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Benefit-Cost Analysis of Flood Management, a Case Study of Jammu and Kashmir

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Abstract: This paper focuses on the cost-benefit analysis (CBA) of flood management by District Disaster Management Kulgam. The assessment is based on secondary pooled data collected from government offices, NGOs, journals, and national newspapers. We describe the scenario, the approach adopted, and sources of flood damage cost information. The estimated total benefits account for 78686.18 lakh rupees, and total costs account for 2218.75lakh rupees. The Benefit-Cost ratio greater than one shows that Flood Management in District Kulgam was economically feasible and successfully managed. The State of Jammu and Kashmir takes essential prevention and management measures to bring down the damages due to floods to significant status.

Keywords: Cost-benefit analysis, nature, flood management, disaster, environment.

1 Introduction

Change is the law of nature. It is a continuous process that uninterruptedly involves phenomena, big and small, material and non-material, making our physical and socio-cultural environment. It is a process existing worldwide with daily variation in terms of amount, intensity, and scale. Change can be a gradual or slow action like the evolution of landforms, and it can be as fast as volcanic eruptions, tsunamis, earthquakes and flash floods. Except for inevitable floods triggered by dam collapse or landslides, floods are climate phenomena determined by the circumstances of geology, geomorphology, relief, soil, and vegetation [1]. The World has become highly vulnerable to natural hazards. While floods are natural events, the river basins' condition has changed dramatically about human activities and human interference in biological processes, such as changes in drainage patterns resulting from urbanization, agricultural practices, or deforestation [2]. Floods are relatively sudden in occurrences and often occur in well-identified regions and within the expected time in a year. Floods commonly occur when surface run-off water exceeds the river channels' carrying capacity and streams and flows into the adjacent low-lying floodplains. Floods in the South, Southeast, and East Asian countries, particularly in China, India, Pakistan and Bangladesh, are frequent and equally disastrous. In the past decade, various states of India have faced heavy loss of lives and property due to recurrent floods [3].

In September 2014, Jammu and Kashmir saw gigantic floods that left thousands of people abandoned inside their houses. Two hundred fifty towns across Kashmir had been affected, one hundred sixty individuals had passed on, and many domiciles were bored away [4]. One can scarcely observe the lofty Chinars, the fragrant pine trees, and the rich sobbing willows that gave harbour to those slammed by the destinies. The charming magnificence of Mughal gardens, reviving springs, and impressive cascades lament the condition of the destroyed land, the contaminated streams, and the enduring individuals. River Jhelum, flowing five feet above the danger mark in 2014, had inundated over hundred villages [5]. The most affected districts were Anantnag, Kulgam, Shopian, Pulwama, Bandipora, Ganderbal, Srinagar, and Badgam. The condition heightened as virtually all the significant emergency medical institutions were unfavourably influenced and delivered dead. Almost ten days after the floods, three significant healthcare facilities in the city stayed shut for patients, while two partially continued their administrations to specific patients (outpatient care just)[6]. The floods straightforwardly influenced more than two thousand six hundred villages in the State and turned down thirty per cent of the town zones. The water levels ascended to twenty feet in the city while numerous towns were sliced off because of the decimation of the main extensions and streets driving into these towns[7]. The state government declared a calculated loss of rupees one trillion because of the floods, with housing

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sphere deprivations of thirty thousand crores and business sector losses of seventy thousand crores [8].

2 Flood management in Jammu and Kashmir

John Stuart Mill "What has so often excited wonder [is] the great rapidity with which countries recover from a state of devastation; the disappearance, in a short time, of all traces of the mischiefs done by earthquakes, floods, hurricanes, and the ravages of war"[9]. Despite the gains ground in science and technology, humanity cannot still cope with nature's anger. The natural order of life is interrupted by destruction. It has challenges and adverse health effects. We can not avoid disaster entirely, but disaster management is necessary. The flood's aftermaths can be prevented by taking practical action strategies for disaster prevention. The measures to reduce the flood catastrophe will involve. 1. Design strategies to resilience these risks and enforce them. 2. A solid plan for post-flood recovery and reduction [10].

As mentioned above, heavy rains in September 2014 caused devastating floods and landslides in UT of Jammu and Kashmir, affecting some parts of Jammu and most of Kashmir valley. More than 700 villages remained submerged. Srinagar, the capital city, got submerged. 6.48 lakh hectares of Agriculture/horticulture land got affected. About 3 lakh houses got fully or partially damaged [8]. The case of the Kulgam district was not different. The situation warrants a close probe to identify the factors at work from a policy perspective—the various research issues delineated below would provide a rationale for the proposed study in the Kulgam district. The flood devastation is severely affected the Kulgam district. In light of the above reflections, the present researcher intends to analyze flood

participation, was the first used CBA in the World in flood management to control flooding on major country rivers. According to that, flood management is economically feasible "if the benefits to whomsoever they accrue are more than the estimated costs"[11].

The essence of CBA lies in:

- (i) To identify the items of benefit and cost in the flood management from an economic point of view, i.e., allowing all the benefits accruing to and all the costs incurred by the private or public sector;
- (ii) Adopting appropriate prices for measuring the benefits and costs in monetary terms; and
- (iii) To adjust the future costs and benefits prices to present values to make them comparable.

Because benefits and costs stemming from many different effects, a systematic procedure must ensure that each is considered and evaluated correctly. The practise so far has been to include only the direct effects, even though some other effects are also being taken into account.

This study has three goals. The first is to analyze the direct and indirect benefits Loss due to flood] incurred due to the 2014 flood in Kulgam district. In the case of a flood management project, direct benefits include the reduction in physical damage. Thus, flood damage to crops, cattle, houses, commercial and industrial buildings, infrastructure etc., avoided because of construction of embankments, flood retention reservoirs or flood warning systems, are direct benefits. Indirect benefits may occur by avoiding disruption to business, transport networks, and public services and avoiding the accident and emergency response and recovery costs.[11].

Table 1: Classification of Direct and Indirect Benefits to the society through Cost of Damage Due to Flood Approach.

S. No.	Type of Benefits	Components
1	Direct benefits:	Physical damage to property: Housing, Agriculture, Commercial Buildings and Livestock
	i) Tangible Costs ii) Intangible costs	
2	Indirect benefits:	a) Primary: Loss of human life
		b) Secondary: Illness of flood victims
2	Indirect benefits:	a) Primary: Disruption of traffic and trade
		b) Secondary: Reduced purchasing power

management in-depth. Accounting for the damage assessment and documenting administration records in management and rehabilitation works gives specific policy directions.

Cost-Benefit Analysis.

The United States Flood Control Act of 1936, which specified the Federal Government of the United States'

The 2nd goal of the study is to compute the direct and indirect costs of flood management in the Kulgam district after the 2014 flood. The State Government adopted many methods to tackle future disasters in the district. As benefits, the costs of flood management projects can be defined as primary and secondary. However, cost estimation is comparatively more exact and easy.

Table 2:Types of Costs.

Structural: Mitigation costs	Non-structural: Adaptation costs
Reshaping of land surface	Flood defence
Protection from erosion	Forecasting
Levees, dykes, floodwalls	Warning
Dams and reservoirs	Floodproofing
Flood ways and diversion works	Evacuation
Polders and fills	Relocation
Drainage works	

The study's third and last goal is to compare the cost and benefit of flood management in the Kulgam district. Cost-benefit analysis compares the reduced risk due to measure implementation with the costs of implementing the measures. Implementing measures does not change the probability of a weather event occurring; however, the propagation and related damage cost do.

3 Data Construction

The study is based on the secondary pooled data on the cost and benefits of the flood from the publishing record of District Disaster Management plan Kulgam 2017-18,2021-22, research journals, Government offices, and newspapers. The data was treated for a cost-benefit analysis to derive the necessary results—the analysis was based on past damage data. In the case of flood management in the Kulgam district, important information was available as the number of damaged houses during the 2014 flood, relief amount, construction on river banks, damaged roads, etc. However, some data, particularly on the social impact, were lacking, and the analysis followed the pooled data approach based on estimates of past impacts. Impacts assessed cost-estimation of measure implementation. 4. Reduced risk costs as a result of measure implementation. 5. Cost-benefit analysis.[12].

Limitations

This study focused on the estimation of the effects of measures for flooding and their related benefits. There is no intention to list all available measures to reduce the risk of Construction measures and their prices are at the core of cost analysis. One method for estimating costs is to use a comprehensive checklist of cost items readily available in the professional literature. However, any such list should be updated and modified according to the latest thinking and local requirements. Thus, the cost estimates are based on actual market prices even if these are distorted and not suitable for CBA[11].

flooding, as this is highly dependent on local conditions. This analysis is the first of its form in the Kulgam district while using the CBA model for flood management. Since relevant in-data has been provided using secondary data, the quality of the case study results fluctuates accordingly.

4 Analyses of Benefits of Flood Management in theKulgam District.

The Vishow tributary of River Jhelum flowing through Kulgam District caved embankments and eroded habitants, healthcare system, schools, Govt. offices, and many other buildings and infrastructure. The most significant tangible costcategory which was hit badly was considered to be housings. Most of the houses were made with bricks and cement. Three thousand three hundred sixty-fivehouses got damaged during the 2014 floods in twenty-two villages, according to the rapid assessment report 2014 and District Disaster Management Plan Kulgam (2021-22).

4.1 Direct Benefits

4.1.1 Damage of Houses and Assets

The Centre for Science and Environment of India stated that Kashmir floods were caused by mismanagement, heavy rains, unplanned urbanization, and lack of preparedness.[13]. An African proverb, "where water is the boss, there must the land obey," is ideally suited to our valley. The illegal construction on river banks will pave more risk when one disobeys the water bodies and their nature. The modern architecture of the housing sector in the valley does not suit the climatic conditions. The housing damage in district Kulgam in the 2014 floods was devastating. The housing building's total damage cost has been estimated with rupees nine thousand nine hundred fifty lakh calculated on the current market price of infrastructure material. In contrast, the total cost of damages of assets (durable and nondurable assets) has been calculated as five hundred fifty-two lakh of rupees. Flood damage has the potential to step up into a grievous emergency if not treated immediately.

4.1.2 Agriculture

Flood 2014 was one of the devastating floods in the history of Kashmir, as mentioned above. The study revealed that human interference and non-eco-friendly development in Jammu and Kashmir were the main reason for such a disaster [14]. Agriculture is the mainstay of the Kulgam district. Almost eighty per cent of people directly depend on agriculture for their livelihood. It had been seen that mainly the villages along the NallaiVishow were suffering from soil erosion, whereas other villages suffered from flooding, inundation, and sedimentation. Out of three thousand three hundred sixty-five affected households, thirty-seven per cent are large farmers, and sixty-two per cent of small or marginal farmers were affected by the flood. The total estimated cost of land damage is fifty-five thousand seven hundred and eighty-five lakh of rupees using present value calculation. Since the August- September season for apples in Kashmir has been considered the ripe growth season, the Floods of 2014 hit this sector very hard. The cost of apple loss is figured by adding the cost of apple loss of big cultivators with that of small cultivators, and it is figured as two thousand one hundred twenty-three lakh of rupees. Regarding loss of crops, rice, wheat, maize, and vegetables, the estimated total cost of loss of crops accounts for rupees one thousand and eighty-nine lakhs.

Animal husbandry is the second-largest source of income after agriculture in the district. A vast number of livestock deaths occurred because of the flood, and unidentified diseases after the flood impacted the living standard of people. There was also infrastructure damage to cow yards in the vicinity. The estimated total cost of loss of livestock and livestock infrastructure accounts for rupees lakhs.

4.1.3 Loss of Commercial Buildings

Since the district has a large rural population, there is not much commercial property in the villages. But 2014 flood-hit small business shops as well. Commercial businesses contain many kinds of property, inventory, machinery, equipment, products, and goods. The total number of commercial buildings damaged was one thousand one hundred ninety lakh. Fifty-six per cent of the households, as per data available, were not attached to commercial activities. So the commercial business affected by the 2014 flood was less[21].

4.2 Indirect Benefits

Indirect benefits come from the effects of technological linkages of a Management project. These could be described as "Management externalities." Flood management projects may benefit users of transportation by reducing interruptions to traffic.

4.2.1 Reduction in Purchasing power.

The devastation caused by the 2014 flood was colossal. It destroyed everything that came in its way: residential houses, schools, colleges, hospitals, paddy fields, orchards, government establishments, businesses, etc. It has depicted thousands of people roofless and jobless. The destruction around has left the entire society traumatized [15]. The socioeconomic dimension analysis leads to the distribution of income among victims. The flood has destroyed the sources of income of the families. The income of households was reduced to half when comparing pre-flood income. The total cost reduction in purchasing power is accounted for one hundred forty-seven lakhs of rupees in the district. The cost reduction in purchasing power in income group (A) is estimated as rupees forty-two lakhs (20.6), and it is rupees one hundred five lakhs of rupees in case of income Group B. Before the flood, the monthly income ranges from 10000>(A) to 20000>(B)

4.2.2 Transport

Flooding of roads can cause physical damages and interruptions in both passenger and freight traffic. In district Kulgam, main roads were blocked by landslides. Roads connecting the Kulgam town with rural areas of the district were washed away by floodwater. It is not easy to attain reliable values for flooded roads. Current values for road damages have been maintained using the restoring cost data from Jammu and Kashmir Home Department. The total cost of damaged roads and bridges accounted for wight hundred twenty lakh of rupees. It indicates that the main roads of Kulgam district were washed away by floodwater in 2014, resulting in interrupted traffic for two to three years in the district [22]

5 Analysis of the Direct and Indirect Costs Incurred due to Flood in Kulgam District.

As benefits, the costs of a project can also be defined as primary and secondary. However, the cost estimate is relatively more accurate and accessible. Construction measures and their prices are at the core of cost analysis. One method for estimating costs is to use a comprehensive checklist of cost items readily available in the professional literature. However, any such list should be updated and modified according to the latest thinking and local requirements. Thus, the cost estimates are based on actual market prices.

5.1 Primary Costs

Prime Minister's National Relief Fund (PMNRF).

The government and key stakeholders were engaged to restore the livelihood of the population. Alternative livelihood strategies took place in different areas of District Kulgam. Prime Minister's relief fund was one of the successful rehabilitation plans for constructing damaged houses.

5.1.1 Reconstruction of Damaged Houses:

The Sanction rate of reconstruction of fully damaged pucca and kutcha houses was Rs.1 lakh and rupees fifty thousand per household, respectively. The reconstruction rate of partially damaged pucca houses and kutcha houses was twenty-five thousand and rupees five thousand each. Altogether, Rupees five hundred sixty-five crore was released for Jammu and Kashmir to reconstruct twenty-one thousand eighty-eight fully damaged Pucca & Kutch houses and one lakh ninety-six thousand six hundred fifty-two severely and partially damaged pucca and kutcha houses[16]. The total amount released for the Kulgam district is four crores twenty-three lakh. However, there is a massive gap between damaged costs and the relief incentive by the government[22].

5.1.2 Infrastructures costs for Disaster Management

Because of flood mitigation, many govt agencies took steps to construct approach walls, reshape land surfaces, protect from erosion, levees, dykes, and floodwalls in district Kulgam. The data we used were collected from Irrigation and Flood Control Department Jammu and Kashmir. Infrastructure cost is estimated as seven hundred lakh of rupees[21].

5.1.3 Cost of Floodways and Diversion Works

In the Kulgam district, the general requirement was drainage systems to cope with rainfall. Flooding in Nallah Vishow often results in overloading in the small canals leading to overflows. Irrigation and Flood Control Department, Jammu and Kashmir, constructed and restored canals to cope with further damage in the future. The data were gathered from Irrigation and Flood Control department Jammu and Kashmir. The total restoration cost accounts for rupees eight hundred sixty-two lakh, and there is a need for further diversions in the Nallah Vishow and restoration of these canals from time to time.

5.1.4 Flood Warning System

The Flood Control Department has initiated to development of a flood monitoring station in the vicinity of Nihama. In this station, a rain gauge and other tools will help deal with anticipating floods. Four number Gauges to install on the various Nallahs to know flood discharges. Since there was no cost-related information available, as per the District Disaster Management Plan (2017-18), the vicinity covered five Kanals of land, which cost twenty-five lakh as per the current market price[21].

5.2 Secondary Costs

5.2.1 Allocation of Costs in Multiuser Disaster Management.

The Kulgam District has been divided into eight beats of the flood. Therefore Flood Control Division Kulgam keeps the availability of flowing items as per the need. The allocation

of costs in Multiuser disaster Management among different items and total cost for Multipurpose disaster Management is estimated as one hundred ninety-three lakh of rupees[20].

5.2.2 Cost of Availability of Emergency drugs.

The most significant diseases experienced during a flood are diarrhoea, fever, and skin diseases. To cope with these types of diseases in the future, the Local Flood Zonal Committee keeps the Medicines available. The cost of the availability of emergency drugs allotted is eleven lakh of rupees[20].

6 Cost-Benefit Analyses

The findings of Cost-benefit Analysis reveal: There are eleven components in the estimation of benefits of CBA. The estimated total benefits account for seventy-eight thousand six hundred eighty-six lakh of rupees. Likely, there are six components in the estimation of costs of CBA. The estimated total costs account for two thousand two hundred nineteen lakh of rupees. The estimated Benefit-Cost Ratio is 35.5:1. The CBA result shows that Flood Management in District Kulgam was economically feasible and successfully managed. The State takes essential prevention and management measures to bring down the damages due to floods to significant status. To protect the district from another disaster, govt should pump more money into its disaster security.

7 Conclusions

As discussed under various perspectives, it is clear from the study that the 2014 floods hit the economic status of people's livelihoods in the district Kulgam badly. Among the categories of property damage, Land value damage is the highest. All the households own apple cultivation land; there was significant damage to the farmers. The study region's average financial assistance was one lakh per household, less than the damages caused. The study has further demonstrated that floods in one sector could also affect other social sectors. In the Agriculture sector, the loss of crops led to the reduction of purchasing power of households. Furthermore, the business sector suffered through interrupted traffic for years due to road damage connecting with the district headquarter.

Competing interests

The author declares that she has no competing interests.

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