IMPACT OF FORESTRY ON DISASTER RISK REDUCTION IN DISTRICT MUZAFFARABAD

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Impact of Forestry on Disaster Risk Reduction in District Muzaffarabad

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In the name of Allah

The most Gracious and the most Merciful

DEDICATION

I dedicate this dissertation to my father, who has supported me throughout the process and taught me that the best kind of knowledge to have is that which is learned for its own sake.

DECLARATION

I hereby declare that the work presented is my own effort, except where otherwise acknowledged and the thesis is my own composition. No part of the thesis has been previously presented for any other degree and the similarity index was determined through Turnitin was 6%, which was below the permissible limit of 19% for MS level thesis.

Iqra Tazeem

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LIST OF ABBREVIATIONS

AJK	Azad Jammu & Kashmir
DRR	Disaster Risk Reduction
EPA	Environmental Protection Agency
ERRA	Earthquake Reconstruction and Rehabilitation Authority
GRID	Global Resource Information Database
GSP	Geological survey of Pakistan
IFAD	International fund for agriculture development
NDMA	National Disaster Management Authority
ISDR	International Strategy for Disaster Reduction
IUCN	International Union for Conservation of Nature
KP	Khyber Pakhtunkhwa
MCDP	Muzaffarabad City Development Project
MZD	Muzaffarabad
NDMA	National Disaster Management Authority
NGO	Non-Governmental Organization
PFIP	Pakistan Forest Institute Peshawar
PMU	Project Management Unit
PEDRR	Partnership for environment and disaster risk reduction United
UNEP	United Nations Environmental Programme
UNOCHA	Nations Office for the Coordination of Humanitarian Affairs
UN	United Nations
UNISDR	United Nations International Strategy for Disaster Reduction

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ABSTRACT

Out of more than hundred sites of active roadside landslides in Azad Jammu and Kashmir, seven are present in Muzaffarabad district which pose severe threats of disaster to communities and infrastructure.In this work an attempt has been made to identify the role of forestry in reducing the risk of disaster based on the study of these seven sites of landslide in Muzaffarabad. It has also tried to explore the role of ecosystem in altering the frequency of disastrous event by acting as a natural barrier against hazards. The study is based on both primary and secondary data; primary data we recollected through on site observations and interviewing the stakeholders including government officials: while secondary data were obtained fromdifferent reports highlighting the significance of forest in the context of disaster risk reduction. The results indicated that apart from the geology and climatic conditions of the district, deforested slope in district Muzaffarabad had resulted in more landslides which have drastic negative impacts on the lives of people. But planning for anefficient land and forest management system is lacking as foresty is a low priority sector in AJK. There is an increasing agreement worldwide about connecting environmental and natural resource management with disaster risk reduction, but this aspect is missing in planning at AJK. It is suggested that plantation of fast growing trees and bushes are required to reduce occurance of landslides and the disaster risks in distric Muzaffarabad. It is hoped that this study will help in providing research based information to the planners and decision makers to integrate the ecosystem approaches inplanning for disaster risk reduction, which in turn will also promote forestry in AJK.

1. INTRODUCTION

1.1 Background

After decades of neglect, the value of defending and improving ecosystems for minimizing disaster risk started getting attention in the recent years. If ecosystem services diminish, it can lead to increased exposure to hazards and also lessen the disaster resilience. Living things depends on air, water, forests, soil, rock and water bodies for their survival. The management and protection of natural resources is very important for the continued existence of human beings and other living organisms. If the management of natural resources is done in a healthy operating condition it will lead to the reduction in disaster risks for the communities. In mountains, forests provide protection against rock fall. Risk of a disaster can be aggravated by an environmental condition as well. Ecosystems which are degraded can exacerbate the impact of natural hazards. For example, the impact of earthquake of October 08, 2005 in Muzaffarabad, AJK was exacerbated due to environmental conditions. In this background, this study was carried out to assess the impact of forestry on reducing the incidence of landslides in Muzaffarabad.

1.1.1 The approach to ecosystem and disaster risk reduction

All over the world countries have started to incorporate ecosystem approach in disaster risk reduction strategies to decrease susceptibility to natural disasters and to avoid the price expended after the catastrophic occurrence which has a harmful effect on the country's economic growth. Natural disasters are not only affecting human lives but they are also destroying the economic and social infrastructure. To manage the disaster risk and its impacts, the ecosystem approach can make an important contribution. For example land sliding and soil erosion can be reduced by forest cover and wetlands lessen the flooding impacts. An approach to ecosystem to reduce the disaster risk is the one where an ecosystem makes an important contribution to enhance the lives of people (Sudmeier-Rieux *et al.*, 2006).

1.1.2 Protective values of ecosystem

The ecosystem plays a major part in reducing the disaster risk and decreasing its impact when they occur. The threat of hazards like land sliding, storms and flooding

can be reduced by well managed ecosystem. Environmental corrosion produces or provokes many disasters. Sometimes degraded ecosystems can play a defensive role though to a lesser scale or degree than completely functioning ecosystem. The point when an environment provide security against natural disaster and contribute in reducing the risk depends on the wellbeing of ecosystem and the potency of the event striking the part or place(Sudmeier-Rieux*et al.*, 2009).

1.1.3 Significance of forests

Living things depends on air, water, forests, soil, rock and water bodies for their survival. The management and protection of natural resources is very important for the continued existence of human beings and other living organisms. If the management of natural resources is done in a healthy operating condition, it will lead to the reduction in disaster risks for the communities. For example, Mangrove forest decreased the impact of Indian Ocean Tsunami in December 2004 and acted as natural protective shields by reducing the velocity of the storm. The root structures of a forest and vegetation cover guard against erosion and enhance slope stability by binding soil particles together. It also helps in preventing landslide and mud slides. In the region where forests are present, the risk of avalanches gets reduced as forests help in stabilising snow. In mountains, forests provide protection against rock fall. The risk of floods is reduced in the presence of forests especially the primary forests as they accelerate the infiltration of rainfall through the root structures. Forests play a key role in purifying and recharging the water on watershed areas and are very useful for drought mitigation (Gupta *et al.*, 2012).

1.2 Natural hazards in AJK

"A hazard is a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Natural hazards are one of the types of many hazards. Natural hazards are natural processes or phenomena, such as earthquakes, droughts and tropical cyclones, that may constitute damaging event, but their occurrence and scale of impact are often influenced by human induced activities as are the result of inappropriate land use, poor building codes and environmental degradation"(PEDRR, 2010). In terms of occurrence and degree of impact; following are high priority hazards in AJK

1.2.1 Earthquakes

The geographical position of AJK makes it a focus of natural hazards like flooding, earthquakes and heat/drought waves. In the Mountains of Himalaya the risk of earthquake is high because of the tectonic movement. Some huge earthquake in this area had been predicted by the scientists and the greatest disaster was the earthquake of 7.6 on the Richter scale on October 8, 2005. The epicenter of that earthquake was in Muzaffarabad but it affected the area over 30,000 km. (Stolton*et al.*, 2008). The geological profile of entire AJK shows that nearly ¾ area of Muzaffarabad, Poonch and Bagh is covered by Murree formation. Furthermore, 71% of slopes are found in Murree formation and the remaining 29 % in Punjab and Hazara formation (Bukhari, 2013).The region of Kashmir including Muzaffarabad is situated in high or extremely high risk vicinity.

1.2.2 Floods

Due to varying weather patterns,flash floods are likely to happen more in recent years. Formerly there was an absence of early warning system to warn susceptible area.The most destructive floods in the history of AJKoccured in 1992 and 2010. Both hydro-meteorological disasters poses threats to AJK due to the intensity of monsoon precipitation and climate changes which needed incorporated surge and quick response (GoP, 2012).

1.2.3 Avalanches

Avalanches poses threat to the kashmir region especially Neelum valley and Leepa on a regular cyclic basis. Local community living in the risky region and travelers are susceptible to this danger (UNDP, 2007). Along with these hazards The region of AJK especially Mirpur, kotli, Mzd are vulnerable to the hazard of forest fire (UNDP, 2007).

1.2.4 Landslides

The regions of Kashmir are particularly susceptible to landslide hazard. Accelerated deforestation apart from fragile soil of mountainous region and geology of AJK increased the incidence of landslide in the region. According to a report published by NDMA the occurrence of landslides may enhance in coming years because the forest cover is shrinking by 3.1%annually (UNDP, 2007).Many existing slides and troubled slopes are exacerbated by 2005 earthquake and created many new slides and slopes.

Theses slides are a big challenge in this area because they regularly block the roads. In many areas of Hattian Bala, landslides have washed away the whole area of agricultural land, and have put the whole communities living and source of income in danger (ERRA, 2009). In Muzaffarabad and its surroundings, there are large cracks which are noticeable in the mountains which can lead to further landslides. Deep landslides in the earthquake affected area are posing risk for infrastructures and communities (Bulmer *et al.*, 2007). In addition, Murree formation covers almost ¾ area of Muzaffarabad, Poonch and Bagh districts. The formation of Murree is distinguished by impenetrability and heavy rainfall in the region makes it susceptible to landslides. In Muzaffarabad region the average rainfall is 1367 mm, 30-60% is in the form of snowfall in winters. In July and August, Monsoon rains cause great damage as floods or land sliding (Sudmeier-Rieux*et al.*, 2008).

1.3 Rationale

In order to combat challenges of natural hazard like floods, land sliding, storm surges, etc. investments in forestry sector are increasing tremendously worldwide but not in AJK.The integration of environmental aspect in planning for disaster risk reduction are among less studied areas. There is a lack of knowledge about the significance of forests in reducing the disasters due to landslides in AJK. This research work has studied the role of ecosystem as a natural barrier against disaster in general and specifically the impact of vegetation in minimizing the hazard of land sliding in district Muzaffarabad along with their socio, economic and environmental impact.

1.4 Aim and objectives

This study was conducted with the aim to promote integration of environmental consideration in planning for disaster risk reduction with the objectives to review and analyze the work done on highlighting the importance of incorporating ecosystem management for disaster risk reduction and raising awareness among the development planers in AJK on the role of forestry in mitigating the risks of disasters in land slide prone areas.

2. LITERATURE REVIEW

From 1973 to 1997, annually 84,034 persons on average around the globe were killed by natural disaster, and an additional 143,864,855 individuals got affected by these natural disasters in a significant way (Dilley, 2005). Over the past two decades, an approximately $500 billion were lost as a result of natural disasters (Mileti, 1999). When people have more assets they are less susceptible and when there is greater disruption of people's assets their insecurity and danger will be greater too. These assets consist of the access to strong ecosystems as well (Satterthwaite*et al.*, 2008).

After decades of neglect, the value of defending and improving ecosystems for minimizing disaster risk started getting attention in the recent years. If ecosystem services diminish, it can lead to increased exposure to hazards and also lessen the disaster resilience. Proper management and protection of natural resources is very vital for the constant survival of human beings and other living creatures. If the management of natural resources is done in a strong functioning manner, it will result in the risk reduction for communities. The study illustrated that mangrove forest decreased the impact of Indian Ocean Tsunami in December 2004 and acted as natural protective shields by reducing the velocity of the storm. The root structures of a forest and vegetation cover guard against erosion and enhance slope stability by binding soil particles together (Gupta *et al.*, 2012). According to another report, extensive mangrove cover, coral reefs and sea grass beds have partly saved the Simeuleu Island which is only 41 km away from the epicenter of earth quake. The area witnessed only four deaths in the disaster (Dahdouh-Guebas*et al.*, 2005). Mangrove forests, wetlands and coral reefs, are an essential part of coast protection and flood mitigation during hurricanes and tropical storms (Wells *et al.*, 2006).Forests if mismanaged, this condition can lead to many problems which may then transform into a catastrophe. Deforestation, weak forest management and agricultural practices worsen the negative environmental impacts which can lead to soil erosion, silting, flooding, land sliding, aggressive wind storms and water contamination (Yanagisawa*et al.*, 2010). Some European countries regard role of forests as cost

effective natural barriers to disaster risk reduction and firmly promote their plantaion especially in mountainous areas (ProAct Network, 2008).

According to one study, exposure of communities to disasters can be reduced manifold by healthy and robust forest ecosystem. On one hand it reduces physical exposure of people to natural hazards and on the other hand it provides people with the living resources to bear up and get better from crises. The vulnerabilities around the globe have been intensified due to the degradation of the ecosystems. The study further highlights the importance of mangrove forest ecosystem that how it reduces the risk of cyclone-prone coastal communities in Vietnam. Red Cross and local communities of Vietnam have been working together since 1994 for mangrove forests plantation and protection in northern parts of Vietnam and the outcome has been exceptional. The study further states that harsh floods and tropical storm in May and September respectively exterminated over 5,000 people in Haiti. Soon after these disasters have occurred, scientists and the media immediately appeal everyone's attention towards the linkage between these events and the country's extensive deforestation that has removed 98% of its forests (Srinivas*et al.*, 2008).

Another study drew attention towards the importance of forests in the context of DRR. The role of forestry in the prevention of landslides and rehabilitation of landslide-affected areas in Asia has been highlighted here. According to the report, forests can act as a buffer against natural disaster when they are properly planned, supervised and managed. They can resist and guard against disaster of varying extent and types and are very effective contributor to disaster risk management. When forests are combined with proper land use planning, mitigation methods and early warning systems, they can create excessive resistance and reduce disaster impact to a greater extent. Forests can also act as an efficient obstacle against wreckage, mud slide, rock and soil slips from higher altitude. Worldwide, forests and the forestry segment are facing rising challenges and threats from natural disasters. The climate change is likely to exacerbate the occurrence and intensity of disasters in the coming years and with increasing population growth the burden is directly on forests and forest land. Environmental protection from the adverse effects of climate change could only be possible if the forest land is shielded (Forbes *et al.*, 2011). The service

provided by coastal plantation against tsunami waves is dependent on some factors like tidal regimes, density of plant population, latitude, etc. (Koch *et al.*, 2009). Evidence has also proved that physical infrastructure made up for coastal protection from floods results in decreased ecosystem services that could be avoided by using alternatives like conserving the environment and plantation. It is cheap as well as a fruitful practice (Oppermanet *al.*, 2009).

All the existing literature shows that properly managed ecosystem increases the safety of people manifold against disasters with massive provision of ecosystem services. But utilizing ecological unit as 'bio shields' is not a complete cure for lessening people's susceptibility to natural event and must be integrated into other actions like early warning systems, awareness and disaster preparedness (Feaginet *al.*, 2010). On one hand the occurrence of hazard event is altered by environmental conditions and on the other hand ecosystems also act as natural barriers that can slow down the effects and intensity of a hazard and guard communities. "An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the non-living environment interacting as a functional unit" and ranges "from those relatively undisturbed, such as natural forests, to landscapes with mixed patterns of human use, to ecosystems intensively managed and modified by humans, such as agricultural land and urban areas." Ecosystems are socio-ecological systems, and managing ecosystem services is extremely significant for the purpose of disaster risk reduction (WRI, 2005).Ecosystems such as forests can give cost-effective natural buffers against vulnerability to the disasters. The report also points out that the money which has been invested in sound environmental management or sustainable ecosystem management resulted in a cost-effective resolution to decreasing community susceptibility to disasters. Strong and healthy ecosystems, such as undamaged forests, mangroves, and coral reefs are advantageous to local community for the many livelihood benefits and provide a massive list of products like firewood, food, clean water, medicine, fibers and at the same time acting as natural buffers to hazard events for interrupting the intensity of floods, in stabilizing slope, providing protection against avalanches and wind storms. The services that are given by ecosystems are not an extra comfort, but relatively a fundamental requirement to disaster risk reduction.

According to the report these natural buffers are often less costly to set up and maintain and somehow more efficient than physical engineering structures, such as concrete walls or levees. Ecosystems contribute in minimizing the risk of disasters in several and diverse ways. The degree to which an ecosystem will shield against severe events is dependent on an ecosystem's wellbeing and the severity of the hazard event. Well-managed and robust ecosystems can minimize the impact of many natural disasters, such as floods, landslides, storm surges and avalanches. At times degraded ecosystems can still take part in a buffering task, even though to a much slighter level than completely functioning ecosystems (Sudmeier-Rieux, 2009).

The authorities of Philippines have also comprehended the connection between deforestation and disaster risk after the dreadful hazard events. In the Philippines, flash floods in November and landslides in December left over 1,600 people dead or lost. After the shocking event, President Gloria Arroyo openly blamed that the indiscriminate logging has been the root cause of the disaster that has left the nation with less than 6% of its original forests. When Hurricane Mitch in 1998 that killed over 18,000 masses and caused an approximate US$4 billion in damages, the linkage between forest deterioration and disaster susceptibility perhaps got the most consideration. The report also demonstrates how badly the deforested hillside of Central America brought flash floods, landslides and mudslides in the area in less than one week. The linkage between deforestation and disaster vulnerability can further be illustrated though another incidence when the powerful cyclone in October 1999 hit India's Orissa coast. All those areas which were extensively deforested along Orissa's coast suffered the maximum damage due to powerful storm surges killing a large number of people within a very short span of time (Milledge*et al.*, 2007).

Another report prepared by the collaboration between UNEP and UNISDR states that the role of forests has been highly emphasized in different areas of world in the context of disaster risk reduction. The Red Cross in Vietnam worked in collaboration with the local communities for the restoration of coastal forests as a tool of protection against tropical storms. The report further stated that useful approaches have been exhibited by China and Korea to take on communities in forest management as part of flood risk reduction. These sorts of efforts are ongoing in Southern Thailand also.

However, there are some controversial evidences on the account of role of mangroves in protecting communities from the 2004 tsunami, it's an idea of general acceptance that the vulnerabilities of a community to tsunamis of lesser magnitude, storm surge and coastal flooding can be reduced by mangroves. The World Conservation Union, in collaboration with the office of the UN Special Envoy for tsunami recovery, Bill Clinton, took an initiative that protects and restores mangrove forests all over the tsunami-affected areas, recognizing their worth in coastal protection and other ecosystem services. Mangroves for the Future (MFF), was launched in September 2006 (UNEP& UNISDR, 2009).

Anumber of coastal reforestation projects were started in Asia to re-establish affected places, subsequent to the 2004 India Ocean tsunami. Another purpose of these reforestation project was to give sheild against coastal hazard risk particularly events that occur more frequently along coastal side such as cyclones and storms. In Indonesia announcement was made regarding the strategies to reforest 600,000 hectares of worn out mangrove forest in five years. For the safety and protection of coastal areas, governments of Srilanka and Thailand initiated big projects to re-establish mangrove areas. (PEDRR, 2010).

In Burkina Faso and Niger, community resilience against droughts has been improved through the restoration of dry lands by using agro forestry techniques. It has also helped in enhancing community resilience to long dry periods and landslides. In Bolivia, slope firmness and the state of watersheds have been enhanced with the help of community-based forest treatment and rehabilitation. The study highlighted that appropriate supervision and management of forest can be exploited for lessening the risks of disaster and settling in to climate related risks. The three basic elements of the disaster risk reduction which includes regulating hazard, reducing vulnerability and controlling exposure can be dealt with appropriate ecosystem management (Thiaw, 2012).

Another study indicates the importance of effective environmental management in decreasing the vulnerability of communities to the impacts of natural disasters like earthquake, hurricanes, landslides, flood and tsunami. It further illustrates it with the

example of Nicaragua, South America where Hurricane Mitch had least effect on the sustainable farms, i.e. Farms where soil conservation and agro ecological practices were high and thus experienced less economic losses and soil erosion (Holt *et. al.*, 2002). Through ecosystem management, the severity of a natural disaster could be reduced manifold. Mangrove forests along with sand dunes provide protection against wave surge and wetlands reduce the impacts of flood. The level of protection offered by ecosystems depends on many factors, particularly the resilience of ecosystem to pressure and the intensity of the hazard (Folke*et al.*, 2002). In the Andaman Sea, coastal mangroves, casuarinas trees and shrubs helped a great deal in reducing tsunami waves and thus shielded coastlines (Danielson *etal.*, 2005).

The idea of ecosystem wellbeing can be better demonstrated through "forest health" as forests are the most productive among natural ecosystems. Ecosystem management, the term, is described as keeping forest ecosystems functioning well over long periods of time in order to provide resilience to short-term stress and adaptation to long-term change (Bartuska, 1998).

Switzerland long ago acknowledged the worth of forests in shielding people, settlements and considerable economic assets (roads, industries, infrastructure, and tourism) against storms and landslides. The protection offered by forests is approximately saving US$ 2–3.5 billion per year (UN, 2006). Switzerland considered forests as a key part of the nation's disaster prevention plan and perceived the worth of 'protection forests' in lessening damage from landslides avalanches and rock falls (Stolten*et al.*, 2008). In Malaysia the value of whole mangrove swamp for storm protection and flood control has been estimated at US$ 300,000 per km, which is the cost of substituting them with rock walls (Davidson, 2009).

Damage assessment from the 2004 Indian Ocean tsunami concluded that there was significantly more damage to human lives and livelihoods where ecosystems had been disturbed, especially sand dunes, mangroves and coral reefs (Dahdouh- Guebas*et al.*, 2005). Another report written after Indian Ocean Tsunami recommended that if a community wants to recover and reduce the future susceptibility from the natural hazard, two points must be kept in mind

- Be on familiar terms with the fact that ecosystem services offer the basis for sustainable rebuilding and decrease of future vulnerability.
- Durable supervision of both environmental and socioeconomic factors and a management plan that support adaptation to changing conditions (Blaikie*et al.*, 2005).

To halt flooding, land sliding, rock fall and avalanches, protection forests have been planted in mountainous region of Europe so that the vulnerable rural communities can be protected from the risk of getting hurt. The federal and local governments of Switzerland have also spent large amount of money to maintain and preserve such forests but still this money is much less as compared to the cost used for engineered solutions to minimize the hazards related to mountainous region (Dorren *et al.*,2007). According to one study, in 1991, more than 138,000 people died from drowning in a Bay of Bengal when cyclone hit that area. After that, the Bangladesh government has initiated a determined mangrove reforestation program named as the Coastal Green Belt to expand the protective mangrove belt eastward. The program is proposed to express the high protective value of mangrove in minimizing disaster risk. The goal is to plant forest belts 2 km wide on at least one third of the coastline in order to shield susceptible coastline. More than 120,000 ha have been planted till now with high-quality mangroves in the area. According to this report because of growing population pressure, the mangrove belts' maintenance and conservation will be the big challenge (Ahmed *et al.*, 2004).

The environmental dimension is another aspect, which has begun to obtain much concentration in the perspective of natural disasters i.e. the protective function played by ecosystems in reducing the full impact of natural disaster (Birkmann, 2007;&Sudmeier-Rieux*et al.*, 2006).

A report published in 2007 focused on the importance of a strong ecosystem and their role in minimizing the vulnerability to disaster by acting as a physical buffer. The report points out that this natural buffering capacity of a healthy ecosystem can be termed as natural infrastuture which is way less costly than the human built infrastructure. The importance of ecosystem management for risk reduction is recognized by only some development organizations, though diasters hinder the

development goals and still the preventative approach has not been fully included in design and management of projects (Behrens, 2007). Along with better aesthetics provided by forests more than engineering structures, forests are approximately saving between US$ 2–3.5 billion per year in disaster damage (UN, 2004).

Risk of a disaster can be aggravated by an environmental condition as well. Ecosystems which are degraded can exacerbate the impact of natural hazards, for example by changing physical processes that affect the extent, occurrence and timing of these hazards. This has been observed in areas like Haiti, where deforestation has led to increased vulnerability to floods and landslides during hurricanes and heavy rainfall events (Bergin, 2008).

Other studies have also pointed out that deforested slopes are more vulnerable to landslides and erosion (Kramer *et al.*, 1997). According to one study, as a result of a reef degradation in the Caribbean, over 15,000 km of shoreline could experience a 10–20 percent reduction in wave and storm protection by 2050 (Krysanova, *et al.*, 2008).

According to one report, if money is invested in protected areas, the efforts will pay off regarding hazard risk reduction. There are number of economic benefits provided by ecosystem services which are increasingly being determined because of their impacts on hazard risk reduction. In Switzerland, for example, the benefits of protected forests are estimated between USD 2 to 3.5 billion per year, as they are very helpful in mitigating the risk against flooding, landslides, avalanches, and rock fall. Due to the threat of new hazards, re-establishment of formerly ruined areas has been widely encouraged. The rate of high deforestation had worsened the flooding in the eastern part of Madagascar in monsoon rain season(PEDRR, 2010).

When earthquake hit the areas of AJK in 2005, it had aggravated already present landslides and damaged slope and caused number of new slides. These slides kept on posing challenges on the way of supplying goods and services by blocking the route to the affected areas. According to the survey of earthquake affected areas, land sliding in several places has removed complete zone of agricultural land laying whole population's occupation and source of revenue in difficulty, as it can be seen in the

case of Hattian Bala, AJK. 118 active slides on roadsides in AJK have been recognized by GSP survey (ERRA, 2009).

Bukhari (2013) reported that whenever landslide event occurred, it damaged the forest present in that particular area as presented in Table1.

Table 1:- Forest Damages in land sliding sites (Bukhari, 2013)

Sr No.	Landslide	Slope showing level of Failure %	Landslides Area (Acres)			Forest Damage			
			Degraded	Threatened	Total	Vegetation Cover (%)	Vegetation Cover (Damage/ Acres)	Forest Threatened to Damage (Acres)	Total Acres
	1	2	3	4	5 (3+4)	6	7 (3x6.100)	8 (4x6.100)	9 (7+8)
1	Barsala	50-60%	1.55	0.37	1.9	45	0.7	0.2	0.9
2	Patika	50-60%	31.31	37.88	69.2	65	20.4	24.6	45.0
3	Gallani Mill	35-45%	0.71	0.55	1.3	35	0.2	0.2	0,4
4	Kahori	55-65%	2.68	1.14	3.8	75	2.0	0.9	2.9
5	Kamsar	40-50%	81.76	113.34	195.1	30	24.5	34.0	58.5
6	Hattian Bala	45-55%	2.46	2.41	4.9	60	1.5	1.4	2.9
7	Subri	45-55%	4.66	2.59	7.3	30	1.4	0.8	2.2
	Total (7 landslides)		125.13	158.28	283.41		50.7	62.1	112.8
	Average	45-55%	17.9	22.61	40.49	49%	7.25	8.87	16.11

A heavy monsoon exacerbated already existing landslides and caused some new slides in affected area. A number of slides can be expected in coming years as in Muzaffarabad city and its nearby areas huge cracks can be clearly seen in the mountains. Land sliding continued long after the major earthquake of 8th October, 2005 due to regular and sometimes harsh aftershocks which remained one of the reasons of physical environment destruction. The livelihood of majority people of the affected areas was largely relied on forestry for firewood and extraction of timber for construction purpose. Excessive land sliding and rock fall in the affected area damaged the forest ecosystem to great extent with root system being devastated over

an area of about 187,000 Acres in AJK. The affected area in AJK is also rich in flora. Muzaffarabad is a habitat to many species like ash, willow, maple, blue pine, spruce, oak, walnut, deodar, poplar, and chir. Forest area of 710,588 acres was damaged in AJK, District Muzaffarabad was the worst hit area where 165,808 acres of government forest area and 184,987 acres of private forest area were damaged, which is more than 50% of total damage to forest in AJK (Table 2).

TABLE 2:- Forest damages in AJKin Acres (ERRA, 2009)

District	Government forest damaged	Private forest damaged
Neelum Valley	86,413	35,320
Muzaffarabad	165,808	184,987
Bagh	78,038	90,982
Poonch	32,000	19840
Shunuti	10,000	7,200
Total	372,259	338,329

ERRA (2009) further reported that the loss of forest resources due to landslides was intensified by heavy monsoon of July-August 2006 (Table 3).

TABLE 3:- Categories of Forest sector damages in Acres ERRA, 2009)

Types of damages	AJK
Heavy landslides (land turn over)	112,500
Threatened area (roots system damage)	187,000
Threatened area (anticipated new land slide)	70,000
Regeneration area	2,759

According to ISDR (2004) reported that the vulnerable population i.e., those living in mountainous and coastal areas are being affected by natural disasters greatly in number. IUCN jointly with UNEP/GRID-Europe and other collaborators in northern Pakistan, embarked on reforestation efforts to protect against landslides. IUCN

reported that Earth quake 2005 has activated the largest landslide in Hattian Bala that covered an area of about 5km^{2}with volume of roughly 6 Million m^3. After the main earth quake, landslides have brought in enormous sediment accumulation in rivers like Jehlum and Neelum, and thus resulted in noticeable boost in turbidity. This increase in turbidity, which might have affected fish population particularly in breeding season and capacity of downstream reservoir. According to this report, there is a strong proof that slopes with heavy forest cover have offered great defense and shield for roads and buildings from the landslides originated by the earthquake than bare slopes without forest cover. It reported immense environmental degradation in earthquake affected areas of Pakistan caused by land sliding. According to Crudenet *al.*, (1996) causes of landslide susceptibility could be several; fragile geographical arrangements (silt, limestone and clays), forest cutting, irrigation, earthquake shaking, and land use factors like digging of slope, construction etc.

Hufschmid (2010) described that steep forested slopes are usually firm and stable due to extensive root system even under heavy rainfall conditions. Pryor (1982) is of the opinion that only constant maintenance of forests cover can assure the stability, but if there is excessive removal of forest resources along with heavy rainfall, it can cause disastrous results. Zingarie*t al.*, (2002) suggested that replacement of deforestation with other sustainable practices is needed to reduce the occurrence and severity of landslides and floods. Peduzzi (2010) performed an assessment of landslides induced by earthquake of 2005 in AJK. The study revealed that those areas where denser forests were present, the number of landslides were less as compared to those areas with thinner forest cover. The rehabilitation of the forest damages after earth quake in AJK was the focal point of environmental strategy. It has reported that land deterioration and slope destabilization was a consequence of the less forest cover, particularly near the populated areas. The need is for long term planning and preparation for increasing the forest cover area that will in return reduce the vulnerability and endangerment of future landslides in case of an earthquake. Fruitful outcome can only be achieved through public awareness and involvement in long term plans and their execution. Forest department shall take an immediate action to start a forestation or complete the ongoing projects through lines departments and

community participation. Bio-engineering shall be mainstreamed in the rehabilitation of landslides. All damaged forest of AJK will be reformed by making comprehensive project scheme for each forest division after taking into consideration the ongoing projects under forest departments and Ministry of Environment. Estimate of overall forest damages due to landslides and aftershocks have been done by the concerned department. This estimate shall be accurately established and verified by an alternative source before developing complete plans. Total expenditure of the forest cover rehabilitation in AJK is PKR. 914.79 million (it includes: slope stabilization via vegetation). One of the priority elements for rehabilitation is slope stabilization. A long-term comprehensive plan will be prepared for slope stabilization and slips taking place on road sides, near colonized areas, causing future hazard or danger for disaster shall be given priority in the plan. Based on the initial estimates done by specialists, an amount of PKR. 584.890 million is financed for AJK and exact allotment will be identified under complete projects made for each area. Keeping in mind the significance of forests, it should be the central idea of any strategy and planning. Forests will remain the essential resource to assist many societies who are dealing with drought, and also shield them from the bad effects of natural disasters (ERRA, 2009).

The territory of AJK is prone to number of natural disasters. Most of the parts of AJK are covered by mountains where the population face floods, landslides, winter snow storms, blizzards, and avalanches. Earthquake and landslides in previous years have resulted in great loss of life and property. Earthquake of 2005 has triggered a large number of landslides putting life and possessions both in extreme danger. The target established by ERRA to reforest the damaged land due to the earthquake of 2005, involved slope stabilization of AJK through vegetation and required the budget of PKR 914.49 million. Unfortunately the target could not be achieved due the scarcity of the financial resources. Another project for rehabilitation of damaged forests after earthquake 2005 was started by AJK forest department for the state owned forests but it had to be stopped after two years before the actual time. In AJK, various agencies are working to deal with hazard event faced by the inhabitants. ERRA is the leading government agency that supplies foreign aid and assistance for the earthquake

sufferers and it has been very active in bringing out its plans and operations in the context of capacity-building for disaster risk reduction. AJK Forest Department, Integrated Land Management's (ILM) "cluster organizations", supported by the World Food Program and IFAD and EPA are among the local organizations of AJK that assist effective disaster risk reduction. Another chief organization UNDP conducts several forestry trainings for the communities to raise awareness among them. They have also established nurseries and planted trees on communal land to provide benefits to the community and environment. NDMA was established after the earthquake of 2005 in response to the requirement for launching appropriate strategy and formal activities to decreased amages from forthcoming disasters. Despite all these efforts that are underway to reduce the risk of a disaster, the role of forests has not been assessed in the context of disaster risk reduction in AJK uptill now. It is evident from the literature that many countries have acknowledged the role of forestry in combating the hazard event and giving deforestation and disaster susceptibility the most consideration. However, the literature does not provide any evidence in which the DRR interventions were incorporated in hazard prone area-landslide in AJK except for a few projects which have aslo remained unimplemented uptill now.Thus the study was carried out to generate the knowledge about the importance of forest resources in terms of decreasing vulnerability of people and ecosystem to future extreme events.

3. METHODOLOGY

The present study was conducted on the basis of primary data collected through observations on sites and group discussions with stakeholders and experts, and secondary data collected through review of available reports and literature.

3.1 Site selection

Following sites in Muzaffarabad district were selected. The reason behind the selection of these sites was to observe the extent of damage caused by landslides in deforested areas.

1) Gallani floor mill slide
2) Barsala slide
3) Neelum valley road slide
4) Landslides on Chakothi road
5) Patika landslide
6) Kahori landslide
7) Hattian bala slide

3.2 Primary Data Collection

3.2.1 Stakeholders Consultation

The views of local people living in the villages around the selected sites of landslides were also taken through informal discussions to get an idea about the knowledge and understanding of local people about forest cover and occurrence of landslides in the past and the role of forest in reducing the risk of landslides.

3.2.2 Interviewswith Government Officials

Individual interviews were conducted with the key stakeholders at selected areas on the issue of forested slope impact on a landslide hazard.Officers of the concerned departments were interviewed to map their knowledge and understanding about impact of forests in reducing the risk of a disaster due to landslide and to know their

perception about the significance of linkages between environment and disasters. Following government officials were interviewed:

1. Minister, Communications and Road, Government of AJK
2. Secretary, Forest Department, Government of AJK
3. Additional Secretary, Forest (AJK)
4. Conservator Forest, Muzaffarabad Division
5. Director General, AJK Environmental Protection Agency
6. Director (EIA/Implementation) AJK Environmental Protection Agency
7. Director General, Earthquake Reconstruction Rehabilitation Authority
8. Project Director, MCDP, Government of AJK

3.2.3 Personal Observations

For situation analysis and observing the situation on ground the selected sites of land slide were visited. It was considered necessary as some of the respondents did not respond properly. Photographs were taken at all sites.

3.3 Secondary Data Collection

The secondary date were collected from the following documents of various national and international organizations.

3.3.1 Review of government plans

In order to find out whether National Disaster Management Authority (NDMA) has considered the role of forestry in reducing the risks in making the National Disaster Risk Management Framework of 2007 and Monsoon Contingency Plan of 2008, the both documents of NDMA were reviewed.

3.3.2 Review of reports of UN agencies

All the available reports published in recent and distant past by the UN agencies like UNEP, UNFAO and UNPEDRR were critically reviewed and analysed and the useful data were collected and used for the study. The following reports were used for secondary data.

a) A Practice Area Review on Recent Progress (2008-2009) in contribution to the Global Assessment Report on DRR prepared by UNEP in collaboration with UNISDR and PPEDRR presented at the workshop on "Opportunities in Environmental Management for Disaster Risk Reduction", Bonn, Germany, 21-23 September 2010.
b) Demonstrating the role of ecosystems based management for DRR,2010
c) Global Assessment repot on disaster risk reduction by PEDRR
d) Report of Ecosystems, livelihood and disaster reduction workshop, 2010
e) Institute for Environment and Human Security (UNU-EHS) and PEDRR, United Nations University
f) Forest and natural disaster risk reduction in Asia and the Pacific, 2013. Policy Brief, Regional Community Forestry Training Center (RECOFTC) and Food and Agriculture Organization (FAO) of United Nations.
g) Report of International day for disaster reduction event: Managing forests and watersheds for natural hazards protection and livelihoods, 2010, UNEP.
h) Forests and landslides: The role of forests and forestry in the prevention and rehabilitation of landslides in Asia, Policy Brief, RECOFTC and FAO.

3.3.3 Review of the reports of IUCN

The World Conservation Union- IUCN has also did useful research work on ecosystem and community based DRR. The following three reports of IUCN were also reviewed and analyzed and useful information was obtained as secondary data.

a) The role of environmental management in DRR and climate change adaptation, 2008: "Disaster risk, livelihoods and natural barriers, strengthening decision making tools for disaster risk reduction, Northern Pakistan" A Case Study from Northern Pakistan by IUCN Geneva Switzerland
b) Mapping land use change in post-earthquake AJK, Pakistan: lessons learned and challenges, 2006- 2007, case study from Northern Pakistan by IUCN-Pakistan
c) Environmental Guidance note for Disaster risk reduction, Healthy ecosystems for human security, Gland, Switzerland, IUCN, 2009

4. RESULTS AND DISCUSSIONS

4.1 General

Apart from deforestation, AJK falls in high rainfall monsoon area and has fragile geology (Murree formation) which makes it highly susceptible to landslides. The clay material present in Murree formation maintains high dampness content thus reducing the slope resistance and adding to the risk of landslide. The risk of slope failure increases in monsoon season as the capacity for moisture retention increases. Landslide remains a great hazard for people, particularly throughout July/August monsoon rains and heavy rainfall. The stability of Murree formation can be improved by reforestation and can help in making it less vulnerable to slope failure. Forests can play a significant role on mountain slopes and hill sides by stopping soil erosion and landslides. Forests can also play their role as an active hurdle against debris, rocks and soil slipsfrom higher altitudes in mountaionous areas like district Muzaffarabad. Forestcover and vegetaion also decreases moistre level present in the soil making landslides less likely to happen. If forests are removed from sloping area, the risk for landsliding acelerated as the rooting strenghth that binds the soil particles together is completely lost. To support the concept of integrating ecosystem approach in to DRR, participation of different stakeholders, policy work and investments are needed for the execution of different reforestation programs for landslide stabilization.

4.2 Analysis of onsite observations

For this study, seven major threatening landslides located in District Muzaffarabad i.e, Barsala, Gallani flour mill, Patikka, Neelum Valley road, Chakothi, Kahori and Hattian Balawere visited. These sites of landslides sites were selected on the basis of their high negative impact on local population, residential houses, roads, agricultural land, and water supply system and telecommunication tower.

4.2.1 Gallani Flour Mill and Barsala landslides

Gallani Flour Mill landslide is located on Kohala road near Muzaffarabad. This slide is thought to be one of the most dangerous landslides in district Muzaffarabad which is not only posing severe threats to the mill but could also cause blockage of nullahs to Jhelum River. Due to this landslide Murree-Kohala road gets blocked thus impeding transportation completely.

Barsala landslide is also present on Kohala Road. Forthcoming threat due to slide failure may cause damage to the road which may cause additional damage and results in blockage of Jhelum River. There is no population in the vicinity of this landslide but it could have harmful effect on the suspension bridge used frequently by public.

Latitude: 34° 19' 44.54" N Longitude: 73° 28' 14.67" E

Figure 1:- Construction of Kohala tunnel

According to the Secretary Forest Department, Government of AJK, " thegroundwater present at Kohala site is perhaps the most significant contributor to slope destabilization and landslide initiation. Sometimes liquid pressure can act below the slope as a result of groundwater run to deliver a hydraulic push that further reduces the soil stability by which land sliding initiation can occur. This might be the reason that vegetation wouldn't help in these areas as the landslide will also remove it. He further added that drainage is an important part for stabilizing the slope as it

canreduce water pressure in the immediate vicinity of the hillside. The shallow and deep drainage measures can be used to reduce the effects of groundwater but it requires proper design and funds. Therefore, the government has planned to construct a tunnel to maintain the flow of traffic, which is under construction at Kohalaas shown in Figure 1. The tunnel is being constructed at Kohala road to eradicate the risk of existing and potential land sliding in future. The report published by ERRA (2009) focused on preparing a long term comprehensive plan for slope stabilization like water drainage and vegetation to reduce the future hazard like land slidingin mountainous region. The report also suggested that bio engineering tools shall be mainstreamed in the rehabilitation of landslides in district Muzaffarabad to exterminate the risk of future hazards.

4.2.2 Kahori Landslide

Kahori slide is an active landslide present near KahoriBridge. Tree cutting is a very common phenomenon in its vicinity. This slide can badly damage the road which affects daily activities of local population.Machinery has to deploy to clear the path blocked due to landslide as shown in Figure 2.In heavy rainfall events, when landslide occurs after rainfall, the road of Kahori usually remains blocked for 3 to 5 days and sometimes for weeks. The landslide adversely disturbs the transportation thus hamper the economic as well as social activities. According to the Project Director MCDP, they have good traffic management plans to cope with land sliding. They have enough machinery to keep main routes open though link roads but sometimes it takes time to immediately start the operation due to lack of resources.

Latitude 34° 26' 34.55" N Longitude 73° 29' 54.52" E

Figure 2:-Clearing of road at Kahori landslide

Some of the slopes which are extensively deforested along Kahori experience many landslides as compared to those slopes which have thick vegetation. IUCN (2009) reported that slopes in AJ&K with dense forest cover have offered great protection for road and buildings from the landslides triggered by the earthquake of 2005 than bare slopes without forest cover. Peduzzi (2010) also performed an assessment of landslides induced by earthquake of 2005 in AJ&K. The study revealed that those areas where dense forests were present, the number of landslides were less as compared to those areas with thinner forests.

4.2.3 Landslides on Neelum Valley Road

A number of slides are located in Kamsar area on Neelum valley road near Muzaffarabad. The earthquake of 2005 created most of these landslides but crushing units and construction of roads nearby intensifies these slides. Figure 3 shows the deforested slope which causes mudslide in heavy rain. Numbers of deforested slopes are present in Kamsar (Neelum valley) where risk of slope failure remains high during heavy rainfall. The root structure of thick vegetation provide shield against erosion and enrich slope stability by binding soil particles together. Pryor (1982) suggested in his report that only constant maintenance of forest cover can assure the soil stability, but if there is excessive removal of forest resources along with heavy rainfall, it can

have disastrous result. There is no forthcoming risk to the population but the failure can cause severe harm to the main road thus obstructing transportation and destroying power supply lines. According to the Conservator Forests, starting new reforestation projects and engineering tasks to evaluate and stabilize potentially hazardous locations is very costly for the department of forest as they have scarcity of financial resources. Moreover, in fear of landslides, tourists are also terrified to visit areas of Neelum valley which are really famous for their scenic beauty.

Road hazard sign board is installed for safe driving in a land slide prone zone in district Muzaffarabad as shown in Figure 4. Numbers of casualties have been reported in the past along the route of Kamsar due to some massive landslides. Feagin*et al.*, (2010) in his report drew the attention of people towards the integration of ecosystem services into other actions like early warning systems, awareness and disaster preparedness for lessening people's susceptibility to the hazards.Thiaw (2012) illustrated that three basic elements of disaster risk reduction i.e; regulating hazard, reducing vulnerability and controlling exposure can be dealt with appropriate ecosystem management.

Latitude 34° 35' 01.78" N Longitude 73° 54' 15.47" E

Figure 3:- Land slide at deforested slope on Neelum Valley road

Figure 4:-Landslide hazard sign board at Kamsar Road

4.2.4 Patikka Landslide

Patikka landslide is an active landslide of very huge size. The landslide was triggered by 2005 earthquake which has caused massive disturbance in the surrounding area of Patikka but at present it is stimulated due to the construction in its vicinity.

Latitude 34° 27' 09.85" N Longitude 73° 32' 56.78" E

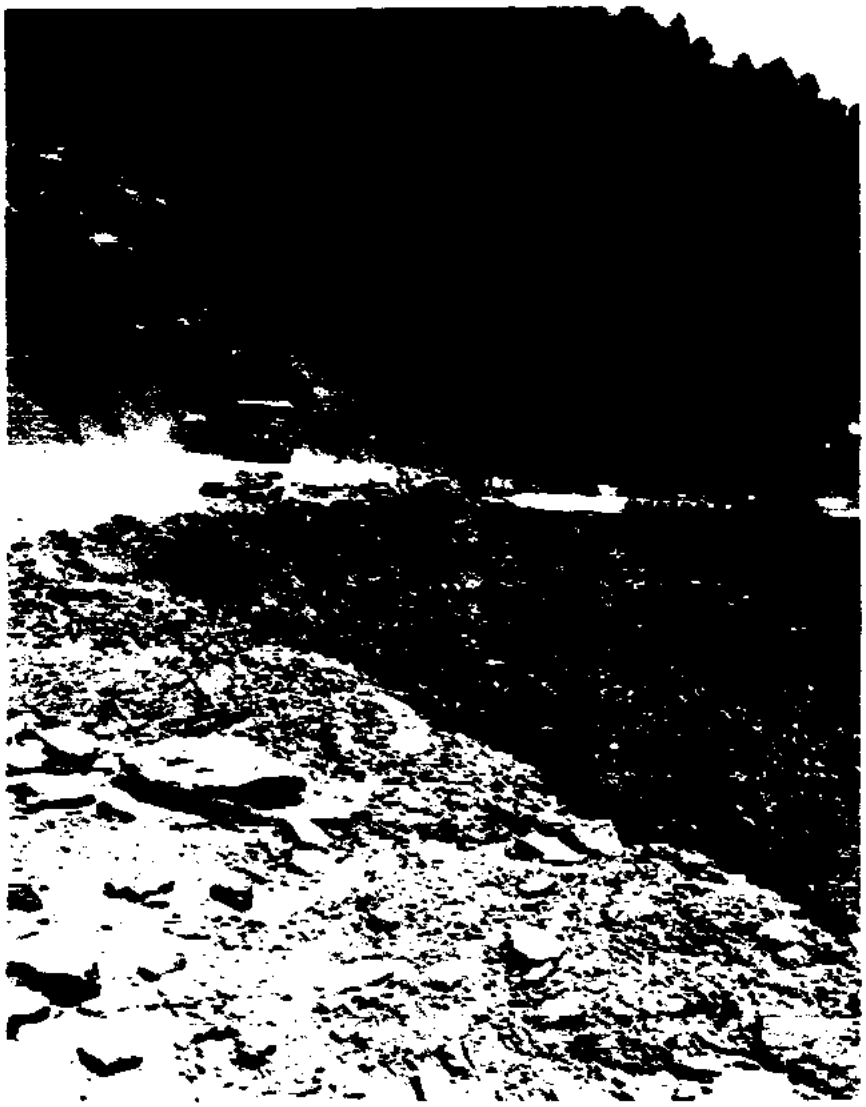

Figure 5:- Forested slope and barren slope at Patikka road

This figure 5 depicts the difference between forested area and barren slope. The forested area resist and guard against land sliding and act as an efficient obstacle against soil slip, rocks and mud slides. Rock fall and land sliding at barren slope which results in loss of people and property are more commonly seen in Patikka road recently. Construction work apart from rainfall in its vicinity also triggers massive landslides. The degraded land gets eroded when it rains causing mud to slough onto the bottom. This land erosion can be minimized by initiating improved standards for construction activities and planting trees which can be helpful in percolating and storing water runoff during rainfall events. According to the locals, territories of numerous species of fauna get damaged due to the landslide and most were

completely destroyed. Forbes *et al.*, (2011) is of the opinion that worldwide, forests and forestry sector are facing rising challenges and threats from natural hazards like land sliding and earthquakes. He reported that there is a strong need to protect forest land which can then in return help in shielding the environment from adverse effects of climate change that is the main cause of many natural hazards.

4.2.5 Landslides on Muzaffarabad - Chakothi road (Jhelum valley)

Subri landslide is present on Chakothi road near Muzaffarabad. This slide can completely block the route from Jhelum valley to MZD. The Earthquake of 2005 has intensified Subri landslide and current situation is worsened by construction work. Slope stability has also been reduced due to the moisture present in it.Road widening activities at Subri site have resulted in land slide during heavy rainfall as depicted in Figure 6. The vegetation was removed during excavation which destabilized the slope and disturbed the root system, leaving area prone to landslide. Land use factors are one of the main reasons that increases soil instability. As the extreme rainfall events are likely to increase, the frequency of landslides in sloping areas will also be increased in these areas thus causing more negative impacts. Bergin (2008) also explained in his report that degraded ecosystems exacerbate the impact of a natural hazard. Through deteriorated ecosystem, the severity of an impact of a disaster could be increased manifold. For example; in Haiti, deforestation has led to increased vulnerability to landslides during heavy rainfall events.

According to the locals when it rains heavily in Chakothi, mud slide and rock fall begins. Most of the slopes at Chakothi site are totally devoid of vegetation. These small and frequent slides contribute to personal and property losses. However the existing condition can be improved by banning tree cutting activities and promoting reforestation programs at land sliding sites.

Latitude 34° 06' 55.08" N Longitude73° 52' 54 43" E

Figure 6:- Slopes devoid of vegetation at Chakothi slide

4.2.6 Hattian Bala Landslide

Hattian Bala landslide is a high risk landslide which was triggered in 2005 earthquake and resulted in vast damages. Many casualties have been reported due to this slide and the risk of slope failure is present there as it is still very active.

Figure 7 shows that preparatory work has been done at Hattian Bala in building and widening the road through excavating machines. The rocks and stones displayed in a given figure are the result of excavation. A large number of trees have also been cut at Hattian Bala due to excavation thus triggering mud slides and landslides in the area. These slides can sometime cause a severe threat to the population and transportation. Besides this, IUCN (2005) reported that Earth quake 2005 has activated the largest landslide in Hattian Bala that covered an area of about 5km^2 with volume of roughly 6 Million m^3. According to the DG ERRA, large scale excavation is not recommended for the areas of district MZD as it can trigger some new and already existing slides. He further demonstrated that retaining walls should be built at landslide sites that can provide permanent sustenance to a soil mass. Retention wall would help in making excavation easier and prevent shedding of moveable soil of slope onto the road. However for any type of retaining wall, suitable drainage is

required because very high groundwater pressure which is present at the site can produce a burden behind a retaining wall which will lead to its failure. Behrens (2007) suggested in his report that strong ecosystem like healthy forests play a very important role in minimizing the vulnerability to a disaster by acting as a physical barrier. The report points out that this natural buffering capacity of a healthy ecosystem can be termed as natural infrastructure which is way less costly than the human built infrastructure like concrete wall or dykes. He demonstrated that sometimes hard practices along with biomedical engineering practices can be very useful for land stabilization to get the fruitful outcome.

Latitude 34° 10' 16.34" N Longitude 73° 44' 38.44" E

Figure 7:- Slide due to excavation after construction of road at Hattian Bala

Figure 8 shows thick forested area with no signs of soil erosion and land slide. The thick vegetation protects the area during heavy rainfall from soil erosion and can form a useful barrier against debris, soil slips and rocks. Roots of the trees strengthen soil layers and provide protection against movement of soil. Trees also decrease the risk of a landslide by dropping levels of soil moisture. Dorren*et al.*, (2007) described that if a large amount of money is spent to preserve and maintain forests, still this money is much less as compared to the cost used for engineered solutions to minimize the hazards related to mountainous region.

Figure 8:- Forested area at Chatter Aklass

The figure9 shows thick vegetation at the top of the hill. At this area nol and slides have been ever reported indicating that forests can also play a vital role in reducing and hindering rock falls and debris flows and by creating a natural physical obstacle against falling material and sliding in *Maakri*. Similar findings have been reported by Stoltenet *al.*, (2008) in Switzerland where forests are considered as a key player of the nation's disaster prevention plan and perceived the worth of "protection forests" in decreasing the damage from landslides, rock falls and avalanches.

Figure 9:-Thick vegetation at the hill of Maakri in Muzaffarabad

4.3 Analysis of Stakeholders' Views

During visit to the AJK Forest department, when officers from forest department were asked that whether any program for control of soil erosion and landslides in Muzaffarabad district is underway. Their response was negative. On inquiry to the cause of such disregard to a major issue by the government, they explained that it is well realized that a soil conservation and reforestation program is a dire need for which both government and private sector should be involved, however since such treatment is much costly whereas forestry is a low priority area in AJK. There is an absence of visionary management and guidance. The government is not taking the forest as a first priority for reducing the risk of landslides. The funds availability for forest department also remains a major issue.

Forest department is also facing problem of tree losses due to illegal cutting and theft. When asked if reforestation and ecosystem based measures for risk reduction can be cost effective in the landslide affected areas, they agreed to it as a long term solution to the problem for the reason that the earthquake of 2005 had shaken up the land, as a result the land has slipped away deep underneath the soil, while trees are planted in

the upper layer of soil and take many years to extend the root system. They further informed that rehabilitation of damaged forest project was started after earthquake of 2005 for the state owned forests but it had to be closed before the time due to scarcity of financial resources. During the course of discussion it also came into notice that 1967 project of reforestation is still under process. However, environment management is a major issue as barren areas are enormous and every year trees are cut due to lack of sense of responsibility and for different personal purposes. They further told that the Forest Act of AJK which was ratified in 1930 and is still being executed in the state. The act does not properly address many emerging issues like global warming, climate change, participation by local communities etc. The Act also neglects all the beneficial services that are being provided by the forests to the people of AJK.

The additional secretary of forest department added that provinces of KPK and Punjab have revised their Forest Act 1927 and Government of Sindh has started working on revision of Forest Act 1927 due to the emerging necessities. Therefore it is the need of the time for government of AJK to update their forest law according to the evolving issues and current environmental problems. The revision of present forest act is a dire need to bring the law in line with the local, national and international requirements. The gaps and opportunities in the Forest Act 1930 was not highlighted properly in the proposed Draft Forest Act AJK, 2007. To improve main flaws and alleviate the gaps in forest act 1930, local and national requirements, ecosystem services, multi-environmental contracts and benefits to the communities should be incorporated in the review of forest act. During revision and update of forest act new forest management approaches and practices must be considered.

Some recommendations also came from the stakeholders that include: forest department needs an intricate and in-depth counseling process with the departments' like MCDP, NDMA, EPA, etc., and all other main participants to cope up with the challenges generated by land sliding in Muzaffarabad district. The involvement of community volunteers and local NGOs support is greatly needed to promote friendly policies and facilitate the process of reforestation. The plantation and engineering tools both are required to deal with massive landslide in district Muzaffarabad.

All the members of forest department, ERRA and EPA were of the same view that in a country like Pakistan where terrorism, poverty, political instability, etc. are the

major issues of a nation, thus the whole consideration of the government remain towards these problems. The idea of incorporating ecosystem approach into DRR is too difficult to implement at this stage where the whole nation is facing social and economic instability.

According to the people living in the vicinity of land sliding, any slope that is devoid of vegetation results in the rock fall, mudslide or a landslide after any rainfall event, excavation activities or construction work along the road. They were of the view that earthquake induced land sliding damages were reduced in those areas which had extensive vegetation as compared to the barren slope. However, majority of the people of villages are not interested in saving or taking care of this natural resource as there is a lack of knowledge about the significance of forests and their role in minimizing any natural hazard.

Local population have also been troubled due the issue of land sliding in district Muzaffarabad and their responses clearly revealed their annoyance and hopelessness. Land sliding has badly disturbed the routine and regular activities of locals.

According to a local of Kohala "The Azad Jammu and Kashmir (AJK) roads and communication department has failed to clear the damaged road near Kohala, some 30 kilometers from here, leaving Muzaffarabad cut off from the rest of the country". A resident of Kahori told that every time during heavy rainfall, 3 to 5 people get injured due to massive land sliding. He further added that land sliding has caused extensive loss to their economic activities as the road gets totally blocked after heavy rainfall especially in July and August.

The closure has left people in the area with no option but to ascend the high peaks in the area to get wherever they are going. "I had to walk for 70 minutes to reach Muzaffarabad. I don't know why the government is not using machines to remove the debris, land sliding has doubled our already existing issues" said a local.

Another man mentioned that it was negligent of the authorities to leave the Kohala road blocked for so long which is the main route used by tourists. An elderly man was carrying a bag of flour on his shoulder in Kamsar. He demanded that the government should construct an underpass in the landslide-prone area to properly address the problem. More than 20 houses were "badly damaged" and 30 were "partially damaged" in 2014 by a heavy landslide in the Chakar area of Hattian Bala district.

According to the AJK minister for Communication and Roads, when such incident occurs, orders are issued as soon as possible to clear the debris. He added that it is a difficult to resettle and displace the local communities away from landslide prone areas as they are not willing to shift from their places. He further added that sign boards are now being installed to prohibit or restrict the access of local population to the landslide hazard areas.

Figure 10:- Consultation with Project Director, MCDP

Figure 11:- Consultation with Secretary Forest Department

4.4 Analysis secondary data

Following is the analysis from reports which were studied to take an insight of the work previously done on the role of forestry in disaster risk reduction.

4.4.1 Mapping land use change in post-earthquake AJK, Pakistan: lessons learned and challenges, 2006- 2007

Neelum valley is located in the northeast of Muzaffarabad where the epicenter of EQ 2005 exists. The data of a right and left bank of Neelum valley was compared to find out the linkage between forest cover and landslides triggered by the EQ. The left bank with more buffering capacity due to greater vegetation cover had less number of landslides (n=16) and the right bank with sparse forest cover had higher number of landslides (n=84). To develop useful disaster risk reduction plan after the hazards caused by EQ triggered landslides in AJK, Pakistan require a broader understanding of possible basic anthropogenic causes, or preparatory factors.

4.4.2 National disaster risk management framework Pakistan, 2007

Increased deforestation is a main source behind accelerated number of landslides. The occurrence of landslides in Kashmir region, NWFP and northern areas may increase in coming years since the forest cover is reducing by 3.1 %. Evaluation of susceptibility of natural assets like forest, mangroves, coral reefs, protected areas, coastal areas to natural disasters and human induced hazards is compulsory. Execution of plans for maintenance and rehabilitation of natural resources in order to decrease risks of natural hazards; e.g. reforestation, mangrove plantation, etc. is needed.

4.4.3 The role of environmental management in DRR and climate change adaptation, 2008:

After the EQ of 2005 hitting the territory of AJK, the land sliding has been more rampant on the steep slopes without much plantation which as a result has led to greater loss. The study has also confirmed that forests played a very positive role in reducing the risk of landslides triggered after EQ. The government of AJK declared the year 2007 as "Year of Plantation" due to importance of the forests and their role that they play for protection of land is being highlighted. However, natural disasters in

mountainous region such as in Kashmir 2005 need an understanding of the basic causes so that the risk reduction programs can be designed accordingly.

4.4.4 Opportunities in Environmental Management for Disaster Risk Reduction: Recent Progress, (2008-2009)

Environmental management reduces disaster risk manifold around the globe.

Environmental conditions not only alter the rate of occurrence of a disaster, but a healthy environment also serves as natural barriers that can reduce the effects of a hazard and save communities from harm. In northern Pakistan, IUCN jointly with UNEP/GRID-Europe and other associates started off reforestation plans after EQ 2005 to implement largely in the disaster prone areas in order to provide protection against landslides. Despite these efforts, there is a strong need to strengthen and expand the corporation between environmentalists and disaster risk managers to maximize the joint contribution in disaster risk reduction.

4.4.5 Demonstrating the role of ecosystems based management for DRR, 2010

Ecosystems that are well managed can give natural defense against natural hazards, such as flooding, landslides, avalanches, storm surges, and drought. The impact of a natural hazard can get aggravated by degraded ecosystem e.g. by altering the physical process that have an effect on extent, frequency and timings of these hazards. Investing capital in ecosystem is not a sole solution to disaster reduction but it should be assembled together with other risk reduction methods as well. Ecosystem based approaches when combined with engineered infrastructure investment is intended to protect crucial property (transport route, hospitals, schools) from damage e.g. breakwater, groans.

4.4.6 Report of workshop on Ecosystem, livelihood and DR,2010

Following the publication of report by PEDRR in 2008, a workshop on ecosystems, livelihood and disaster reduction was held in 2009 and its roport was published in 2010. The PEDRR was established in 2008 and is guided by its vision of " Resilient communities as a result of improved ecosystem management for DRR and climate change adaptation CCA". It also believes that ecosystem management is an integral part of DRR because degraded environments can cause or exacerbate negative impacts of

disasters. However, scientific evidence on the links between ecosystems and DRR is still missing.

4.4.7 Forest and natural disaster risk reduction in Asia and the Pacific, 2013

Hazard impacts are aggravated by environmental changes. If the ecosystem is robust and well manged, it can provide numerous benefits by helping prevent disasters and assist in developing resilience to the impact of natural disaster. This information should be understood and circulated. The report also highlights the significance of forests role in mitigating the impact of natural hazards in Asia Pacific regions. Deep rooted plants and bushes can support shallow soil layers, stable soil and reinforce that resist the movement of soil. Soil moisture level is reduced by the forest undergrowth that really helps in preventing landslides to occur. The capacity of forests to percolate and store the water run off is highly beneficial during rainfall events. Evaporansportation from trees also help out to decrease soil dampness content, generating a more considerable shield against flooding during rainfall occurrence. Keeping in mind all the benefits provided by forests, ecosystem approaches should be incorporated with DRR to mitigate and adapt to disasters to some extent. Scientific evidence is also necessary in preparing disaster risk management and response system associated with forest settings.

4.4.8 Managing forests & watersheds for natural hazards protection & livelihoods, 2010

The International Day for Disaster Reduction was marked on 13 October. in which PEDRR held a discussion to emphasize on the importance of forests and watershed in reducing the risk of a disaster by focusing on hazard mitigation measures. The discussion raised the knowledge and understanding of the linkage between environment and disaster risk and all those challenges that are being faced by the people in minimizing their susceptibility to the risk of a disaster. There is a need to further increase the awareness about environmental dimensions of natural hazard protection around the globe.

4.4.9 Monsoon Contingency Plan, 2008

Vulnerability of downhill movement is severe in districts of Muzaffarabad and Bagh in AJK which are red zone areas and are susceptible to earth quake. No useful DRM

approach put in place so far to check mudslide, land sliding, and other environmental damage activated by rainfall. Moreover, the mountainous regions of AJK are highly vulnerable to flash floods and rainfall instigated sliding and this vulnerability is expected to persist. Thus there is a strong need to enforce effectual DRM plan and establish strong emergency response strategy in time.

4.4.10 Environmental Guidance role for Disaster risk reduction- IUCN, 2009

The report has largely emphasized on linking the ecosystem based approaches into disaster management for the sake of human security and sustainable development. Cost effective solutions to minimize the vulnerability of community to disasters can be derived if money is invested in sustainable ecosystem management. Healthy ecosystems, such as intact forests, wetlands, mangroves, and coral reefs acting as natural buffers to hazard events for flood abatement, slope stabilization, coastal protection and avalanche protection. These natural buffers are often less expensive to install or maintain, and often more effective than physical engineering structures, such as dykes, levees, or concrete walls. The level to which an ecosystem will shield against intense hazards will depend on an ecosystem's strength and the force of an event. If the number and rate of extreme events raises, still the severity of disasters can be condensed by taking up integrated methods that merge disaster risk reduction measures development practices, and ecosystem management. Furthermore, Investing in ecosystems can be used as cost-effective successful alternatives that will go together in balance with physical engineering structures.

4.4.11 Role of Different Vegetation Types in Reducing the Earthquake Damagesin Muzaffarabad District, 2010

The study shows that maximum damages due to earthquake of 2005 were brought on already ruined and weakened lands. On contrary, the damages caused by the earthquake and its resultant landslides were decreased where extensive forests were present. The root system on one hand helps in binding the soil particles altogether and at the same time deliver an anchorage for the trees which results in slope stability. One of the main harms observed in these earth quakes disturbed areas was the devastating burden on forest resources as trees were still cut down unlawfully for fuel wood and timber to fulfill the necessities of local people. There is a need to take an

immediate action against these illegal activities to protect this natural shield against disasters.

4.4.12 Forests and landslides: the role of forests and forestry in prevention and rehabilitation landslides in Asia, FAO

Asia has extensive mountainous and sloppy land where weathering of bedrock is more and majority of highly erodible soils are present. It is characterized by high cyclic rainfall and volcanic material. All these features make the occurrence of landslide higher in Asia as compared to other parts of the world. Forests can play a very significant role in these regions by decreasing and hindering mud slides and rock falls as they act as a natural shield barrier against sliding. Landslides in Asia resulted in economic, environmental and social losses. It is predicted that the frequency of landslides will continue to increase in Asia with time due to growing burden on forests because of the population expansion and infrastructure requirement. Implementation of enhanced and improved standards is needed immediately to avoid the landslide risk.

4.5 Impacts of land sliding

Once land sliding occurs in a region, its negative impacts set to increase and results in social, economic and environmental damages.

4.5.1 Social Impact

Comprehensive study on the damages resulted from land sliding shows that deforestation and land sliding has a lot of direct and indirect damaging effects on socioeconomic stability. Blockage of roads after land sliding not only disturbs the routine activities but creates problems for people to attend important events like wedding ceremonies, funerals, meetings etc. Land sliding causesgreat negative impact on society, as movements are limited, that are mandatory for personal and commercial purposes. Deheragoda (2008) cited in his report that once the landslide hazard strike an area, their social impacts on the population can be easily witnessed. Landslide results not only in changing the daily activities of communities but also harms the social network of affected people. Extreme results of land sliding may also cause loss of source of revenue for people and high negative impact on their cultural integrity that can cause psychological and physical strains among people.

A large population is dependent to a great extent on forests. Land sliding reduces the availability of forest reserves for them.Gupta *et al.*(2012) also described that the management and protection of natural resources like forests is very important for the continued existence of human beings and other living organisms.

4.5.2 Economic Impact

A large proportion of income is also lost because of decreased tourism, due to the fear of land sliding. Another adverse economic impact of landslides involves the expense to renovate the damaged structures, destroyed routes for transportation, medical charges in case of any casualty, and disruption of property values and secondary costs which may involve lost timber. It was observed that almost 80 to 90% of landslides severely effect structures like buildings (residential and commercial), roads, water supply, electric system etc. About 10 to 20 % of landslides can damage big structures like hanging bridges. It was noticed that major work was done on building hard structures like protections walls, while less biomedical engineering measures were taken, which is not satisfactory to prevent slope failure. Some proportion of landslides are found high risk for shops, drainage channels, crushing plants, and cultivated lands. This may result in human and other livestock emergencies. Atta u Rahman *et al.*, (2011) have categorized the economic impact of landslides into four groups: a) impact on houses b) impact on public buildings c) impact on different sectors of earnings like tourism and forestry sector and d) impact on infrastructure like railways, irrigation, bridges, etc. RoR (2012) noted in the case study that the disaster can have many negative economic impacts that includes loss of critical infrastructure, damage to buildings, destruction of water bodies, loss of businesses, etc. The destruction resulted from landslide hazard in an area needs heavy cost to repair the loss that set pressure on country's economy.

4.5.3 Environmental Impact

Deforestation caused by land sliding has severe adverse effects on physical and biological environment. Nearly 90% of the landslides badly effect the environment causing massive air and water pollution. Dust pollution in areas like Patikka and Barsalahas caused serious impact on plantation. Deforestation also results when the growth of plants gets restricted as the process of photosynthesis decreases due to the dust resting over plants. Generally biodiversity is not significantly affected by land

sliding, some wildlife that are present migrate to some other local places. Moreover, it was observed that at slopes there are some common species of plants but not the rare ones. Land sliding also results in debris formation in rivers (Jhelum and Neelum) thus polluting water that causes damage to water life. The polluted water when supplied to homes causes various diseases among locals. Debris increases the sedimentation load that cause sludge formation in dams (Mangla and Tarbela) which reduces the life of these big reservoirs in a long run. In order to remove the debris of land sliding heavy machinery is used that becomes another reason for air pollution in the area as well as loss of forest cover. Kjekstad and Highland (2009) discussed the adverse effects of land sliding on water quality causing pollution due to accelerated erosion and sediment formation in streams and rivers. They noted that habitat of native animals also gets vanished due to land sliding both on surface of earth and water body. Schuster and Highland (2004) reported that landslide impact on environment can be grouped into two categories; impact on total environment that involves effects on public and their belongings, important structures, farms, industrial units; and impact on wildlife, grasslands, forests, morphological changes (mass wasting, degradation) etc.

The interlinked phenomenon of deforestation and landslides have significant parallel impacts. Slope failure and resulting land sliding has seriously damaged the forest resources and currently is a major threat to the forest of AJK. However, timely mitigation measures are needed to reduce environmental, socio-economic and physical impacts on communities, infrastructure and their environment due to the threatened land.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The regions of district Muzaffarabad are particularly susceptible to landslide hazard due to accelerated deforestation apart from fragile soil of mountainous region and geology of the area. Land sliding occurs frequently in distric Muzaffarabad, mostly on deforsted slopes, in the rainy season which causes loss of lives, hamper economic activiies, pollution of water, break up of communication and transportation between two routes, etc. It is found that undamaged forests provide protection against natural hazards like earthquake, storms, floods and landslides. It is concluded that deforested slope in district Muzaffarabad has resulted in more landslides as compared to those areas with thick vegetation cover.There is an absence of efficient land and forest management plan. The eological, economic and the social aspects which are dimensions of forestry are also being ignored. Moreover, the concept of environmental tools are insufficiently integrated into disaster risk reduction and development plans.The major issue related to study in forestry and its linkage with disaster risk reduction in district Muzaffarabad is accessibility to reliable information, which is not easily available and much more research is needed in this sector to create more data.

5.2 Recommendations

i. All potentially dangerous deforested sites likely to fall in district Muzaffarabad should be mapped out for risk assessment and landslide records should be made so that dangers of slope falling and their influence on forest cover can be predicted timely to reduce risk.

ii. Areas that are prone to land sliding should be strictly designated as forest reserves and should be prohibited for access by making boundaries. This will be useful for conservation of forests and infrastructure. There should be an integrated method including hard practices and biomedical engineering for land stabilization. It is necessary to know what type of tactics, records, and knowledge can be most useful in improvement of decision making for reduction of disaster risks in hilly areas.

iii. Improved standards for the construction of roads are needed immediately to decrease the cutting of trees and reduce the risk of land sliding.

iv. There is a dire need to educate people for capacity development in order to conserve forest and to assess the risk and take possible steps especially before monsoon, disaster events like seismic activities.

v. AJK forest department should start an extended program for reforestation on landslides. It can be designed as plantation of trees initially and then maintenance with replacement of damaged ones.At landslide sites there should be plantation of fast growing trees that have deep adventitious roots.

vi. The forest department, Government of AJK should update the data of forest both state and private regularly. For this purpose, proper field surveys and satellite imaging should be used for GIS mapping to find out those land use factors that have induced landslides e.g. construction of houses, roads, etc. changed vegetation, water management, agricultural terraces, deforestation, cropping.

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