Assessing Economic Cost and Effectiveness of the Vulnerable Household's Recovery Measures in Rural Hills of Nepal

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Abstract

This paper measures analytically economic cost and effectiveness of household recovery strategy based on primary data sets collected from household survey in Sot Khola water basin by using indicator basis simple descriptive statistics and "t" statistics. About 13 indicators of recovery at vulnerable households were found in the catchment areas (Gadhi, Kunathari and Lekhagaon) in Surkhet. About 63 percent household preferred on reconstruction and rehabilitation option out of 13 recovery indicators as mentioned in the conceptual framework. Interestingly, the community considered it to normalize their flood trauma and stress situation and to return normal livelihood activities. As a result, about 61 percent household considered its endogenous driver to individual's indigenous knowledge and practice whereas about 39 percent household considered to its exogenous variable as community led. In such strategy, there was a driver of security at night and livelihood activities (food, cleaning, bathing and lodging). About 87 percent household found its effectiveness to rehabilitate themselves day by day in the normal schedule of livelihood and economic activities. In the poor rescue and recovery scheme of the government, recovery and rehabilitation cost to household was 42000 Rs and its days were 34 days. Therefore, vulnerable household have recovery and rehabilitation behavior, drivers and cost. Despite negative impact of its economic cost, household have recovery and rehabilitation behavior. Such type of burden of economic cost should be shared and reduced so that vulnerable household will not be more vulnerable from their recovery and rehabilitation behavior and practices.

Key words: *Climate Shock, Recovery of Disaster, Vulnerability, Poverty, Nepal*

1. Introduction

Disaster is an unpredictable uncertainty in the entire world. It is called nature and human induced. Until date, it is an unstoppable event in the 21st century, although the scientist has discovered sophisticated, scientific and innovative technology and knowledge. The bundles of literature (Fritz et al. 1961, Quarantelli, 1998, Gilbert, 1998, MOH, 2019 and Bista, 2019) mention it as the passage of a state of uncertainty. Its forms are heterogeneous as follows: bushfire, earthquake, flood, storm, cyclone, storm, landslide, tsunami, tornado, etc. (Common Wealth of Australia, 2002 and MOH, 2020).

Disaster event affects annually most countries of the world. The climate risk index rank report 2017 shows top most affected countries including Puerto Rico, Sri Lanka, Dominica, Nepal, Peru, Vietnam, Madagascar, Sierra Leon, Bangladesh and Thailand. In the report, Puerto Rico is explained as a most affected country having 2978 death tolls of hurricane Maria and 82315.24 million US$ PPP (63.32 % of GDP) loss. Similarly, Nepal has 164 death tolls and 1909.98 million USD PPP losses (German watch, 2019). In 2019, a total economic loss of natural and manmade disasters was accounted at 140 billion USD. Similarly, Nepal has total annual economic loss of more than 2 billion Nepali Rupees (20.0 million

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USD). As a result, its impact can be as declining economic growth rate and contraction of GDP, along with employment, output and income. In addition, these disasters have produced trauma, stress and disruption socially and environmentally to the society, along with dysconnectivity, discomfort, sickness and human causalities and losses. All these related to human emotions and natural value cannot be accounted properly in terms economic value. This multidimensional issue has become a big threat to our human civilization in the 21st century.

Such big threat of disaster across the world is uneven. Let's see the figures of Japan, only 26 injured when about 6.7 rector scale earthquake hit Yamagata, in 2019 (www.scmp.com/news). If we see Nepal's earthquake case of 2015, its total economic loss was 700 USD equivalent physical infrastructure (asset, house and public utilities) and more than 8,900 population (child, women and old age) (WB, 2015). These two cases show a sharp difference in loss figures between developed and developing countries, despite the similar earthquake disaster in the different point of time. Such difference indicates the gap in their preparedness, alertness and resilience, along with technology and financial resources.

In the disaster management cycle, the recovery phase, the post disaster phase is a determinant like as the preparedness phase to rehabilitate household as usual before the disaster period and to recover local and national economy. Relatively, the estimated economic cost of the preparedness that is one USD is four times less than the estimated recovery cost (4 USD) in accordance with the World Bank. Despite these costlier affairs, about 87 percent budget in the practice of disaster management was allocated on this activity instead of the preparedness. Few studies mention it as the critical phase to back the community on their own feet. Commonwealth of Australia (2011) explained it highly complex activities with high stress, multi stakeholder's interest, multiple priorities and no demarcation among the stakeholders. Furthermore, UNESCAP (2015) notes it a time-consuming process, having a large number of stakeholders and challenging their coordination. In addition, it follows sustainability, development, collaborative and people centric construction and self-reliant oriented capacity building, quality and accountability for reliable reconstruction and rehabilitation. Furthermore, NPC (2015) comments it as the principles of Build Back Better (BBB).

Categorically, Commonwealth of Australia (2011) mentions these activities and their type as a) social, b) economic, c) built and d) environment. In social activities, these activities include healthcare, counselling and programs targeted to victims. Similarly, stimulus activities and assistance to primary industries or tourism and employment program are main economic activities. Third activity is built in which mainly infrastructure reconstruction and rehabilitation (roads, bridges, etc.) is included. Lastly, the environment activities are clearing, management, replantation and stabilizing terrestrial and coastal eco systems.

In addition, it is costlier than the cost of preparedness. In Gujarat, a powerful earthquake stroke Bhuj Town of the Kutch district in the Western Gujarat on 26th, 2001 with 6.9 rector scale magnitude. It was so devastating with 20000 dead tolls, 0.17 million injured, 0.34 million houses destroyed and additional 0.84 million damaged, along with 15.9 million people affected and 20000 cattle killed. Its effect was found in 21 of 25 districts of the state. The districts had 18 towns, 182 talukas and 7904 villages. Out of 7904 villages, 450 villages were badly affected. Its total direct economic loss was 1.3 billion USD and total indirect economic loss was 5 billion USD. Post-earthquake disaster, the State Government responded with a comprehensive rehabilitation and reconstruction program under which immediate relief, economic

rehabilitation, livelihood restoration as well as long term capacity building of all stakeholders were major activities. Its reconstruction, recovery and rehabilitation cost were assessed at 7.7 billion USD (UNESCAP, 2015). Similarly, over the last decades, the Australian Government alone   spent around 8 billion USD on post-disaster relief and recovery (Productivity Commission 2014). On the recovery of the Christchurch earthquake, the New Zealand government allocated 15.2 billion USD and forward estimates predict a total of 40 billion USD will be spent on the rebuilding effort (The Treasury, 2013). In 2015, Nepal had spent 7.8 billion USD for reconstruction, recovery and rehabilitation (MoH, 2015). Therefore, the recovery is a vital phase of disaster risk management with reconstruction and rehabilitation towards return back into normal business of life and of socio-economic activities and state affairs.

In Nepal, a disaster risk management (DRM) is mostly and widely post disaster related particularly recovery, reconstruction and rehabilitation of disaster victims. At some extent, such approach has practiced a long since the ancient period. In Nepal, big and small earthquakes were recorded in Kathmandu epic center in 1255 AD with 7.8 Richter scale, in Sagarmatha epic center in 1260 AD with 7.1 Richter scale, in Mechi in 1344 AD with 7.9 Richter scale, in Karnali zone in 1505 AD with 8.7 Richter scale, in Northern Koshi Zone in 1681 AD with 8.0 Richter scale, in Northern Bagmati zone in 1767 AD with 7.9 Richter scale, in Kathmandu in 1833 AD with 8.0 Richter scale, in Kathmandu in1869 AD with 6.5 Richter scale, in Nepal/Tibet in 1916 AD with 7.7 Richter scale, in Nepal Bihar border in 1934 AD with 8 Richter scale, in Nepal/India border in 1966 AD with 6.3 Richter scale, in Nepal in 1980 AD with 6.5 Richter scale, in Nepal/Bihar in 1988 with 6.6 Richter scale and in Gorkha in 2015 AD with 7.8 Richter scale (MoHA, 2020). In these disasters, the government attempted their recovery at some extent. Its beautiful example is the recovery, reconstruction and rehabilitation cost of the Great Earthquake 2015 with about 7.8 billion USD. In addition, the multi disaster cycle functions annually in the different seasons. In 2019, the disaster cases were 2940 hazard events (boat capsizes, earthquake, epidemic, fire, flood, landslide, heavy rainfall, windstorm, lighting, drowning, high altitude and others). Nepal has lost per annum more than 2 billion Nepali Rupees (20.0 million USD). Annually, the post disaster management particularly recovery, reconstruction and rehabilitation are practiced. Therefore, the post disaster management or disaster management is understood theoretically as the concept of recovery.

As mentioned in the Post Disaster Need Assessment (PDNA), NPC (2015) considers it Build Back Better (BBB) in Disaster. Its short-term priorities include reconstruction of damaged DRR assets and improvements on BBB principle, measure to improve preparedness, response, relief and logistics systems, measures to strengthen information and communication capacities for relief, response and recovery and measures to enhance multi-hazard risk monitoring, vulnerability assessment, risk information dissemination and awareness. Similarly, its medium to long term priorities includes improvements in legal and institutional arrangements, measures to mainstream DRR into developmental sector, particularly housing, private and public infrastructure, social sectors (health and education) and livelihood and measures to improve integration of climate change adaptation and DRR. It is a reflection of Disaster Risk Management (DRM). It has a backdrop of international scientific and academic discourse and interaction in the Second World Conference on Disaster Reduction in Kobe, Hyogo, Japan in 2005. Then, its result has initiated internationally Building the Resilience of Nations and Communities in Disasters as Hyogo Framework for Action (HFA).   In 2015, the Sendai Framework for Disaster Risk Reduction 2015-2030 is

the first major agreement of the post 2015 development agenda with seven targets and four priorities for action. It was endorsed by the UN General Assembly following the 2015 Third UN World Conference on Disaster Risk Reduction (WCDRR). At the policy level, this approach is recommended in the post 2015 DRM Regulatory Framework in Nepal, the National DRR Policy and Strategic Action Plan for Nepal (2017-2030) and National Disaster Management Act 2017. Its reflection can be found in the establishment of National Reconstruction Authority (NRA) and in the integrity with national, provincial and local government development policy framework and budgetary allocation. Thus, the post disaster management is widely used to improve the resilience of the community.

With the recovery vision of well planned, resilient settlements and a prosperous society, Nepal Earthquake 2015: Post Disaster Recovery Framework (2016-2020) carries strategic objectives: restore and improve disaster resilient housing, government buildings and cultural heritage, in rural areas and cities, develop and restore economic opportunities and livelihoods and re-establish productive sectors and strengthen capacity and effectiveness of the state to respond to the people's needs and to effectively recover from future disasters. Its key policies are reconstruction of housing and cultural heritage sites, relocation and land use, engaging the community, private sector, volunteers and diaspora in reconstruction, integrating principles of disaster risk reduction and building back better, providing financial assistance, restoring employment and livelihood, improving data collection and public information, compliance and monitoring etc. Its approaches are owner driven reconstruction, relocation of villages, integrated habitat approach, urban reconstruction to improve cultural or historical settlements, application of building code and disaster risk reduction measures, community outreach, cash transfers, social inclusion, livelihoods support, capacity building, environmental and social safeguards etc. (NPC, 2015). None of literatures in Nepal have concerned to the issue of recovery in the post disaster. Therefore, this study may be highly relevant to further academic and scientific work.

This study examines whether status and nature of recovery are proper, whether household prefers to recovery, whether household's recovery is effective and whether household's choice is rationale. It is hopeful that this study would contribute valuable inputs to National Disaster Authority (NDA) to revise and implement disaster management policy and program and also multi sector development policy.

2. Objectives

This paper examines recovery of vulnerable household in the post disaster management in disaster prone hill areas of Nepal. Its specific objectives are to identify recovery options of households in the post disaster, to assess household preference, choice and behavior to select recovery options, to assess the effectiveness of household's recovery and their choice in climate induced disasters and to assess its economic cost and recovery days and its impacts at household level.

3. Disaster Risk Management (DRM)

Chen, Sharman, Rao & Upadhyaya (2011) mentions DRR as emergency management with different phases a) detection, b) preparation, c) responses, d) recovery and e) mitigation (Figure 1). In the disaster management or emergency management, recovery phase concerns to destruction and damage loss of household and public infrastructure and assets with the post disaster phase as well as human loss. A large studies and literatures have noted this phase as complicated and complex phase in policy action and program activities in the identified disaster spots mentioned as target spots because large evidences show multiple stakeholders (Government, Non-Government, Community organization and households) and with their heterogeneous objectives and unregulated and uncoordinated their activities induced multi-collinearity issues. Similarly, the results of cost assessment of these recovery phases provide an evidence of huge cost four times more than the cost of pre disaster preparedness and resilience. In general, the government expects the recovery within *least time* so that the cost of maximum time for recovery may not add extra and unproductive cost in terms the potential benefit loss from the productive socio-economic activities of human and economic agents from production to distribution and to consumption and from unvalued mental stress of productive human resources. Therefore, time for recovery is a valuable more than recovery cost.

Figure 1: Disaster Risk Management Cycle
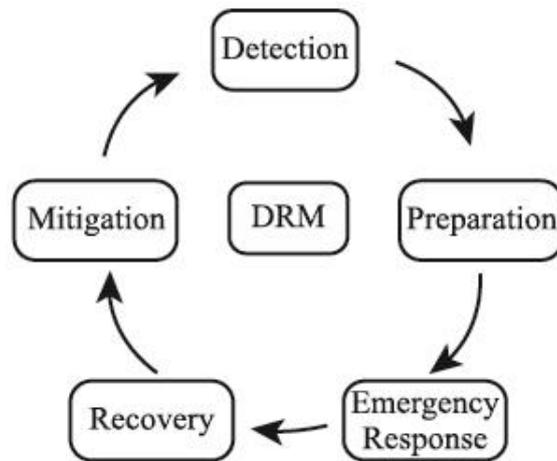
In addition, the government as well as mostly household considers it as an opportunity to reconstruct resilient infrastructures and to aware households to be prepared for next possible disasters (Figure 2). Therefore, it is a vital phase of disaster management.

Figure 2: A framework for disaster risk reduction
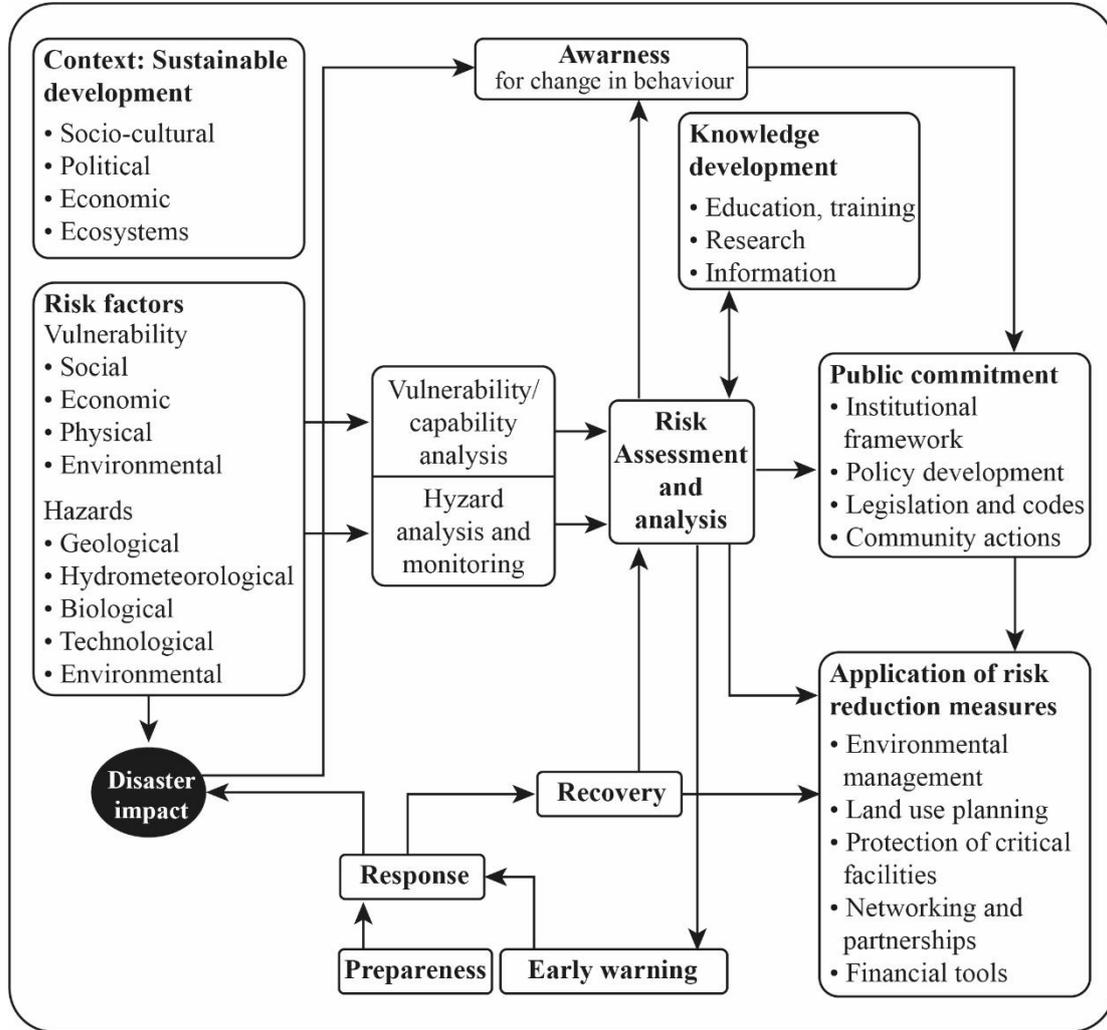
Source: Living with Risk: A Global View of Disaster Reduction Initiatives (Geneva: UN International Strategy for Disaster Reduction, 2002),p.23

4. Methodology

This section carries analytical framework, study area, data and data collection method as follows.

Nature of recovery is the community led if we observe reconstruction and rehabilitation under the recovery phase. Out of its large evidences, few evidences are as follows: a) in 2005, the community was involved in the disaster recovery in Australia Ministry of Civil Defense & Emergency Management 2005; b) in 2011, New Zealand had similar module (Commonwealth of Australia 2011) and c) in 2015, Nepal had also. It is supplemented by Hawkins and Maurer (2010) and Lead beater (2013). Therefore, it is the community led.

It is assumed that the recovery is an obligatory to the government and household to be resilient and to restore productive activities of economic sectors and the circular of wealth among product, money and labour markets. The recovery has two groups of agents: Group 1: Government Organization (GO), Non-Government Organization (NGO) and Community Organization (CO) and Group 2: Household (HH). Group 1 has dual responsibilities: i) direct leadership and ii) indirect leadership. Under direct leadership, Group 1 reconstructs public infrastructures restoring economic, social and environment, whereas under indirect leadership, Group 1 technically and financially assists to Group 2: households. In the reconstruction of private houses, Group 2 leads directly using indirect leadership of Group 1.

Figure 3(a): Analytical Framework
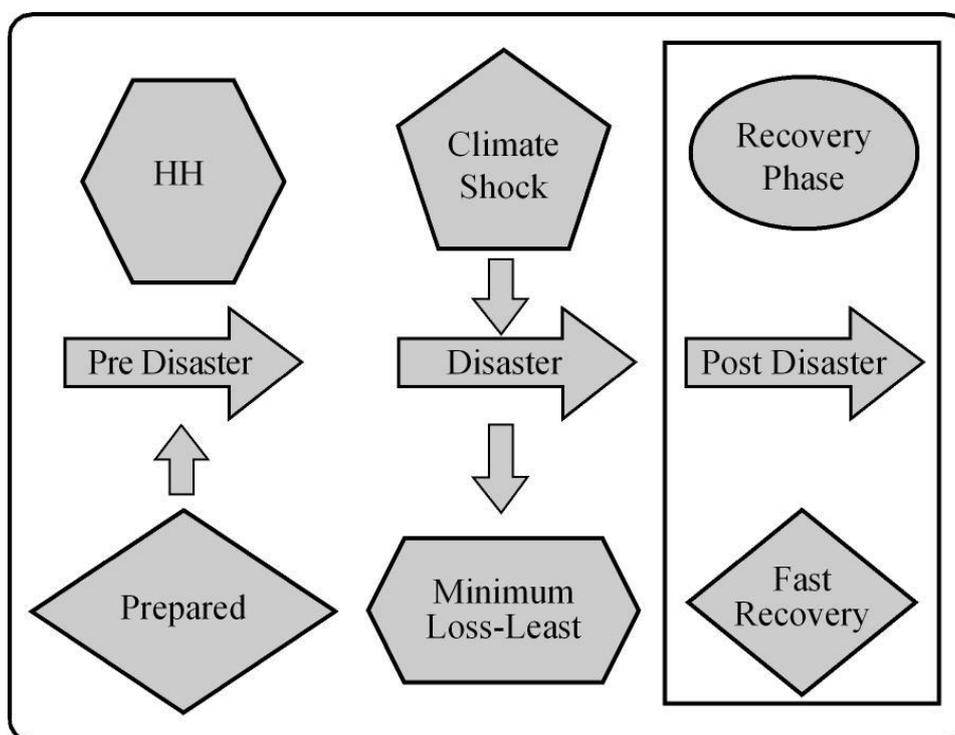
Source: Field Survey, 2015 & 2018

Let's assume that reconstruction and rehabilitation under the recovery of household depends on household's adaptation capacity: education level, socio economic level, indigenous knowledge, skill and experience and their income level, which determine their preference and choice of recovery options and orders in the post disaster management have contributed to their result and effectiveness level to reduce recovery time to restore their normal life and their productive activities (Figure 3 (b)). Therefore, household's adaptive capacity is significant to minimize recovery time and to restore their life and activities to maximize resilient to climate shock and climate induced disasters. This analytical framework is used to analyze household behavior-choices and preferences on recovery options in the post climate change induced disaster.

Figure 3(b): Analytical Framework
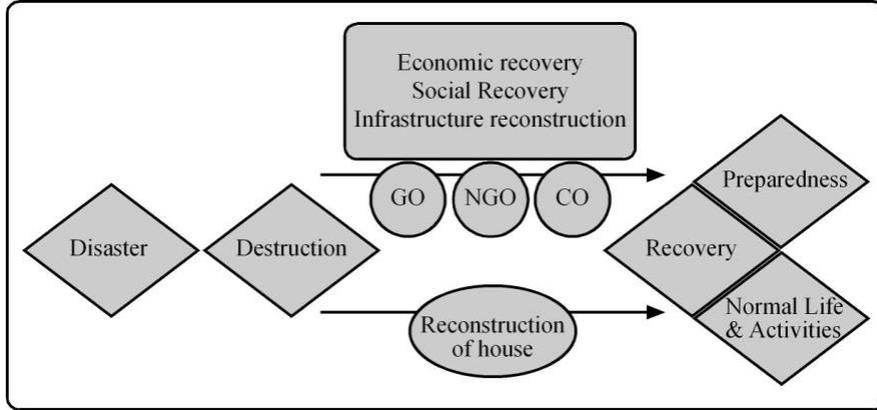
Source: Field Survey, 2015 & 2018

It is a query about the outcomes of post disaster recovery. Archer et al. (2015) found that there was no common understanding, definition or indicators of success for post-disaster recovery. The Canterbury Earthquake Recovery Authority (2014) examined the outcomes of the post-disaster recovery efforts for the 2011 Christchurch earthquake. The evaluation included indicators for economic recovery, social recovery, the built environment and the natural environment and Outcome indicators for post disaster (Table 1). Similarly, in this study, there are different indicators of the analytical framework measuring recovery's effectiveness level (Table 2). They are as follows in the table.

Table 1: Output Indicators

Recovery Components	Outcome Indicators
Economics	Business activity
	Economic Output
	Economic confidence
	Labor market
	Central city activity
Social recovery	Quality of life
	Educational achievement
	Mental Wellbeing
	Social connectedness
	Offending patterns
Built Environment	Land supply
	Central city repair and rebuild
	Horizontal infrastructure repair
	Ease of travel and transportation
Natural environment	Air Quality
	Bio Diversity
	Drinking water sources
	Waterway health

Source: Field Survey, 2015 & 2018

Table 2: Recovery Indicators

	Recovery Indicators
1	Repairing just damage houses
2	Reconstruction of full damaged house using anti flood materials and resilient structures
3	Cleaning environment and maintaining electricity, clean drinking water etc.
4	Setting rooms and household items
5	Maintaining agricultural land and crops
6	Participate in rescue and rehabilitation activities
7	Getting back to production activities (by repairing dams, paddy fields etc.)
8	Migrating to other areas in search of work; working more to earn extra income to aid family recovery
9	Coping with financial shortfall (withdrawing savings, selling stock, borrowing money)
10	Selling assets such as gold, motorbikes, land, livestock and selling means of production (seed s and machines)
11	Asking for aid/support from the government/NGO
12	Asking for support from relatives
13	Contributing man hours and money to local government to help repair the damage caused by the disasters

Source: Field Survey, 2015 &2018

Furthermore, recovery and rehabilitation activity carried out its economic cost. In that context, there was a query whether economic cost of recovery and rehabilitation changed household's income and expenditure. For this objective, n1 and n2 two random sample households (77) were withdrawn from 642 sample household's population randomly with means µ1 and µ2 and variances σ12 and σ22. Its hypothesis:

H0: µ1= µ2, (no significant difference between the population means), H1: µ1≠ µ2 (significant difference between the population means).

Theoretically, Its standardized statistics of "t" statistics: $t = \dfrac{\bar{x} - (\mu_1 - \mu_2)_{H_0}}{\widehat{\sigma}_{\bar{x}}}$

Where, variance $\widehat{\sigma}_{\bar{x}} = \dfrac{\widehat{\sigma}}{\sqrt{n}}$ $\qquad \widehat{\sigma} = s = \sqrt{\dfrac{\sum x^2 - n\bar{x}^2}{n-1}}$

4.1. Study Area

This study evaluates above objective to measure recovery options and their effectiveness of household in Sotkhola Water Basin Catchment areas (Gadhi, Lekhagaon and Kunathari VDCs) in the northern hill area of Surkhet, Nepal, selecting this study area based on the event of climate variation induced flood and landslide disaster and its huge damage cost in 2014 and the report of higher vulnerability and its morphological change and agricultural loss and risk.

This study area, Sotkhola Water Basin Catchment Areas (SWBCA) covers three VDCs: Gadhi, Lekhagaon and Kunathari locating geographically in the corridor of Sotkhola stream. This Sotkhola

stream, a tributary of a big river, Bheri (Figure 1) is of 30 km long originating from Chandane, Gadhi VDC and ending to Rakseni, Kunathari VDC (Figure 1) (DDC, 2015). Hydrological facts and figures show its consistent water level in both seasons: summer and winter seasons, despite its higher water level in summer time. Since the stream origins from Tibetan Plateaus like of major big streams, Koshi, Karnali, Gandaki and Mahakali, it can be categorized as a permanent nature. The field survey and observations of the catchment areas establishes the bold and warm relationship between the stream and the community households, although the settlements locate in the top hills. Almost all households use it as the livelihood drinking water. In terrace land and corridor plane land, it supplies regularly canal and lift irrigation water. Some section of the community uses it as adventurous water activities and fishing. Besides it, it maintains natural beauty and aesthetic values with aquatic life and ecosystem as well as terrestrial ecosystems and wildlife.

The catchment areas of 28 km2 spreads from the sea level to the Mahabharata range: Gadhi VDC (Upper stream), Lekhagaon VDC (Middle stream) and Kunathari VDC (Downstream) (DDC, 2015). Mahabharat range (hill and mountain) is the upper catchment area where Gadhi VDC with natural heterogeneity locates.

Demographically, population size is about 3369 (VDC, 2015). b) Lekhgaon village thatspreads 110 km length and 30 km breadth of 2451 square km (249016 hectare) from 198 meter (Tata pani) to 2369-meter (Matela gurase) altitude (Figure 4) is second catchment area where its landscape is dominated by Hill with 84 percent to 16 percent valley and its demographic size is 3999 (651 households) (DDC, 2015). c) Kunathari is another catchment area lying between 600 meters and 1200 meter (Figure 4). It is 20 km far from district headquarter. Its demography is 3413 (CBS, 1991&DDC, 2015).

Figure 4: Sotkhola and its catchment study Area
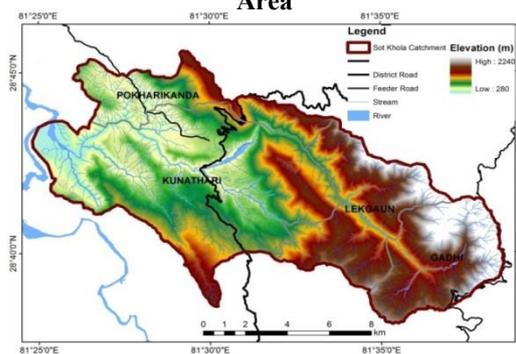
Source: GIS map of Study area based on field survey, 2015

4.2. Data sets and Data collection method

This study used secondary data sets of climate shock induced flood and landslides disaster and household vulnerability collected from District Development Committee (DDC) office as well as from Ministry of Home, along with the primary data sets related to household socio economic information collected from household survey conducted in the post natural disasters in 2014 during from September 2015 to October 2015 and during from Oct 2018 to Nov 2018 (Follow up Field work) to collect reliable and accurate data and information about climatic events and disasters and its vulnerability to install hydrological monitoring system, alert system, infrastructure and building adaptation capacity. As supplementary tool, Key Informant Interview (KII) was employed.

Table 3: Recovery and Rehabilitation options

S.N.	Recovery and Rehabilitation Options	Percent
1	Repairing just damage houses	40.7
2	Reconstruction of full damaged house using anti flood materials and resilient structures	22.2
3	Cleaning environment and maintaining electricity, clean drinking water etc.	5
4	Setting rooms and household items	
5	Maintaining agricultural land and crops	
6	Participate in rescue and rehabilitation activities	
7	Getting back to production activities (by repairing dams, paddy fields etc.)	5
8	Migrating to other areas in search of work; working more to earn extra income to aid family recovery	5
9	Coping with financial shortfall (withdrawing savings, selling stock, borrowing money)	4
10	Selling assets such as gold, motorbikes, land, livestock and selling means of production (seed s and machines)	
11	Asking for aid/support from the government/NGO	10.6
12	Asking for support from relatives	7.4
13	Contributing man hours and money to local government to help repair the damage caused by the disasters	
	Total	**100**

Source: Field Survey, 2015 & 2018

The household survey was designed into two stage sampling method: cluster and random sampling method. In first stage sampling method, cluster method was used by dividing nine clusters based on altitude, location and place covering 3310 households over the catchment areas: Gadhi, Lekhagaon and Kunathari. Similarly, in second stage sampling method, 642 household samples (19.3%) was randomly selected by using random sampling method from nine clusters.

In the survey, the structural questionnaire was its tool to survey 642 sample households to collect about 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, along with their emergency response. As analytical tools, there was employed indicators based simple descriptive statistics and t statistics.

5. Results and Discussion

Result 1: Household Choice Perfernce on Recovery Options

Table No 3 presents explicitly the results of 13 recovery options in the three watershed areas (Gadhi, Lekhagaon and Kunathari) including1) repairing houses, 2) reconstruction of house using anti flood materials and resilient structures, 3) cleaning environment and maintaining electricity, 4) clean drinking water etc., 5) setting rooms and household items, maintaining agricultural land and crops, 6) participate in rescue and rehabilitation activities, 7) Getting back to production activities (by repairing dams, paddy fields etc.), 8) Migrating to other areas in search of work; 9) Coping with financial shortfall(withdrawing savings, selling stock, borrowing money), 10) Selling assets such as gold, motorbikes, land, livestock and selling means of production(seed s and machines), 11) Asking for aid/support from the government/NGO, 12) Asking for support from relatives and 13) Contributing man hours and money to local government to help repair the damage caused by the disasters. Out of 13 recovery options, heterogonous households in terms of education level, income level and socio-economic level reflects heterogeneous nature of their choice, preference and behavior, although almost all households focus on fast recovery through their reconstruction and rehabilitation of economic activities for their normal life and activities.

Result 2: Determinants of Household Choice, Preference and Behavior on Recovery Options

Table 4 reveals the results of seven determinants behind household choice of adaptation measures such as a) repairing houses, cleaning environment and maintaining electricity, b) clean drinking water etc., c) Getting back to production activities (by repairing dams, paddy fields etc.), d) Coping with financial shortfall (withdrawing savings, selling stock, borrowing money), e) Migration to work, f) Supporting from relatives and g) Support from GO and NGO

Table 4: Recovery Options

S.N.	Recovery Options	Indigenous Knowledge & Practices			Government Circular
		Indigenous knowledge	Neighbor's initiation	Everyone is doing it	
1	Repairing houses and reconstruction	62.3	17	20.7	
2	Cleaning environment and maintaining electricity, clean drinking water etc.	58.4	10	31.6	
3	Getting back to production activities (by repairing dams, paddy fields etc.)	80	2.8	17.2	
4	Coping with financial shortfall (withdrawing savings, selling stock, borrowing money)	96		4	
5	Migration to work	82.8	4.4	12.8	

6	Supporting from relatives	45.7	2.8	51.5	
7	Support from GO and NGO		10	65	25
	Average (Mean)	61	7	29	3

Source: Field Survey, 2015 & 2018

Result 3: Effectiveness of Recovery Options

Table 5 provides the result of effectiveness of recovery options: a) repairing houses, cleaning environment and maintaining electricity, b) clean drinking water etc., c) Getting back to production activities (by repairing dams, paddy fields etc.),d) Coping with financial shortfall(withdrawing savings, selling stock, borrowing money), e) Migration to work, f) Supporting from relatives and g) Support from GO and NGO and their choice, preference and behaviour in the post climate change induced disasters in the catchment areas. Its effectiveness determines to reconstruction, rehabilitation and recovery of life and activities. If household holds good education level, income level, network, socio economic level and access to the government and NGO, recovery will be at minimum time to reconstruct and rehabilitate themselves without delay and additional economic loss. The recovery measures show its effectiveness and highly effectiveness. If not,

Table 5: Effectiveness of Recovery Options

Effectiveness	Not effective	Fairly effective	Effective	Very Effective
Repairing houses	0	6.8	6.8	86.7
Cleaning environment and maintaining electricity, clean drinking water etc.			27.9	71.9
Getting back to production activities (by repairing dams, paddy fields etc.)		2.7	15	81.3
Coping with financial shortfall (withdrawing savings, selling stock, borrowing money)	0		26.7	72.3
Migration for work			9.7	91.3
Support from relatives			41.3	58.7
Support from GO and NGO	65.4	15.6	9.5	9.5
Average (Mean)	9	4	20	67

Source: Field Survey, 2015 & 2018

Household will be rush to reconstruct, rehabilitate and recover at minimum time to return in normal life and activity. The recovery measures show its ineffectiveness. Table No 5 reveals measurement of effectiveness of household's recovery on their preference and choice of return back in their own house.

Economic cost of Recovery

Table 6 offers the result of recovery options: a) repairing houses per annum, b) cleaning environment, maintaining electricity and clean drinking water etc., c) Getting back to production activities (by repairing paddy fields etc.) and their economic costs including material cost per household (HH) and labour days per household (HH).

Table 6: Recovery options and Economic cost (Rs)

Recovery Options	Economic cost (Rs)			
	Material Cost (Rs) per HH	Material Cost (Rs) per HH	Material Cost (Rs) per HH	Material Cost (Rs) per HH
Repairing houses per annum	25000	34	500	42000
Cleaning environment and maintaining electricity, clean drinking water etc.		8	500	4000
Getting back to production activities (by repairing paddy fields etc.)		27	500	13500
Average (Mean)				59,500

Source: Field Survey, 2015 & 2018

Table 7 presents the result of recovery areas in three catchment areas: a) Gadhi (Upper Catchment), b) Lekhagaon (Middle Catchment) and c) Kunathari (Lower Catchment) and indicators: a) Mean Cost per household (HH) and b) Recovery days per household (HH).

Table 7: Reconstruction of house options and Economic cost (Rs) across the Catchment Areas

Recovery Areas/indicators	Economic cost (Rs)	
	Mean Cost (Rs) per HH	Mean Cost (Rs) per HH
Gadhi (Upper Catchment)	38400	26.8
Lekhagaon(Middle Catchment)	41600	33
Kunathari (Lower Catchment)	46000	42
Average (Mean)	42000	34

Source: Field Survey, 2015 & 2018

Table 8 provides the result of the impact of recovery and rehabilitation in three catchment areas: a) Gadhi (Upper Catchment), b) Lekhagaon (Middle Catchment) and c) Kunathari (Lower Catchment) on household's expenditure and income level.

Table 8: Result of "t" test on the effect of disaster

Variable	t-Statistics (Standard Error)	p-value
Change in expenditure level in the post disaster	-23.602 (0.847)	(0.000)
Change in income level in the post disaster	-5.86 (0.053)	(0.000)

Source: Field Survey, 2015 & 2018

Discussion

Household Recovery

Above results of descriptive statistics, they provide sufficient and necessary fact, figure and evidence about *household recovery* as action of household in the post water induced disaster management, like as of the community and the government because disaster distorts physically, financially, socially, emotionally and mentally to do normal business of life. In the catchment areas, flood damaged partially and fully food, cloths, papers and assets in Kunathari whereas landslides swept out all tangible and non-tangible assets along with house in Gadhi and Lekhagaon. It was difficult time to households to restore their house and activities in the absence of livelihood materials such as food, species, energy, vegetables, cloths etc. and money. Either rich or poor Household stayed temporarily in the community public place with social discussion, communication and integration. Gradually, they started to visit their house to assess household damage to find out a way out and alternatives. In general, they identified household's items and their condition. And then, they started to clean house's external environment and entered inside house. Interestingly, they checked and managed kitchen items, food items and sleeping rooms to assess house's comfort ability and feasibility to return in house from the community. Then after, they started reconstruction and rehabilitation of their livelihood activities with the support of friends, relatives and community. Thus, household started independently their recovery. In the catchment areas, the community and the government level were not properly reached out to disaster affected all households because these community-based organizations and the government had not institutional, financial and human resource wisely.

In the catchment areas, the local people were painfully shocked and murmuring silent without any words of their great tragedy. Almost all expressed their sadness and painful in their tears. Their positions were scattered into small family clusters with deep and pinpoint silent, except natural phenomenon sound. At that severity of vulnerability and zero-sum crisis, they had not a better alternative to believe for their disaster management and recovery as soon as possible, except their own indigenous knowledge, experience and skill. Almost all's desire was to return at house as soon as possible. In this context, nature and pattern of household recovery was indigenous, simple, slow, traditional, individual, and emotional and family oriented. Its scale was very small. Despite their painful tragedy, barter oriented cooperation and support and using local material were prominent. The recovery was basically survival and livelihood oriented across different income groups, different cultural groups and different religious groups. As a result, the recovery would help to rehabilitate them gradually in normal life. Thus, such household recovery activity and option has policy relevancy at micro level and also at macro level because Nepal is disaster prone country with 4th rank in the Global climate risk index and 11th in the multiple disasters risk

index. In addition, Nepal has not completed the great earthquake disasters 2015's recovery and reconstruction activities all over the country.

Household Recovery: options, choices and preferences

Above figure provide household's automatic recovery to manage disaster with their indigenous knowledge & skill, despite their vulnerability. Above the result of the descriptive statistics shows several socio-economic household recovery options in the post disaster management as follows: 1) repairing houses, 2) reconstruction of house using anti flood materials and resilient structures, 3) cleaning environment and maintaining electricity, 4) clean drinking water etc., 5) setting rooms and household items, maintaining agricultural land and crops, 6) participate in rescue and rehabilitation activities, 7) getting back to production activities (by repairing dams, paddy fields etc.), 8) Migrating to other areas in search of work; 9) coping with financial shortfall(withdrawing savings, selling stock, borrowing money), 10) selling assets such as gold, motorbikes, land, livestock and selling means of production(seed s and machines), 11) asking for aid/support from the government/NGO, 12) asking for support from relatives and 13) contributing man hours and money to local government to help repair the damage caused by the disasters. Out of 13 socio economic household recovery options, individual household tried to make best choice and preference with the expectation of best performance and effectiveness in terms of time, money and other resources for fast reconstruction, easy rehabilitation and satisfied recovery, although their vulnerability is a barrier to be rationality. In the assessment of household damage, there were different levels. If we categorized into two groups: fully and partially. In addition, there were extremely vulnerable and non-vulnerable groups. Its reflection can be found in their choice and preference shown in Table 3. Table 3 shows majority of households (100%) choose house repair and reconstruction. However, those households (41 %) who had partially damaged house choose repairing house but about 22.2 percent household who had fully damaged house choose reconstruction of house. Concerning highly vulnerable households (25%) who had partial damaged house preferred to ask external assistance from NGO/GO and relative. Out of 25 percent, about 17.4 percent preferred to ask external assistance from NGO/GO and about 7.4 percent household preferred to request to relatives. Therefore, almost all household's choice and preference were related to reconstruction and repair first and then others as household recovery because house was socially and economically considered as the foundation of life, livelihood and security. In addition, household shows their preference on cleaning environment and maintaining electricity, clean drinking water etc., getting back to production activities (by repairing dams, paddy fields etc.), coping with financial shortfall (withdrawing savings, selling stock, borrowing money), and migration to work. In 2020, such type of similar practices at household level in Tikapur, Kailali and Rajapur, Bardiya can be found in flooding in Karnali River 2020 (Practical Action, 2020).

Household Recovery: behaviour and drivers

Household's behavior is generally conscious and responsive to crisis trauma induced abnormal situation in terms of emotionally, mentally and physically loss demotivated desire disruption and shortage of finance and also disruption of supply and production of livelihood goods and services. In the abnormal situation, household couldn't show their rationality in choice and preference, except compromises and silent acceptance on whatever available goods and services.

Above results of household's choice and preference on a) repairing houses and reconstruction, b) cleaning environment and maintaining electricity, clean drinking water etc., c) getting back to production activities (by repairing dams, paddy fields etc.),d) coping with financial shortfall(withdrawing savings, selling stock, borrowing money), e) migration to work, f) supporting from relatives and g)support from GO and NGO are found two major drivers: indigenous knowledge and practices and government circular. In the case of accepting support from NGO and GO, small size of households opined to Government circular as driver of that decision, whereas all household's choice and preference was driven by indigenous knowledge, neighbor and community level. In the table 4, most their choices and preference were influenced by indigenous knowledge (61%) and then by the community's action (29%) and neighbor's initiation (7%). Thus, the role of government could not be valuable to household at micro level, except indigenous knowledge and the community led. Similar cases can be found in the different river and catchment areas. As example, in 2020, household behavior and drivers in Tikapur, Kailali and Rajapur, Bardiya were found. In the post flood in Karnali River 2020, the community preferred to use their own indigenous knowledge to reconstruct their houses. In addition, Chowdhary community had community level behavior (Practical Action, 2020). Therefore, indigenous knowledge of household is a key driver of their behavior.

Household Recovery: effectiveness and ineffectiveness

Recovery is sensitive issue. It is if effective, household recovery will be complete and household's response will be satisfied. It is possible only when household's choice and preference on recovery strategy option is rationally logical and strategically need. Therefore, household's choice and preference must be relevant to disaster induced socio economic and emotional crisis and abnormality.

Above results of descriptive statistics shows household's recovery strategy options: a) repairing houses and reconstruction, b) cleaning environment and maintaining electricity, clean drinking water etc., c) getting back to production activities (by repairing dams, paddy fields etc.),d) coping with financial shortfall (withdrawing savings, selling stock, borrowing money), e)migration to work, f) supporting from relatives and g) support from GO and NGO. Since the degree of their effectiveness depends on their outputs and outcomes in terms of fast, easy and reliable reconstruction, rehabilitation and recovery, above household's recovery strategy options were measured with two ranks: a) ineffective and b) effective (i) fairly effective, ii) effective and iii) very effective) based on the decision maker of household.

Above results of descriptive statistics shows 91 percent effective to all choices, preferences and behavior of households but only 9 percent ineffective, particularly on Go and NGO's role. Recovery strategy I: repairing houses and reconstruction was 100 percent to contribute rehabilitation and recovery of household. Majority household (87%) opined it very effective. After then, household preferred on b) cleaning environment and maintaining electricity, clean drinking water etc., c) getting back to production activities (by repairing dams, paddy fields etc.),d) coping with financial shortfall (withdrawing savings, selling stock, borrowing money), e)migration to work and f) supporting from relatives for rehabilitate in production activities for socio economic recovery. Almost all (72%) households realized very effective measure to these five recovery strategy options for their normal life. About 27.9 percent thought effective measure. Thus, all were 100 percent effective in table 5.

Extremely vulnerable households expected the support from GO and NGO. However, GO and NGO could not reach out to the target victims. In table 5, the recovery strategy option was considered not effective by 65.4 percent household because GO and NGO had not supported properly. Besides, the remaining household (34.6%) though effective measure in which there were 9.5 percent household for very effective, 9.5 percent household for effective and 15.4 percent household for fairly effective.

Household Recovery and Economic Cost

Above results of descriptive statistics (Table 6) shows three major recovery activities: a) repairing houses per annum, b) cleaning environment, maintaining electricity and clean drinking water etc., c) Getting back to production activities (by repairing paddy fields etc.) and their economic costs including material cost per household (HH) and labor days per household (HH).

Above results of descriptive statistics (Table 6) reveals three major recovery activities having economic cost of house reconstruction and paddy farm repair. In general, house damage was found into two groups: a) fully damaged and b) partially damaged. In addition, almost house was constructed mud and stone and wood accessing free of cost to local people. The house was only two stairs. There was a cost of cement and rod. Therefore, the reconstruction material economic cost per household was 25000 Rs and labor cost of 34 days at 500 Rs was 17000. Thus, its total cost of household reconstruction was 42000 Rs. In general, labor supply was available inside household.

Similarly, there was activity of cleaning environment, maintaining electricity and clean drinking water having 4000 Rs cost if we convert household's their labor allocation. Simultaneously, household allocate their labor on paddy farm repair including cleaning sediments loaded by the flood and manage properly to the paddy farm for 27 days. Its average cost was 13500 Rs. In total, household had 59500 Rs reconstruction and repair economic cost. Since in the catchment areas, about 67 percent households were socio economic vulnerable, such recovery cost would be financial burden and driver to increase their critical vulnerability.

Similarly, above results of descriptive statistics (Table 7) reveals the result of recovery areas in three catchment areas: a) Gadhi (Upper Catchment), b) Lekhagaon (Middle Catchment) and c) Kunathari (Lower Catchment) with 42000 Rs. mean cost per household (HH) and 34 recovery days per household (HH). Relatively, recovery cost of Kunathari (Lower Catchment) (46000 Rs) was higher than Lekhagaon (Middle Catchment) (41600 Rs) and Gadhi (Upper Catchment) (38400 Rs). In addition, a recovery day of Kunathari (Lower Catchment) (42 days) was higher than Lekhagaon (Middle Catchment) (33 days) and Gadhi (Upper Catchment) (26.8 days). Similarly, in Tikapur, Kailali and Rajapur, Bardiya, their reconstruction cost was approximately Rs. 40000 per household and their recovery days were found about 25 days. Therefore, it represents our low cost building's reconstruction cost per household and recovery days if all variables are constant.

Above table of the result of "t" test indicates insignificant change in income and expenditure of household because of flood disaster and recovery and rehabilitation activity. In the comparison with the table "t" value, the calculated value is less than the table "t" value. Therefore, the null hypothesis is rejected. It means there was significant difference in household income and expenditure before and after recovery and rehabilitation activity. We can conclude that the cost of recovery and rehabilitation had negative impact in the catchment areas: Gadhi, Lekhagaon and Kunathari, Surkhet.

6. Conclusion

Based on above discussion on the result of descriptive statistics of recovery options, its determinants and effectiveness, the recovery response and behavior of almost households of the catchment areas (Gadhi, Kunathari and Lekhagaon) in the post disaster 2014 occurred with speed up, despite their vulnerability and poverty. As per their urgent need, almost all household's preference and choice to repair and reconstruction of house were most relevant to rescue themselves from trauma and stress into normal life: returning in house and livelihood activities. Its endogenous driver was individual's indigenous knowledge and practice whereas its exogenous variable was community led. Such recovery strategy of household could fill up their gap and need on time with security of night and day and schedule of food, cleaning, bathing and lodging. Therefore, it was very effective to rehabilitate themselves day by day in the normal schedule of livelihood and economic activities, despite the poor rescue and recovery scheme of the government. In addition, in total, household had 59500 Rs reconstruction and repair economic cost. Out of it, average reconstruction of house was 42000 Rs and average days of reconstruction were 34 days. Similarly, the result of "t" test provides the change in income and expenditure household was significant because of flood disaster and recovery and rehabilitation activity. Since in the catchment areas, about 67 percent households were socio economic vulnerable, such recovery cost would be financial burden and driver to increase their critical vulnerability. Therefore, the result may be more relevant theoretically and empirically to the policy maker of the federal government of Nepal, the province government and local government and Non-State actors to improve their network, focus, connectivity, coverage, accessibility and rescue scheme and also to change priority on preparedness along with development activities (infrastructure, construction and capacity building). In addition, the three tier governments should allocate financial and technical resources to reduce financial burden to the vulnerable groups and recovery days for reducing their invisible and visible non-economic cost for reducing their poverty and vulnerability. Thus, the policy reforms could help for achieving safety from the disaster and SDG 2030's Goal: Goal 1: No Poverty, Goal 13: Climate Action, Goal 14: Life below Water and Goal 15: Life on Land.

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