An account of Nepal disasters and economic fallout

Sujan Adhikari, Dileep Adhikary

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Sujan R Adhikari[1] and Dileep K Adhikary[2]

Abstract: Nepal has remained a disaster-prone country with major disasters occurring at various intervals. There has not been sufficient research on Nepal disasters regarding the degree of loss, effects on the economy and post-disaster responses and its effects on economic revival. This paper was primarily set to analyze economic effect of natural disasters from 1971 to 2017 but for the lack of complete data on loss value for all the events an attempt was made to make a proper estimate for all the events; and the economic loss ensuing from the disasters has been assessed as a proportion of gross domestic product, and further to its impact on the year to year growth of the economy. The paper adds to the finding of other studies that disaster lends negative effect and that too is more prominent in the event of major disasters and more pronounced when coupled with political disruptions.

Key Words: Manmade and natural disasters; Typology/category of disasters; Hazards and vulnerability; Cost, effects and impacts of disasters; Disaster response; Economic growth and loss; Desinventar data.

1. Introduction

Disasters occur when hazards meet vulnerability (Blaikie, Cannon, Davis, and Wisner 1994). There are either natural disasters or man-made. The first could be categorized into meteorological (atmospheric: cold, heat, windy/storm), climatological (land conditions affected by weather: droughts, famine, wildfires, avalanche), hydrological (water-related: rains, floods, landslides), geophysical (earthquake, volcanic eruptions, tsunami) and biological (life affected by way of diseases, infestation, etc.) origins. The second resulting from deliberate or negligent human actions could be categorized into accidents (explosion and blasts, leakage and bursts, fire), disruptions/disorders (civil unrest, power blackout, transport blockades, cyber terrorism), aggression (violence, armed incursion, war) and emergencies (medical such as chemical contamination, and environmental such as pollution). Besides, manmade disaster is also implicated owing to mismatch in human-nature relationship as building or settling in flood-prone or geologically unsustainable areas, and overuse of natural resources beyond the cycle of replenishment.

Lives, assets, and output are elements of risk which could be affected or wiped out in the event of disaster depending upon the state of vulnerability or the extent these are exposed. As per Green (2004) vulnerability exposes the negative relationship between a purposive system and its environment, where that environment varies over time. Hallegatte, 2014 specifically states that disaster occurs when a hazard affects the system and causes sufficiently larger negative consequences to this system (on assets, production factors, output, employment, or consumption).

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Every country has been overrun by one or other kind of natural disasters in different periods of time. People are at the mercy as some 75% of the world's population lives in areas affected at least once by natural disaster between 1980 and 2000 (UNDP, 2004). This study is focused on the analysis of natural disasters that occurred from 1971 to 2017 in Nepal.

2. Review

2.1 Costs

When disaster occurs, the cost comes into question, a synonym for loss, damage or impact. van der Veen (2004) reckons that it may refer to accounting costs (expenditures) or economic concepts of costs, which include both expenditures and opportunity costs.

Generally, when disasters are reported an estimated loss in terms of lives (human and livestock) and destruction (built-ups, farms and crops) are provided. The cost of disaster does not end here. Apart from direct physical and output losses disasters lead to indirect losses (as there would be resultant capacity (capital) losses, market and non-market losses, and losses will ensue from backward and forward ripple effects on infrastructure and utility services (electricity, water and sanitation, gas, etc.). Hallegate and Przyluski (2014) state that indirect losses span over 'a longer period of time than the event, and they affect a larger spatial scale or different economic sectors. In wider probabilities disasters would increase emergency costs, interrupt business, disrupt supply-chain, limit production, reduce demand, increase repair costs, constrain economic growth, impair health, provoke psychological trauma, disrupt social network, provoke poverty or inequalities, and weaken security, cohesion, and stability.

More appropriately as Hallegate and Przyluski (2010) point out the cost of the disaster has indeed to be calculated by comparing the actual trajectory (with disaster impacts) with a counterfactual baseline trajectory (i.e., a scenario of what would have been the situation in the absence of disaster). They add that the output losses are likely to increase nonlinearly with the size of the disaster (and the amount of destruction) for reasons of the ripple effects, and owing to slow reconstruction capacity (limited by financial and technical constraint).

2.2 Effects

The studies are divided as to whether disasters exert negative or positive influences in the national economy. Hallegate and Przyluski (2010) report that Albala-Bertrand (1993) and Skidmore and Toya (2002) found a positive influence of natural disasters on long-term economic growth, due to the productivity effect as well as the stimulus effect of reconstruction. However, studies by Noy and Nualsri (2007), Noy (2009), Hochrainer (2009), Jaramillo (2009), Raddatz (2009), and Felbermayr and Gröschl (2013) state a negative impact of disasters on growth.

Cavallo, Galiani, Noy, and Pantano (2010) examined the short and long-run average causal impact of catastrophic natural disasters on economic growth by combining information from comparative case

studies. The study found that only extremely large disasters followed by radical political revolutions (the cases of the Islamic Iranian Revolution and the Sandinista Nicaraguan Revolution, both in 1979) have a negative effect on output, both in the short and long run. The study further states that even extremely large disasters do not display any significant effect on economic growth once these political changes are controlled for. Horwich (2000) reports that despite the 1995 Great Hanshin earthquake at Kobe, Japan causing $114 billion worth of damages representing about 2.5% of gross domestic product, within 15 months manufacturing was operating at 98% of the pre-earthquake trend, all department stores and 78% of small shops had reopened within 18 months, and trade at the port was operating close to pre-earthquake levels within 1 year. However, a study by duPont and Noy (2012) shows that household incomes in Kobe more than 15 years after the disaster are still about 15% lower than what would have been had the earthquake not occurred.

Arguing that natural disasters do not have systematic effects on economic growth, Zenklusen (2007) provides explanations that include the geographic and economic localization of most catastrophes, the compensatory effects of reconstruction, and the primary importance of human capital for aggregate output. Firstly, in small developing countries, aggregate effects may be observed for large disasters. Secondly, catastrophes may have repercussions on variables other than aggregate output, such as external balances. Thirdly, macroeconomic effects may be related to floods, storms and droughts, but rarely to earthquakes and volcanic eruptions. Finally, catastrophes appear to primarily affect the poor.

Albala-Bertrand (1993a) state that "…disasters are primarily a problem of development, they are not necessarily a problem for development." Though Albala-Bertrand, 1993, 2006; Caselli and Malhotra, 2004 find natural disasters do not negatively affect GDP other studies find significant short-to-medium-term macroeconomic effects (Otero and Marti, 1995; Benson, 1997a,b,c; Benson, 1998; Benson and Clay, 1998, 2000, 2001; ECLAC 1982, 1985, 1988, 1999, 2002; Murlidharan and Shah, 2001; Crowards, 2000; Charveriat, 2000; Mechler, 2004; Hochrainer, 2006; Noy, 2009). Kreimer and Arnold (2000) considered natural disasters as setbacks or obstacles for development. As described by DHA (1994) "disasters frequently wipeout years of development programming and set the slow course of improvement in the third world countries further behind, wasting precious resources." Freeman et al. (2000) noted the characteristic of developing countries lacking means for financing that could further aggravate by political or social destabilisation (UNDP and UNDRO, 1992; Caviedes, 1995), business cycles, financial crises or fluctuations in the price of important exports or import goods (Benson and Clay, 2000). Disasters could cause distributional implications as well regarding wealth, income, and exposure to risk (Hoogeveen, 2000; Wisner, 2003).

Okuyama and Sahin (2009) worked on the global aggregate of disaster impacts from 1960 to 2007 using Social Accounting Matrix (SAM) methodology. The analyses of 184 major disasters in terms of the size of economic damages show a growing trend of economic impacts over time in absolute value. Fomby, Ikeda, and Loayza (2009) study traced the yearly response of gross domestic product growth—both aggregated and disaggregated into its agricultural and non-agricultural components—to four types of natural disasters— droughts, floods, earthquakes, and storms. The results of assessment of cross-country and annual time-series data covering 87 countries over the period 1960-2007 revealed the following: First, the

effects of natural disasters are stronger, for better or worse, on developing than on rich countries. Second, while the impact of some natural disasters can be beneficial when they are of moderate intensity, severe disasters never have positive effects. Third, not all natural disasters are alike in terms of the growth response they induce, and, perhaps surprisingly, some can entail benefits regarding economic growth. Hallegatte and Ghil (2007) added business cycle framework to the study of disaster impacts. They analyzed the effects of exogenous shocks, including natural disasters and stochastic productivity stocks, on economic behavior. Employing a Non- Equilibrium Dynamic model with endogenous business cycles, they found that total GDP losses resulting from natural disasters are higher when occurring during expansions than during recessions. The regression analysis by Kim ( ) suggests a robust positive correlation between the frequency of disasters and long-run economic growth.

The post disaster restoration will not be the same. Tomsho (1999) describes the Jacuzzi effect that occurs specifically when homeowners add new or improved features to their dwellings during disaster repairs. Horwich (2000) stated that "restored economies will not be a replica of the pre-disaster economy. Destruction of physical assets is a form of accelerated depreciation that hastens adoption of new technologies and varieties of investment." Toya and Skidmore (2005) used per capita GDP, total years of schooling attainment, trade (exports + imports), finance, and government consumption to examine the degree to which the human and economic losses from natural disasters are reduced as economies develop. They find that countries with higher income, higher educational attainment, greater openness, more complete financial systems and smaller government experience fewer losses. Noy (2012) shows that 'aggregate adverse short-run effects at the national level can be observed in middle- and low-income countries experiencing traumatic disasters. These countries have difficulty financing reconstruction; as they generally face difficulties conducting counter-cyclical fiscal policy and their insurance and re-insurance markets are significantly shallower. The short-term adverse impact in high-income countries, in contrast, is typically countered by the increased reconstruction spending'.

2.3 Responses

Benson and Clay (2004) state that the vulnerability depends upon level of development. Zenklusen (2007) adds on that with development, direct damages decrease while indirect impacts increase. Disaster effects (as a % of GDP) increase with development for poor countries and decreases with development for rich countries. As such mainstreaming of disaster risk management into long-term development strategies has been prescribed including programmes for decoupling vulnerability from poverty and the countries are found adopting this so as to minimize the negative effects of disasters.

Toya and Skidmore (2005) state that income is not the only important measure of development in reducing disaster deaths and damages. Socio-economic fabric can improve the level of safety and as such higher educational attainment, greater openness, a well-developed financial sector and smaller government are important.

Noy (2012) states that certain economic conditions and policies may lead to increased resilience in the aftermath of disaster, but, its negative impact could be exacerbated significantly by factors such as the existence or absence of ex-ante disaster management plans, the flexibility to re-allocate resources

efficiently for disaster relief and reconstruction, the expected access to extra-regional funds from the central government or from other sources (foreign aid, re-insurance payments, etc.), and the ability of the region's dominant economic sectors to rebound.

2.4 Approaches

With respect to direct losses the estimates either follow the market value or insurance perspective or repair costs. Clower (2005) states of the several data analysis techniques used to assess the indirect and income effects of disasters. These techniques include surveys, econometric models, Box-Jenkins time series analyses, input-output models, general equilibrium models, and economic accounting models (Cochrane, 2004; Chang, 2003; Zimmerman et. al., 2005). Econometrics analyses have been used to measure output losses, understood as reduction in GDP following a disaster, but as noted by Hallegate and Przyluski (2010) they reach contradictory conclusions.

Munich Re (2001) provides insurance perspective of disasters loss assessment as shock to stock variables are taken into account that include buildings, production facilities, contents, inventories, public infrastructure, agricultural crops etc. It accounts for the replacement plus the damage remediation. UN Economic Commission for Latin America and the Caribbean, in short ECLAC (2003) proposes an analytical framework and a practical methodology for estimating disaster impacts, differentiated by direct, indirect and secondary effects. Zenclusen (2007) has captured differential methodologies in assessing disaster effects as follows:

Direct, indirect, and total loss(ECLAC, 2003)	**Insured and Economic Loss (Munich Re, 2001)**	**Neoclassical Framework**
Direct effects: Economic **Damage to assets and stock of goods, raw materials etc.**	Direct losses The primary (re-) insurance definition of economic loss.	ΔKd Shock to the capital stock
Direct effects: Humanitarian **Valuation considered impractical.**	Not included. Effects on GDP in some instances estimated from the number of workers affected.	ΔLd Shock to the labour force
Indirect effects **Goods and services not produced due to disaster plus increased expenditure. Time span: 2.5 years.**	Indirect losses Aggregated "business interruption" (ΔYd at the micro level).	ΔYd = f(ΔKd, ΔAd, ΔLd)
Total loss **Direct effects + indirect effects**	Economic loss Direct losses + indirect losses	-
Secondary effects **GDP, growth, external balances,** **public finances, gross investment, employment, inflation etc.**	Secondary losses GDP, GNP, balance of payments, budget deficits	Effects on macroeconomic variables: Y, dY/dt, C, I, IM, EX, CA, G, T

Mechler (2003) and Freeman et al. (2002, 2004) analyse the macro- economic implications of natural disasters in a modeling framework that combines an insurance approach to loss estimation with an economic growth model. Zenclusen (2007) adds on that this approach includes elements from both microeconomics (the insurance perspective) and macroeconomics (a growth model) while the overall perspective is primarily normative. Albala-Bertrand (2006) criticised the Mechler-Freeman approach from a theoretical point of view as "failing in its realism" as the model "heavily relies upon fixed coefficients, an actuarial concept of losses and an inert conception of society."

Murlidharan and Shah (2003) conducted an explorative empirical survey and an econometric analysis for detecting "empirical regularities in the behaviour of economies affected by catastrophes". They introduced three model variants that "simulate the behaviour of a typical economy when perturbed by an unanticipated and large change in the capital stock followed by an arbitrarily complex change in the affected region's productivity." Model 1 depicts a closed economy which would following a disaster would see output and consumption fall whereas growth rates increase. Model 2 introduces the two types of capital: productive capital and maturing capital that gradually becomes productive capital. Model 3 studies two open economies, one of which is affected by a disaster, in the event of a disaster in one it is assumed that another will try to mitigate the situation by diverting some of its output for relief and reconstruction. Zenclusen (2007) contends that the findings of Murlidharan and Shah remain inconclusive for a number of material inconsistencies.

Following Abadie, Diamond and Hainmueller (2010) Cavallo, Galiani, Noy, and Pantano (2010) study, pursued a comparative framework, constructing an appropriate counterfactual—i.e., what would have happened to the path of gross domestic product (GDP) of the affected country in the absence of natural disasters—and to assess the disaster's impact by comparing the counterfactual to the actual path observed. Importantly, the counterfactuals were constructed following Abadie and Gardeazabal (2003) by building a synthetic control group.

3. Profile of Nepal

In the global map Nepal is located at in between 80°4′ and 88°12′ East longitude and ranges from 26°22′ to 30°27′ North latitude. Locked between China on the north and India on other sides Nepal spans over an area of 147,181 km² extending roughly 885 km from east to west and varies from 145-241 km north to south. The area is home to 26,494,504 people belonging to more than 125 ethnic groups living in 5,427,302 households as per Census (2011). From a geographic perspective, Nepal's location lies on the middle portion of the Hindu Kush-Himalayan Region. This area displays extreme variations in natural environment ranging from tropical plain to alpine heights with decreasing elevations from north to south classifiable into three major geographic regions, notably, Mountain, Hill, and Terai regions. It has a unique altitudinal variation from 60 meters from mean sea level in the south to 8,848 meters at Mt. Everest in the north that tantamount to big variation within a short horizontal distance of only 90 to 120 km. The topological variations of the country create distinct climatic conditions that vary from region to region and can be summarized as tropical in the south and temperate and alpine in the north. Summer and late spring temperatures range from about 28° Celsius in the hilly region of the country to more than 40°C in the

Terai. In winter, average maximum and minimum temperatures in the Terai range from a 7° to 23° Celsius, it stands at below the freezing point to 12° Celsius as maximum in the central hilly range while much colder temperatures prevail at higher elevation.

Geologically, Nepal is divided into five major tectonic provinces from south to north separated by major thrusts and faults. These provinces are elongated in a general east-west direction. From south to north these include: the Terai, the Sub-Himalaya (Siwalik), the Lesser Himalaya, the Higher Himalaya, and the Tibetan-Tethys Himalaya. These tectonic zones nearly correspond to the currently used five-fold classification of physiography of Nepal into Terai, Siwalik, Middle Mountain, High Mountain, and High Himalaya. The Terai and Indo-Gangetic Plain is separated from the Sub-Himalaya (Siwalik) by the Himalayan Frontal Fault (HFF); the Sub-Himalaya (Siwalik) are separated from the Lesser Himalaya by the Main Boundary Thrust (MBT); the Lesser Himalaya are separated from the Higher Himalaya by the Main Central Thrust (MCT); and the Higher Himalaya are separated from the Tibetan-Tethys Himalaya by the South Tibetan Detachment System (STDS). The Himalaya is said to be the most active and fragile mountain range in the world as is still rising and its rocks are under constant stress as the northward–moving Indian Plate pushes against the more stable Tibetan block. This pressure forces the Himalaya to rise and move horizontally southward along major thrusts. However, the inherently weak geological characteristics of the rocks make the Himalaya fundamentally very fragile. Triggering factors such as rainfall and earthquakes make the mountains highly vulnerable to landslides and other mass moving processes.

Nepal is one of the most disaster-prone countries in the world exposed to various types of natural disasters mainly due to its diverse topographical features, and fragile geological conditions. Because of its location between two major plates, the Indian and Tibetan, the country lies in the highly active seismic zone of the Himalayas. Actually, the country has suffered devastations due to earthquakes a number of times since 1254 AD, the earliest recorded event of earthquake. Occurrence of other hazards such as floods, landslides, fire, windstorm, hailstorm, epidemics, glacial lake outburst floods (GLOF), and avalanches are frequent that cause enormous physical damages and human life losses. The risk due to disasters is on the increase due to poor economic condition and low literacy rate resulting in very low level of awareness, at all levels. The type of natural disaster events and their impact is found to be of different degrees and types depending upon the geographic location of the event. The high-altitude areas of mountain districts in the country are found to be prone to avalanches, snowstorms and GLOFs. The mid-hill areas with steep slopes and rough topography are frequently affected by landslides causing heavy loss of lives, property and other infrastructures. Likewise, southern Terai plains and hilly valleys are prone to floods. Heavy rain and storms can cause severe flooding, or trigger landslides that have an enormous effect on property, structures and live. On the other hand, during the dry season, Nepal is prone to fire and wildfire. In summary one can say that a combination of rough topography, steep slopes, active seismic zone and intense impact of monsoon rain has made this fragile environment vulnerable to hazards and disasters.

4. Disasters in Nepal

Disaster occurrence in Nepal over the period 1971 to 2017 is presented below.

Table 1 : Disasters in Nepal (1971-2017)

Type	Events			Life (heads)				Property			
	Total	with loss value	w/o loss value	Human Death	Human Missing	Human Injuries	Livestock lost	Houses Lost	Houses Damag.	Farm (ha)	Reported loss value Rs mn
Accident	2375	15	2360	2395	330	1051	35	66	648	61	94
Climato..	1450	1019	431	266	0	462	108285	6269	583	167	5062
Others	124	3	121	255	81	285	0	59	5	0	1
A. Manmade	**3949**	**1036**	**2913**	**2917**	**411**	**1798**	**108320**	**6394**	**1236**	**228**	**5157**
Biological	3950	18	3932	16839	0	43115	79643	0	0	47865	25
Climato..	6016	3650	2366	1346	18	1336	22340	77265	2420	514422	27170
Geophysical	316	16	300	9719	0	29361	516353	639817	343647	0	7060580
Hydrological	7828	1572	6256	9475	1927	2666	554945	118856	157643	297950	17208
Meterio..	4531	547	3984	3174	40	4386	12901	4607	18685	264063	5323
Others	884	78	806	937	552	1064	183	1851	632	30055	78
B. Natural	**23525**	**5881**	**17644**	**41490**	**2537**	**81928**	**1186365**	**842396**	**523027**	**1154355**	**7110386**
Total	**27474**	**6917**	**20557**	**44407**	**2948**	**83726**	**1294685**	**848790**	**524263**	**1154583**	**7115543**

Source: Desinventar Database; DRR Portal, MoHA

Manmade disasters remain limited in comparison to natural disasters that are heavily weighted towards geophysical category, and succeeding it are climatological and meteorological categories. Available data include loss of life and injuries for human and livestock, property destroyed or damaged for educational institutes, medical centers and other categories that comprise residential, administrative and commercial buildings. Year wise data on natural disasters is presented in table below.

Table 2: Year wise Natural Disasters in Nepal (1971-2017)

Year	Events	Life (heads)			Property					
	(Nos.)	Human D + M*	Human Injuries	Livestock lost	Farm (ha)	Ed. centre	Med. centre	Others Lost	Others Damaged	Reported Loss Rs mn
1971	98	303	47	1335	500	2	0	89	133	0.06
1972	112	209	86	340	397	1	0	762	86	4.71
1973	180	211	317	709	1404	0	0	1499	160	2.41
1974	225	549	725	1431	17347	1	0	2582	856	11.48
1975	142	301	127	723	1292.34	4	0	2011	36	6.15
1976	208	267	85	1499	30404	0	0	4339	436	17.16
1977	189	161	182	295	12876.85	0	0	1248	459	2.80
1978	289	458	77	959	345	0	0	3014	70	12.50
1979	191	639	113	583	803.45	0	0	1988	63	16.22
1980	211	401	502	10881	16818	68	1	14337	13650	10.49
1981	174	455	434	687	9537	1	0	1227	1003	6.24
1982	158	699	14	6894	1614.28	1	0	956	37	52.14
1983	168	482	107	399	1448.02	20	0	1183	1207	30.23
1984	355	1100	609	2892	5429.43	6	0	2499	485	38.34
1985	165	235	77	1067	26.977	5	0	1438	63	39.20
1986	108	289	34	392	222.65	1	0	1152	18	256.87
1987	117	119	68	794	2494.24	6	0	1040	6114	38.47
1988	336	1272	8108	1446	1002.8	2388	0	23202	41182	28.45
1989	287	356	1412	669	7898	4	0	4795	1370	126.77
1990	196	544	4100	91	1791	2	0	1187	1364	11.44
1991	406	1123	177	100	243	4	0	1383	196	86.71

1992	398	1052	27	411	77993	1	0	6182	77	187.45
1993	865	1889	299	25155	90484.76	2	1	20889	21665	1123.98
1994	431	1213	1253	760	158970.7	15	0	3173	516	97.53
1995	412	1193	1484	2409	23647.42	0	0	9672	15898	2108.99
1996	366	1245	1574	2995	6849	6	0	19638	13923	395.10
1997	532	1322	942	26411	80666.15	0	0	4510	1043	466.87
1998	422	1168	303	1035	3975.36	6	0	15970	473	370.43
1999	465	1450	422	1100	3023.08	4	0	3860	691	524.58
2000	652	727	342	1125	36579.8	9	3	2987	1807	732.76
2001	1147	1952	3429	28671	51920.36	12	0	6169	2337	1477.01
2002	1158	978	12082	3653	12586.07	3	0	13841	5476	837.98
2003	892	1054	3434	2386	72626.94	26	2	1944	754	478.69
2004	955	1134	214	1935	37480	25	2	1427	3318	1383.83
2005	421	415	148	1428	15.81	20		1195	528	60.82
2006	457	645	5814	1237	72745.51			1845	8488	344.94
2007	811	684	4615	499562	5774.79	31		9174	1447	611.04
2008	1168	804	1171	8721	89447.52	63	6	15431	3127	1890.92
2009	1127	1047	1100	7556	38754.63	99	4	3107	9079	730.60
2010	1257	717	464	2102	11160.83	38	1	5187	27710	1508.27
2011	1371	764	888	1320	31105.48	404	7	7395	7873	1897.88
2012	967	572	499	7132	13058.76	331	4	3394	7762	16218.91
2013	757	590	461	1273	2172.45	22	2	2096	7624	1863.27
2014	583	1097	441	5272	9184	48		2712	7086	607.53
2015	370	9276	22387	514656	92	26974	898	605500	288104	7060762.39
2016	740	557	527	3205	108134	87	2	1703	3701	2091.62
2017	486	309	207	669	2012	34	2	1464	13532	10814.09
Total	**23525**	**44027**	**81928**	**1186365**	**1154355**	**30774**	**935**	**842396**	**523027**	7110386.30

Livestock and Property, *Death and Missing

Source: DRR Portal and Desinventar

Life loss has been heaviest in 2015 single-mostly caused by Gorkha Earthquake, and this year stands as the foremost with respect to property destroyed and damaged as well. 2007 recorded most loss of the livestock second only to 2015. Farm losses (mostly recorded as land loss as against harvest loss) were heaviest in 1994 and the nearest to it was in the year 2016. Second most destruction and damage of houses occurred in 1988 that too was the result of earthquake.

A closure look of natural disasters in terms identifiable description shows that earthquake remains the major causant. Diseases come second with respect to loss of human life while flood tops the earthquake regarding loss of livestock. The foremost factors for farm loss are drought and flood whereas flood and fire closely follow the earthquake in leading to destruction and damage of the houses. For the losses accounted in monetary terms second most factors are flood and fire behind the loss impacted by the earthquake. The following table depicts the loss by type of disasters:

Table 3: Nepal Natural Disasters by Types (total of 1971-2017 years)

Type	Period	Events	Life (heads)			Property					
			Human D+M	Human Injuries	Livestock Lost	Farm (ha)	Ed. centre	Med. centre	Others Lost	Others Damag.	Reported Loss Rs mn
Avalanche	1971-2017	125	352	125	658	1.01	0	0	82	33	20.30

Boat mis.	1971-2016	153	796	158	0	0	0	0	0	0	0.32
Cold wave	1974-2017	743	943	87	732	26906.5	12	0	0	0	834.65
Drought	1974-2016	167	0	0	0	465901.7	0	0	0	0	531.70
Earthquake	1971-2017	316	9719	29361	516353	0	29746	905	639817	343647	7060581.00
Epidemic	1971-2017	3596	16817	43076	7608	2000.94	0	0	0	0	2.631
Famine	1996-2016	29	10	0	0	26136	0	0	1	1	1.10
Fire	1971-2017	5552	1268	1274	21893	2192.49	72	8	75113	2369	25223.98
Flood	1971-2017	4233	5026	585	543214	275364.3	133	5	99427	123114	15747.62
Forest fire	1971-2017	285	96	62	423	46327.88	0	0	2152	51	1414.38
Frost	2003-2017	8	7	0	0	5005	0	0	3	0	457.20
Hailstorm	1971-2017	797	66	102	951	133481.9	16	1	218	4648	2732.85
Heat wave	1972-2017	60	53	20	250	0	0	0	0	0	0
Landslide	1971-2017	3469	6024	1956	11073	22584.29	147	8	19347	34496	1437.59
All Others	1971-2017	3992	2850	5122	83210	148453.6	648	8	6236	14668	1401.24
Total	1971-2017	23525	44027	81928	1186365	1154355	30774	935	842396	523027	7110386.30

Livestock and property

Source: DRR Portal and Desinventar

It is seen from above table that earthquake is the major disaster impacting all the columns save for the farm loss. Discounting all others category that include (...) boat mishap, heat wave, and avalanche remained the least impactor and the impact of epidemic and frost also remained limited. Behind earthquake mid-heavier impactors are flood, forest fire, drought, and cold wave.

5. Data improvisation

The reported loss (above tables) does not include monetary value for death and injuries, and majority of the events with respect to property as well. While so many reporting did not bother about the cost of the loss, the assessment of monetary value that has been made is mostly based on reporters' guesstimates.

An attempt was made in this study to assess the loss value of all events with regards to natural disasters digging into the cost of the loss that could be applied as being representative of the then period. Based on the price reported in several documents and as experienced by key informants the cost estimate of the loss has been made as follows:

a. Houses destroyed and damaged (NRs)

Table 4: Basic rates for the houses

	Destroyed			Damaged		
Period	Urban	Rural	UR av.	Urban	Rural	UR av.
1971-1976	15666.44	10983.5	13324.97	1566.64	1098.35	1332.49
1977-1986	46999.33	21967	34483.17	4699.93	2196.7	3448.31

1987-1996	140998	43934	92466	14099.8	4393.4	9246.6
1997-2006	422994	87868	255431	42299.4	8786.8	25543.1
2007-2017	1268982	175736	722359	126898.2	17573.6	72235.9

Source: Based on urban and rural houses rate data for 1971/1991 and key informants for the later years

b. Land lost (NRs per 0.0508 ha)

Table 5: Basic rate for the land

Area	1971	1981	1991	2001	2011	2016
M Rural	1968.50	5905.51	17716.54	53149.61	79724.41	159448.82
H Rural	3937.01	11811.02	35433.07	106299.21	159448.82	318897.64
M Urban	196850.39	590551.18	1771653.54	5314960.63	7972440.94	15944881.89
M Rural	19685.04	59055.12	177165.35	531496.06	797244.09	1594488.19
H Urban	393700.79	1181102.36	3543307.09	10629921.26	15944881.89	31889763.78
H Rural	39370.08	118110.24	354330.71	1062992.13	1594488.19	3188976.38
V Urban	3937007.87	11811023.62	35433070.87	106299212.60	159448818.90	318897637.80
V Rural	177514.79	532544.38	1597633.14	4792899.41	7189349.11	14378698.22
T Urban	295857.99	887573.96	2662721.89	7988165.68	11982248.52	23964497.04
T Rural	14792.90	44378.70	133136.09	399408.28	599112.43	1198224.85

M=Mountain, H=Hills, V=Kathmandu valley, T=Terai

Source: Based on land price data of Jhapa, Bardiya, Lalitpur, Dhankuta, Kalikot, Humla and Sankhuwa Sabha Districts

c. Harvest lost (Rs per kg applied to average yield of paddy and wheat for the given year)

Table 6: Basic rate for the harvest

Year	All Nepal	Year	All Nepal	Year	All Nepal	Year	All Nepal	Year	All Nepal
1971	3120	1981	6500	1991	14178	2001	40220	2011	98896
1972	3120	1982	6500	1992	15743	2002	41617	2012	98896
1973	3120	1983	10306	1993	18995	2003	47721	2013	103075
1974	3900	1984	10306	1994	18995	2004	47721	2014	103075
1975	4063	1985	10306	1995	22168	2005	60773	2015	103075
1976	3663	1986	10306	1996	26403	2006	60773	2016	103075
1977	3775	1987	14107	1997	26403	2007	66912	2017	103075
1978	3775	1988	14178	1998	30465	2008	71925		
1979	3775	1989	14178	1999	32273	2009	76793		
1980	6500	1990	14178	2000	40220	2010	98896		

Source: Based on information of Ministry of Agriculture, and Economic Survey, MoF

d. Livestock lost (average for buffalo and goat)

Table 7: Basic rate for the livestock (NRs)

Period	All Nepal
1971-1975	975
1976-1985	2925
1986-1995	8775

1996-2005	17550
2006-2015	35100
2016-2017	70200

Source: Based on Key informants information

Besides, loss of human life (death or missing) does add cost to the economy while a healthy human life would contribute to the economy. The value of insurance has been taken as indicative of the value of human loss which based on insurers practices in Nepal stands equivalent to a person's five years' earnings. As such GDP per capita x five years has been used in the assessment.

Accordingly as against the reported loss value the implication of disaster turns out as follows:

Table 8: Disaster Loss value

	(Nos.)	Human D + M*	Livestock lost	Farm (ha)	Houses Lost	Houses Damaged	Reported Loss Rs mn	**All events w/o human loss Rs mn**	**Insurance implications (human) Rs mn**	**Total loss estimation Rs mn**
1971	98	303	1335	500	91	133	0.06	32.54	1.36	33.90
1972	112	209	340	397	763	86	4.71	22.52	0.88	23.40
1973	180	211	709	1404	1499	160	2.41	70.21	1.11	71.32
1974	225	549	1431	17347	2583	856	11.48	356.27	3.65	359.92
1975	142	301	723	1292.34	2015	36	6.15	246.88	2.04	248.93
1976	208	267	1499	30404	4339	436	17.16	727.26	1.75	729.01
1977	189	161	295	12876.85	1248	459	2.80	302.76	1.18	303.93
1978	289	458	959	345	3014	70	12.50	152.29	4.32	156.61
1979	191	639	583	803.45	1988	63	16.22	103.62	5.25	108.87
1980	211	401	10881	16818	14406	13650	10.49	976.35	3.75	980.10
1981	174	455	687	9537	1228	1003	6.24	468.81	4.69	473.51
1982	158	699	6894	1614.28	957	37	52.14	189.80	7.71	197.50
1983	168	482	399	1448.02	1203	1207	30.23	156.50	6.05	162.55
1984	355	1100	2892	5429.43	2505	485	38.34	657.50	16.03	673.52
1985	165	235	1067	26.977	1443	63	39.20	88.82	4.01	92.83
1986	108	289	392	222.65	1153	18	256.87	308.24	5.54	313.78
1987	117	119	794	2494.24	1046	6114	38.47	285.37	2.69	288.06
1988	336	1272	1446	1002.8	25590	41182	28.45	2489.45	32.68	2522.13
1989	287	356	669	7898	4799	1370	126.77	936.19	10.38	946.56
1990	196	544	91	1791	1189	1364	11.44	237.22	18.08	255.30
1991	406	1123	100	243	1387	196	86.71	217.12	45.39	262.51
1992	398	1052	411	77993	6183	77	187.45	9608.98	47.69	9656.67
1993	865	1889	25155	90484.76	20892	21665	1123.98	26459.85	97.31	26557.16
1994	431	1213	760	158970.7	3188	516	97.53	31905.50	67.20	31972.70
1995	412	1193	2409	23647.42	9672	15898	2108.99	4792.25	73.39	4865.64
1996	366	1245	2995	6849	19644	13923	395.10	3506.38	84.40	3590.78
1997	532	1322	26411	80666.15	4510	1043	466.87	7305.78	93.98	7399.75
1998	422	1168	1035	3975.36	15976	473	370.43	5057.47	92.30	5149.76
1999	465	1450	1100	3023.08	3864	691	524.58	2036.55	124.30	2160.86
2000	652	727	1125	36579.8	2999	1807	732.76	6646.11	69.33	6715.44
2001	1147	1952	28671	51920.36	6181	2337	1477.01	34841.22	189.44	35030.66
2002	1158	978	3653	12586.07	13844	5476	837.98	13931.50	99.46	14030.97

2003	892	1054	2386	72626.94	1972	754	478.69	36354.96	114.33	36469.29
2004	955	1134	1935	37480	1454	3318	1383.83	66342.03	132.11	66474.14
2005	421	415	1428	15.81	1215	528	60.82	531.45	52.45	583.90
2006	457	645	1237	72745.51	1845	8488	344.94	48593.80	93.22	48687.02
2007	811	684	499562	5774.79	9205	1447	611.04	23019.03	109.26	23128.29
2008	1168	804	8721	89447.52	15500	3127	1890.92	60465.07	153.45	60618.52
2009	1127	1047	7556	38754.63	3210	9079	730.60	17637.07	237.85	17874.93
2010	1257	717	2102	11160.83	5226	27710	1508.27	9102.35	184.96	9287.32
2011	1371	764	1320	31105.48	7806	7873	1897.88	23794.02	217.28	24011.30
2012	967	572	7132	13058.76	3729	7762	16218.91	34310.91	178.13	34489.04
2013	757	590	1273	2172.45	2120	7624	1863.27	4856.03	210.11	5066.14
2014	583	1097	5272	9184	2760	7086	607.53	59465.57	417.96	59883.54
2015	370	9276	514656	92	6071382	288104	7060762.39	7060991.01	3688.51	7064679.52
2016	740	557	3205	108134	1792	3701	2091.62	121995.11	256.31	122251.42
2017	486	309	669	2012	1500	13532	10814.09	35110.73	159.65	35270.38
Total	**23525**	**44027**	**1186365**	**1154355**	**874105**	**523027**	**7110386.30**	**7757686.46**	**7422.91**	**7765109.37**

Source: Tables 2 & 4-7

Losses in excess of one billion rupees are recorded for 1988 and from 1992 to 2017 with exception of 2005. Losses in 2015 alone accounts for 90.98 % of the total loss over 1971 to 2017 at current prices; 2016 accounted a distance second to the massive figure of the previous year.

6. Nepal's Economy vis-à-vis Disasters

It is known from Table_8 that the size of disasters in terms of rupee value was limited in the first decade spanning 1971 to 1980. It averaged Rs 301.6 million per annum with the highest Rs 980 million in 1980. The losses averaged Rs 592.6 million per annum from 1981 to 1990 with the heavy loss of Rs 2,522 million accounted in 1988 for being the year of earthquake. From 1991 onward the losses have escalated with an average of Rs 10 billion per annum. From 2001 the losses have been overwhelming every year except for the year 2005 which accounted for a loss of Rs 583.9 million only.

The economy of Nepal depicted in terms of GDP was moving slow before 1981. With the onslaught of conflict in 1994 the state of moderate GDP growth was compromised but the economy was able to track on the growth at a higher level till 1999. The escalation of armed conflict had its say on downsizing GDP growth that remained lowest till the end of cessation of conflict in 2006. On the high expectation of normalization of business environment with the signing of peace agreement GDP mustered a sizeable growth in 2007 but as it takes time to get things normalized it could improve further only in 2013. Political scenario was not that encouraging in 2014 and 2015. Then there was a major earthquake in 2015 that together led to a negative growth. The economy finally returned to appreciable growth track in 2016 and remained satisfactory at 2017.

The following table presents the data on GDP and disasters loss:

Table 9: Nepal GDP, Economic Growth and Disaster Loss (NRs in million)

Rs in millionear	GDP Nominal	Disaster Loss (DL)	DL as % of GDP	GDP deflator	GDP Real	GDP growth %	Disaster Real loss
1981/82	30988	473.51	1.53	18.60	166602.15		2545.75
1982	33761	197.50	0.58	20.07	168216.24	0.97	984.06
1983	39390	162.55	0.41	21.53	182954.02	8.76	754.99
1984	44441	673.52	1.52	22.73	195516.94	6.87	2963.13
1985	53215	92.83	0.17	25.98	204830.64	4.76	357.31
1986	61140	313.78	0.51	29.23	209168.66	2.12	1073.49
1987	73170	288.06	0.39	32.68	223898.41	7.04	881.46
1988	85831	2522.13	2.94	36.37	235993.95	5.40	6934.64
1989	99702	946.56	0.95	40.29	247460.91	4.86	2349.37
1990	116127	255.30	0.22	43.99	263985.00	6.68	580.36
1991	144931	262.51	0.18	52.35	276850.05	4.87	501.45
1992	165350	9656.67	5.84	57.72	286469.16	3.47	16730.20
1993	191596	26557.16	13.86	61.98	309125.52	7.91	42847.95
1994	209976	31972.70	15.23	65.95	318386.66	3.00	48480.21
1995	239388	4865.64	2.03	71.10	336691.98	5.75	6843.38
1996	269570	3590.78	1.33	76.24	353580.80	5.02	4709.84
1997	289798	7399.75	2.55	79.27	365583.45	3.39	9334.87
1998	330018	5149.76	1.56	86.31	382363.57	4.59	5966.59
1999	366251	2160.86	0.59	90.27	405728.37	6.11	2393.77
2000	413428	6715.44	1.62	100	413428.00	1.90	6715.44
2001	430396	35030.66	8.14	103.89	414280.49	0.21	33718.99
2002	460324	14030.97	3.05	107.11	429767.53	3.74	13099.59
2003	500699	36469.29	7.28	111.44	449299.17	4.54	32725.49
2004	548484	66474.14	12.12	117.95	465013.99	3.50	56357.90
2005	611118	583.90	0.10	126.18	484322.40	4.15	462.75
2006	675859	48687.02	7.20	135.28	499600.09	3.15	35989.81
2007	755256	23128.29	3.06	142.94	528372.74	5.76	16180.42
2008	909528	60618.52	6.66	165.77	548668.64	3.84	36567.85
2009	1083415	17874.93	1.65	189.56	571541.99	4.17	9429.70
2010/11	1248482	9287.32	0.74	210.34	593554.25	3.85	4415.38
2011	1387482	24011.30	1.73	224.13	619052.34	4.30	10713.11
2012	1525221	34489.04	2.26	237.77	641469.07	3.62	14505.21
2013	1758738	5066.14	0.29	259.18	678577.82	5.78	1954.68
2014	1899089	59883.54	3.15	272.41	697143.64	2.74	21982.87
2015	1993560	7064679.52	354.38	286.11	696780.96	-0.05	2469217.97
2016	2307586	122251.42	5.30	309.13	746477.53	7.13	39546.93
2017	2609939	35270.38	1.35	329.99	790914.57	5.95	10688.32

Source: GDP from CBS data, disaster loss from Table_8

A cursory look at the above table reveals that while the disaster loss jumped to 2.94 percentage of GDP in 1988/89 mainly owing to earthquake the rate of GDP fell by 1.64% percentage points from the previous year. In situation of the disaster loss rising to 5.84%, 13.86% and 15.23% of GDP in the years 1992/93, 1993/94 and 1994/95 GDP growth slackened, moved up but fell again. Likewise similar happening appears in the year 2001/02. However, the rise of disaster level in 2003/04 and 2004/05 to 7.28%, and 12.12% of the GDP did not show a fall in the level of GDP growth in 2003/04 and the fall next year is also not that sharp. This seems to be an exception as the rise in disaster loss to 7.2% in 2006/07 showed a fall in GDP by one percentage point. Again the increase of disaster level to 6.6% in 2008/09 had a corresponding fall of GDP by 1.92 percentage point.

It is cautioned here that the trend in GDP is the outcome of investment and doing business conditions and that disaster would add the economic woes. The situational fact is that the economy in the 1990's was on an upbeat trend which faced a down turn with Nepal plunging into the period of armed conflict that escalated considerably from 2000 till the change of regime in 2006. Adhikary (2016) states of the economic loss impacted by the conflict accounted to the order of 2.77% per annum. The post conflict period following the signing of peace agreement in November 2006 was on wait and see mode as the orderly political resolution was not easily forthcoming which ultimately had a date on September 2015 for Nepal to promulgate new Constitution. Just before then in April 25, 2015 Nepal plunged into a catastrophic Gorkha Earthquake of 7.8 magnitude and another on May 12 with 7.4 magnitude. The disaster loss caused by earthquake and aftershocks was monumental: a whooping 354 percentage of GDP in 2015/16. The resultant economic growth was negative in 2015/16 from the level fallen in 2014/15 as the earthquake had struck in the fourth quarter of that fiscal year. In the shadow of this the disaster loss in 2016/17 had a very limited effect as the economy did strike an improved growth rate.

From the perspective of disaster what we know from the studies elsewhere is that large disasters coupled with political upheaval would lend negative economic effects. Analysed from this angle we find the following situation:

- The disaster level was minimal but there was an impasse in economic relations with India which led to lower economic growth in 1989/90
- The disaster level was minimal and despite the political upheaval that led to establishment of multi-party democracy doing away with Panchayat regime there was no slowing down of economic growth in 1990/91
- During the period of armed conflict (more specifically 2000-2006) the economy in general slowed down and it impacted more when the level of disaster jumped in 2001, 2004 and 2006 with an exception of 2003
- 2015 accounted for post constitution political showdown and a major earthquake beforehand that led to negative impact into the economy

The limited disaster level would have a limited effect for reasons of cushion at hands of the affected household/nation. When the level exceeds the degree of cushion or safety it requires funds (grants or debts) to makeup the capacity and recover the loss of market. Otherwise the level of poverty would rise. This has been the case in Nepal with the major earthquake of 2015. While the path of reconstruction has been slow both for the lack of handling capacity and the finance it is estimated that the earthquake pushed to poverty as much as 15-20 percent households that translates to at least 700,000 people. During the period of armed conflict local economies in Nepal had a breakdown as it displaced an estimated 52,000 people apart from about 17000 killed across Nepal, this, however, was overshadowed by the people moving abroad and the resultant increase in remittances into the country which largely contributed a fall in poverty level from 41.8% in 1995/96 to 30.9% in 2003/04.

Alternatively what could be analysed is the resultant economic effects that would have been generated by the amount put for recovery of the assets and markets as equivalence of investment in normal trend. However, the post disaster reconstruction has remained slow owing to the weakness of the economy in

general and government prowess to generate/provide funds for reconstruction in particular. This is more vivid in 2015 post earthquake reconstruction which demonstrates that the capacity to provide augmented response is weak for the least developed economy that Nepal is and hence would take years. The example of Japan in post 1995 Kobe earthquake showed that though the developed economy had the prowess to normalize economic activities (trade within 12 months, manufacturing within 15 months, retail within 18 months) yet the household incomes in Kobe more than 15 years after the disaster, were still about 15% lower than what would have been had the earthquake not occurred.

As we learn from Table 9 the average natural disasters level was 0.85% of GDP for 11 years from 1981 to 1991, which got significantly increased to 5.07% for next 11 years from 1992 to 2002 and it dropped to 3.91% in the 11 years from 2003 to 2013. If 2015 earthquake had not occurred the degree of disaster would have been just over 0.23% of GDP, however, even by applying 3.91% of the third 11 years average the average for the entire 17 years of the 2000s would have been 4%. It raises a question on the degree of self adjustability of the economy so to say the absorptive capacity in coping with the hitch arising from the disaster beyond which the economy would have to draw in additional resources to support the normal growth trends. Assuming the absorptive capacity of the economy to cope disaster at 2% of GDP the pumping back of differential loss of the disaster would have contributed to uplift the economy by an average of 0.37 percentage point per annum from 2012 to 2017 with value addition efficiency level at 10% of the added capital.

7. Way forward

Working for disaster risk reduction, immediate disaster response and quicker post disaster reconstruction is what a country has to muster. In case of Nepal while the efforts for disaster risk reduction has got improved attention at donors behest, basically the improvements are called for primarily is areas of disaster loss value assessment requiring an improved framework and mechanism in place. Secondly, while the post 2015 post earthquake reconstruction has been too big a task even for the National Reconstruction Authority set up for the purpose, a framework ought to be in place to facilitate reconstruction needed out of the regular occurrences of natural disaster.

Further research are required in areas of localized economic effects of the disaster, working out response frameworks, as well as effectiveness of various institutional presence from facilitating disaster risk reduction to post disaster relief, rehabilitation and reconstruction.

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