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Economic impact of natural disasters: Evidence from India

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ABSTRACT

India, one of the developing countries with huge demographic dividend has been constantly facing devastating cost of natural disasters. In this study an attempt has been made to analyse the impact of natural disasters on human and economic capital in India. Besides, the study discussed different economic thoughts in relation to exogenous shocks like natural disasters. By using data from EM-DAT database, the study found that on average there has been threefold increase in the incidence of natural disasters which consumed huge chunk of population, number of people affected being even more overwhelming. In the recent years the economic damage due to natural disasters has also been catastrophic. Droughts and its associated famines although less in number are found to cause greater percentage of casualties and population affected. Economic damage in India is mainly associated with floods and earthquakes. The study highlights that due to greater vulnerability (in terms of weak economic conditions, widespread poverty, inequality, weak housing conditions, low medical and insurance coverage etc.); general masses are found to be more exposed which increases the severity of natural disasters in India.

Key words: Natural disasters, Human and Physical capital, Vulnerability

I.INTRODUCTION

One of the basic concerns of economics over the ages has been to address the issues of "development gap" between developed and underdeveloped countries of the world; i.e. why in some countries the standard of living is so high and why in others the people are not even able to satisfy basic necessities of life. Although from time to time various policy measures for combating and reducing the 'developmental gap' were recommended but hitherto instead of various efforts to reduce it, the gap has widened drastically. The reason for this widening development gap are many, one of the major reasons is variability to natural disasters across various nations of

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the world. In some countries natural disasters may setback the development process initiated and thus it may push them towards the state of being underdeveloped.

Although over the years preventive and preparedness measures have been taken but till today natural disasters consume a huge chunk of physical and human capital. In 2015, 346 natural disasters were recorded in the EM-DAT database. They claimed 22,773 lives, affected over 98 million people and the economic damage was up to the tone of US$66.5 billion [1]. In 2015 largest disaster in terms of economic and human costs was the earth-quake in Nepal which caused 8,831 deaths and over $5 billion losses to GDP.

Natural disasters are nothing new, they have occurred since the day's human civilisation took birth. However, economic research on natural disasters is still in its infancy stage with much focus diverted to mitigation and preparedness measures that aim to describe how societies should better prepare themselves against the natural disasters to reduce the devastating impact of natural disasters. Up to now not much attempts have been made to estimate the human and economic costs associated with natural disasters. A good estimate of these costs will help policy makers to execute investment measures on preparedness and mitigation in an efficient way.

The interest in examining the human and economic costs of natural disasters is due to the increase in incidence and intensity of natural disasters around the world, especially in the context of developing countries like India which are found to bear greater burden of natural disasters [2]. The above figures reveal the devastating nature of natural disasters and a need for high research priority for economists to address the impacts of natural disasters. Moreover in India we have low economic performance, widespread poverty, higher income inequality, weak housing condition, low medical and insurance coverage etc. These are the factors which make general masses more exposed and vulnerable to natural disasters and thereby increase the severity of natural disasters in a particular country. Therefore while analysing economic performance of a country, due consideration should be given to natural disasters and its associated costs.

The reason behind analysing human and economic costs of India is due to the greatest exposure and vulnerability of natural disasters to general masses in India. In Indian subcontinent we have widespread poverty, higher income inequality, malnutrition, low medical coverage, weak housing conditions etc, these increase the severity of natural disasters. More ever in case of India, we do not find any study that has analysed the consequences of natural disasters at the aggregate national level. Although many studies [3, 4, 5 6, 7 etc] have analysed the impact of a single disasters at the regional level but no systematic attempt has been made to examine the impact of all natural disasters at the aggregate national level. Therefore this study will try to bridge this gap in already existing literature of natural disasters.

II. NATURAL DISASTERS AND IMPACTS

According to the Centre for Research and Epidemiology of Disasters, "Disaster is a situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering" (Centre for


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Research on the Epidemiology of Disasters, CRED, 1988). A disaster is an extreme disruption of the functioning of a society that causes widespread human, material, or environmental losses that exceed the ability of the affected society to cope with its own resources (Ministry of home affairs India, 2011). Therefore disasters concern the interaction of sudden natural hazards with socio- economic systems of a economy.

Natural disasters cause destruction to human life, physical capital and environmental resource present in an economy. Among these resources which one gets highest damage depends on which of these is more exposed to natural disasters. Underdeveloped countries are usually found more vulnerable to human and environmental costs of natural disasters [2]. In developed countries the percentage damage to human and environmental capital occurs in smaller proportion than the physical capital. For developed countries, development acts as an insurance against natural disasters [8]. Due to differences in construction and engineering designs, a natural disaster of same magnitude may damage physical capital in different amounts across different countries.

As far as impacts of natural disasters are concerned, European commission for Latin-American countries (ECLAC) distinguishes between direct, indirect and macroeconomic damages of natural disasters. Direct damages are the direct effects of natural disasters which happen at the time of occurrence. These include loss to life, infrastructure, residential, output, delays in economic activities, loss to arable land and ecosystem etc. Also expenditure on reconstruction and relief during the time of natural disasters is included in direct impacts. The indirect and macroeconomic impacts which occur after some time depends on the magnitude of direct damages and rehabilitation effort. Indirect damages are the disruption caused in the production process. These include losses in output due to destruction in physical and human capital, delays and temporary span of unemployment. These also include higher prices paid during the time of natural disasters. The secondary or macroeconomic costs of natural disasters comprises the impact of natural disasters on macroeconomic indicators such as economic growth, public debt, fiscal deficits, balance of payments, foreign reserves etc.

The duration and geographical area covered by a disaster also play an important factor in determining the consequences of natural disasters. Disasters which are local in nature usually tend to have limited aggregate impacts than those events which occur throughout the whole economy. The impact of natural disaster to a particular economy depends on the degree of diversification of the economy and its macroeconomic performance before the disaster hits [9]. The countries which are mainly dependent on agricultural sector are likely to be severely affected than those which have larger diversification in economic activities. Economic structure present in a country and inter-linkages between different sectors also play an important role in destructive costs of natural disasters. Countries with large informal sectors are likely to suffer greater costs of natural disasters.

III. THEORETICAL BACKGROUND

Since the evolution of political economy, there has been controversy among the economists regarding the sources of growth and development. As far as growth and development theory is concerned, this controversy has

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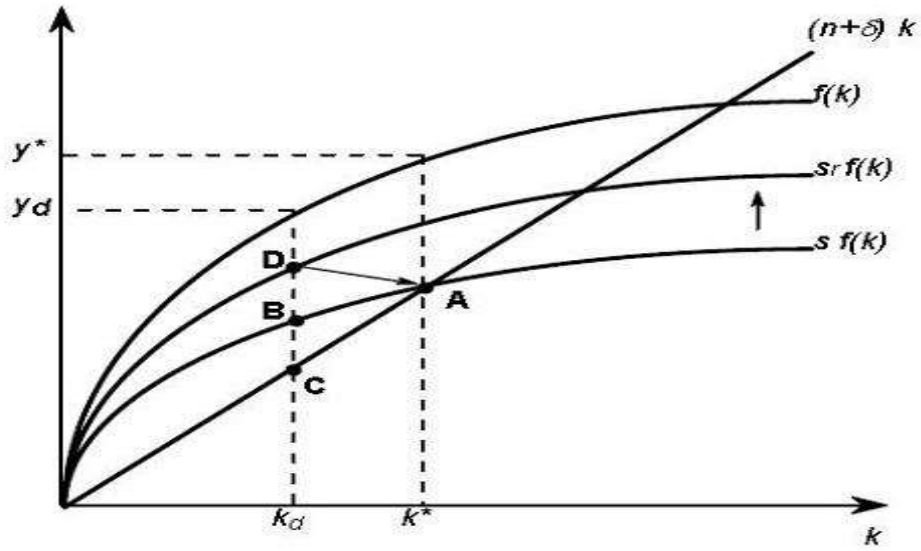
resulted in development of three main traditions namely neo- classical slow swan growth models, AK model and Endogenous technical change models. Based on sound arguments and empirical background, all these schools of thought held a different viewpoint regarding exogenous shocks like natural disasters. These theoretical stands in relation to a negative exogenous shock like natural disasters are discussed below:

Neo-classical growth models believe in diminishing returns to capital and as a result on steady state level of per capita equilibrium output. They treat technological progress as exogenous and driving force for long run per capita output growth. They held that deviation from the steady state equilibrium as a result of exogenous changes like natural disasters will enhance output growth [10]. Since due to natural disasters more capital than labour is destroyed, so fall in K/L ratio will shift per capita output to a higher level. This process is a result of reconstruction and rehabilitation efforts which lead to more capital accumulation, so output growth will lift until

Figure I: Slow Swan Model and a Disaster situation



In fig 1.1 steady state equilibrium output is given at point A where the saving function intersects the exogenously determined growth rate of population. Since natural disasters destroy the physical capital, it is assumed that the effect on population growth is not much. Due to natural disaster output per labour and capital per labour will decrease from $y^*$to y_d and k^* to $k_d$respectively. So the initial effect of natural disasters is to deteriorate the growth rate of output and capital stock and in the above fig the economy gets disturbed from the point A to the point D. Any disturbance from the equilibrium point A will result in forces that will move the variables towards the equilibrium level already achieved. Due to reconstruction and re-habitation programs, more capital accumulation diverts the economy towards the already existing steady state equilibrium level. Besides this during the recovery process saving rate and capital per worker improves, as a result the saving

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function will shifts above and thus we have a new steady state level of equilibrium at a higher level. This process is a result of investment surge in the aftermath of natural disasters which stimulates output growth to a higher level. The belief that natural disasters can boost economic growth is also shared in Schumpeterian tradition. They held that natural disasters provide a chance to update existing stock of capital and adopt new technology, leading to improvements in total factor productivity and thus economic growth [12].

AK type growth models held that human capital is an important determinant of output growth and a vital factor that overcomes diminishing returns to capital notion held by neo-classical economists. Besides human capital they advocated the role of economy wide capital in terms of total factor productivity. By incorporating both physical and human capital, AK tradition demonstrated that destruction in stock of physical and human capital due to natural disasters will have no effect on the economic performance. But it should be noted that the economy that receives destruction to capital stock will lead to a permanent deviation from existing growth path and will never go back to its old growth trajectory [10]. Also the magnitude of loss in any particular country will dependent on whether the nation is human abundant or capital abundant.

Endogenous growth models suggest technological change as a driving force for achieving higher growth rate of output. In accordance with the AK-models they believe in inherent technological progress and human capital but in addition they consider the impact of knowledge spillovers generated by technical progress and technical adaptation. Endogenous technical change models with increasing returns to production generally predict that destruction to physical or human capital due to natural disasters will lower the long run economic growth and consequently it lead to a permanent deviation from the already existing growth path. The negative long term impact on the economy is as a result of destruction of the capital stock, an increase in the perception of uncertainty, increases in defensive expenditures that draw resources from more productive sectors, and an impact on specific industries such as tourism [10].

IV. DATA SOURCES

The data on natural disasters and its impacts is taken from the EM-DAT database. EM- DAT is a world wide database and it contains data from 1900 to the present. The EM-DAT database is maintained by Centre for Research on the Epidemiology of Disasters (CRED) at Universite Catholique de Louvain (UCL) in Brussels. The data is compiled from various sources including UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies [13]. The entries in the EM-DAT database are constantly reviewed for redundancy, inconsistencies and incompleteness. EM-DAT reports data on two broad categories of disaster (natural and technological disasters), with several sub-types in each category. For a disaster to be entered into the EM-DAT database, at least one of the following criteria must be fulfilled:

• 10 or more people reported killed;
• 100 or more people reported affected;
• Declaration of a state of emergency;

• Call for international assistance.

EM-DAT database reports annual data on number of events, killed, total affected and economic damage for all types of disasters. The number of people killed includes "persons confirmed dead and persons missing and presumed dead". As far as total affected is concerned it includes people injured, trauma or an illness, homeless and people those requiring immediate assistance (food, water shelter, sanitation etc.) during the time of emergency. Economic damage includes damage to property, crops and livestock in the year of the event measured in thousand US dollars. In this study focus will be on the human and economic costs of natural disasters sub-type only. In EM-DAT database, from 1964 to 2014 data related to 584 natural disasters has been reported for India. Earlier to this time period, no data is available for economic damage. Therefore this study is restricted to 1964 to 2014.

V. NATURAL DISASTERS IN INDIA

Natural disasters are a common occurrence around the world, including India. India one of the developing countries of the world with huge demographic dividend, has been constantly suffering the effects of natural hazards. India, in its history, has come across scores of natural disasters and catastrophes which have taken huge toll of life and property. Quite often India has been among top 10 nations of the world facing largest burden of natural disasters [14]. In 2015, India was at the 3rd position in terms of people killed with 3271 casualties, 2nd in population affected with 10.6 million people affected and it was at the 5th spot in terms of economic damage with 3.3 billion US dollars loss to national wealth [1]. One interesting fact about the impacts of natural disasters in India is that severity of natural disasters is greatest in terms of destruction to population indicators. This is due to prevalence of mass poverty, inequality, low medical and insurance coverage, weak housing conditions etc. These conditions make the general masses more exposed and vulnerable to natural disasters.

The summary statistics of various natural disasters variables for India are given in the table below:

Table 1: Summary Statistics of Disaster Variables

	Events Occurred	Killed Population	Total Affected	Economic Damage
Mean	24.63	33471	39179588	1640934731
Median	25	3333.5	15116646	521767500
Std. Dev.	16.35	207490	70782099	3502239598
Minimum	2	65	25100	400000
Maximum	64	1500560	342029618	23263000000

Source: Authors calculation

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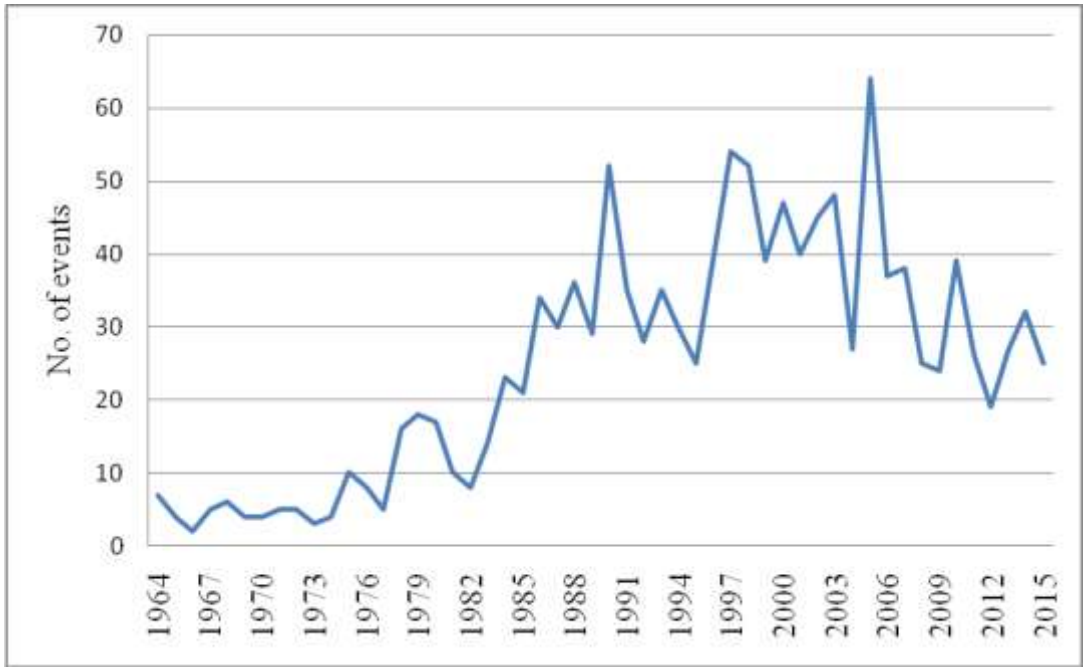
From the above table we can see on average 24 natural disasters hit Indian subcontinent every year which are found to cause 34 thousand casualties every year. Number of people affected is even higher, each year 3 crore people were found to get affected which is about 4 percent of total population. As far as economic damage is concerned, natural disasters in India every year result in average loss of around 164 crore US dollars. India has usually remained more prone to natural disasters and its catastrophic costs are higher than the other countries of the world. The average annual killings in disasters in India was four times more than the average of Asia, eight times more than the world average during the time period1982-2001 [14]. It is evident from above that there is a great amount of variability in associated costs for these three disasters variables. The magnitude impact of population affected is greater in proportion as compared to two direct measures population killed and economic damage. This is in accordance with the earlier facts that destruction of natural disasters is especially in terms human capital in developing countries like India.

Apart from this the standard deviation for these variables is also too high. There have been some years where the death toll was more than one percent and damage as a proportion of GDP was above one percent. Due to greater vulnerability Population affected has been even more devastating, many a times around 10 percent of total population, and in some years it was above 30 percent of total population.

Given these figures, it would to be critical to analyse whether over the year's natural disasters frequently has increased and if so then what would be the implications on human and physical capital in India? The fig below shows the incidence of natural disasters in India for the time period 1964 to 2015.

Figure II: Incidence of Natural disasters



Source: Authors calculation

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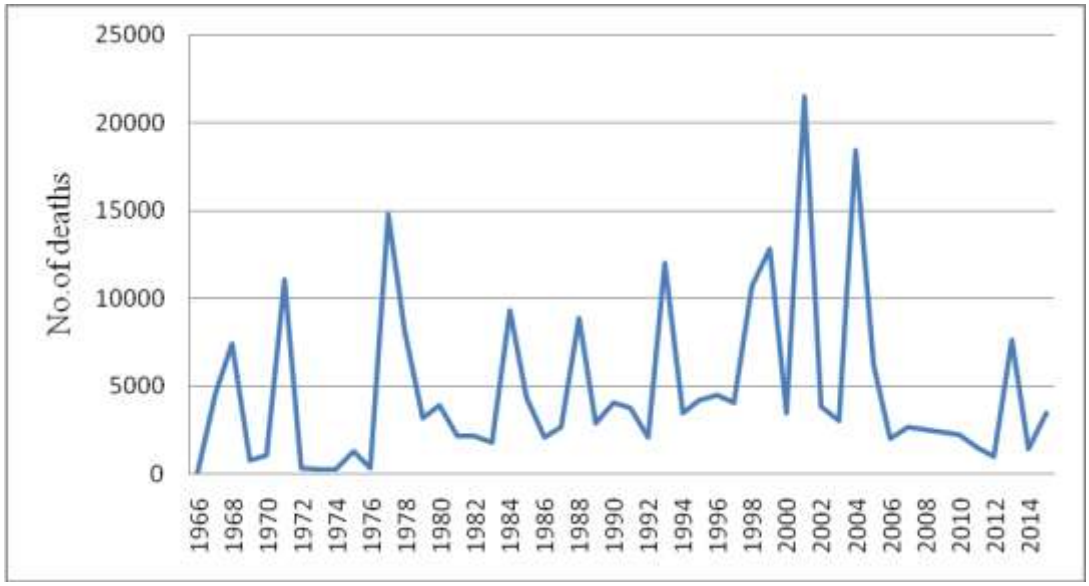
As is indicated in the fig above, from the last five decades India has been more prone to natural disasters. On average the incidence of natural disasters in India has witnessed threefold increase. So India besides facing challenges from widespread poverty, higher income and regional inequality, huge educated unemployment, malnutrition etc has to face devastating costs of natural disasters which are increasing year after year. Therefore to assess whether natural disasters have become severe or not, people killed, total affected and economic damage from 1964 to 2015 have been plotted in the figures below.

Figure III: No. of people killed due to natural disasters



Source: Authors calculation

As can be seen from the fig above, from 1966 to 2004-05, on average there has an increase in death totals that resulted from natural disaster. After this time period there has been a little dip in deaths from natural disasters and then again it increased in 2012 to 2014. On the whole a huge chunk of population in India is found to be consumed by natural disasters and its magnitude is increasing year after year. There have been some years where the death toll was more than one percent of the total population. These includes severe droughts in 1971 which occurred in large part of the country, 1977 cyclone in Andhra Pradesh, 1993 latur earthquake of Maharashtra, 1999 super cyclone in Orissa, 2001 devastating earthquakes in Gujarat and lastly widespread flood of 2004 that hit eastern coast etc.

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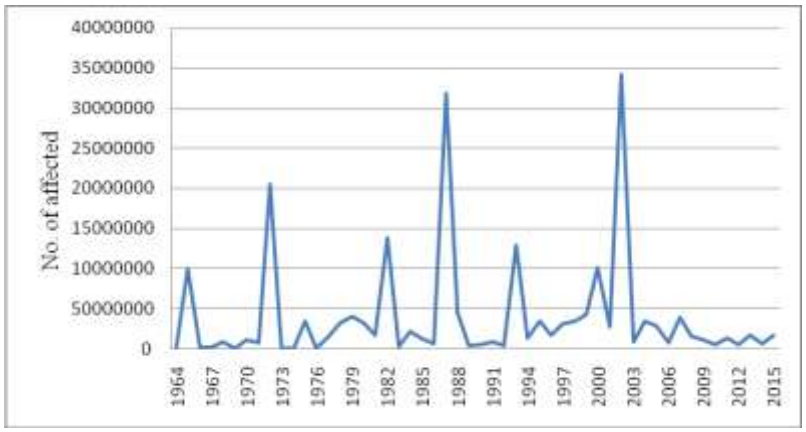
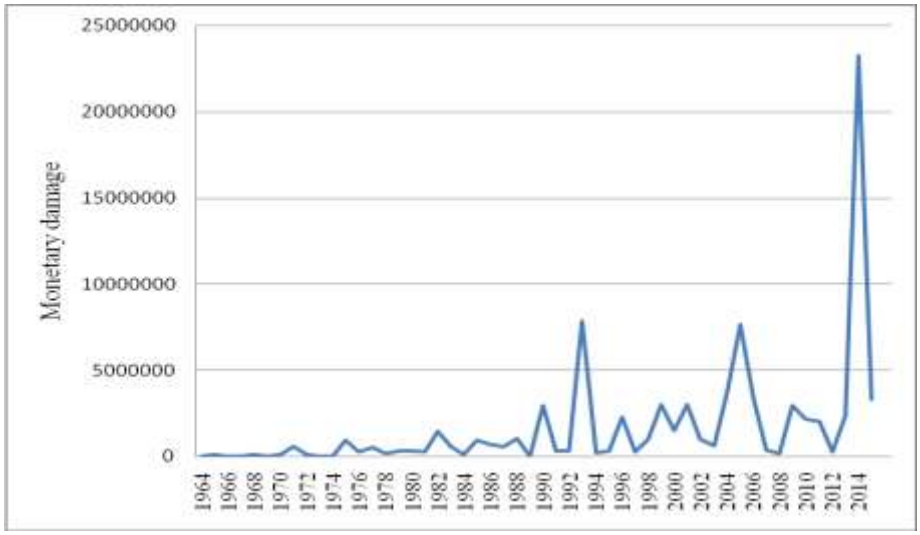
Figure IV: No. of people affected by natural disasters



Source: Authors Calculation

Due to greater vulnerability, population affected has been even more prone to natural disasters in India. From the above fig it can be inferred that on average the no. of people affected has been constant, only slight reduction were observed after 2004. This clearly reveals that the mitigation and preparedness measure taken by the Govt. Of India has not been on the line. Many times no. of people affected has been more than one crore which is around 10 percent of total population, sometimes even 30 percent of the population was found to get affected. These include droughts of 1965 and 1972 which prevailed over large parts of the country, 1977 flood that swept in West Bengal; again droughts occurred in 1987 in 15 states, 1993 earthquake in Maharashtra and 2004 tsunami that hit eastern cost of India. These costs are intolerable for any economy and particularly for a developing country like India whose main source of economic growth is its high demographic dividend.

Figure V: Economic damage (000) due to natural disasters



Source: Authors calculation

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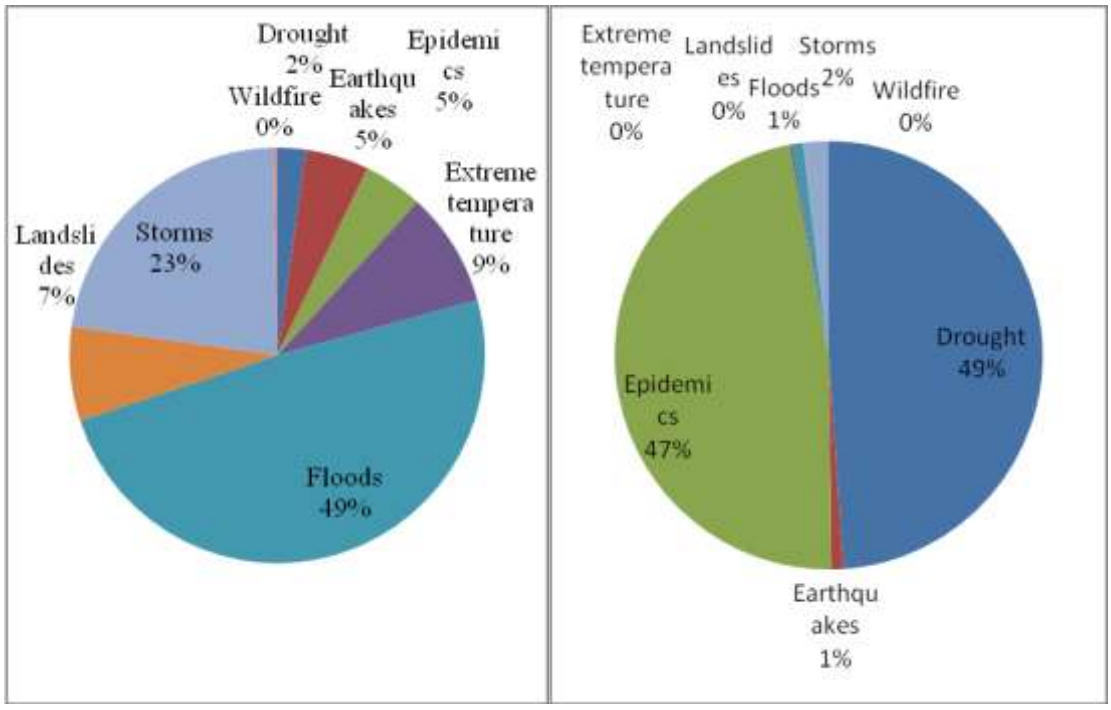
As far as economic damage is concerned in spite of engineering and technological improvements its value has been continuously increasing, especially in the recent time period. Percentage of economic damage to GDP many a times remained around or above one percent. Economic damage has been greatest in 1993 when earthquake hit latur region in Maharashtra, 2001 earthquake in Gujarat, 2004 tsunami of south eastern part of India and repeated and relentless flooding in Northeast India in 2013. This economic cost is only the cost which is observed in the year of the event, if indirect and macroeconomic cost i.e. impact observed in the aftermath of disaster are also taken into account then it would be a big amount of GDP of India.

India being a subtropical nation has been facing various types of natural disasters every year. In the pie-diagrams below the percentage number of events occurred, people killed, people affected and economic damage for various types of natural disasters occurring in India from 1964 to right now have been calculated.

Figure VI: Proportion of events occurred, killed, affected and economic damage among different disasters



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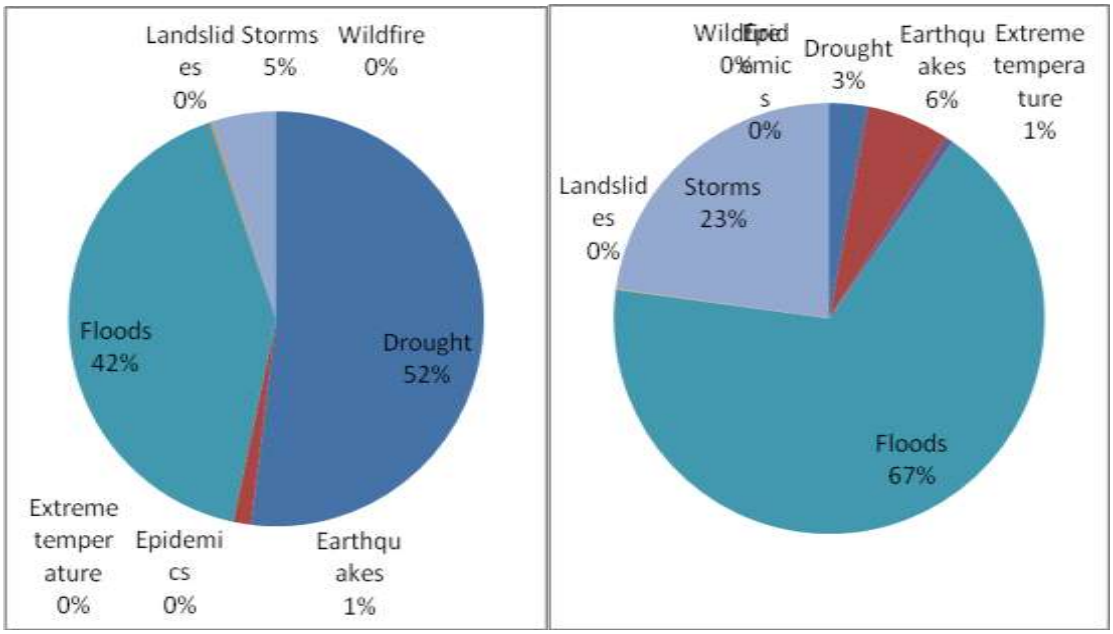

Source: Authors calculation

In the fig above we can see that over the years India has been more prone to climatic disasters like floods, storms, extreme temperature, landslides etc. Climatic disasters were mainly found to cause greater percentage of economic damage and also a sizable portion of people affected. But these are not among the prominent disasters which cause highest percentage of deaths. People killed in India were mainly associated with droughts and epidemics. These two calamities have although not been common in India occurring only 2 and 5 percentage times but they have claimed huge percentage of fatalities sharing 49 and 47 percent respectively. The main reason for this is that they directly affect general masses. Other types of climatic disasters mainly cause damage to property. Droughts are found to be more severe causing the highest percentage of fatalities (49%) and population affected (52%). Earthquakes, landslides and extreme temperature even though occurred good in number but their impact on population and national income has been meagre. Among these only earthquakes are found to cause 6 percent damage to property. Economic damage is mainly associated with earthquakes and floods with 67% caused by floods alone.

One interesting point to note is fatalities and population affected in India are mainly associated with droughts, earthquakes and tsunamis. In our country about 20 percent of the geographical area is drought prone which on average affect 12% of the total population. This is the type of natural disaster which has tremendous devastating character. Since droughts never improve economic growth and given droughts are more prone in India, therefore they are bound to have sound economic implications on India.

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Conclusion and Suggestions:

The study by using data from EM- DAT database during 1964 to 2015 period tried to analyse the human and economic costs of natural disasters in India. The study found that over the years India has been more prone to natural disasters and its associated costs. From last 5 decades, on average there has been around threefold increase in the incidence of natural disasters in India. These constantly increasing natural disasters are found to consume huge chunk of population, the number of people affected is even more. Economic damage in many years has remained above one percent to the annual GDP. Among the various types of disasters, India has been more prone to floods and storms. However, droughts and epidemics although less in number are found to cause greater percentage of casualties. Droughts are found to be more severe, causing the highest percentage of fatalities (49%) and population affected (52%) where as floods and earthquakes are found to cause greatest percentage of economic damage. This is mainly a result of their direct effects on general masses and also due to greater vulnerability in terms of widespread poverty, higher income inequality, weak housing conditions, low medical and insurance coverage etc. These conditions make general masses more exposed to natural disasters and therefore increase the severity of natural disasters.

From this study, there is a clear indication that not much effort has been made by the government of India to repeal the immediate and future costs of natural disasters. The preventive and mitigation measures taken by the government of India against natural disasters has not been up to the mark, still magnitude of deaths, total affected, total economic damage is huge which is unacceptable for a growing economy like India. Since India is constantly facing natural disasters and also its costs are so devastating, therefore steps should be taken to consider natural disasters in long term economic planning. These costs are unacceptable for a growing economy like India where main source of growth is its demographic dividend. Since greatest damage to natural disasters occurs in terms of population indicators, therefore efforts should be made to reduce the vulnerability and exposure of general masses against natural disasters.

The present study is a preliminary analysis on the economic impacts of natural disasters. Future research in this area should try to examine the macroeconomic costs of natural disasters in India. These include impact on economic growth, public debt, foreign inflows, inflation etc.

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