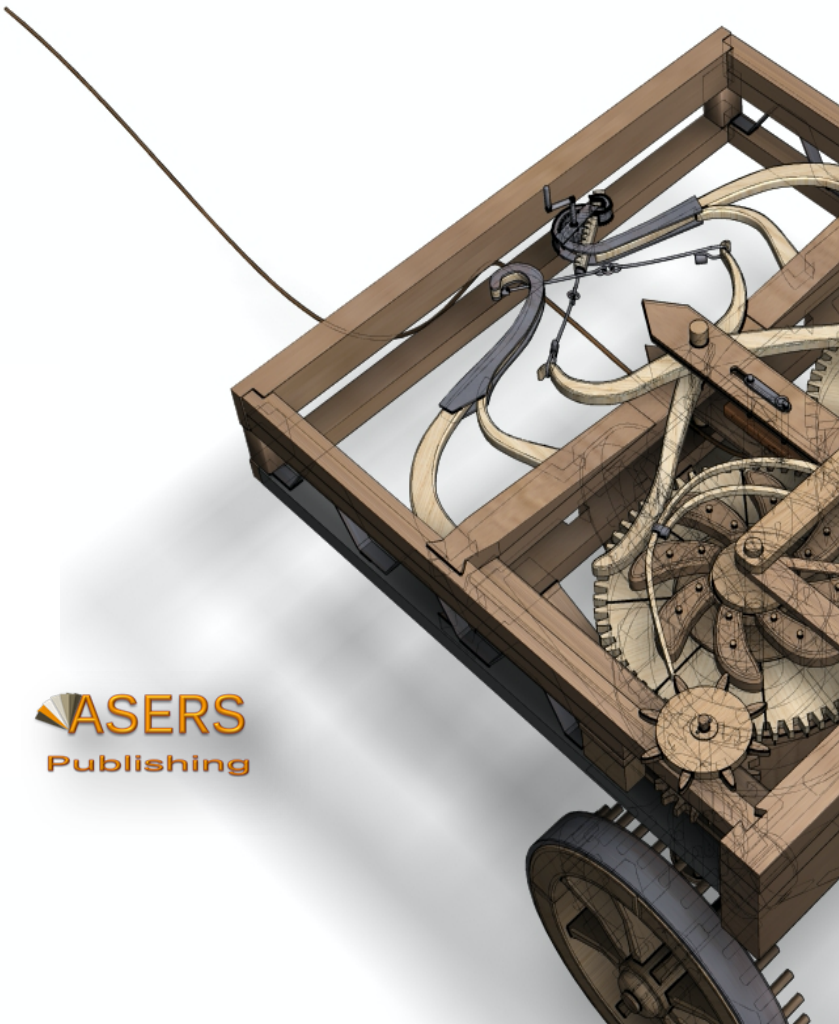
ASERS

Journal of Environmental Management and Tourism



Quarterly
Volume XIV
Issue 3(67)
Summer 2023
ISSN 2068 – 7729
Journal DOI
https://doi.org/10.14505/jemt

ASERS Publishing

Summer 2023
Volume XIV
Issue 3(67)

ASERS Publishing
http://www.asers.eu/asers-publishing
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt

Table of Contents:

Summer 2023
Volume XIV
Issue 3(67)

ASERS Publishing
http://www.asers.eu/asers-publishing
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt

Call for Papers
Fall Issues 2023
Journal of Environmental Management and Tourism

Journal of Environmental Management and Tourism is an interdisciplinary research journal, aimed to publish articles and original research papers that should contribute to the development of both experimental and theoretical nature in the field of Environmental Management and Tourism Sciences.

Journal will publish original research and seeks to cover a wide range of topics regarding environmental management and engineering, environmental management and health, environmental chemistry, environmental protection technologies (water, air, soil), pollution reduction at source and waste minimization, energy and environment, modeling, simulation and optimization for environmental protection; environmental biotechnology, environmental education and sustainable development, environmental strategies and policies, etc. This topic may include the fields indicated above, but are not limited to these.

Authors are encouraged to submit high quality, original works that discuss the latest developments in environmental management research and application with the certain scope to share experiences and research findings and to stimulate more ideas and useful insights regarding current best-practices and future directions in environmental management.

Journal of Environmental Management and Tourism is indexed in SCOPUS, RePEc, CEEOL, ProQuest, EBSCO and Cabell Directory databases.

All the papers will be first considered by the Editors for general relevance, originality and significance. If accepted for review, papers will then be subject to double blind peer review.

Deadline for submission:	21st July 2023
Expected publication date:	September 2023
Website:	https://journals.aserspublishing.eu/jemt
E-mail:	jemt@aserspublishing.eu

To prepare your paper for submission, please see full author guidelines in the following file: JEMT_Full_Paper_Template.docx, then send it via email at jemt@aserspublishing.eu.

DOI: https://doi.org/10.14505/jemt.v14.3(67).01

Assessing and Mapping the Impact of Tourism and Changing Climatic Conditions in Himalayan Region of Pakistan

Asma YASIN
Sustainable Development Study Centre, Government College University, Lahore Pakistan

Laila SHAHZAD
Sustainable Development Study Centre, Government College University, Lahore Pakistan
Institute of Risk and Disaster Reduction, University College London, UK
*Corresponding author: l.shahzad@ucl.ac.uk; lailashahzad@gcu.edu.pk

Muhammad Umar HAYYAT
Sustainable Development Study Centre, Government College University, Lahore Pakistan

Gul Zareen GHAFOOR
Sustainable Development Study Centre, Government College University Lahore, Pakistan

Salar SAEED
Agrosphere (IBG-3), Institute of Bio and Geosciences, Forschungszentrum Jülich Germany

Faiza SHARIF
Sustainable Development Study Centre, Government College University, Lahore Pakistan

Umair RAIZ
Department of Soil and Environmental Sciences, MNS University of Agriculture Multan, Pakistan

Muhammad Bilal SALEEM
RS/GIS Analyst, National Engineering Services Pakistan (NESPAK), Pakistan

Suggested Citation:

Yasin, A. *et al.* (2023). Assessing and Mapping the Impact of Tourism and Changing Climatic Conditions in Himalayan Region of Pakistan. *Journal of Environmental Management and Tourism*, (Volume XIV, Summer), 3(67): 605-622. DOI:10.14505/jemt.v14.3(67).01

Article's History:

Received 24th of January 2023; Received in revised form 13th of February 2023. Accepted 7th of March 2023; Published 2nd of June 2023.

Abstract:

Khaghan and Naran Valley of Pakistan are popular tourist mountainous region and face direct impacts of environmental degradation in past years. The current study aims to map the impacts of tourism on the local community and how it has affected the environmental settings. Mixed method approach was utilized including questionnaire survey; meteorological records, focused group interviews and mapping the land cover changes using satellite imagery. Meteorological data shows anomaly in rainfall patterns and extreme temperature which can be considered as climatic pressures on fragile environment. Spearman's correlation showed that environmental degradation was linked with increased tourism activities in the region. Normalized Difference Vegetation Index (NDVI) shows an increasing trend of land degradation by the conversion of forested areas into settlements. Considering the significant magnitude of degradation over the last decade, appropriate and urgent actions are needed to address the growing demand of the tourism sector.

Keywords: degradation; development; land use and land cover; NDVI; tourism.

JEL Classification: Q54; R11; Z32.

Introduction

Tourism is among the leading economic sectors as it stimulates economic growth across the globe during the current globalization era (Danish and Wang 2019). About 5992 billion USD was added to the global economy by the tourism sector (including all domestic and industrial tourism activities) in 2011 (World Travel and Tourism Council). It has made a major contribution in development as about 260 million jobs were created, accounting for 9% of total global employment. Thus, the mainstream countries in the world are stressing towards sustainable tourism as a driver for the 'green' economic growth (Hastings 2013).

On the other hand, environmental degradation has become a global concern (Stewart *et al.* 2015; Le *et al.* 2016), as it destroys and deteriorates the land as well as agriculture soil (Hoffman and Todd, 2000). It became a serious hurdle in the universal development therefore it was marked as a major risk by United Nations Convention to Combat Desertification (UNCCD) (UNEP, 2007). The higher the rates of socio-economic and industrial developments in the world, greater will be the mushrooming of cities. The ultimate result is the rural and urban population rises which dramatically cause land-use change. This paves the way to unsustainable use of land which lowers the economic value of a region, productivity is reduced, and natural beauty starts to fade. Some of the major indications of land/ environmental degradation are the enhanced level of salinity and soil erosion along with the significant reduction or loss of biodiversity over the course of years. Demographic pressures induce changes in land use and land cover. Rapid human growth induces more resource consumption which caused the earth's environment to change at an accelerating pace. Changes in land use and land cover are basically outcomes of these earthly transformations and rapid climatic changes such as increasing temperature, precipitation variations, increasing the CO2 concentration, and overall global warming (Turner and Meyer, 1995; Tucker *et al.* 1991). Expanding populations and greater tourism have placed great pressure on the present resources creating a variety of intricate land use dilemmas.

Pakistan has emerged as the most coveted tourist destination since the past few years as it is bestowed with incredibly enchanting natural as well as cultural beauty, which has helped it to attain inordinate global attention for its intricate beauty. The northern parts of Pakistan are known as a heaven on earth as the valleys here encapsulates cultural heritage and captivating nature. Summers especially bring millions of tourists to the northern part of country due to its pleasant weather (Arif *et al.* 2019a). But unfortunately, our tourism industry is not very established or properly planned and delivers immense issues and negatively influences international tourism in our country (Arif *et al.* 2019b).

Naran-Kaghan Valley are collectively known as '*the fairyland of Pakistan'* because of its undeniably unique landscapes, cultures, and traditions (Schickhoff 1995). It is situated in the district of Mansehra with an average width of 15 miles and 92 miles from Babusar Pass to Balakot via road (Watson 2015). The mountainous areas of our country were previously the hotspots of international tourism. Greater numbers of tourists were attracted by the magnificent natural landscapes that exponentially led to rise in the economic growth in the host region. Enhanced tourism comes at a price much higher than economic uplift. Environmentally, the region is degrading at a relatively slow pace but visible apparently after a huge loss to biodiversity, forestry, or overall greenery. Moreover, with the passage of time developments were made, not only in the formation of buildings, but dense forests were converted into small scale marketplaces and grazing lands. But such environmental deprivations are much harder to replenish since they require proper care, specific policies, and collective work.

This study explores and covers the dynamic changes in the land use/land cover in Kaghan and Naran Valley, of KhyberPhktoonKhawa, Pakistan due to excessive development and over tourism using spatial analysis of GIS (Geographic Information System) and remote sensing (Goldbulm and Wong 2000). Using the multi-temporal analysis, remote sensing can help in keeping a close watch of how the area has evolved during previous decades. It distinguishes rural land uses such as forestry, water bodies, farmlands, or agricultural lands from quarries (Ram and Kolakar 2007). Shifts in the land use pattern results in the change of physical land cover which ultimately effects water bodies, biodiversity and other processes which collectively affects biome and ultimately climate of the area defers (Quarmby and Cushnie 2010).

There are very few studies which has assessed the environmental degradation and community development in such fragile environment of Pakistan. This study would therefore provide an insight to what extent the degradation has already been done to this valley due to excessive tourism with little to nonenvironmental protection.

1. Material and Methods

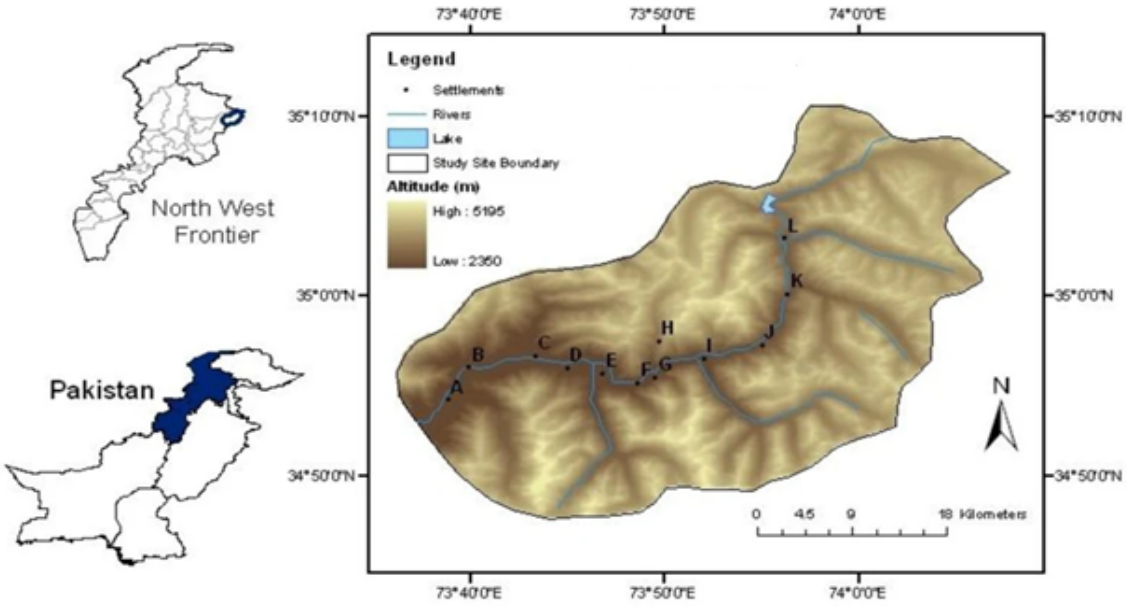
A mixed-method approach was used to gather quantitative and qualitative data in the study area, details of each are given under specific legend.

1.1 Study Area

Kaghan-Naran Valley is in Mansehra district, KPK (Khyber Pakhtunkhwa), Pakistan covers 155 kilometres (96 mi) with its lowest elevation of 650 m (2,134 ft) to its highest point at the Babusar Pass around 4,170 m (13,690 ft). The study area is located at 2450-6100m elevation above sea level where it is surrounded by high mountains of lower Himalyan having Kunhar River, which flows down the valley (northeast to southwest direction). Geographically, the valley is located on the extreme western boundary of the Himalayan range, after which the Hindu Kush range of mountains starts to the west of the River Indus. Geologically, the valley is situated on the margin of the Indian Plate where it is still colliding against the Eurasian plate (Figure 1). Naran valley has been recognised as an important part of the Western Himalayan province floristically. It has a dry temperate climate with distinct seasonal variations (Ali and Qaiser 1986). The area is popular as a tourist location; every year many tourists from Pakistan and neighbouring countries visit the place from May to October. It is one highest highways in the world with pleasant weather conditions. Winters are cold and have snow everywhere which restrict travels.

Traditionally livestock, non-timber forest products, fisheries and agriculture are the sources of income in this area but over the time tourism has evolved and dominated the region. All development now is in lieu of tourist activities including river rafting, boating, fishing, and residences.

Figure 1. Study area map.



1.2. Data Collection through Questionnaires

Two types of respondents were selected for the survey.

- Tourists
- Residents

Questionnaires were the source of our primary data collected from the study area while online questionnaires were also circulated for tourists. Approximately 100 questionnaires were collected from tourists while 200 questionnaires were from local households. The Questionnaire had four sections including Demographic, socio-economic information, environment, and tourism related. In the first section, questions were dealing with their qualification, gender, monthly income, source of livelihood, total bread earners of the house and other whereabouts. The second section of the questionnaire deals with household living characteristics as water availability, over-grazing issues, food availability, level of greenery and other factors. While the third and fourth section of the survey questionnaire contains observation-based questions regarding tourist arrival and its link with the degrading beauty of the Valley. The collected questionnaire data is compiled and evaluated using spearman's correlation via SPSS software version 25.

1.3 Focused Group Interviews

Focused group interviews are a well-known qualitative tool to gather a small group of people with similar backgrounds to acquire certain pre-determined information. In the current study, two FGI were conducted, 10 respondents in each, gender balance was considered. One group consists of respondents below age 30; while the other group has respondents of age above 30. Respondents were selected on one basic criterion that they must have visited the valley at least twice in their lifetime with at least 3-5 years of gap in between. As this year is a tourism hotspot, we were lucky to find such respondents effortlessly. Interview questions were mostly observation based. Questions asked include: a short introduction, years of their visits, places visited, road condition, comparison of the visible differences observed (in terms of houses, more hotels, more tourists' points compared to past), greenery level, landscape they could see compared to past, degradation level, sustainable tourism and role of government, climate change and their opinion. Based on their observations, they were asked to mark the impact of tourism in scale of 0 to 5 for development or degradation in the region.

1.4. Meteorological (MET) Data for Assessing Change in Climatic Indicators

Secondary data of temperature and precipitation records of Khaghan-Naran Valley were collected from the meteorological department (MET office, Lahore). Daily data of twenty years (1996-2015) was taken and converted into monthly basis to assess the difference in two decades which are considered major developmental periods in study area.

1.5 Land Change Analysis

Land use and land cover *(LULC)* were depicted by GIS mapping of that area. Arc GIS 10.8 was used to picturize the level of biodiversity reduction, conversion of forests to agriculture land, surge in human housing indicating population rise and more over the course of last decades. Multispectral, multi-temporal IKONOS, QUICK BIRD data was acquired for four years: 2000, 2007, 2014, 2021.

The following years were chosen as these were the major developmental years in the region. IKONOS, QUICK BIRD images for LULC change detection having a total of 3 bands and spatial resolution of 2.5m for better categorization. These satellite images used a scale of 1:1125 to investigate the historical changes of land use land cover in our study area over the period of 2000 to 2021.

Geo-referencing

Google base maps were used as a reference image for geo-referencing of all the satellite imagery. Several grown points were chosen for every image. The root means square error for years 2000, 2007, 2014 and 2021 was calculated as 0.3, 0.4, 0.25 and 0.35 respectively. RMS error below 1 is considered appreciable and acceptable error.

Classification

For land use analysis, maps of the corresponding years were created using software Arc. GIS. We followed following steps for LULC analysis:

- Digitization using polygon tool of various classes available;
- All the classes in the same layer demonstration;
- Areal calculations of each class created.

The classification scheme to form a broad classification of LULC of our study area, Naran Valley includes 8 classes: forest, settlements, roads, river, streams, barren land, vegetation cover and agriculture land.

Percentage change

The interpretation was done using IKONOS, QUICKBIRD images. Supervised classification method was used, and Google Earth Engine 7.3 was utilized for the processing of classified raster images. Arc GIS 10.8 was used to produce final output maps of all four years. Increase or decrease in time periods for each LULC class were calculated and percentage change was calculated using the equation (1.1) where V_1 is the final year and V_2 is the initial year (Shahzad *et al.* 2019).

$$\textbf{Percentage Change} = (V_1 - V_2/V_1) \times 100 \qquad 1.1$$

Change Detection

This method allows us to explore the changes that have been conducted in a time period, but it is also helpful in determining the nature, pattern of change (expansion or shrinkage) and spatial extent of a body (Singh 1989; Lu *et al.* 2004). Although several methods are available to determine change detection analysis in remotely sensed data but the most effective among them is the post-classification comparison technique (Foody 2002).

Classified maps of the years (2000, 2007, 2014, and 2021) were compared to understand the change status and its magnitude rate for the given time periods. Magnitude of change and the annual rate of change for every LULC class was calculated using following equation.

Magnitude of change (ha) = A_i-A_f 1.2

Annual rate of change (ha/year) = (A_i-A_f/n) 1.3

Annual rate of change (%) = (A_i-A_f/n)× 100 1.4

Where:
A_i = class area (ha) of the initial year
A_f = class area (ha) of the final year
n = number of years of the time period

1.6 Vegetation Index Analysis

Satellite images were used to investigate the changes that occurred in the LULC classes of our study area over the period of 21 years from 2000-2021. Four Landsat satellite images were used to calculate the level of vegetation cover over the last decade specifically by calculating the *Normalized Difference Vegetation Index (*NDVI). Four Landsat satellite imagery scenes of 150/36 path/row from two types of sensors were downloaded from USGS website (United States Geological Survey). Landsat7 ETM+ images were used for 2000 and 2007 maps consisting of 8 bands each. Landsat 8OLI/TIRS imagery was utilized for 2014 and 2021 maps, with each consisting of 11 bands. These Landsat images have a spatial resolution of 30m. Each satellite image used was from the month of September way past the rainy season and was selected on the basis of minimum cloud presence.

NDVI or Normalized Difference Vegetation Index is a dimensionless index constructed from near infra-red (PIR) and red band (R). It helps distinguish vegetation, its greenness, health/vigour of growth from other types of land cover, indicating the overall state of any area. A balance amid the received radiations and emitted energy by various objects on Earth is determined by NDVI. Being a dimensionless/unit less index, values range from -1 to +1 which is explained in a sense that every value below 0.1 are water course or bare land while values close to 1 are indicating more greenery (forests, vegetation, scrubs etc.). NDVI is calculated by the following equation (equation 1.5) (Han *et al.* 2009).

NDVI = PIR - R/PIR + R 1.5

For Landsat 8: **NDVI = B5 – B4/ B5 + B4** 1.6

For Landsat 4-7: NDVI = B4 – B3/ B4 + B3 1.7

Where: **PIR** = near infra-red radiations; **R** = red band, **B** = band

2. Results

2.1. Survey Response

In order to investigate how tourism has impacted the local community and environment, some indicator questions from both the respondents (locals and tourists) were chosen. The questions to assess **Environment** were as land grazing, problems related to water supply and availability; to assess **Tourism** were income, number of visits, gully erosion increase, littering problem etc; to acquire **Development** related, numbers of hotels developed, paths paved, crop yield in the last 10 years, livestock density owned, grow own crops and to assess **Degradation** in region LULC change since last decade, landscape/vegetation visible, habitat degradation in early 2000 as compared to present.

Table 1 shows characteristics of study population and their perception (locals and tourists) of tourism in the study area.

Table 2, 3 demonstrates the outcomes of spearman's correlation for tourists and locals of the region; positive as well as negative correlations are obtained for many variables. Moderate positive correlation was observed for land grazing, crop yield in the last decade, paths paved and LULC changed since the last decade. According to locals, paths paved led to water supply issues while land grazing was limited. LULC change led to problems related to water supply and availability for them. On the other hand, habitat diversity has been reduced and gully erosion enhanced as land grazing by livestock increased. Littering issue has also elevated as number of hotels were increased and habitat diversity was also affected. As LULC was changed over the last decade,

lesser vegetation is visible. Low correlation of variables indicates a lower impact ratio as compared to moderate correlation.

Table 1. Responses of study population

Variables	Options	Naran Locals	Naran Tourists
Gender	Male	64%	32%
	Female	36%	68%
Age group	15-25	36.5%	57%
	25-35	30.5%	39%
	35-40	29%	4%
	45-50 or above	4%	0%
Education	Primary education	17.5%	2%
	Matric	32%	1%
	F.Sc	31.5%	5%
	Graduation	19%	92%
Land cover type	Cropland/grassland	34%	23%
	Forest	49%	52%
	Wetland	5%	16%
	Bare areas and urban land	12%	10%
Hotels developed since last decade	More than 15	26.5%	51%
	10-15	48.5%	28%
	5-10	19.5%	15%
	Less than 5	5.5%	6%
Tourists visitation	Quite often	35%	66%
	Sometimes	35.5%	26%
	Less often	25%	4%
	Don't know	4.5%	4%
Visible landscape/vegetation	One mature tree or 3 scrubs per 20m	36%	43%
	One mature tree or 3 scrubs per 40m	39.5%	31%
	One mature tree or 3 scrubs per 80m	11%	17%
	One mature tree or 3 scrubs per 100m	13.5%	9%

All the responses shows that directly and indirectly tourism is impacting the area in many ways. Greater tourists' influx leads to more resource consumption, more litter, greater demand of accommodation leading to more hotel development and in short greater human invasion is leading to slow and steady degradation which might not be visible to some at this moment, but this slow process would soon engulf this beautiful tourist hotspot depriving its natural beauty and source of income.

Table. 2 Correlation showing the perception of Local community

	Income	Grow own crops	Problems of water supply	Land grazing	Habitat diversity in early 2000	Habitat diversity now	Crop yield last 10 years	Gully erosion increased	No of hotels developed	Paths paved	Littering issue	Landscape/ vegetation visible	LULC Change since last decade
Income	1.000												
Grow own crops	0.47	1.000											
Problems of water supply	0.148*	0.248**	1.000										
Land grazing	0.094	-0.155**	-0.067	1.000									
Habitat diversity in early 2000	-0.126	-0.107	-0.098	0.236**	1.000								
Habitat diversity now	-0.045	-0.053	-0.090	0.443**	0.273**	1.000							
Crop yield last 10 years	-0.173	-0.017	0.072	-0.075	0.166*	0.098	1.000						
Gully erosion increased	0.001	0.185**	0.235**	0.144*	-0.027	0.196**	0.415	1.000					
No of hotels developed	0.040	-0.036	0.198**	-0.027	-0.026	-0.176*	0.098	-0.025	1.000				
Paths paved	0.158*	0.099	0.400**	-0.351**	-0.092	-0.024	0.238**	0.158*	0.033	1.000			
Littering issue	-0.183**	0.147*	0.096	-0.208**	0.049	-0.194**	0.105	0.028	0.085	0.153	1.000		
Landscape/ vegetation visible	-0.006	-0.243**	-0.041	-0.082	0.094	0.099	0.041	0.034	0.042	0.105	0.047	1.000	
LULC Change since last decade	0.091	0.126	0.418**	-0.119	-0.069	-0.122	0.161*	0.096	0.156*	0.348**	0.308**	0.000	1.000

Table 3. Correlation showing the perception of Tourists in study area

	No. of visits	Problems of water supply	Land grazing	Livestock owned	Habitat quality in first visit	Habitat quality in recent visit	Gully erosion increased	No of hotels developed	Paths paved	Littering issue	Landscape/ vegetation visible	LULC Change since last decade
No. of visits	1.000											
water supply	0.245*	1.000										
Land grazing	-0.157	0.217*	1.000									
Livestock owned	0.032	0.164	0.094	1.000								
Habitat quality in first visit	-0.055	-0.075	0.211*	-0.121	1.000							
Habitat quality in recent visit	-0.234*	-0.202*	0.345**	0.031	0.217*	1.000						
Gully erosion increased	-0.177	0.112	0.451**	-0.097	0.315**	0.350**	1.000					
No of hotels developed	-0.092	0.202*	0.033	0.077	-0.006	0.197*	0.060	1.000				
Paths paved	-0.042	0.051	0.061	0.105	0.270**	0.218*	0.123	0.178	1.000			
Littering issue	-0.127	0.067	0.126	0.186	0.382**	0.259**	0.149	0.335**	0.428**	1.000		

	No. of visits	Problems of water supply	Land grazing	Livestock owned	Habitat quality in first visit	Habitat quality in recent visit	Gully erosion increased	No of hotels developed	Paths paved	Littering issue	Landscape/ vegetation visible	LULC Change since last decade
Landscape/ vegetation visible	-0.055	0.100	0.142	0.015	0.195	0.056	0.010	0.106	0.197*	0.320**	1.000	
LULC Change since last decade	-0.118	0.118	0.143	0.207*	0.354**	0.051	0.207*	0.391**	0.243*	0.546**	0.310**	1.000

*Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)

2.2. Outcomes of Focus Group Discussion

All the participants have visited Khaghan-Naran Valley in the last two decades as they could tell their experience based on their visits. When asked about their road journey and the comparison of road conditions with their first visit and recent visit to Naran Valley, some major experiences were shared. Respondent 1 shared: *"……my friends and I visited this area on bike first in 1997. At that time roads were extremely dangerous to travel for people riding in their personal vehicles. They were rocky and even if was difficult for us bikers to travel at that time. But now, roads are carpeted and could be travelled easily without any bumps and heaps."*

Most of the respondents claimed that *"Tourist destinations or stay points have been vastly developed since the last few years with every facility needed for a comfortable stay. In the recent times, hotels with huge accommodation are also available and all types of hotels from 3-star to 5-star hotels are available."*

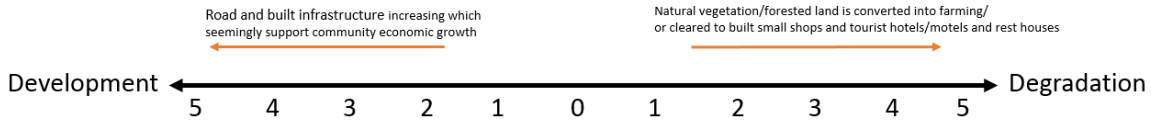
"*Hotels have been increased in number 500 times in the last 20 years*." R7, R8, R2 and R10 added:

"*Since tourists are attracted to this region, huge investments can be seen in the last 5 years in form of international hotel chains. And also, development is going on near river which will in turn loose the actual lure of this region which is its natural beauty*." Responded by R4.

Most of the respondents believed that the level of greenery was much less in their recent visit as it was substituted by the number of hotels and vehicles driving there. As far as greenery is in question, R2 said: "*Forests and greenery was much more previously when it was my first visit. But with the passage of time as there are more people, much of the area is cleared to build hotels, accommodations, and more houses*."

All the interviewees were asked to mark the level of degradation and development over the course of years on a scale from 1 to 10 according to their experience; their observation as given in Figure 2.

Figure. 2 Scalar representation of Tourism's impact in the region



In the study area, degradation was rolling but it became visible now that greater development is eradicating the natural essence of the area. Almost all of the interviewees responded to this as a major factor which was significantly causing environmental destruction. Tourists visit this valley to enjoy and attain peace of mind so most of them were ignorant of climate change. Interviewees (R8) pinpointed this fact that they have visited the valley in almost every season but in their recent visit they get to observe huge change in climatic conditions. In past year's August, the weather in the valley was too pleasant to feel any heat, but this time it was hot just like a city environment.

2.3. Climatic Trend in the Study Area

An inconsistent trend has been observed by the average analysis of the temperature of twenty years. In this study, an increasing and decreasing temperature trend was analysed. Year 2005 received the mean minimum temperature of 10.3℃, while mean maximum temperature recorded in 2010 was 26.5℃. In October 2005, Pakistan faced an extreme earthquake which was the reason no data was recorded in this month.

Rainfall pattern was also following a similar intermittent and unpredictable trend as we have analysed in temperature of 20 years (1996-2015) (Figure 3). The annual mean precipitation of these twenty years was 1667.938mm. A drifting rainfall pattern was calculated in the table below (Table 1). This haphazardness in the 4 time; periods of five years gap in each timeline *e.g.* (1996-2000, 2001-2005, 2006-2010, and 2011-2015) was observed in pre-monsoon, mean monsoon and some changes were also observed in post monsoon period. Mean winter rainfall was at an increasing trend till the third timeline of 2006-2010 which is also the highest mean winter rainfall among all but then a sudden downfall is seen in 2011-2015. A decreasing trend was observed in pre-monsoon period in the months of March-May during 2000-2005 and 2006-2010, but then a sharp increase in seen in the next time period of 2011-2015. Pre-monsoon and monsoon period is the time of year where every area receives plenty of rainfall. As a myth coming from the tourists, that lesser the trees lesser the rain, seems to be true here as validated from the MET data.

Figure. 3 Climate graph (Average mean maximum temperature, average mean minimum temperature, average precipitation) of Kaghan- Naran Valley (1996-2015)

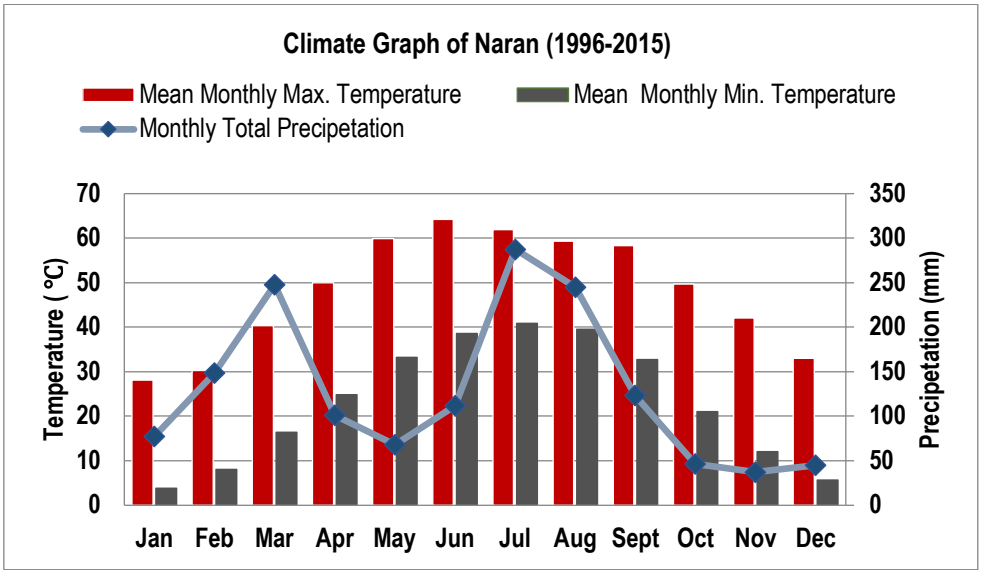


Table 4. Rainfall Pattern in winter and summer periods over 20 years' time span (millimetre)

Year	Average Annual Rainfall (Jan-Dec)	Mean Winter (Dec-Feb)	Mean Summer		
			Pre-Monsoon (March-May)	Mean- Monsoon (June-Sept)	Post-Monsoon (Oct-Nov)
1996-2000	108.3516	61.2468	117.1863	181.095	40.37
2001-2005	118.9533	95.5268	93.6066	195.11	39.80
2006-2010	126.1183	121.75268	90.8464	211.665	32.48
2011-2015	117.53	82.7925	110.9334	180.145	54.3

2.4. LULC Classification

For the current study, eight LULC classes were formed according to the prior knowledge of the study area and reconnaissance field survey which are as follow:

- **Forests**: Includes dense forests in the Valley and all other type of forests in forms of trees growing in patches and canopies.
- **Settlements**: Areas of intensive use which are majorly covered with infrastructures incorporating continuous and discontinuous buildings, including houses of local people, commercial areas (hotels, Naran bazar, small or large shops, etc.), local colonies and mosques.
- **Roads**: Solid concrete pavements for travel with heavy vehicles without any danger. It also includes streets, katcha track, metalled road and un-metalled road.
- **River**: Main water course like River Kunhar, lakes (Saif al Malook etc.) and ponds.
- **Barren land**: Areas stripped off of vegetation natural disasters. Land with eroded soil and top surface soil with no vegetation and no settlements, open lands of no particular use, and totally barren lands with thin layer of soil on steep mountainous areas.
- **Vegetation cover**: Shrubs, grasses, vegetal cover and sparse forests.
- **Agriculture land**: Prominent terraces (areas on the mountainous regions where locals grow their crops)
- **Streams**: Small water courses like streams and nullahs

The Table 5 shows the land use land cover changes detected from the analysis of multi-sectoral spatial imagery.

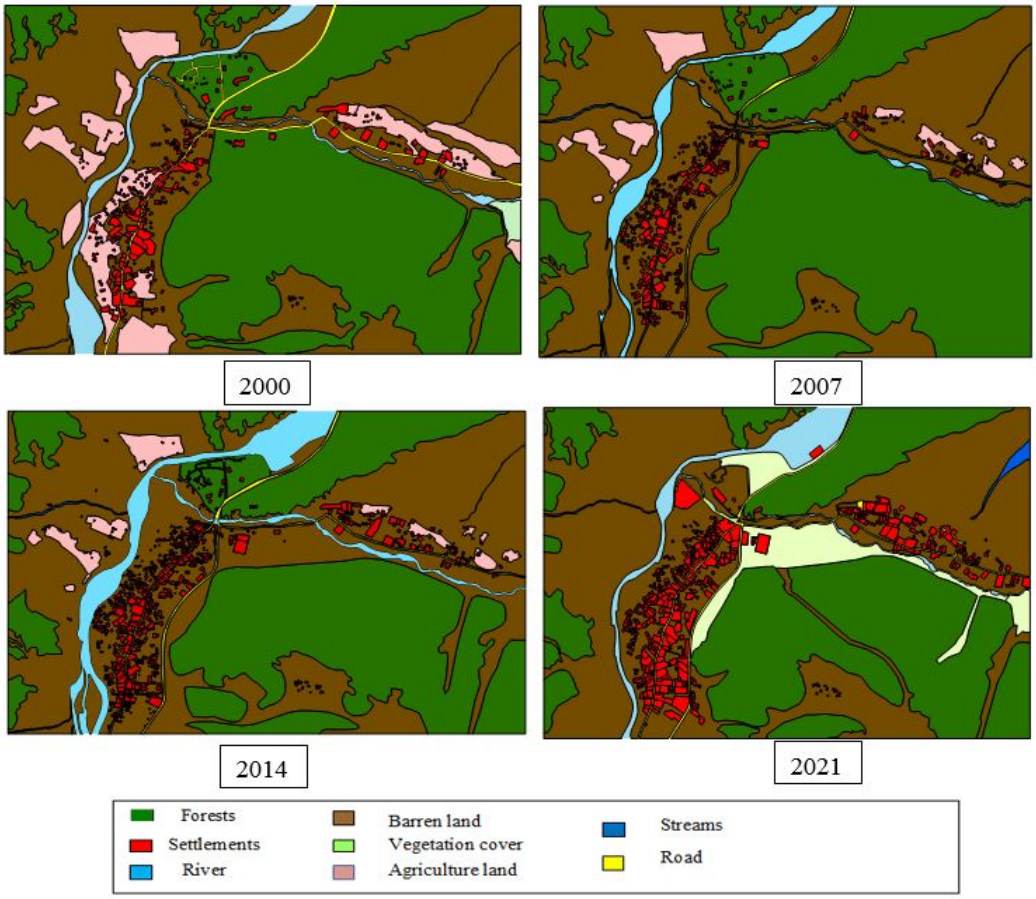
Table 5. Area Calculations and percentage change of each LULC class

LULC Classes	2000		2007		2014		2021		Percentage Change			
	Sq. km	%	Sq. km	%	Sq. km	%	Sq. km	%	2000-2007	2007-2014	2014-2021	Overall 2000-2021
Forests	2.104	41.7	2.220	44	1.936	38.4	1.938	38.4	2.30	-5.63	0.03	-3.29
Settlements	0.127	2.5	0.114	2.3	0.177	3.5	0.334	6.6	-0.27	1.24	3.11	4.09
Roads	0.041	0.8	0.055	1.1	0.063	1.2	0.064	1.3	0.28	0.15	0.02	0.45
River	0.152	3	0.168	3.3	0.246	4.9	0.185	3.7	0.32	1.55	-1.21	0.66
Barren Land	2.180	43.2	2.244	44.5	2.325	46.1	2.030	40.2	1.128	1.59	-5.84	-2.97
Vegetation Cover	0.021	0.4	0.095	1.9	0.168	3.3	0.315	6.3	1.46	1.46	2.92	5.83
Agriculture Land	0.417	8.3	0.141	2.8	0.122	2.4	0.149	2.9	-5.47	-0.37	0.52	-5.32
Streams	0.005	0.1	0.009	0.2	0.009	0.2	0.032	0.6	0.08	0.01	0.45	0.54
Total	5.047		5.046		5.046		5.047					

-ve % = decline in the land class
+ve%= increment in the land class

Table 5 present areas calculated for each land use land cover class and overall percentage change for different years. If we look closely at the area occupied by each class, then increase or decrease over the last 21 years can be visualized. Forest cover decreased over time from 2.104 square km to 1.938 square km. Settlement area in the Valley has increased significantly over the decade from 0.127 square km to 0.334 square km which beamingly claims that development bloomed. Roads were also in better condition now compared to the past extended to 0.064 square km from 0.041 square km. better roads bring more tourism and ultimately more income. Barren land has faced a decrease in this mountainous region. It has reduced from 2.18 square km to 2.03 square km which could be attributed to the increase in the number of hotels, homes, more tourist attraction areas and deforestation since it constitutes the largest portion after forest area.

Figure 4. LULC Maps of Khaghan-Naran Valley



Vegetation cover have dramatically increased over past decade as the area have enhanced from merely 0.021 square km to 0.315 square km now while agriculture land area plummeted from 0.417 square km to 0.149 square km which could probably be because people are shifting their livelihood sources and are no more dependent upon their own grown crops. Lastly, when it comes to water bodies (river and streams), it is increased significantly 0.152 square km to 0.185 and 0.005 square km to 0.009 square km respectively. Percentage change was calculated using a specified formula so that the significant increase or decrease in the LULC classes could be shown evidently (Figure 4). Negative % shows decrease in the land area while positive % explains the increment in the land are over the course of last 21 years (2000-2021). The land use land cover maps of the stated years are shown in Figure 4.

2.5. LULC Change Detection

From the results of the post-classification comparison, the total amount of area increased or decreased in due time is calculated. All the spatial imagery are the visible evidence of the areal changes occurred in all LULC types whose outcomes bring either the expansion or waning of that area between the progressive dates. Statistics and change matrices for periods of 2000-2007, 2007-2014, 2014-2021 and finally 2000-2021, an overall comparison was generated from the classified maps of stated time period for further analysis.

2.5.1 Change detected between 2000 and 2007

In 2000s, forests and barren land constituted the major type of LULC in our study area 41.6% and 43.1% respectively, followed by agriculture land (8.26%), settlements (2.5%), river (3%), roads (0.8%), whereas vegetation cover (0.4%) occupies the smallest area. During this period, agriculture land has declined in area from 41.7 ha to 14.1 ha, viz. 27.6% of the initial area, settlement area decreased by 1.3%, vegetation cover increased 9.5 ha by 7.4%from the primary area while all other LULC classes show increment or decline at different rates. 504.7 ha is the total study area size, barren land covered 210 ha of land in year 2000 which was significantly changed to 224.4 ha showing an increase in area by 6.4 ha while agriculture land decreased by 27.6 ha in 2007 with a negative annual rate of change about 6.9 ha (-16.54%). This is a plausible hypothesis that agriculture land could have been converted to barren land which had an annual increment of 2.9 ha per year.

2.5.2 Change detected between 2007 and 2014

During the next four-year span (2007 to 2014), forest land was significantly due to massive deforestation as barren land was also increased from 224.4 ha to 234.5 ha with 2.53 ha per year annual rate of change. Settlements area enhanced from11.4 ha in 2007 to 17.7 ha in 2014 showing an increment rate of 1.58 ha per year. Agriculture land show a change of 1.9 ha showing a visible decrease in it area while vegetation cover has increased dramatically in this time period 9.5 to 16.8 ha with an annual rate of change calculated to be 1.83 ha per year. Increase settlements gives hints about the population increase which demands more area as it could be the reason forest land area has been reduced as it faces the loss of 7.1 ha per year in this time period. Or forest could have been converted to vegetation cover hinting to the amount of degradation or land deterioration with 19.95% of annual rate of change in 2007-2014. Since we are extracting evidence from these values about level of development, roads are covering more area as it has increased from 5.5 ha to 6.3 ha with a slow and steady rate of development is seen as the annual rate of change is 0.2 ha per year.

2.5.3. Change detected between 2014 and 2021

LULC Change between 2014 and 2021 illustrates that barren land decreased significantly from 234.5 ha (46.4%) in 2014 to 203 ha (40.2%) in 2021. The decline rate of barren land from 2014 to 2021 was projected at 7.88 ha per year, about thrice the rate of change recorded in 2007-2014 and 6 times that of change calculated in time period 2000-2007 (as per table 6 and 5). In 2021, settlements have enhanced exponentially from 17.7 ha to 33.4 ha which shows the level of developmental influence. On the other hand, vegetation cover has increased twice in are then it was recorded in 2014 (12.2 ha) while in 2021 its areal augmentation is 31.5 ha. A small change could be seen in forest area.

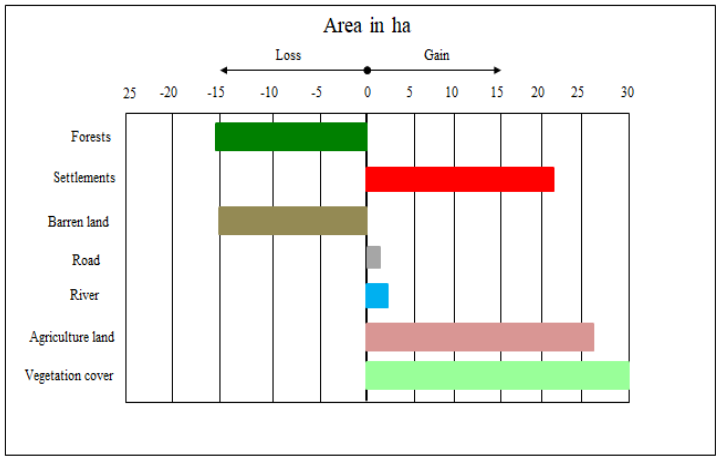
2.5.4 Overall LULC Change between 2000 and 2021

The results in Table 6 illustrate a comparison of overall change that occurred in 21 years from 2000 to 2021 in the study area.

Table 6. Comparison of the annual rate of overall change in 21 years.

LULC Classes	Annual rate of Change 2000-2007		Annual rate of Change 2007-2014		Annual rate of Change 2014-2021		Annual rate of Change 2000-2021	
	ha.year^{-1}	%	ha.year^{-1}	%	ha.year^{-1}	%	ha.year^{-1}	%
Forests	2.9	1.378	-7.1	-3.19	0.05	0.03	-1.29	-0.613
Settlements	-0.325	-41.25	1.58	13.82	3.93	22.18	1.59	12.53
Roads	0.35	8.54	0.2	3.62	0.03	0.4	0.18	4.314
River	0.4	0.701	1.95	11.61	1.53	6.12	0.25	1.67
Barren Land	1.6	0.732	2.53	1.13	-7.88	-3.36	-1.15	-0.53
Vegetation Cover	1.85	88.1	1.83	19.95	3.68	21.88	2.26	107.69
Agriculture Land	-6.9	-16.54	-0.48	-3.37	0.68	5.533	2.06	4.94
Streams	0.1	20	0	0	0.58	13.88	0.21	41.53

Figure. 5 Net loss and gain of each LULC class for the period 2000–2021.



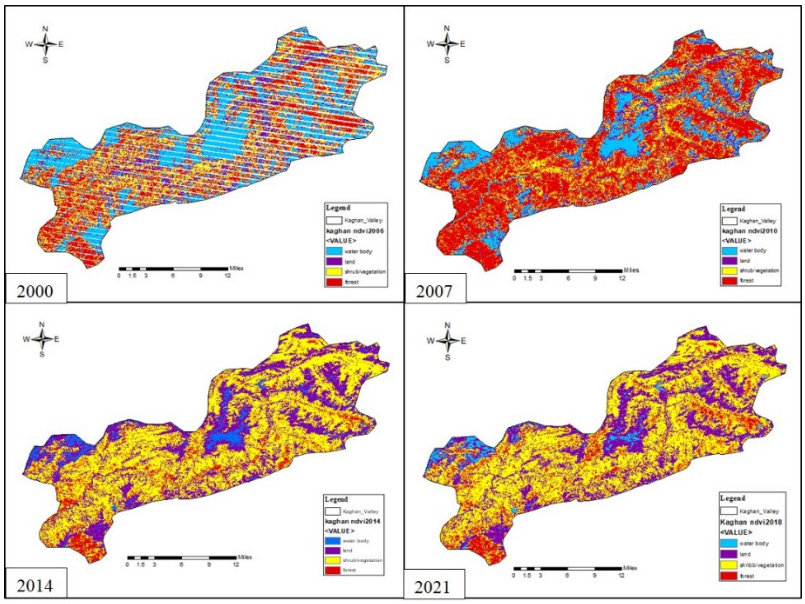
In 21-year, time frame, we can see major changes which may or may not be influenced by external factors. Forest area has seen a drastic decrease in this time span from 210.4 ha to 193.8 ha with a decline in an annual rate of change about 1.29 ha per year. Barren land area has also decreased from 218 ha in 2006 to 203 ha in 2018, with evident decline of 15 ha. Enhancement in settlement and road area is clearly seen from the areal data of LULC maps of all years. This increase in the settlement (12.7 ha (2000) to 33.4 ha (2021)) and road extension (4.1 ha in 2000 to 6.4 ha in 2021) clearly explains that growth and development have done in this area in the last 21 years. This could also be attributed to the economic progress of this area as the level of local as well as foreign tourism is much higher now than the last decade. Vegetation cover shows 15 times rise from 2.1 ha in 2000 to 31.5 ha in 2021 with a positive annual rate of change of 2.26 ha per year. Contrary to this, agriculture land faced a solid areal decline which explains that either the income source shifted from cropping towards over-grazing by livestock, or agriculture land converted to vegetation cover or barren land.

2.6. Vegetation Analysis

Shown below are the NDVI maps of four years of Kaghan Valley using NDVI formula (Eq. 5, 6, 7). For 2000 and 2007, we used LANDSAT 7 satellite images while LANDSAT 8 satellite images were made into use for year 2014 and 2021 NDVI maps. The NDVI extracted from the above maps abides by the values provided in Table 6. Since the index expresses the values from -1 to +1. Negative values were generated from water bodies, clouds, or snow where light reflects back without any deviation with similar intensity as shown by colour blue in the above maps and was clearly at the verge of reduction from 2000 > 2007 > 2014 > 2021. Values closer to zero usually represents bare soils and rocks (very small values like 0.1 or less = empty areas, snow, sand). Such areas are shown in purple in NDVI maps, and this shows the bare lands 2000 > 2007 < 2014 < 2021. Values from 0.2 to 0.3 correspond to shrubs, vegetation and meadows. Above maps shows a subsequent increase in the level of vegetation and shrubs in the last 21 years except in 2007 there is a decrease in this value. The trend observed via NDVI for shrubs/vegetation was: 2000 > 2007 < 2014 < 2021. For dense forests, NDVI gives of a higher value of 0.6 to 0.8 (close to 1) which is a pretty high value as chlorophyll containing rich forest areas gives off

different radiations than any of the above mentioned. A decreasing trend related to forest area was observed in NDVI over the course of 21 years: 2000<2007>2014>2021. This trend coincides with our calculated data for LULC mapping as forest are either cut down to clear the land for the purpose of development or are degraded to such an extent that they are converted to less dense forests or shrub lands or grassland (Figure 6).

Figure 6. Vegetation analysis using NDVI in the study area



3. Discussions

This study emphasizes how tourism at the expense of environment could have deteriorating effects on the host region. Kaghan-Naran Valley receives thousands of tourists from all around the country annually due to its exotic and mesmerizing natural beauty. It also serves as the gateway to the main tourist destinations, including Babusar top, Lake Saiful Muluk, Lulusar, Pak-China border, Dodi Pat Sar and Hunza valley. It was reported that only in Eid holidays about 30,000 to 40,000 tourists flock in Naran and Kaghan Valley (The Nation, 2019), and the number increases tremendously with every passing year. This year (2021), about 0.7 million vehicles were recorded to have entered with numerous tourists in this scenic valley (The News, 2021). Over-tourism could be negatively affecting the locals (culture, environment, education, local resources), despite the income it generates according to the local perceptions of Kaghan Valley Arif *et al.* 2019b). The level of education of the Naran residents was much lower as compared to the tourists according to our survey, as most of them were high school graduates. Low literacy rate and level of awareness could be a reason for their lesser interest in the reduction of their biodiversity. The concept of environmental degradation was also new to many of the respondents who became part of focused group interviews.

The only means of travel to Naran Valley is land transport. Visitors use their own vehicles most of the times, affects the environment during off road drives, causing noise pollution, air pollution, traffic congestion in that small road and increase in total carbon footprint. Impact of carbon emissions from the tourist's vehicles were studied by United Nations World Tourism Organization (2008) revealing that about 5% of total carbon-based emissions were from tourism sector, mainly the land transport (Lemma 2021). Recreational activities, including trekking, hiking, camping, visit to cultural places, etc. are moderately affecting the surrounding environment of the valley by disrupting natural ecosystem, trampling on the plants as explained in a case study of Mauritius, East Africa (Beeharry *et al.* 2021; Giddy and Webb 2016). Waste generation and pollution greatly contributed towards environmental degradation. Tourists display irresponsible human behavior by leaving behind garbage and waste (Naidoo and Burton 2020). Same problems are emerging in Kaghan-Naran Valley as waste was seen on roadsides, at the backend of hotels and also in openly littered near lakes and other tourist points. All the tourists as well as the locals found this issue disturbing as it destroys the view. Moreover, no operative management authority was there to ensure to cleanliness. The solution to this environmental impact of tourism-based activities was presented by Yi & Tsung (2019), according to the evidence from their study in Taiwan was mainly depending upon the responsible human behavior (Juan and Xueyi 2022).

China faced unadorned degradation due to colossal deforestation leading to soil erosion and rendering land useless. A ripple effect has been observed due to increased degradation leading to frequent natural hazards (Wang 2002). Similar degradation patterns were observed in Beijing, China where ecologically valuable land has been degraded as it has experienced intense land use and land cover change (Zhang *et al.* 2007). The results provided an accurate depiction of how the wider environment was affected leading to accelerated rate of degradation. This desertification has led to an increase in saline land.

Our study is consistent with the findings of a Libyan study (Alawamy *et al.* 2020). Sparse forest (vegetation cover) is increased during our study period which is primarily attributed to the shift from dense forest class and agriculture land class (Qamer *et al.* 2016). These evidently explain the deforestation spells occurred in the time period of 2012-2018 leading to lesser firewood for locals. A shift of livelihood, from cropping and grazing herds of cattle and sheep (Rashid *et al.* 2019), to tourism related activities, corresponds with the statements of the interviewees during focused group interviews. Degradation cost was much more than its restoration as a study conducted in India (Mythili and Goedecke 2016), states that about 44% of the land has been degraded due to greater pressures on the natural resources. Similar results were exhibited by Stevens (2003), in his study of tourism-based degradation in Mt. Everest, region of Nepal. According to their study, a complex nexus of tourism growth, waste generation due to huge number of human invasions, deforestation and degradation is existed.

Environmental degradation, community development, tourism interlink in a complex nexus (Stevens 2003), which has not been drawn previously in any study in Pakistan since positive impacts of tourism are highlighted. A lot of tourism-based countries like China, Tokyo (Japan), Singapore and Thailand are facing similar perils. Our study mechanism coordinates with the results of 39 global level correlative studies comparing degradation levels, with several other factors like population pressures, income generation, governance, over-tourism (Vlek *et al.* 2010; Nkonya *et al.* 2013).

In order to promote responsible tourism and to reduce the negative impacts of tourism on areas enriched with forests, a forest policy needs to be strictly implemented similar to that formulated in Turkey (Kuvan 2012). The need of this hour is to formulate a policy similar to UN policy, which highlights the involvement of stakeholders in formulation of a framework for proper management of waste in mountainous regions (Semernya *et al.* 2017). This would be significantly useful keeping in mind the case study on Lake Urmia in Iran, which basically analysed the socio-ecological impacts of tourism on nature (Alipour and Olya 2015). An institutional formulation has the ability to assist nature as well as local community (Heenehan *et al.* 2015).

Environmental sustainability and tourism growth are directly associated with each other. As tourism grows and develops, environmental sustainability increases in accordance with good governance, policies and regulations, in line of work with Azam *et al.* (2018), where on-site and off-site cost of the land were discussed in economic perspective. Rural poverty could be the existing outcome of land degradation causing severe damage to the people frugally. Thus, in order to preserve and sustain the cultural environment and natural diversity around the world, the need of hour is '*eco-tourism'*. Environment is minimally disturbed while adequately entertaining and accommodating the visitors along with sustaining and supporting the native culture where it's operating.

Conclusions

The current study tries to develop a link of how growing tourism is affecting environmental resources in the Kaghan- Naran valley which is a popular destination in northern Pakistan. With the help of local and tourists, an overall impact of tourism in the study area was assessed. Opinions and observations of the tourists as well as locals recorded during focused interviews revealed that the Valley has seen much more growth but losing its natural beauty because of more human invasion and over-tourism. Income sources of the local people have also changed in the last two decades, from growing crops, livestock rearing to selling off their lands for hotels developments, souvenir shops and other tourism related activities. Temperature and precipitation data from the meteorological department provides and insight of the erratic rainfall pattern and increasing trend in temperature. GIS and remote sensing were the most significant tool for mapping of land use and land cover change in our study area. A decline in the area of forest covered area can be observed and increasing trend in barren land is a proof that in the past 21 years (2000-2021) significant degradation has occurred. Drastic decline is the agriculture land from 0.417 square km in 2000 to 0.149 square km dictates that the land has been degraded. While settlement area and road connections are verily increased showing that the significant development took place to support the growing needs of tourists in the region.

Most possible implications of the study involve public policies for resource conservation, against timber mafia, land zoning, extensive grazing by livestock, proper land management and more importantly to nullify risks

of over-tourism. Our study points out an immediate concern, potential risk of degradation can be minimized by developing policies for local and sustainable tourism in the fragile environments.

Acknowledgments: authors are thankful to the local community and tourist of the study area to fully cooperate in the data collection.

Author Contributions:

AY- conducted the field surveys and drafted literature
LS- Conceived the main idea and supervised whole work
FS- statistical analysis and proof reading
MB and SD- carried out GIS based analysis
UR AND MF- conducted the field surveys and helped in writing manuscript.

Data Availability Statement: all linked data is available in the manuscript.

Statement and Declaration

Ethics approval and consent to participate: all the participants of the study were informed through a consent letter about the study objectives before and taken permission to be part of the study. Also, it was informed that their information will only be used for research purposes. Surveys were approved by the ethics review committee of Sustainable Development Study Centre (SDSC) at GC University, Lahore.
Availability of data and materials: All data generated or analysed during this study are included in this published article [and its supplementary information files].
Competing interests: The authors declare that they have no competing interests.
Funding: Not applicable

References

[1] Alawamy, J. S., Balasundram, S. K., Hanif, A. H. M. and Sung, C.T.B. 2020. Detecting and analyzing land use and land cover changes in the region of Al-Jabal Al-Akhdar, Libya using time-series Landsat data from 1985 to 2017. *Sustainability*, 12(11): 4490-4505. DOI: http:/doi.org/10.3390/su12114490

[2] Ali, S.I. and Qaiser, M. A. 1986. Phyto-Geographical analysis of the Phenerogames of Pakistan and Kashmir. *Proc. R. Soc. Edinburgh*, 89: 89-101. DOI: http:/doi.org/10.1017/S0269727000008939

[3] Alipour, H. and Olya, H.G.T. 2015. Sustainable planning model toward reviving Lake Urmia. *International Journal of Water Resources Development*, 31(4): 519-539. DOI:https://doi.org/10.1080/07900627.2014.949636

[4] Arif, A.M., Khan, S. and Samad, A. 2019a. Tourism problems in Pakistan: An analysis of earlier investigations. *WALIA Journal*, 35(1): 122-126.

[5] Arif, A.M., Khan, S. and Samad, A. 2019b. Problems caused by tourism in Kaghan Valley, Pakistan: A study based on local community perception. *Global Social Sciences Review (GSSR)*, 4(3): 284–291. DOI:http://dx.doi.org/10.31703/gssr.2019(IV-III).37

[6] Azam, M., Alam, M. and Haroon, M. 2018. Effect of tourism on environmental pollution: further evidence from Malaysia, Singapore and Thailand. *J. Clean. Prod*, 190: 330-338. DOI:http:/doi.org/10.1016/j.jclepro.2018.04.168

[7] Danish and Wang, Z. 2019. Dynamic relationship between tourism, economic growth and environmental quality. *Journal of Sustainable Tourism*, 26(11): 1928-1943. DOI:https://doi.org/10.1080/09669582.2018.1526293

[8] Foody, G.M. 2002. Status of land covers classification accuracy assessment. *Remote Sens. Environ*, 80: 185–201. DOI: https://doi.org/10.1016/S0034-4257(01)00295-4

[9] Giddy, J. K. and Webb, N.L. 2016. The influence of the environment on adventure tourism: From motivations to experiences. *Current Issues in Tourism*, 21(18): 2132–2146. DOI:https://doi.org/10.1080/13683500.2016.1245715

[10] Goldbulm, C. and Wong, T. C. 2000. Growth, crisis and spatial change: A study of haphazard urbanization in Jakarta, Indonesia. *Land Use Policy,* 17(1): 29-37. DOI: http:/doi.org/10.1016/S0264-8377(99)00043-5

[11] Hastings, D. 2013. Combating Visitor Pressure: Impact of Tourism on the Conservation of World Heritage Sites. Master's Thesis, University of Washington, DC, (15th November 2013). Available at: https://digital.lib.washington.edu/researchworks/bitstream/handle/1773/27123/Hastings_washington_0250O_13213.pdf?sequence=1

[12] Heenehan, H., *et al.* 2015. Using Ostrom's common-pool resource theory to build toward an integrated ecosystembased sustainable cetacean tourism system in Hawaii. *Journal of Sustainable Tourism,* 23(4): 536-556. DOI: https://doi.org/10.1080/09669582.2014.986490

[13] Hoffman, M. T. and Todd, S. 2000. A national review of land degradation in South Africa. The influence of biophysical and socio - economic factors. *J. Southern Afr. Studies,* 26(4): 743–758. DOI:http:/doi.org/10.1080/713683611

[14] Juan, He. and Xueyi, Shi. 2022. Detection of social-ecological drivers and impact thresholds of ecological degradation and ecological restoration in the last three decades. *Journal of Environmental Management*, Vol 318:115-513. DOI: https://doi.org/10.1016/j.jenvman.2022.115513

[15] Kuvan, Y. 2012. Assessing the impacts of tourism on forests: Mass tourism and policy in Turkey. *Environmental Engineering and Management Journal*, 11(8): 1415-1424. DOI:https://doi.org/10.30638/eemj.2012.176

[16] Le, Q. B., Nkonya, E. and Mirzabaev, A. 2016. Biomass productivity-based mapping of global land degradation hotspots. In: Nkonya E, Mirzabaev A, Von Braun J, (eds) Economics of land degradation and improvement-A global assessment for sustainable development, 2nd ed. Springer: Switzerland, Europe, 2: 55–84.

[17] Lemma, A. F. 2021. Tourism impacts: Evidence of impacts on employment, gender, income. EPS PEAKS, UK. Available at: https://assets.publishing.service.gov.uk/media/57a089f2ed915d622c000495/Tourism_Impacts_employment_gender_income_A_Lemma.pdf

[18] Lu, D., Mausel, P., Brondízio, E. and Moran, E. 2004. Change detection techniques. *Int. J. Remote Sens*, 25: 2365–2401. DOI: https://doi.org/10.1080/0143116031000139863

[19] Mythili, G. and Goedecke, J. 2016. Economics of land degradation in India. In: Nkonya E, Mirzabaev A, von Braun J (eds) Economics of land degradation and improvement – A global assessment for sustainable development. 3rd eds; Springer: Cham, 2, 320-345. DOI: https://doi.org/10.1007/978-3-319-19168-3_15

[20] Naidoo, R. and Burton, A. C. 2020. Relative effects of recreational activities on a temperate terrestrial wildlife assemblage. *Conservation Science and Practice*, 2(10): 200-271. DOI: https://doi.org/10.1111/csp2.271

[21] Nkonya, E., *et al.* 2013. Economics of Land Degradation Initiative: Methods and Approach for Global and National Assessments. ZEF - Discussion Papers on Development Policy. 183, Center for Development Research, Bonn, October 2013: pp. 1-41.

[22] Qamer, F. M., *et al.* 2016. Mapping deforestation and forest degradation patterns in Western Himalaya, Pakistan. *Remote Sens*, 8(5): 385-92. DOI: https://doi.org/10.3390/rs8050385

[23] Quarmby, N. A. and Cushnie, J. L. 2010. Monitoring urban land cover changes at the urban fringe from spot HRV imagery in South-East England. *International Journal of Remote Sensing*, 10: 953-963.

[24] Ram, B. and Kolakar, A. S. 2007. Remote sensing application in monitoring and land-use change in arid Rajasthan. *International Journal of Remote Sensing*, 14(17): 3191-3200. DOI:https://doi.org/10.1080/01431169308904433

[25] Rashid, W., *et al.* 2019. Making goat herders as scape goats for high-altitude pasture degradation: a case study of Haripur-Naran pastoral system in northern Pakistan. *The Journal of Animal and Plant Sciences*, 29(4): 953-963.

[26] Schickhoff, U. 1995. Himalayan forest-cover changes in historical perspective: A case study in the Kaghan Valley. Northern Pakistan. *Mountain Research and Development* 15(1): 2-18. DOI:https://doi.org/10.2307/3673697

[27] Semernya, L., Ramola, A., Alfthan, B. and Giacovelli, C. 2017. Waste management outlook for mountain regions: Sources and solutions. *Waste Management and Research*, 35(1): 73-117. DOI:https//:doi.org.10.1177/0734242X17709910

[28] Shahzad, L., *et al.* 2019. Does livelihood vulnerability index justify the social-economic status of mountainous community? A case study of post-earthquake ecological adaptation of Balakot population. *Applied Ecology and Environmental Research*, 17(3): 6605-6624. DOI: http://dx.doi.org/10.15666/aeer/1703_66056624

[29] Singh, A. 1989. Digital change detection techniques using remotely sensed data. *Int. J. Remote Sens*, 10(6): 989–1003. DOI: https://doi.org/10.1080/01431168908903939

[30] Stevens, S. 2003. Tourism and Deforestation in the Mt Everest Region of Nepal. *The Geographical Journal*, 169(3): 255–277. DOI: http://www.jstor.org/stable/3451451

[31] Stewart, N., Thomas, R. and Schauer, M. 2015. Introduction In: Stewart N (eds) The value of land: Prosperous lands and positive rewards through sustainable land management, 2nd eds.; Bonn: ELD Initiative, 1: 8–23. Available at: www.eld-initiative.org

[32] Tucker, C. J., Dregden, H. E. and Newcomb, W. W. 1991. Expansion and contraction of the Sahara Desert from 1989 to 1990. Science 255: 299-301. DOI: https://doi.org/10.1126/science.253.5017.299

[33] Turner, B. L. and Meyer, W. B. 1995. Global land use and land-cover change: an overview. In: Meyer W and Turner BL (eds) Change in land use and land cover: A global perspective, 2nd ed.; Cambridge University Press: Cambridge, UK, 3: pp. 3-10. DOI: https://doi.org/10.2307/2996094

[34] Vlek, P. L. G., Le, Q. B. and Tamene, L. 2010. Assessment of land degradation, its possible causes and threat to food security in Sub-Saharan Africa. In: Lal R., Stewart BA (eds) Advances in soil science: Food security and soil quality, 2nd eds. CRC Press: Boca Raton, 57 – 86. DOI:10.1201/EBK1439800577-c4

[35] Wang, Y. 2002. Environmental degradation and environmental threats in China. *Environmental Monitoring and Assessment*, 90(1-3): 161–169. DOI: https://doi.org/10.1023/b:emas.0000003576.36834.c9

[36] Watson, H. D. 2015. (eds). Gazetteer of the Hazara District. Under the Authority of the Northwest Frontier Province Government. 1(A), London. Available at: https://ia601605.us.archive.org/16/items/in.ernet.dli.2015.31463/2015.31463Gazetteer-Of-The-Hazara-District-1907.pdf

[37] Yi, H. L. and Tsung, H. L. 2019. How do recreation experiences affect visitors' environmentally responsible behavior? Evidence from recreationists visiting ancient trails in Taiwan. *Journal of Sustainable Tourism*, 28(5): 705–726. DOI: https://doi.org/10.1080/09669582.2019.1701679

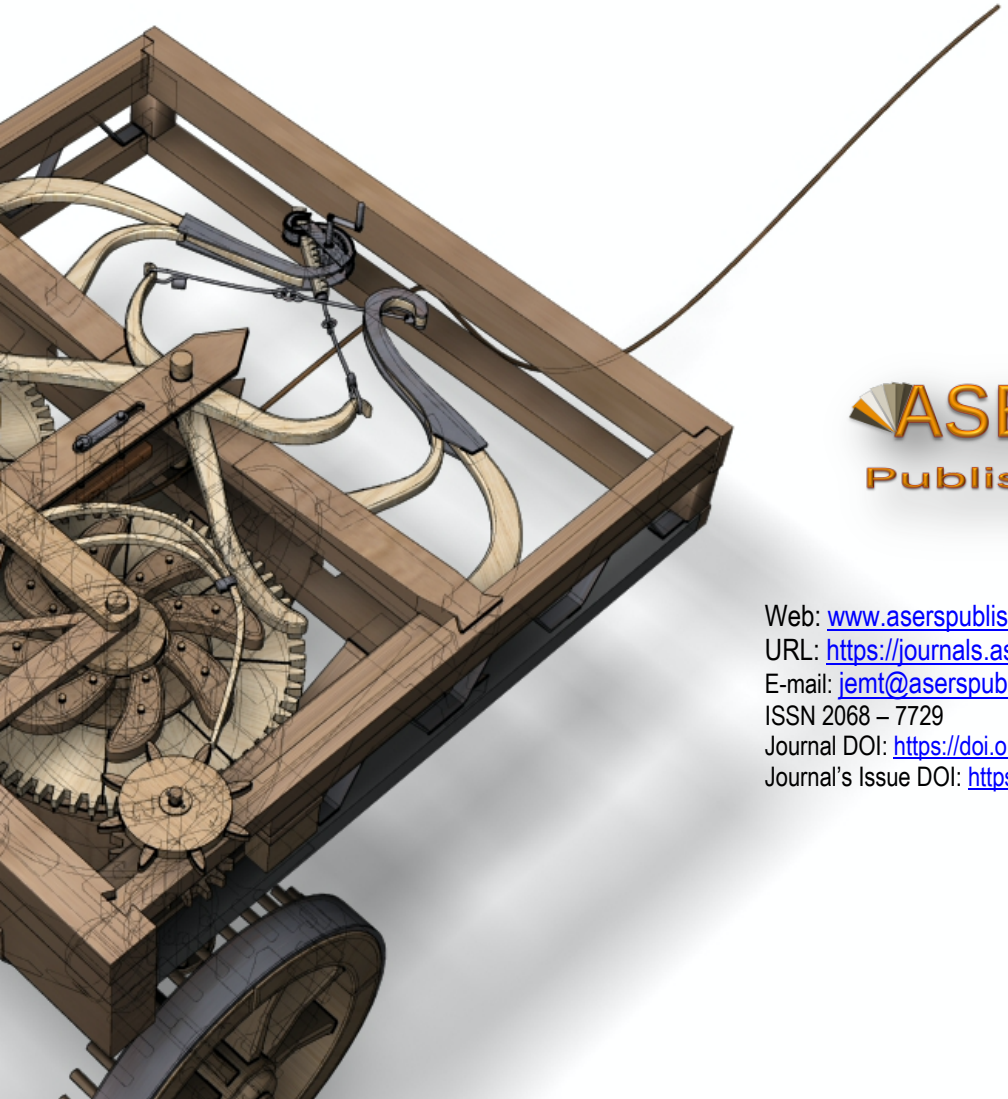
[38] Zhang, K., *et al.* 2007. Land use change and land degradation in China from 1991 to 2001. *Land Degradation & Development*, 18(2): 209–219. DOI: https://doi.org/10.1002/ldr.757

[39] The Nation. 2019. 40,000 tourists visited Naran, Kaghan. Available at: https://nation.com.pk/10-Jun-2019/400-000-tourists-visited-naran-kaghan

[40] The News. 2021. Kaghan Valley receives high number of tourists. https://www.thenews.com.pk/print/868524-kaghan-valley-receives-high-number-of-tourists

[41] UNEP. 2007. Global Environmental Outlook GEO-4, UN Environment Programme, Nairobi. Available at: https://www.unep.org/resources/global-environment-outlook-4 (20th October 2020)

ASERS



Web: www.aserspublishing.eu
URL: https://journals.aserspublishing.eu/jemt
E-mail: jemt@aserspublishing.eu
ISSN 2068 – 7729
Journal DOI: https://doi.org/10.14505/jemt
Journal's Issue DOI: https://doi.org/10.14505/jemt.v14.3(67).00