 (2008).

[42] Panthi Jeeban et al (2015) Livehood vulnerability approach to assessing climate change impactson mixed agro-livestock smallholders around the Gandaki River Basin in Nepal Regional Environmental Change, 15 (4).