



A Study: Economic Impacts of Landslide in Rural Areas of Idukki District

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Abstract

Landslide is defined as the movement of debris, mass rocks or earth down a slope. Apart from the geological impacts landslide causes severe problems in the society in terms of social economic and environmental issues. This paper is mainly focussed on the economic impacts of landslide in the form economic loss and the reconstruction loss in the selected study villages. Through the calculation of the cost, it is possible to analyse how extend the landslide has affected the inhabitants in the village. Through this study, it found that damages on house, land and the crops loss were the most intense damages met by the respondents. This study is purely based on the primary data and collected 312 samples from three most affected villages by using the technique of multistage proportionate stratified probability sampling method. According to the result of this study the total cost of loss met by the respondents in the study area is 15911983 rupees and they spent 51469770 rupees for the reconstruction of their demolished things. This study also postulates that the government compensation was not so enough to take them back into the safe situation and majority of them are still in the prone area. The effective resettlement policy is the only measure for the rehabilitation of the victims in the study area.

Keywords: Landslides, Economic loss, Idukki district

Introduction

The hilly regions of Kerala facing several kinds of landslides. Debris flow is the most common type of landslide occurring in Kerala. In the local vernacular they are called 'Urul Pottal'. One of the major characteristics of this debris flow is sudden and swift movement of saturated water containing various collection of debris material and it will destroy everything which come into its path. Since the early 18th century, the main triggering factor of the landslide is accelerated by the anthropogenic activities such as deforestation and others. In Idukki district, the landslide in 2018 is the massive and destructible one in the landslide history of Kerala in the sense of economic loss. According to the Disaster Management Plan published by the Kerala State Disaster Management Authority 2016 "as many as 295 persons have lost their lives in eighty-five major landslides in the State between 1961 and 2016". Of the 5067 sq. km or 14.4% of the total area of the state is vulnerable to the landslides, stated by the SDMA Kerala in 2016. According to the SDMA Kerala in the State out of 77 administrative divisions 10 taluks were considered as the highly susceptible to the landslides as well as the moderate prone area includes the 25 taluks and the 14 taluks were least prone area. It dealt with the various impacts of landslides occurred in the Idukki district. In 2018, 2019 and 2020 Idukki has witnessed the real face of natural disaster in the forms of heavy rain and flood. The frequent rain falls and caused the heavy flood which triggered the massive landslides in all over the regions of Idukki district. In 2020, the Pettimudi disaster in Idukki that was the largest landslide in the history of disasters in Kerala. More than 60 peoples were died and all the shelters and vegetations were washed out with the massive mud flow. In the case of Kerala, a total of 2.34 lakh houses were destroyed by the landslide and floods (Kerala flood and Landslides: 2018). Apart from that, around 1.20 lakhs houses lost its basement and filled with debris and heavy mud and it had gifted many post- disaster effects to the people in the forms of health hazards. When considering the Idukki district 259 buildings and land were lost. There is a total of 8496 buildings were affected by the flood and landslide which may include partially destroyed and fully destroyed households all over the district. The real problems to be faced by these destructed households and other buildings are its reconstruction. It should need a huge amount of economic assistance. According to the report published by the Kerala Government on flood and landslides in 2018, 154.2 lakhs rupees were registered as the cost of rebuilding of the demolished and destroyed houses in Idukki district alone. The cost should be varied with styles and facilities of the households to be rebuilt in the sense of concrete roof houses and without concrete roof houses. According to the report, Kerala: Floods and Landslides- 2018, 'half of the population of Kerala 52% lives in rural areas and 17.15 % of the population depends on various agricultural fields like various crops, livestock, and fisheries. The sector contributes 11% of the total gross state value addition (GSVA) at current prices, such as crops 5.42%, livestock 3.84% and fisheries 1.78% respectively'. As a result of the recent landslides and flood, all the areas of agriculture were hit worse. More than 88% of the damages were centralised to the agricultural sector. More clearly 10% to the livestock and 2 % to the fisheries were registered as loss all over in Kerala respectively. In the case of Idukki district, 536.7 crore rupees was registered as loss damage in crop sector under the private ownership. On the other hand, 52.0 crore under the public ownership land as considered as the loss. Total crop loss was 588.8 crore in Idukki district due to the disaster.

To conclude, the most recent landslides in Idukki district witnessed in 2018, 2019 and 2020. In 2018 the disaster was spread out all over the regions of Kerala. In 2020 a massive landslide ensued only in Idukki district, Pettimudi village. It has washed out the entire small shelters known as 'Layam' in the plantation area and 60 life loss were recorded. Apart from the geographical causes of the landslides, anthropogenic activities like steep cutting, unscientific cultivation, mining and quarrying have triggered the intensity of the disaster. To mitigate the severity of the disaster on loss on economic- social and environment new mitigation measures and policies should be carried out.

Methodology

This study is purely based on the primary data collected from the three most affected villages of the Idukki district. there are 312 samples were collected from the three villages namely Konnathady, Kanjikkuzhi and Rajakkad. The multistage proportionate stratified random sampling was used for the selection of samples in the study area. For the collection of data, the survey method was used with a structured interview schedule.

The main focus of the study is calculation of economic loss and the reconstruction cost in the three study villages. The study was divided into the calculation of economic loss, using of regression analysis to find out the major determinant variables for the various loss and the effectiveness of the government compensation after the disaster. For the calculation of loss, the major losses like, house damage, land loss, furniture and home appliances, food grains, employment loss, health cost etc were taken into the consideration. For reconstruction, roof, electricity, walls, furniture etc were considered.

The Regression Model.

The regression model is used to find out the variables that influenced the major economic losses such as loss on damage on houses, loss on land eroded and the crop loss.

House type, income of the family, proximity to prone area, type of proneness, cultivating habit are identified as the key factor to determine the damage on house, loss on land eroded and the crop loss.

Function: $Y = \alpha + \beta_x + \epsilon$

Paired t test.

The government compensation to the victims is an important concern after the occurrence of landslide. The paired t test is employed to find out the variation between the average loss met by the respondents and the average amount of compensation given by the government to the victims.

Results and Discussion.

The results of the study shows that the losses met by the inhabitants in the three villages viz Kanjikkuzhi, Konnathady and Rajakkad.

Table 1: Landslide loss in study villages

Sl No	Loss particulars	Study Villages			TOTAL	Sig.
		Loss in Kanjikkuzhi	Loss in Konnathady	Loss Rajakkad		
1	House Damage	16214000	8821500	1845500	26881000	0.000***
2	Land Loss	49914006	53830000	13415000	117159006	0.000***
3	Furniture loss	1110000	1152800	304400	2567200	0.001***
4	Home appliances loss	677500	682700	128500	1488700	0.003***
5	Loss on food grain	116900	228100	27900	372900	0.320NS
6	Employment loss	1646694	4936056	1145880	7728630	0.026**
7	Health Cost	47500	115700	6100	169300	0.002***
8	Loss of offensive measures	320000	4568200	767000	5655200	0.559NS

9	Agricultural Loss	2779940	6985330	1772745	11538015	0.260NS
10	Animal husbandry loss	404800	878050	170600	1453450	0.554NS
11	Loss on water facilities	335150	565830	85650	986630	0.188NS
12	Loss on sanitation facilities	1523000	3157700	568800	5249500	0.000***
13	Other loss	449200	994650	439350	1883200	0.002***

(Source: Primary Survey 2021)

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level,

NS- Not Significant

Table 2: Reconstruction cost met by the respondents in the study area

Sl No	Reconstruction cost spent for	Study Villages			TOTAL	Sig.
		Reconstruction cost in Kanjikkuzhi	Reconstruction cost in Konnathady	Reconstruction cost in Rajakkad		
1	Roof	7806500	9351970	3118000	20276470	0.008***
2	Electricity	825100	778200	232800	1836100	0.000***
3	Walls	6827000	7199600	2122500	16149100	0.000***
4	Furniture	580500	601000	432000	1613500	0.041**
5	Kitchen appliances	485500	518600	156000	1160100	0.043**
6	Water and sanitation	1123000	3060800	639500	4823300	0.101NS
7	Defensive measure	685000	2394000	385000	3464000	0.195NS
8	Others	1043000	732200	372000	2147200	0.082*

(Source: Primary Survey 2021)

Note: *** significant at 1% level, ** significant at % level, * significant at 10% level. **

NS- Not Significant

The resultant table deals with the loss and reconstruction met by the respondents in the study area. According to the table 1, the most intense loss met by the respondents is the land loss due to the eroded land they owned. Even the value of land is lower in the prone area, the loss is very large because of the huge erosion of acres of land. In Konnathady village loss of land is calculated as 53830000 rupees, it is the highest land loss among the villages. It is because of the village is mainly based on the cultivation of the crops like rubber, nutmeg, cardamom, pepper and other spices. It is also evident from the loss of agriculture in Konnathady village. Another important dimension of loss is the house damage in the three villages. The cost of damage of house is very high in Kanjikkuzhi village. That is 16214000 rupees and the land loss is 49914006 rupees. In the case of agricultural loss, the amount is 2779940 rupees. The loss of water and the sanitation facilities were made disturbances to the victims in the study area. The fallen debris were completely destroyed and polluted the supply of water and the quality of water. The demolition of sanitation facilities was fully destroyed and partially destroyed. According to the mode of destruction the cost were increased. This has been increased in Konnathady village that is 3157700 rupees and 1523000 rupees in Kanjikkuzhi and 568800 rupees in Rajakkad village. In the case of water facilities damage, it is also higher in Konnathady that is 565830 rupees. When comparing to the other villages Konnathady is much hilly region and the supply of water is much difficult. So, they will find some alternative sources for the collection of water rather than the normal water connection. This will led to additional cost on water supply. It was also destroyed in the landslide and the cost was increased under water damage. Like the land loss, house damage and the agriculture loss, another massive loss is coming from the loss of revenue due to the loss of employment. Before the landslide the major employment in the study areas were agriculture, plantation works, NREGP. In the other sense most of them are depended on the natural sources for their livelihood. But the creepy landslide was destroyed everything and it has directly affected their employment option also. As the land loss and the agriculture loss are higher in Konnathady village, the employment loss is also higher in the same village. It is evident from the table 1 also. These were the major and significant losses in the study areas. When considering the Konnathady and Kanjikkuzhi villages, the losses in Rajakkad village is significantly low but higher when comparing to the landslide loss in the other villages in the nearby zones.

The reconstruction cost for all these met by the victims showed in the table 2. The major reconstruction cost borne by the respondents are from roof, electricity, walls, furniture, kitchen and home appliances, water and sanitation, defensive measures and others. After the landslide, the victims were only constructed their houses partially not fully. They have not enough financial sources to reconstruct their belongings. The government assistance for reconstruction activities were less and it has not been properly assigned according to the loss met by the victims in the study area. According to the table

the construction of roof, walls, electricity and the water and sanitation were the important dimensions of reconstruction made by the victims in the whole study area.

Regression Model

The regression model is used to find out the variables that influenced the major economic losses such as loss on damage on houses, loss on land eroded and the crop loss.

Table 3: Regression Result

Dependent Variable Independent variable	Loss on House Damage (Function A)		Loss on Land Eroded (Function B)		Crop Loss (Function c)	
	β	t	β	t	β	t
Constant	-133436.94***	-3.354	1620645.474***	8.349	110970.14***	8.09
House type	32849.023***	3.195	88279.21*	1.726	1059.50 ^{NS}	0.29
Income of the family	2.490**	3.112	-21.593***	-3.849	-0.179 ^{NS}	0.64
Proximity to prone area	-24554.60***	-5.118	-423376.80***	-12.562	-11017.91***	-0.364
Type of proneness	112329.09***	5.802	20084.67 ^{NS}	224	8222.58 ^{NS}	1.232
Cultivating or not	46358.30***	2.205	57056.91 ^{NS}	0.758	20140.54***	3.92
Multiple R	0.58		0.71		0.41	
R square	0.34		0.50		0.17	
Adjusted R ²	0.33		0.49		0.16	
Std Error	128454.75		491516.30		44273.62	

Functions: $Y = \alpha \pm \beta_x + \epsilon$

Where 'Y' = Economic losses (House, Land eroded and crop loss) taken as the dependent variable and the independent variables are

HT= Type of House

FI= Family Income

PROX= Proximity to prone area

PRONE= Type of Proneness

CULT= Cultivating or not

Function A: Y= Loss on House damage.

$$Y = -133436.94 + 32849.02_{(HT)} + 2.490_{(FI)} - 24554.60_{(PROX)} + 112329.09_{(PRONE)} + 46358.30_{(CULT)} + \epsilon$$

Function B: Y= Loss on land eroded.

$$Y = 1620645.474 + 88279.21_{(HT)} - 21.593_{(FI)} - 423376.80_{(PROX)} + 20084.67_{(PRONE)} + 57056.91_{(CULT)} + \epsilon$$

Function C: Y= Crop loss.

$$Y = 110970.14 + 1059.50_{(HT)} - 0.179_{(FI)} - 11017.91_{(PROX)} + 8222.58_{(PRONE)} + 20140.54_{(CULT)} + \epsilon$$

The regression result shows that, under function A (House damage) all the independent variables are got significant with the dependent variable damage cost on the house. The type of house is a major factor which determines the intensity of the economic loss to the houses, mainly the structure of the house it turned significant at 1 percent level to the dependent variable damage loss on house. Secondly income of the family, it also directly associated with the dependent variable at 5 percent level of significance. The family income increases the economic value of the household asset will also increases and it led to larger losses to the households. Another two variables are proximity to prone area and the type of prone area turned to significant at 1 percent level to the dependent variable. The proximity to prone area is negatively associated with the loss on house damage. The proximity to landslide event place increases the intensity of the loss on house or the exposure to the landslide will be reduced. The type of area such as prone or non-prone, obviously the loss will be less in non-prone area and higher in the prone area, a positive relation is carried out there. The final variable, cultivating habit of the respondent is also positively associated with the loss on house damage.

In the Function B, the loss on land eroded, only three independent variables are associated with the dependent variable loss on land eroded. The type of house is significant at 10 percent level to the independent variable. Sometimes, the houses are fully slipped with the eroded land and the loss will be assessed jointly. These kinds of problems are observed by the researcher during the field survey. Some of the respondents opined that, they have only meagre land for the base of their house. When the landslide is occurred, the house will slip first with a huge portion of their land. The income of the family is negatively associated with loss on land eroded. It is because the changes in the land holding pattern with respect to changes in income. In the study area, the researcher found that the amount of land holding is small in the category of high-income groups when comparing to low-income group. It is because, most of the lands they are using for cultivation purposes and the high-income group will cultivate less when comparing to others. So, they have not larger amount of land. In short, the income increases, the land holding will decrease and it will be resulted as a negative relation with loss on land eroded.

Finally, the function C, crop loss. two independent variables are turned significant with the dependent variable. Proximity and cultivating habits are significant with 1 percent level negatively and positively with dependent variable respectively. the level of income. It is negatively associate with the crop loss. It shows, the income increases the crop loss is decreases, same as in the situation of income and loss on land eroded case.

The difference in government compensation and economic loss: Using paired 't' test

The government resettlement is the major rehabilitation of the victims after the occurrence of the landslide in the areas. The government must have to give the compensation to the victims those who are faced immense loss during the time of landslide. It is fair to test the average difference between the government compensation and the total loss met by the respondents in the study area after the occurrence of landslide. The statistical tool Paired 't' test is employed to test the hypothesis given below

Hypothesis: The government compensated equal amount for the major losses met by the victims.

H_0 = The government has compensated equally for the major losses met by the respondents

H_1 = The government has not compensated equally for the major losses met by the respondents

Table 4: Paired 't' test result

Pair 1	Mean	N	Std. Deviation	Std. Error Mean
Total govt compensation	309847.0714	196	383269.49330	27376.39238
Total loss	646689.2398	196	805532.54638	57538.03903

Proportion of Government total loss to total disaster loss	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Govt total Total loss	-336842.16837	718006.04356	51286.14597	-437988.91322	-235695.42351	-6.568	195	0.000

The test statistic shows that, there is a significant variation between the total loss met by the respondents and the compensation given by the respondents. There are only 196 respondents got compensation from the government out of the 312 selected samples. According to the results the average total loss is 646689.23 rupees and the average government compensation is 309847.07 rupees. This shows that the government has failed to compensate the victims according to their massive loss. So, this variation is significant at 1 percent level and strong enough to reject the null hypothesis and accept the alternative hypothesis.

Finally, the problems in the rural villages of Idukki district due to the natural calamities still haunting the inhabitants in the prone areas. The effective resettlement policy is the only one option to tackle the risk and vulnerabilities of the people residing in the prone areas.

Conclusion

To conclude, in Idukki district landslide has caused immense socio-economic and environmental pressure to the people. The different dimensions of loss have affected the people in different ways. They were not able to come back to the normal situations after the landslide because of the huge economic loss. The loss of land and the houses are the most tragic damages according to the experiences and opinions of the victims. The only way for reducing the landslide vulnerabilities is the effective government resettlement policies. The government must have to give equal or more compensation proportionately the economic losses met by the respondents. The environmentally vulnerable areas due to the frequent landslides must have labelled as buffer zones and remove all the settlements and give them new safer place for their livelihood.

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