The Impact of Vulnerability and Income distribution on Inequality and Poverty: Analysis of Flood and landslides in Vulnerable Locations of Nepal

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The Impact of Vulnerability and Income distribution on Inequality and Poverty: Analysis of Flood and landslides in Vulnerable Locations of Nepal

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Abstract

Natural disaster is a key exogenous driver to unpredictable *risk* of *uncertainty* and cost of *economic loss*. GDP loss at national economy and welfare loss at household level in the world are major cost of such disaster. The cost that is a burden to households could change on income distribution and household income vertically and horizontally and then their livelihood and welfare. This relationship makes a curiosity whether natural disaster could change income distribution at household level in developing countries, where socio economic vulnerable groups exist so that alternative policy option can be explored to minimize such bad effects on socio economic vulnerable groups and their livelihood and welfare.

This paper measures empirically the income distribution effects of natural disaster at household level based on primary data sets collected through household survey in Sot Khola water basin by using Gini coefficient method. As reference line, inequality and poverty level are employed. Comprehensive and comparative analytical tools are used for testing above research question based on two periodic data sets and information. As a result, the water shed areas had higher inequality and poverty level than national inequality line (0.33) before natural disaster. The residents were socio economically and geographically vulnerable. The natural disaster damaged heavily tangible and non-tangible assets, houses, household utensils, documents, dresses, valuable indigenous materials, emotions and food grains. Thus, the vulnerable households lost inferior their assets and insufficient food grains. Its distribution was acute at higher and lower altitude watershed areas and households than middle areas and households. In general, higher altitude watershed areas and households were more vulnerable than middle and then lower altitude

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watershed areas and households. Such acuteness of economic loss redistributed their inequality and poverty level in such a way with the cost of risk and uncertainty. Thus, the vulnerable population became more vulnerable and the non-vulnerable population with their adaptive capacity became less vulnerable. Thus, the natural disaster has negative income distribution effect at household level, particularly at the vulnerable household with expansion of inequality and poverty. Therefore, natural disaster results the growth of vulnerability at rural hilly areas of the river basin.

Key words: *natural disasters, income distribution, income inequality, poverty, Nepal* etc**.**

1. INTRODUCTION

Natural disaster with multiple hazards and risks is frequently happening events with high intensity and high density across the world. Such undesired events have unaccountable negative externality at macro and micro level economy and the society. UN (2019) reports negative externality as 2.9 trillion USD in direct economic losses, with 77 percent resulting from climate change between 1998 and 2017. Data show the United States has suffered the greatest economic losses, nearly 1 trillion USD, followed by China, Japan, India and Puerto Rico. Thus, natural disaster is unpredictable and undesired threat in the world.

Over 30 years, major and minor natural disaster event with higher intensity has been frequently recorded in Nepal. Few major Glacial Lake Outburst floods (GLOF) are as follows: Khosi GLOF 1985, Tamakhosi GLOF 1991 and Dudh Khosi GLOF 1998 (Mool, Bajaracharya and Joshi, 2001a) and other GLOF (Bista, Dahal & Gyanwali, 2018). These floods were uncontrolled wild destructing physical infrastructures (Road, Hydro plants, Bridges, Transmission lines, Telecommunication towers, school buildings and houses), cutting agricultural land in the banks of these rivers and initiating major and minor landslides, clearing crops in the land, killing human and displacing settlements, As a result, every year natural disaster damages 2 billion Rs (20 million USD in 1 USD=100 Rs) and kill more than 200 people all over the country(MOH, 2019). Let's imagine its negative implications on livelihood, assets and income of households. Naturally, they might manufacture poverty and inequality at some extents. In addition, in 1991, the higher intensity of rainfall over 48 hours (2 days) induced floods. Its evidences were the flood of Nakhu Khola in 1991, Bagmati and Narayani in 1993, Andhi Khola in 1998 and Bagmati in 2002 (Chalise and

Khanal, 2002). The flood of Nakhu Khola curbed heavily the bank of Le Le Village Development Committee (VDC), destroyed nearly 48 houses and 7 water turbines and killed 27 local peoples. Similarly, in 1993, the flood swept fully and partially about 28000 families in the Middle Mountain and 42000 families in the lowlands. Thus, the low land received double negative implications of the flood (Chalise and Khanal, 2002). Further, such approach would contribute to the growth of poverty and inequality.

The debris flow is another powerful disaster. It happened in 1996. The Larcha debris washed out away physical and hydroelectricity infrastructure including roads, bridges and transmission lines, along with 18 houses. Its negative implications can be found at household. (Chalise and Khanal, 2002). It has an obvious similar impact.

In 2015, the great earthquake made disastrous 900 billion Rs. (9 billion USD) economic loss with 8000 deaths, 0.7 million household destruction and numerous infrastructure (MoF, 2018). Annual loss in average is of 2000 million Rs. (20 million USD) per annum including dead, missing, damage, loss of asset and death of livestock (CBS, 2011). The study indicated the growth of poverty level and inequality with 2 percent. Like as developed countries, Nepal has natural disasters as major issues of development economics as well as environmental economics. Thus, all disasters have immediate economic implication at household level and community level (Dahal, Hasegawa, Nonomura, Yamanaka, Dhakal, and Paudyal, 2008; Malla, 2008; Pant, 2011; Acharya and Bhatta, 2013 and Karn, 2014). However, Mool, Bajaracharya and Joshi(2001a) and Chalise and Khanal (2002) have descriptively covered glacier bursting disasters, flooding and landslides and its losses.

Gradually, recent literatures have focused on the relationship between natural disaster and economic growth. Bista(2016) and NPC (2016) has assessed the economic growth effects of the great earthquake 2015 by using descriptive statistics. It found 2 percent economic growth loss due to 900 billion economic losses of the earthquake disasters in 31 districts of Nepal. However, rare literatures have concerned on the income distribution effects of natural disasters. Therefore, this study is relevant to fill up such gap for policy measures in pre and post disasters.

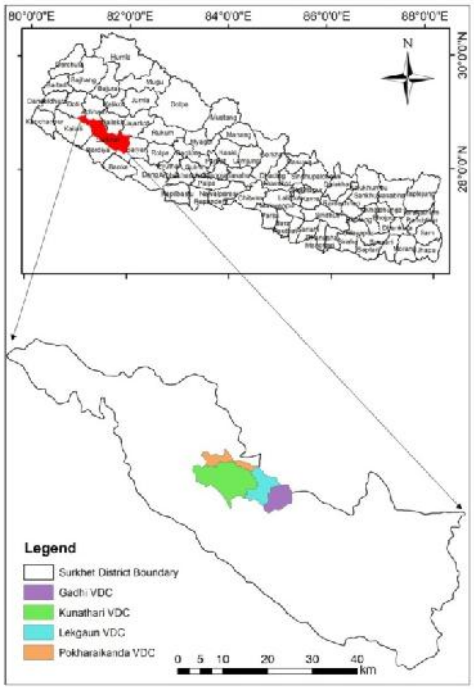
2. MATERIALS AND METHODS

This paper has a broaden objective to measure the income distribution effect of natural disaster in the study area. Its specific objectives are to estimate economic loss during natural disaster, to estimate the income distribution before natural disater, to estimate the income distribution after natural disaster and to identify issues for policy recommendation.

2.1. Methodology

2.1.1. Study Area

This paper estimates the effect of disaster on household income and then poverty and inequality to minimize its adverse effects and to control drivers of disasters based on the household survey undertaken in the Sotkhola water basin and its catchment areas (Figure 1) in the northern part of Surkhet, the western Nepal. Geomorphologically, the water basin that originated from Chandane, Gadhi Village Development Committee (VDC) and ends to Rakseni, Kunathari VDC is 30 km long stream of a big river, Bheri (Figure 1) (DDC, 2015). Runoff water level fluctuates from monsoon to winter seasons of a year. In monsoon, the river is highly wild and unstable with 18 times more flow and speed with silt of mud and stones meanwhile in winter, it is nearly dry and stable with unexpected lower water level.



Its three catchment areas have 28 square spread from sea level to Mahabharata range: Gadhi VDC (Upper stream), Lekhagaon VDC (Middle stream) and Kunathari VDC (Downstream) (DDC, 2015). Geographically, Gadhi and Lekhagaon VDC are hilly and mountainous landscape more than Kunathari VDC. Naturally, these catchment areas are rich for heterogeneity and diversity in wildlife and ecosystem across different altitudes. a) Gadhi Village Development Committee (VDC) is at the altitude of 1200 meters in the Mahabharat Range. Its geographical areas is 29 square km. The population size is 3369 (VDC, 2015). b) Lekhgaon Village Development Committee(VDC)

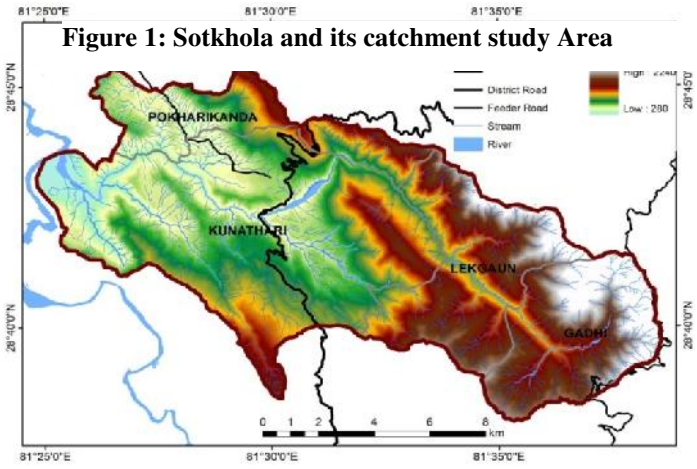
spreads 110 km length and 30 km breadth of 2451 square km (249016 hectare) from 198 meter to 2369-meter altitude (Figure 1). Hill (84%) dominates to valley (16%). Population size is 3999 (DDC, 2015). c) Kunathari Village Development Committee (VDC) is another study village lying between 600 meter and 1200 meter (Figure 1). It is 20 km far from district headquarter). Population size is 3413 (CBS, 1991) and (DDC, 2015). This water basin is a source of clean drinking water, irrigation water and water and terrestrial ecosystem to the catchment households. This study area is purposively selected by i) its climatic variation and disasters event as flooding and landslides in 2014, ii) its huge vulnerability at the catchment areas, iii) its morphological structural change, iv) its aquatic and terrestrial ecosystem and biodiversity and v) its agricultural lifeline and its risk.

2.1.2 Data and Method

This study is explorative and descriptive design in which qualitative and quantitative data are employed. These data sets are comprised of socio-economic information of household, vulnerability occurrence and level and natural disaster events related to the above study area (figure 1).

Figure 2: Study Area

Figure 1: Sotkhola and its catchment study Area



Source: ***GIS map of Study area based on field survey, 2015***

Data of natural disaster and their extremities and vulnerability level is secondary nature (Bista, 2018 and Bista, 2019). In 2015, the data from 2009 to 2015 were collected from District Development Committee (DDC) office, Home Ministry, the government of Nepal and Department of Hydrology and Metrology, the government of Nepal.

Similarly, socio economic information and vulnerability level of household are primary nature. In 2015, household survey was employed to collect these socio-economic information and vulnerability level in the post disaster. The survey was scheduled from September 2015 to October 2015. The survey was conducted under the supervision and management of UNDP.

Household survey was conducted altogether 642 households as the sample randomly selected from 3310 household populations of the study area. In 2015, there was two stage sample selection process in which the cluster sampling method was employed covering 3310 households of the study area and nine clusters based on altitude, location and place. After then, the random sampling method was used to select 642 sample households (19.3%) from such nine clusters.

As survey tool, structural questionnaire was employed. The questionnaire relates to socio economic information about household (land holding, income level, source of income, size of family, gender, age, caste etc.), climatic events and vulnerability, agriculture activity and adaptation capacity, behavior and decisions in wheat production. Similarly, climatic events and vulnerability set of questionnaire provides information, experience and perspective about climatic events, its types, natures, patterns and vulnerability level. Agricultural activity related data include data related to agriculture activity, farm revenue, types of crops, crop cycle, inputs, infrastructure and markets. Lastly, adaptation capacity, behavior and decisions set provide data set related to income, information, technology, experience, indigenous skills, application and loss reduction. Further, the effects of disasters on household income and their inequality and poverty are analyzed and identified by using Lorenz curve.

2.1.3. Gini Coefficient Method

Despite development efforts of the government and federalism, the study area has 33 percent inequality and 42 percent poverty level (DDC, 2015). Factors including altitude, location, caste community, employment level and asset holding has made complex to these socio-economic issues. Its extremity between the top and bottom twenty percent income clusters has been a threat to social harmony and peace of the community along with development efforts and distribution. In addition, it is assumed that natural disaster has widen such gap and increased vulnerability of the study area. Therefore, Gini Coefficient Method is relevant to the income distribution effects of the disaster and understanding sensitivity level of household.

The Gini coefficient value provides sensitivity of household. It is derived from Lorenz curve and measuring the ratio of area between Lorenz curve and the line of perfect equality distribution. Its value lies between 0 and 1. If the value is near 1, it indicates higher inequality but if it is near zero, lower inequality occurs.

$$\text{Area of Lorenz curve} = b_1 / b_1 + b_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\text{Gini coefficient} = 0.5 - \text{area of Lorenz curve}$$

Where, b_1= first area of Lorenz curve (percent)

b_2= second area of Lorenz curve (percent)

In the way of computation of Gini coefficient, household incomes are arranged from smallest to largest. Then, the data were grouped into quartiles having 20 percent each quartile of total income. Then the sum of each quartile was calculated and cumulatively sum in percentage. It gave Lorenz curve. Then, above mathematical equation provides Gini coefficient (Equation 1). In addition, another Gini Coefficient formula is also used as follows.

$$G_1 = 1 - \sum (x_k - x_{k-1})(y_k + y_{k-1}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, G_1= Gini coefficient, x_k=cumulated proportion of the population for k=1----n and y_k=the cumulated proportion of the income variables for k=1----n,

3. Results and Discussion

3.1. Estimation of Economic Loss (Household Vulnerability)

Economic loss is evidence of natural disaster. In Nepal, this result is due to heavy and intense rainfall in monsoon season and glacier burst in summer season. Therefore, the government of Nepal has listed major and minor rivers as driver of wildly and massively disastrous landslide and flood (MoH, 2019). Sot Khola water basin is a minor river having unstable, turbulence and disastrous in the catchment areas and the driver of household vulnerability. In 2014, the flood in Sot Khola water basin and landslides in the catchment areas were unexpected catastrophic. As a result, about 69 percent households were mostly affected and made extreme vulnerable across altitude, location, areas and resilient of households. Its key driver is a devasting loss or damage to the system as the result of natural disaster. Further, it is determined by sensitivity and adaptive capacity (IPCC, 1996, Bista, 2018 and Bista 2019). Such vulnerable households have higher sensitivity and less adaptive capacity.

Table 1 presents three types of assets: household property, crops and income in household. Household property refers to building and household utensils and physical tangible and non-tangible materials. Similarly, household crops and product include crops and livestock. Income

Table 1: Damages and Loss of Household Property, Asset and Income from Hazards

Items		Effected Household		Total Damage (Rs)	USD 1$=100	Mean (Rs)	Mean USD	Max (Rs)	Max (USD)
		No	%						
Household Property	Houses (building)	43	6.7	3,344,000	**33440**	167,000	**1670**	500,000	**5000**
	Asset (kitchen, bedroom, etc.)	20	3.1	10,000,000	**100000**	293,000	**2930**	3,120,000	**31200**
Household crops/product	Crops	152	23.75	798,777	**7897.7**	5,255	**52.5**	100,000	**1000**
	Livestock	11	1.7	410,000	**4100**	37,272	**372.7**	60,000	**600**
Lost income	Salary	9	1.4	88,650	**886.5**	9,850	**98.5**	30,000	**300**
	Business income	10	1.5	266,200	**2662.0**	4,840	**48.4**	115,000	**1150**
	wages	55	8.5	101,000	**1010.0**	10,100	**101.0**	100,000	**1000**
	agriculture	138	21.5	3,455,800	**34558**	25,000	**250**	500,000	**5000**
Total				18,464,427	184644.2				

Source: *Field Survey, 2015*

has four sources: salary, business, wages and agriculture activity. Thus, economic loss of natural disaster -flood and landslides were damages and loss of household property, asset and income in the study area in 2014.

Above table 1 demonstrations what is a level of natural disaster and its contribution to make the community vulnerable. Let's discuss it in details.

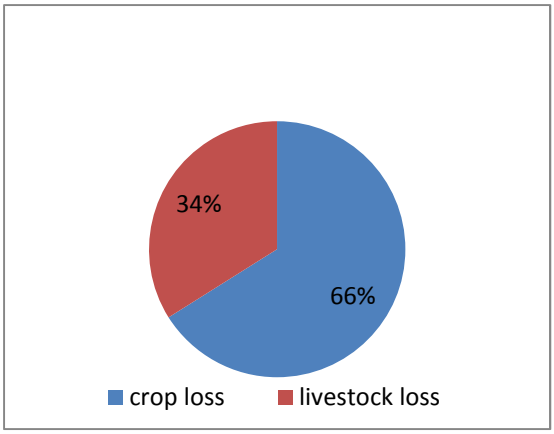
- **Household Property Damages and Loss**

  Vulnerability at household level at some extent is a result of household property damages and loss. In 2014, such event happened in Sot Khola water basin catchment areas: Gadhi VDC, Lekhagaon VDC and Kunathari VDC. It is a key finding of Rapid observation and household survey in 2015 as similar with the publication of District Development Committee (DDC), 2015. Table 1 shows the evidence of 6.7 percent two story house and 3.1 percent asset fully and partially damaged. Its values were Rs. 3,344,000 (33440 USD) houses damaged and Rs.10,000,000 (100000 USD) asset damaged. In total, there was Rs. 13,344,000 (133440 USD) household and property loss (Table 1). Its negative result is to redistribute household income across the study area through the possible growth of poverty

and inequality but it is determined by resilient and exposure level of household. Human Development Index (HDI) and Poverty Index (PI) of the study area district, Surkhet will lower than before 2014.

- **Damages to Household Crops and Livestock**

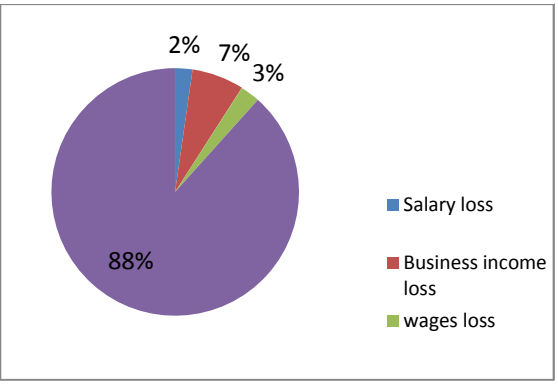
Figure 3: Loss of Household Crops and Livestock



Source: *Field Survey, 2015*

Agriculture is major sources of income and livelihood of almost households in Sot Khola water basin catchment areas: Gadhi VDC, Leghagaon VDC and Kunathari VDC. Almost households hold crops and livestock as livelihood assets and sources. As a result of natural disaster, these assets were fully damaged in 2014. Table 1 shows about Rs. 798,777 (7987.7 USD) worth of agricultural crop, along with the large units of fertile land and loss of 41 livestock's (cow, buffalo and goat) with the worth of Rs. 410, 000(4100 USD). In total, crop damage share was 23.75 percent meanwhile livestock loss share was 1.7 percent. Out of total household production and agro product loss, crop loss share dominated with 66 percent to 34 percent livestock loss (Figure 3). Thus, almost households of all catchment area (VDCs) have a huge economic cost to induce high level of household vulnerability.

Figure 4: Income loss of Household



Source: *Field Survey, 2015*

- **Income loss**

Farm and off farm income (business and labor income) are alternative income of households supplementing their household income to meet their basic livelihoods and nonfood activities (education and health) expenditure. As a result of disaster, active population of households could not go in business and daily work. Its outcome was the loss of the off-farm income (business income) but there was not opportunity labor cost because of nearly zero opportunity cost in the study area. Table

shows 1 percent such income along with 88 percent agricultural income. In addition, there were loss of wage (3%) and of salary (2%) (Figure 4). The survey found Rs. 3,911,650 (39116 USD) income loss in total. It was verified and validated through the secondary data of District Development Committee 2015. Thus, such outcome has increased to household vulnerability more and more in depth.

- **Injury and loss of life**

  Natural disaster damage human life fully and partially, if human beings have not adaptative capacity and adaptative behavior against their exposure and sensitive to natural disasters due to their location, altitude and characteristics. In general, the poorest of the poor households have lower adaptative capacity and behavior due to their high vulnerability. Therefore, life loss depends on human being's adaptative capacity and behavior to move at safe places and warning system's installation. The rapid observation and topographical map show the river basin at the bottom level of the catchment areas and its far distance from households and the settlements. The survey indicates the local community having alert, communication and witness of the flood. Therefore, there was only one-person loss in Kunathari. Thus, there was a least vulnerability.

3.2. Estimation of Income Distribution and its impacts on Inequality and Poverty

Income redistribution outcome of natural disaster has a power to driver the growth of inequality and poverty level. It depends on the vertical growth and distribution of above asset and income losses across the different income groups. If the poorest of the poor has more loss, its vulnerable outcomes will be extreme more than before. The rich poor gap will be magnificent. If the poorest of the poor has less loss, its vulnerable outcomes will be additional more than before. The rich poor gap will be. Therefore, the paper has a query whether household vulnerability changed income distribution towards inequality and poverty and what was its degree at household level.

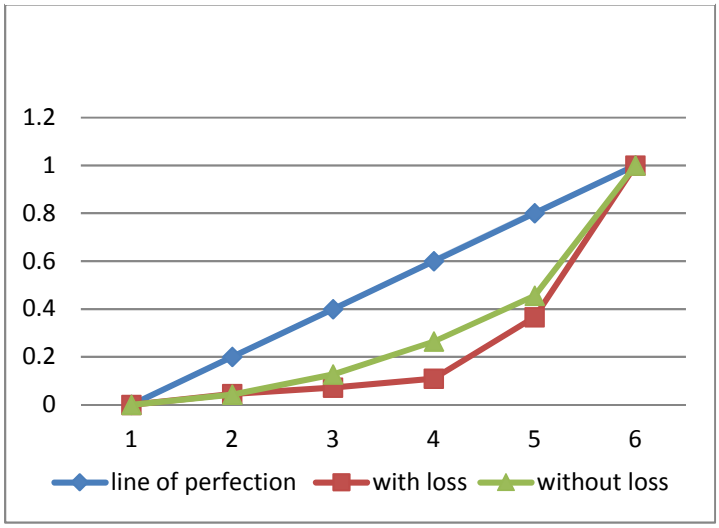
Based on primary information collected from the household survey of sample household (642), household income was collected and made 20 percent difference quintile from zero income to 100 percent income. Similarly, the worth of damage or loss was also arranged in this way. By using Gini coefficient method, income distribution across different income level households was

observed by categorizing into two groups: without loss (base line) and with loss (the effect of multi hazard) at VDC level. The change in income inequality and poverty could be calculated.

3.2.1. Estimation of Income Distribution and its impacts on inequality of poverty in the post disaster at Gadhi

Gadhi VDC is one of the catchment area of the water basin located at higher altitude than other VDCs. The VDC has 3369 populations including different income and caste groups. Due to the landslides, household vulnerability level was extreme more than before. Figure 5 presents household income distribution of Gadhi VDC in which Gini coefficient value before and after multi hazard. In Gini coefficient method, there are two categories: without loss (base line income) before multi hazard and with loss after multi hazard. The area of base line (before multi hazard) is smaller than income distribution with loss in Gadhi. Thus, there is a significant increment of areas outwards indicating changing income distribution across the community and its significant effect on inequality and poverty is as wider inequality than before and deepen poverty level. Figure 5 shows the bottom 20 percent poorest of the poor having not change but the income group from 20 percent to 100 percent (lower middle income to higher income group) have significant loss leading to the poor more than before but wider inequality between the bottom 20 percent lower income group and the upper 20 percent higher income group. Further, Gini coefficient was 44 percent in the base line and became 56 percent after the multihazard. Thus, natural disaster has redistributed household income of the study area Gadhi VDC with 12 percent. Its outcome is the growth of extreme vulnerability with 12 percent growth of inequality and poverty in the community(Figure 8).

Figure 5: Lorenz Curve of Gadhi

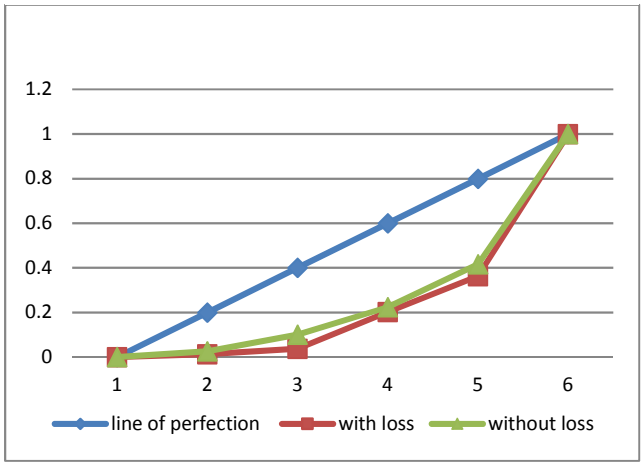


Source: Field Survey, 2015

3.2.2. Estimation of Income Distribution and its impacts on inequality of poverty in the post disaster at Kunathari

Kunathari VDC is one of the catchment areas having low altitude in the comparison with Gadhi and Lekhagaon having 3413 population size with different income and caste group. Due to the flood of Sotkhola water basin, household vulnerability is higher. Figure 6 presents household income distribution of Kunathari VDC in which Gini coefficient value before and after multi hazard. The area of base line (before multi hazard) is just expansion of income distribution with loss in Kunathair. Thus, there is a significant increment of areas. There is significant effect of vulnerability on inequality and poverty. Figure 6 shows the bottom 20 percent poorest of the poor having change but the income group from 20 percent to 60 percent (lower middle income to lower higher income group) have significant loss leading to the poor more than before but wider inequality between the bottom 20 percent lower income group and the upper 20 percent higher income group. Natural disasters have not affected to all income groups. Further, Gini coefficient was 49 percent before the multi hazard and became 56 percent after the multihazard in Kunathari. Thus, natural disaster has redistributed household income by 7 percent. Its outcome is the 7 percent growth of inequality and poverty level in the community(Figure 8).

Figure 6: Lorenz Curve of Kunathari



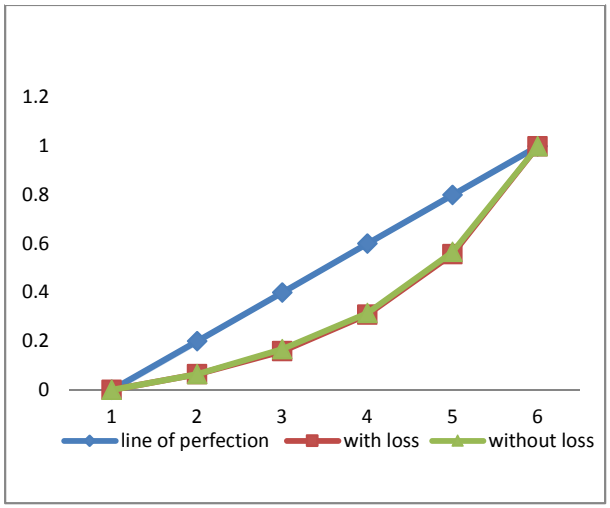
Source: Field Survey, 2015

3.2.3. Estimation of Income Distribution and its impacts on inequality of poverty in the post disaster at Lekhagaon

Lekhagaon is another VDC of the catchment area of Sotkhola water river basin where 3999 populations live. Their characters are diverse in income and caste. Figure 7 presents household

income distribution of Lekhagaon VDC in which Gini coefficient value before and after multi hazard. There are two categories: without loss (base line income) before multi hazard and with loss after multi hazard. The area of base line (before multi hazard) is just overlapping of income distribution with loss in Lekhagaon. Thus, there is not a significant increment of areas. There is nominal effect of vulnerability on inequality and poverty. Figure 7 shows disaster have not much more affected to change income distribution across the community from the bottom 20 percent poorest of the poor to the upper 20 percent richest of the rich because of the overlapping graph, although there is a nominal change. Further, Gini coefficient was 35 percent before the multi hazard and became 36 percent after the multihazard. Thus, natural disaster has redistributed household income across different income group with 1 percent. Its outcome is the growth of 1 percent inequality and poverty in the community(Figure 8).

Figure 7: Lorenz Curve of Lekhagaon



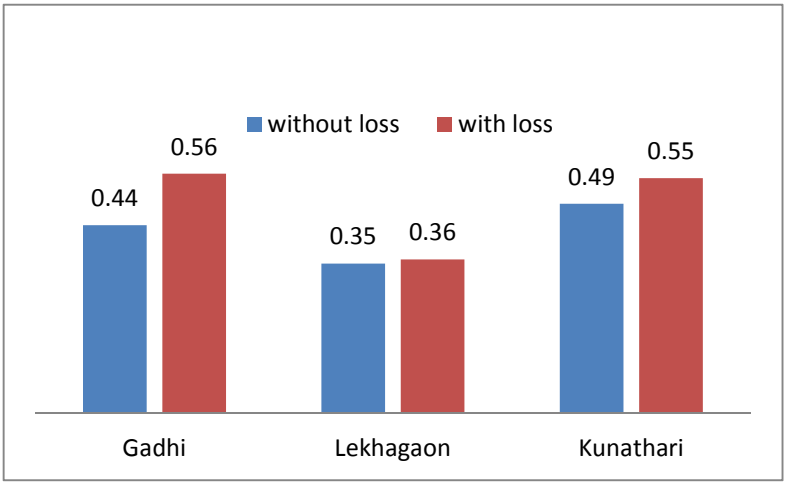
Source: Field Survey, 2015

4. Discussion and conclusion

Above results of Gini coefficient provide sufficient and necessary evidence on income redistribution in the watershed areas with natural disaster. The estimation of Gini coefficient of income distribution is two period: base line (without loss) and post disaster (with loss) in these water basin catchment areas: Gadhi, Lekhagaon and Kunathari.

Base line scenario of inequality and poverty in the study areas was intense and acute. Its distribution across three VDCs were 49 percent in Kunathari, 44 percent in Gadhi and 35 percent in Lekhagon. The inequality and poverty level in Kunathari VDC were massive and extreme of all catchment VDCs, although Gadhi and Lekhagaon had also above the national poverty level (32 percent). Thus, large section of households was socio economically vulnerable and struggling for livelihood and survival.

Figure 8: Disaster induced change in Gini coefficient of VDC



Source: *Field Survey, 2015*

In the post disaster, there was the occurrence of economic loss induced household vulnerability from vulnerable household to extreme vulnerable households and from non-vulnerable households to vulnerable households. The economic loss was determined by the distribution of natural disaster and its effects outward circle of the disaster point. The distribution and size of economic loss redistributed household income across the study area. Its pattern is different as follows: 0.12 percent in Gadhi, 0.7 percent in Kunathari and 0.1 percent in Lekhagaon. In Gadhi VDC, the redistribution of household income was with 12 percent. It increased 12 percent inequality and poverty level from non-vulnerable to vulnerable households and from vulnerable households to extreme vulnerable households. It was followed by Kunathari VDC where the redistribution of household income with 7 percent. It made complex more inequality and poverty level with 7 percent from non-vulnerable to vulnerable households and from vulnerable households to extreme vulnerable households. In Lekhagaon, the redistribution was only 1 percent. It increased slightly inequality and poverty with 1 percent. It shows the intensity of natural disaster in Gadhi was higher than Kunathari and Lekhagaon. Its positive correlation with vulnerability shows household vulnerability of Gadhi is more extreme than Kunathari and Lekhagon. Therefore, natural disaster redistribute income in the community in accordance with its intensity and loss.

Based on above result, households of Gadhi and Kunathari have least adaptative capacity, poor resilient and higher exposure to natural disaster in comparison with Lekhagaon. Therefore, Households of Gadhi and Kunathari need resilience intervention not only at emergency but also at short and long run because these two VDCs are disaster prone areas with more exposure and sensitive from natural disaster. Therefore, the local and national emergency and resilient development action policy and budget should be immediate with respect to the household vulnerability ranks and the redistribution of inequality and poverty in the community of the disaster-prone areas before their complexity development. Otherwise, the disaster induced vulnerable and extreme vulnerable household, particularly women, old age and children will be unexpected and undesired extreme issues at local and national development course and discourse.

Reference

Central Bureau of Statistics (CBS). (2011). *Population census*. Kathmandu: CBS

Bista, R.B. (2016). *Economics of Nepal*. Kathmandu: New Hira Books

Bista, R.B. (2018) Analyzing climate vulnerability in Nepal, *the Journal of Economic Concerns*, 9 (1): 1-12

Bista, R.B., Dahal, K. & Gyanwali, R. (2018) A Review of climate change and its effects in the western mountainous water basin of Nepal, *Journal of Hydro Nepal*, 23: 22-26

Bista, R.B. (2018) Determinants of flood disaster household's vulnerability in Nepal, *Economic Journal of Development Issues*, 25 & 26: 47-59, https://doi.org/10.3126/ejdi.v25i1-2.25093 , https://www.nepjol.info › index.php › EJDI

Bista, R.B. (2019) Trend and forecasting analysis on climate variability: a case of Nepal, *Journal of Advanced Research in Civil and Environmental Engineering,* 6(1): 13-22.

Bista, R.B. (2019) Groping climate vulnerability in western mountainous Nepal: applying climate vulnerability index, *Forum for Social Economics, 0(0): 1-19, http://:doi.org* 10.1080/0760932.2019.1619607.

Bista, R.B. (2019) Index measurement of climate variability and household vulnerability: a case of western Nepal, *International Journal of Ecology and Environmental Science*. India, 1(1):07-14. www.ecologyjournal.in

Chalise, S.R and Khanal, N.R. (2002) 'Recent extreme weather events in the Nepal Himalayas'. In Snorasson, A.; Finnsdottir, H.P.; Moss, M.E. (eds) *The extremes of the extremes: Extraordinary floods*, Publication 271, 141-146. Reykjavik (Iceland): IAHS

Dahal, R.K., Hasegawa, S., Nonomura, A., Yamanaka, M., Dhakal, S., and Paudyal, P. (2008). Predictive modeling of rainfall-induced landslide hazard in the Lesser Himalaya of Nepal based on weights-of-evidence. *Geomorphology,* 102, 496–510.

DDC (District Development Committee) (2015). *District Profile*. Surkhet: DDC

MOF (Ministry of Finance).(2018). *Economic Survey*. Kathmandu: MoF

Mool, PK; Bajracharya, SR; Joshi, SP (2001a) Inventory of glaciers, glacial lakes, and glacial lake outburst floods: Monitoring and early warning systems in the Hindu Kush-Himalayan region – Nepal. Kathmandu: ICIMOD

NPC (National Planning Commission) (2016). *Nepal Disaster Report*. Kathmandu: NPC

Pant, K.P. (2011). Economics of climate change for smallholder farmers in Nepal: A Review paper, *The Journal of Agricultural and Environment*, 12(5).

UN (United Nations) (2019). World Disaster Report 2019. Washington: UN