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Natural Disasters and Economic Growth in Pakistan: An Enquiry into the Floods Related Hazards' Triad

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ABSTRACT

Floods affect the lives of the people in different ways. Livelihoods are affected, crops are destroyed and the usual patterns of life are disrupted. In extreme cases, floods lead to massive dislocations and even large scale deaths. This study explores three floods related hazards: mortality, damage to property and non-fatal effect on the population. We estimate the impact of these hazards on GDP growth in Pakistan for the period 1972-2013. We argue that damages done by floods are endogenous and 2SLS technique is used to address the problem of endogeneity in the model. The evidence suggests that GDP per capita growth and disaster management mitigate scale of floods related hazards. Most importantly and counter to the evidence from many other countries, floods frequency accentuates floods related hazards in Pakistan suggesting lack of learning from the past experience with floods. Regarding the relationship between floods and economic growth, this study finds that floods related hazards have significant negative impact on GDP growth of the economy. The damage to property leaves the strongest impact on the economic growth.

Keywords: Floods Frequency, Per Capita GDP Growth, Education Attainment, Infrastructure, Determinants of the Magnitude of Floods-related Hazards

1. INTRODUCTION

Damage to environment in recent years has caused a dramatic increase in the frequency of natural disasters [Sadia, *et al.* (2012)]. Among the natural disasters floods figure out conspicuously because they can potentially cause massive damage to the life and property. Floods primarily affect economy by damaging the agriculture land, urban businesses and death of the labour force. Government and non-government sectors also shift their resources from production sector to rehabilitation and reconstruction activities that slow down GDP growth rate [Sadia, *et al*. (2012)]. Floods and hurricanes particularly affect the primary output. Further, they affect the sectors that heavily depend upon natural capital such as tourism. The damage to the secondary sectors such as fall in production capacity, damages of roads and bridges that causes delay for transport input lead to fall in productive capacity of the economy. [Toya and Skidmore (2007)].

Pakistan has recently witnessed an unusual increase in the floods. From 1973 to 1993, only sixteen floods hit Pakistan but in the next twenty years, 54 floods of different intensity struck Pakistan. It is ranked 10th in the Global Climate Risk Index during period of 1994 to 2013 [Kreft, *et al*. (2015)]. According to the Federal Flood Commission (FFC) report in 2013, floods of varying intensities caused the death of 11,239 people, affected 180,234 villages and damaged 599,459 square kilometres area from 1950 to 2012. Floods have also caused different kinds of diseases[1] and the economic damages to the national economy is estimated to exceed 39 billion US$ [FFC (2012)]. Only in 2013, floods damaged[2] 1.05 million acres of standing crops and contributed losses equal to US$2 billion to the agriculture sector of the country [ECF (2013)].

Floods related hazards are an outcome of both climate change and change in the socioeconomic factors such as poverty, unemployment and mitigation policies [Barredo (2009)]. Some of the other factors behind steep rise in the floods are increasing GHGs emissions, changing intensity of the precipitation in the monsoon season [Ferreira (2011)]. IPCC (2014) warns even more frequent floods because of the increasing climate vulnerability and changes in precipitation pattern in the future.

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[1]Diseases like as diarrhea, skin, eye infection, malaria, respiratory infection and hepatitis etc.

[2]See European Commission Floods Report on Pakistan, 2013.

Pakistan has seen frequent natural disasters in its national history. Data shows that among the total number of fatalities in the natural disasters, the flood-related deaths far exceed the fatalities from other natural disasters. From 2005 to 2014, 5522 people died, 42.7 million people were affected and property worth US$ 18.5 million was damaged [CRED (2015)]. The following graph shows the disproportionate damage done to the national economy caused by the floods. Given the massive adverse impact of the floods on the national economy, we analyse the determinants of the floods related hazards and also quantify the effect these hazards on the national economy. The exploration is also necessary as the floods are getting more frequent and intense in the country.

The rest of the paper is organised in five sections. Section two describes literature review. Section three provides theoretical framework, data, variables, source and methodology. Section four details estimation, results and discussion. Conclusion is furnished in Section five.

2. LITERATURE REVIEW

Natural disasters have a significant relationship with key macroeconomic variables and may immediately diminish the economic growth and trade balance. Popp (2006a) finds a long run relationship between natural disasters and macroeconomic key variables like saving, investments, fiscal and trade balances, human capital, physical capital and technology. Climatic disasters have negative impact while geophysical[3] disasters have positive impact on the output growth in the long run due to destruction and reconstruction hypotheses. Narayan (2003) finds that natural disasters have short run impact on the economy and affect the net trade, per capita income, saving, investment and the balance of payments as well.

The scale of fatalities related with natural disasters is dependent on the economic development level and quality of governance and management system in some country [Raschky (2008)]. Toya and Skidmore (2007) use data of 151 countries for the period of 1960-2003 and find that countries who have relatively higher per capita GDP experienced less human killings and monetary damages than the countries having lower per capita GDP. It is argued that developed countries having greater per capita income would assign greater proportion of the GDP for taking the important safety measures for reducing the effects of natural disaster. Tariq (2012) see little evidence of reduction in the flood related damages even after crisis management and institutional setups were put in place. Moreover, developed counties with greater literacy rate, and *openness* of trade, foreign reserves, domestic credit and income have the greater ability to bear with the disaster risk to the economy [Noy (2009)]. The economic damages from the floods depends upon floods prone area, coastal region and economy of the country [Jonkman, *et al*. (2008)].

[3]This term is used for hazard which originates from solid earth for example earthquake, mass movement and volcanic activities (Em-dat disaster data web.)

Toya and Skidmore (2007) show how income moderates the level of floods-related fatalities. They suggest that private demand for safety nets increases due to rise in income of the people as higher income allows the people to reduce the risk by spending additional on precautionary method. With GDP growth increased, people may have better infrastructure, alarming system and floods resistant precautionary and defensive measure which may lessen floods impact. Padli and Habibullah (2009) did a study on the panel of 73 countries and find a negative correlation between per capita income of the country and impact of natural disasters. Skewed income distribution and high population density are important predictors of the disaster related mortalities [Cavallo, *et al*. (2010)].

Apart from the adverse effects on the economy, floods can have positive externalities in some cases as well. Noy and Vu (2010) find that disasters adversely affect the economic growth but in the short run economy experiences boom because of the increased reconstruction activity. Albala did a study on 28 large natural disasters from 1970-1990 in UK and found that floods had an insignificant effect on GDP but gross fixed capital formation, public and trade deficit increased significantly due to rehabilitation and reconstruction activities.

The adverse impact of natural disasters in one country spills over to other countries through the channel of trade. Oh and Reuveny (2010) studied the relationship between international trade, political risk and impact of disaster for 116 countries from 1985–2003 and suggest that gradual increase in frequency of disasters and political risk in importer or exporter countries would adversely effect on trade. World's economic output may be diminished as the frequency of climatic disaster like floods, cyclone increases over the time.

Ahmad (2011) suggest that damages from floods could be analysed at two levels. The damage to the infrastructure and fatalities could be considered the first disaster which is followed by second disasters such as the families reduced to poverty because of the death of earning hands. The cost of the second disaster could be higher than the first disaster. Tariq (2012) investigate floods management and flooding behaviour of Pakistan. This study also finds that main source of flooding in the Indus Basin are monsoon rain falls.

Crisis management and institutional setup has been developed to mitigate floods related hazards over the years. However, data indicate that there is no major reduction in the flood damages caused by the floods. Study suggests that inter-linkage of structural and non-structural measures with combined efficiency can optimise for more effective floods management. Sadia, *et al*. (2012) investigate disaster's related mortalities on per capita GDP of Pakistan. They find significant positive impact of disaster related killings, human capital and life expectancy on per capita GDP.

3. ECONOMETRIC FRAMEWORK, DATA AND METHODOLOGY

This study identifies the determinants of the floods related hazards and the impact of the floods related hazards on the national economy.

3.1. Determinants of the Floods Related Hazards

It is important to assert that floods as an event are exogenous but magnitude of floods related hazards as an endogenous because it is determined within the system. Such as immediate effects of the floods are a function of vulnerability of the population, physical intensity and occurrences of the floods events [Ferreira (2010)]. The vulnerability of population depends upon the level of preparedness and mitigation activities. When floods occur, population exposure determines the number of mortalities both directly and indirectly. Higher population exposure is correlated with more death on provision of occurrence of floods. Magnitude of floods related hazards is the outcome of socio-economic vulnerability to the people and frequency of the floods events. Socio-economic vulnerability to the people depends upon the per capita income of the people, and role of the government to meet with sudden situation, precautionary and alarming system of the country.

The floods related hazards (FRH) are assumed to be the function of a set of variables:

$$Ln(FRH_t) = \alpha_0 + \alpha_1 Y_{ct} + \alpha_2 POPDENS_t + \alpha_3 FF_t + \alpha_4 INFRA_t + \alpha_5 ID_t + +\alpha_6 UF_t + \epsilon_t \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

The dependent variable FRH here is the floods related hazards where FRH refers to three different indicators of the hazards, namely, floods affected people[4] percentage of population, floods related mortalities[5] percentage of population and the monetary damage[6] to the property as a share of total GDP respectively. The subscript *t* refers to the time 1972-2013. *Yc* is per capita GDP growth, *POPDENS* is the population density, *FF* represents frequency of floods in a year, *INFRA* indicates infrastructure, and *ID* is the institutional dummy, and *UF* refers to area covered by the forest. The infrastructure variable is the low type of roads[7] (as percentage of the total roads) in kilometres. Area under forests (UF) refers to the area under natural or planted tree what are at least 5 meters tall. We have used The National Disaster Management Authority (NDMA) as an institutional indicator variable ID which takes the value 1 for the years following

[4]Flood affected people refers to total affected people from floods which included sum of injured, homeless, and affected persons.

[5]Floods related mortalities include persons who confirmed as dead and persons missing and presumed dead (official figures when available).

[6]According EMDAT data web several institutions employ different methods to value these losses in their specific domain. However, there is no standard technique to determine a global figure for economic impact. Valued damage is given (000) US$.

[7]Pakistan Economic Survey segregates total roads in two types. Firstly, high type of roads and secondly, low type of roads. National highways, super high way, GT road which have heavy traffic are characterised as high type of roads while single and light traffic roads are characterised as low type of roads [Annual Flood Report (2012-2013)].

2006 when NDMA was established and 0 before 2006. Precautionary and alarming system of the country is measured by infrastructure variable (INFRA). Public services may affect the flood-affected people directly and indirectly. Disasters relief operations and early warning system are considered to directly affect the level of fatalities while floods management related actions such as construction of levees, dams and bridges and enforcement of zoning regulations may influence the fatalities indirectly. We have included a set of socioeconomic variables such as per capita income (GDP) and area under forests.

3.2. The Impacts of Floods Related Hazards on Per Capita GDP Growth

In the second stage, we set to analyse the impact of FRH on economic growth of the country. Barro and Sala-i-Martin (1995) employ labour augmenting technological Solow model [Solow (1956)] to investigate the impact of natural disasters. As this study focuses on the floods events only so it affects the economy in the following way,

$$Y=K^{á}F^{-\beta}AL^{1-\alpha+\beta}$$

$\alpha > 0$,

It is assumed that FRHs are the burden over the economy so expected change in economic output with respect to floods hazards is,

$$\frac{\partial Y}{\partial F} < 0$$

So, $\alpha + (-\beta) < 1$

Following, the impact of FRHs on the aggregate economy in the line of Loayza, *et al*. (2009) is specified as under:

$$Y_{ct} = \beta_0 + \beta_1 \ln L_t + \beta_2 \ln K_t + \beta_3 \ln OE_t + \beta_4 \ln EDU_t + \beta_5 \ln INFRA_t + \beta_6 \ln HEALTH_t + \beta_7 \ln FRH_{i,t} + \epsilon_t \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

The variables in this specification can be partitioned into two groups each with a direct and indirect impact on the GDP. The three indictors of floods related hazards, namely, mortalities, damage to property and the number of affected people, have a direct impact on GDP. Labour, capital, openness, and expenditures on education, infrastructure and health are assumed to have an indirect impact on the GDP after occurrence of the floods [Noy and Vu (2010); Ferreira (2011)]. GDP growth in Equation 2 not only depends on the floods related hazards but also affects the outcome of the floods. A country growing strongly can afford to spend more on flood protection, can fix better alarming system and may have good flood resistant infrastructure and resilient communities. The implication of this situation is that the floods related hazards variable is endogenous and therefore the Equations 1 and 2 suffers from the endogeneity/ simultaneity bias.

3.3. Data Definition and Sources

The variables used in this study are defined in the Table 1 below. The sources of the data are also indicated.

Table 1

Variables, Definition and Data Source

Variable	Definition	Source
Log (Population density)	Log of the population density (people per sq. km of land area)	WDI, 2014
Log (Openness)	Log of the openness of the economies	
Log (Labour)	Log of labour force participation rate	
Log (Capital)	Log of gross fixed capital formation (as % of GDP)	
Log (Infrastructure)	Log of Low type of roads (as percentage of total roads) in kilo meter	Pakistan Economic Survey, 2014
UF	Area covered by the forest as a percentage of total land area	
Log (Education)	Log of education attainment	Barro-Lee, 2013
Log (Health practitioners)	Log of the registered medical staff	Pakistan Statistical Yearbooks, 2014
FF	Occurrences of the floods in a year	EM-DAT, 2014 (http://www.emdat.be/)
Yc	Per capita GDP growth rate	
Log (Flood affected population)	Log of 1+floods affected people (percentage of population)	
Log (Flood related mortalities)	Log of 1+floods-mortalities (percentage of population)	
Log (Monetary damages)	Log of 1+floods monetary damages (to GDP ratio)	

3.4. Methodology

This study uses 2SLS estimation technique to analyse the determinants of the magnitude of floods related hazards and its impact on per capita GDP growth of Pakistan. Lastly, misspecification test of residual analysis for models validation and instruments exogeneity are reported in Section 4.3

4. EMPIRICAL RESULTS AND DISCUSSION

The empirical outcomes and explanations are reported in this section. Determinants of the floods related hazards, impact of floods related hazards on

per capita GDP growth and Misspecification Test are given in Sections 4.1, 4.2 and 4.3 respectively.

We have used the Hausman specification error test to identify any possible simultaneity and exogeniety in the three indicators of FRH, namely, mortalities, damage to property and flood related affectees. Results from each equation are reported in Tables 2 and 3.

Table 2

Results-Simultaneity Test

Variables	LNF_AFF	LNF_DAM	LNF_MORT
Resid	1.29	3.11	1.91
	(1.31)	(3.34)	(2.02)

Note: Standard errors in parentheses.

Table 3

Result-Exogeniety Test

Variables	LNF_AFF	LNF_DAM	LNF_MORT	Y_C
$W^{\wedge}$	1.84**	1.89***	2.71**	2.76***
	(0.78)	(0.45)	(1.32)	(1.21)

Note: Standard errors in parentheses.

Above Table 2 shows that residuals of floods affected people, floods damages and mortalities of the floods are not significant. Therefore it rejects the possibility of the simultaneity present in the equations. While results of the exogeniety test in Table 3 indicate that predicted values of floods affected people and floods related mortalities are significant at 5 percent level while damages caused by the floods and per capita GDP growth are significant at 1 percent level respectively. Therefore, FRHs exert weakly exogenous[8] in this study in the line of Noy and Vu (2010). So this work rejects null of exogeniety, and treats the floods related hazards and per capita growth as the endogenous variables [Noy and Vu (2010)]. In this case, the least squares would be inconsistent and two-stage instrumental variables estimation strategy is appropriate. Per capita GDP growth and floods related hazards are endogenous variables so lagged values of these endogenous and other exogenous variables present in the model are used as instruments in 2SLS estimation technique.

4.1. Determinants of the Floods Related Hazards

In the Table 4 below, the estimates from Equation 1 are given. The three columns correspond to three indicators of floods related hazards, namely,

[8]In the present study magnitude of FRH treated as weakly exogenous because it depends upon not only socio-economic factors but also on climate change phenomenon.

Table 4

Determinants of Floods Related Hazards (Eq. 1)

	Log (Flood Affected Population) (1)	Log (Flood Related Mortalities) (2)	Log (Monetary Damages) (3)
C	8.744	6.316	2.715**
	(7.845)	(5.678)	(1.322)
Log (Population density)	1.181***	3.193**	3.976**
	(0.401)	(1.562)	(2.021)
GDP growth rate	–1.840**	–0.412**	–0.034**
	(0.787)	(0.191)	(0.001)
Floods frequency	0.030***	0.0135***	0.026***
	(0.008)	0.003	(0.010)
Log (Infrastructure)	–1.361*	–0.281**	–1.314**
	(0.790)	0.132	(0.645)
Area under forest cover	–0.156	–0.512	–0.135
	(.124)	(.351)	(.119)
Institutional dummy	–0.022***	–0.060*	–0.016
	(0.007)	0.034	(0.010)
R-squared	0.777	0.713	0.653
Prob(J-statistic)	0.719	0.170	0.157

Note: Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

percentage of floods affected people, the percentage of mortalities and the monetary damage to the property as a share of total GDP respectively. Summing up GDP growth impact on FRH, that is, for one point increase in GDP growth rate, there is decrease in floods affected people (% of total population), floods related mortalities (% of population) and direct damage to the property (% of GDP), by 1.84%, 0.41% and 0.034% respectively. Results show that per capita GDP growth and infrastructure have significant negative effect on the floods related hazards triad while floods frequency and population density have a significant positive impact. The impact of institutions on the floods affected people and floods related mortalities is negative and significant but it is insignificant with respect to the monetary damages of the floods. Area covered under forest (UF) has an expected negative but insignificant effect on floods related hazards triad. Lull and Reinhart (1972) suggest that forestry significantly reduces the flood related damages when the rains/storms are heavy, but this impact is not significant in case of Pakistan. Another possible reason why forest areas do not reduce floods related hazards in Pakistan is that only about five percent of the area is Pakistan is under forest cover which cannot effectively reduce the intensity of floods.

Floods frequency (FF) has a significant and positive impact on the floods related hazards. This is an indication that little is learnt from the past experience.

Numbers of strategies are planned over the years to reduce the magnitude of the floods related hazards by the government such as basin wide planning, drainage, construction of temporary floods protection walls, preparation of emergency shelters, but they do not seem to work [FFC (2012)].

Population density also positively and significantly affects the floods related hazards triad. High population density has the most pronounced effect on the flood related mortalities and monetary damages. Population density affects the flood related losses both directly and indirectly. Inadequate housing and congestion increases the individuals' exposure to the flood events particularly in flood prone areas leading to higher losses of life and property. The result is similar with Ferreira (2011).

Infrastructure variable negatively and significantly affects magnitude of floods related hazards. Better roads and health facilities reduce the fatalities because it is easier to move to safer places during the floods and timely health interventions can effectively be made in time. This finding is consistent with Toya and Skidmore (2007), Noy (2009) and Padli, *et al*. (2010).

GDP growth rate significantly reduces the magnitude of floods related hazards. This result is in line with earlier literature. See Kahn (2005) and Raschky (2008). Ferreira (2011) suggests the per capita GDP is the first line of defense against the damages of floods. Schumacher and Strobl (2008) argue that income not only raises the demand for safety but also enables the individuals to utilise costly precautionary measures to escape from the natural disasters. Higher level of income also provides the better opportunities for better medical care and emergency treatment. Better economic conditions allow the governments to invest in developing early warning systems that enable mass evacuations and save lives. That is why richer nations typically have lower fatalities than poor nations [Kellenberg and Mobarak (2008)].

4.2. Impact of Floods Related Hazards on Per Capita GDP Growth

Table 5 presents the results estimated from Equation 2. Two indicators of floods related hazards (floods affected people and monetary damages) have a significant negative impact on the GDP growth rate. Summing up floods affected people and floods related monetary damages impact on economic growth, that is, for one percentage point increase in floods affected people (% of total population) and direct damage to the property (% of GDP), there is decrease in GDP growth by 0.032% and 0.038% respectively, regardless of the initial output level.

However, impact of mortalities on the economy remains insignificant as compared to two other measures of flood related losses. The findings of this study are in the line with earlier literature Bieler C. (2006) and Popp (2006b). The massive GDP loss caused by floods should highlight the necessity of allocation of adequate funds for flood control and rehabilitation efforts.

Table 5

Impact of Floods Related Hazards GDP Growth (Eq. 2)

GDP per capita growth	(1)	(2)	(3)
C	1.891***	1.861***	1.974***
	(0.449)	(0.451)	(0.400)
Log (Capital)	0.0262**	0.022**	0.062*
	(0.0126)	(0.046)	(0.036)
Log (Labor)	0.434**	0.440**	0.453***
	(0.208)	(0.200)	(0.173)
Log (Openness)	0.044	0.0446	0.016
	(0.071)	(0.068)	(0.030)
Log (Education)	0.642**	0.602**	0.760***
	(0.266)	(0.246)	(0.209)
Log (Infrastructure)	0.201**	0.229**	0.156*
	(0.094)	(0.095)	(0.092)
Log (Health practitioners)	0.131***	0.126***	0.126***
	(0.025)	(0.023)	(0.019)
Log (Flood affected population)	-0.032***	–	–
	(0.011)		
Log (Flood related mortalities)	–	-0.513	–
		(0.398)	
Log (Monetary damages)	–	–	-0.038***
			(0.013)
$GDPc_{t-1}$	0.488***	0.005**	0.456***
	(0.107)	(0.002)	(0.076)
R-squared	0.878	0.918	0.809
Prob (J-statistic)	0.573	0.231	0.674

Note: Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Labour, capital, education, infrastructure, and health positively and significantly affect GDP growth. This is consistent with some other studies [Banerjee, *et al*. (2012); Noy and Vu 2010). Openness has a positive but insignificant impact. This finding is similar with Sadia, *et al*. (2012). Openness can affect GDP growth positively or negatively depending on the specific context. If an economy opens itself up after years of protectionism, the initial result could be reduction in GDP growth [Lensik, *et al*. (1999)]. However, in the long run the openness is expected to benefit for an economy.

Flood related mortalities have insignificant negative effect on per capita GDP growth. The reason might lie in the demographic characteristics in the flood prone areas. The flood prone areas have generally higher poverty rates where family size is generally large with relatively few skilled earning hands. So

the share of the skilled labour from the flood prone poor regions contributes marginally to the total labour force. The damage to the property caused by flood exerts a significant negative impact on income growth. This damage is done predominantly to the agriculture sector. As agriculture sector contributes around 21 percent share to the GDP and olds the biggest employer of the labour force [Pakistan (2012)], it is only expected that damage to largely agriculture property slows down economic growth [Causes, *et al*. (2014)]. As the GDP growth depends upon its previous lag so lag value of GDP has significant positive impact on GDP growth.

4.3. Misspecification Test

Present study uses time series data for the period 1972-2013. To identify any misspecifications in our estimated models due to presence of serial correlation, we ran Breusch-Godfrey LM Test on the estimates of Equation 1 and Equation 2. Results are reported in Tables 6 and 7.

Table 6

Serial Correlation LM Test for Eq.1 (Determinants of Floods Related Hazards)

	Test Statistic	Prob.
Log (Flood affected population)	0.3386	0.6217
Log (Flood related mortalities)	0.7381	0.4710
Log (Monetary damages)	0.4212	0.6592

Table 7

Serial Correlation LM test for Eq.2 (Impact of Floods Related Hazards on GDP Growth)

	Test Statistic	Prob.
Log (Flood affected population)	0.4376	0.8035
Log (Flood related mortalities)	1.6495	0.1990
Log (Monetary damages)	0.8454	0.3313

The insignificant p-values for each specification suggests that residuals are uncorrelated and 2SLS results are reliable.

5. CONCLUSION

This study finds that GDP growth per capita, floods frequency, population density, infrastructure and institutions of disaster management are important determinants of the magnitude of floods related hazards. In addition, floods related hazards have significant negative impact on GDP per capita growth. Contrary to the theoretical prediction of a negative relationship between floods frequency and floods related hazards, we see a positive significant impact of floods frequency on the all three indicators of floods related hazards. The implication of this positive

relationship is that despite high frequency of floods in Pakistan, we have failed to learn the right lessons from the experience. Findings of this study also confirm that socio-economic factors *i.e.* role of the disaster management institutions (ID), infrastructure (INFRA) and national income (Y_C) significantly affect the floods related hazards. Higher per capita GDP growth allows the government to improve the infrastructure and early warning system. Negative coefficient sign of the institutional role variable ID indicates the importance of establishing effective institutions to mitigate the floods related hazards. The study finds the significant impact of developing infrastructure such as construction of levees, floodwalls and dams to minimise losses related with floods. Population density also negatively and significantly affects the floods related hazards, while the role of forests could not be precisely estimated.

We also find that all three measures of floods related hazards, namely, the floods related mortalities, the monetary damage to property and the number of affected population have a negative impact on the national economy. Only the flood related mortalities have insignificant negative effect on per capita GDP growth. The reason might lie in the demographic characteristics of the households in the flood prone areas. The flood prone areas have generally higher poverty rates where family size is generally large with relatively few skilled earning hands. So the share of the skilled labour from the flood prone poor regions contributes marginally to the total labour force. This situation gives important insights regarding how the population in the floods prone areas suffers from multiple deprivations and also highlights their extreme vulnerabilities.

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