A GIS based Conservation Status Assessment of Wild Medicinal Plants in Pakistan

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FINAL APPROVAL

It is certificate that we have read the thesis titled as "**A GIS Based Conservation Status Assessment of Wild Medicinal Plants in Pakistan**" submitted by Ms Hareem Ehsan and it is our judgment that this project is of sufficient standard to warrant its acceptance by the International Islamic University, Islamabad for the M S Degree in Environmental Sciences

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DEDICATION

My work is dedicated to my dearest and beloved ***Mother***

DECLARATION

I hereby declare that the work presented in this study is my own effort, except where otherwise acknowledged and that the report is my own composition No part of this thesis has been previously presented for any other degree

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LIST OF ABBREVIATIONS

AJK- Azad Jammu and Kashmir

ENT- Ear, Nose and Throat

GIS- Geographic Information System

KPK- Khyber Pakhtunkhwa

LAT- Latitude

LONG- Longitude

NIPS- National Institute of Population Studies

SRS- Satellite Remote Sensing

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(January, 2017) Hareem Ehsan

Abstract

The present study was conducted to review the conservation status of wild medicinal plants in Pakistan through Geographic Information System (GIS) in different areas of Pakistan A database on conservation status of wild medicinal plant species was generated by extracting relevant information from peer reviewed articles (n=550) from the year 1982-2012 The database comprised of 431 plants variously categorized as extinct, critically endangered, endangered, threatened, rare, vulnerable, exploited and extensively usedwild medicinal plant species The database is expected to be helpful in evaluating the conservation status of wild medicinal plant species with reference to their area of occurrence along with associated information such valid name, local name, habitat, time frame, medicinal and commercial value The study noted that the northern portion of Pakistan is the area needed to be addressed regarding the conservation status of wild medicinal plant species It was revealed that out of 431, 59 were found to extinct, 5 were critically endangered, 149 were endangered, 50 had got the status of vulnerability, 103 were recorded as threatened, 2 wild medicinal plant species were being extensively used by the local people and 15 were being exploited at their locale The factors behind their present conservation status were mainly related to anthropogenic activities such as deforestation, over exploitation, habitat degradation, environmental changes, over grazing, illicit smuggling of trees, introduction of new species (sometimes invasive), and unskilled methods of collection The study is helpful to identify the areas of Pakistan where conservation of wild medicinal plant species needs to be initiated on priority basis GIS mapping is beneficial to target the high risk areas at broader level

INTRODUCTION

1.1 Importance of Flora

Plants are globally characterized as an essential part of the world's biological diversity and considered as a vital resource on earth Plant itself or any part of it can be defined as a plant resource having any kind of actual or potential importance to people This importance of plants varies from small number of plants used as crops fulfilling the basic requirements of people dependent on them to millions of medicinal plants having countless economic and cultural value, providing shelter, food, clothing etc to the people living around the world Plants are meant to be an important element of earth as they maintain natural environmental system by cleaning the earth's atmosphere through photosynthesis thus stabilizing the whole ecosystem This ultimately helps human as well as the animal life on earth According to a study the total number of plants on earth is not clearly defined but according to an estimate the total number of vascular plant species ranges from 300,000 to 320,000 (Prance *et al*, 2000)

Plants provides variety of services like medicine, fuel, fodder, timber, food, shelter and are characterized as a vital role in world's sustainability It is worth mentioning here that for the well-being of all humankind and for betterment of live hoods, the presence of vigorous ecosystem cannot be denied (Western, 2001, Woodruff, 2001) Plants also play an important role in prevention of natural disasters like they reduce the severity of floods, helps in preventing landslides, reduces soil erosion, avalanches, wind erosion and prevents the siltation in dam and reservoirs (Shah, 2008)

Nowadays global warming is the hot issue being discussed throughout the whole world It is continuously affecting the natural pattern of cropping causing severe famine especially in under developed countries Plants are contributing their part in the reduction of global warming by their natural balancing system They not only helps in lowering the global

temperature but also helps in maintaining the sea level which a serious threat to many European countries these days Plants not only provide food for survival, habitat for birds and animals, provide fuel and fodder but also own biological information, preserve folk heritages and have indigenous information (Ahmad *et al* , 2012)

1.2 Importance of Wild Medicinal Plants

Medicinal plant is defined as a plant which holds any active chemical ingredient having a particular remedial functional response in the treatment of different diseases in human beings and animals in any of its part like leaves, rots and stem (Humayun*et al* , 2006) Medicinal plants are always being used by human being from past many years as natural remedy at home for curing different types of diseases Usage of medicinal plants as a natural therapy in order to treat ailments is being done in almost all parts of the world (Heinrich, 2003, 2005, Abella et al , 2000, Bodeker et al , 2005)

Plants have been used by the human beings for treating and preventing several ailments from several years Plants are being treated as medicine in two ways in the world, one is traditional medicine (includes herbs, shrubs and other in the western pharmaceutical industries Pakistan, China, India, Thailand &Srilanka are those countries which use the traditional medicine (Nwachukw et al, 2010) Medicinal plants contain bioactive substances such as flavonoids, carotenoids, vitamins, quinones, anthraquinones specially in roots, proteins, essential oils, carbohydrates, lipids, phenols, saponins, reducing sugar, tannin and organic acids (Bharati&Bansol, 2014) Medicinal plants can also be used in perfumes and cosmetics as flavoring agents, in food stuff, biological and pharmaceutical agents (Craig, 1999)

Mankind has been used medicinal plants in order to cure different ailments and to get relief from body pain and illness from the earliest times The knowledge of plants being used a remedy for treating diseases has been resulted from practicing and was based on assumptions and misconceptions (Humayun*et al* , 2006) In earlier times, use of plants was restricted to

food, medicine and shelter but from the passage of time the dependency on plants has been increased as local people kept on exploring them (Ali *et al* ,2003) The major uses of medicinal plants for treatment of diseases has been observed in tribal areas which are normally situated far away from the cities and are devoid any kind basic health facilities People living in tribal areas are more dependent on medicinal plant resources form many years ago because this knowledge comes from their ancestors and based on experiences They are basically poor people who are not financially sound to afford expensive medicines for treating their illness (Shinwari and Khan, 1998)

The use of herbal remedies possesses a significant position from the early times till the present years The pharmacology of use of plants as medicines is very old The record of first herbal medicine was originated between 4500-1600 BC which turns into Ayurveda between 2500-600BC. The system gets its foundation from Greek medicine, later adopted by Arabs which then extended to Europe and India It has been recorded that about 80 % of total world's population depends upon traditional health care system (Shah 2006)

According to a study it has been observed that 70% of the world's population is using herbal remedies for curing diseases through their traditional practitioners and approximately 20, 000 plant species are used for medical purposes throughout the whole world (World Health Organization report, 2002) A survey conducted by WHO revealed that 60% population of Indonesia is being treated by the traditional healers, 65% in Sri Lanka, 75% in Nepal, 85% in Mayanmar, 80% in India The highest percentage is being found in Bangladesh i e 90% In Pakistan the trend is little lower and only 60% population depend upon the treatment prescribed by the Hakims (Humayun*et al* ,2006) In developed countries like USA, Australia, France and Germany, the use of traditional medicine is decreased by 40-50%, 42%, 48%, and 49% respectively because of the dependence on allopathic medicines or unavailability of wild medicinal plants (Titz, 2004)

Pakistan is rich in its medicinal flora which is being distributed over a large are due to the diverse climatic conditions present here(Murad *et al*., 2011) Due to its varied ecological zones, Pakistan is blessed with variety of herbs, medicinal and aromatic plant natural resources Medicinal plants are abundantly found in mountain region as compared to plain areas It has been estimated that out of 400-600 medicinal plants, 5700 exists in Pakistan (Khan *et al*., 2005) Only 600 plant species are documented and being used for medicinal purposes out of 5521 identified species Majority of the people living in Pakistan especially in tribal areas depends upon medicinal plants for curing most of their diseases (Murad *et al*., 2011)

It has been observed that ethnobotany in Pakistan is a hot issue and there is a severe need of identification, documentation, and application of this ethnobotanical knowledge (Shinwari,1996)

1.3 Need for Conservation

Plant resources constitute the ingredients which are having medicinal and forage values and are important for survival (Morgan, 1981) It has been observed that there is a strong need of conservation of indigenous knowledge associated with medicinal plants because when a plant species has been lost from an area, then the information associated with it will also be slowly becomes vague or completely vanished Therefore the proper identification and documentation of medicinal information and conservation of plant species, both are basic issues need to assess on time (Cunningham, 1996)

The issue of conserving medicinal plants should be addressed at a global level and an urgent action should be required at regional level The role of medicinal plants is very important in an environment because they can be helpful in involving people in the conservation of natural habitats (Schopp-Guth and Fremuth, 2001)

According to a study, it has been observed that wild medicinal plants are continuously disappearing as they are under severe threat because of high poor's dependency on natural resources, habitat fragmentation, urbanization and increase in human population (Western, 2001, Woodruff, 2001)

Plants play a significant role in the natural ecosystem as they are important part of global biological diversity Different threats have been faced by these plants like over exploitation of available resources, introduction of new species, habitat loss and degradation, pollution and diseases and change in climatic conditions (Sudhersan*et al* , 2003)

Factors affecting the conservation status of plant species include deforestation, breeding success rates, extent of grazing and fuel demand etc Sustainable management practices, beginning with establishment of databases, social organizations, building management capacity, range management initiatives, agriculture development and cottage industry programs shall be required for the conservation of medicinal plants within an area (Ahmad *et al* , 2009)

According to ecological perspective, Pakistan has 410 endemic species and 200 are meant to be threatened out of total 600 plant species (Adnan *et al* , 2006, Sher & Hussain, 2009, Sher *et al* , 2004) Due to over exploitation of natural resources, un-planned urbanization, population expansion and deforestation are the major factors threatening the plant biodiversity (Khan and Hussain, 2012) It has been reported that a a very limited knowledge is available regarding the threatened plant species of Pakistan and no significant work has been on it so far (Alam and Ali, 2009) It has been estimated that approximately 580- 650 flowering plants are expected to get threatened in near future (Nasir, 1991)

Hot spots of Pakistan are extended over 13 regions from mangrove forests to alpine pastures Flora which is endangered in Pakistan is more than 10% (Shinwari*et al* , 2002) The increase in endangered medicinal plant species is due to lack of management practices, population

expansion, poverty, bad quality natural resources, lack of land use plans and failure of social institutions About 709 endangered species are endemic to Pakistan which is nearly 37% of the total species (Chaudheri, 1991, Qureshi, 1991) According to another study it has been recorded that total 600 species are endemic to Indo-Pakistan (Shinwari*et al*, 2002) Medicinal plants abundance has been threatened due to their over harvesting for commercial and their chemical analysis The country on the whole has serious issues with the loss of plant diversity Major factors incudes deforestation followed by the heavy grazing by domestic livestock and unsustainable uses of resources available (Scakali, 2008)

1.4 Helpful Methods of Conservation

In the historic era, people living in the tribal areas worked on the protection of plants and ecosystem through their own have formulated and planned traditional conservation method based on their cultural tradition and local information system Drastic population growth and economic development have already destroyed the natural habitats to a significant extent (Shinwarietal , 2000)

1.5 Application of GIS

GIS emerged as major change in the cartography pattern in 1970 to 1980 GIS is defined as a "system based knowledge that captures, stores, manages, interprets and displays geographic data" GIS is used to collect and store data that is required and best suited for management and interpretation of environment (Aspinalls Pearson, 1995) It includes the data regarding digital maps, locations, organizations, institutions, computer hardware and software for the collection, storage, interpreting and presenting the geographic information about the earth (Nyerges*et al*, 1993) Scientist's ability has been improved to a greater extent due to advancement in area of GIS and remote sensing and also helpful in describing the designs in nature over changeable spatial scales and levels of details (Carpenter*et al*, 1993)

Biodiversity distribution mapping has gained importance in the area of scientific research through cyber infrastructure

Science has been originated in the 18th century or earlier than that from the work of naturalist/botanists Majority of these scientists were the travelers on exploration trips and their work came out to be blend of Botany and Geography In order for conservation mapping and assessment of vegetation, there should be strong correlation between environment and vegetation

In order to achieve successful vegetation mapping, identified classification units, processes and assessing landscapes in terms of their vegetation models are required (Graham and Hijmans, 2000, Hirzel and Lay, 2008, Parlo*et al* , 2008, Schreoder*et al* , 2007, Guisan and Zimmermann, 2000, Thuiller*et al* , 2009, Zimmermann *et al* , 2007)

Despite having undesirable importance, many plant species are under threat, especially endemics or those having local use value are more prone to extinction (West, 1993) Therefore it is necessary to locate the physical location either actual or potential where these species could be found and such information is helpful in many aspects of environmental research, resource management and conservation planning (Franklin, 2010) The application include biological reserve design, habitat management and restoration , biodiversity assessment, species and habitat conservation plans, environmental risk assessment community and ecosystem modeling , invasive species management, population viability analysis and predicting the effects of global environmental change on species and ecosystem (Burgman*et al* , 2005)

The main objectives of the study included

- To develop a database containing useful information regarding medicinally important plants in different regions of Pakistan
- To identify the current status of wild medicinal plant species in Pakistan

- To recognize the high risk areas in terms of conservation status by using GIS based assessment
- To explore major threats to wild medicinal plants especially in the high risk areas

METHODOLGY

The objective of the study was to generate a database of medicinally important plants and their conservation status in Pakistan The database generated is supposed to be helpful in documentation of area wise conservation status of wild medicinal plants along with their medicinal and commercial values

2.1 Study Area: Pakistan

2.1.1 History

Pakistan appears on the map of the world as a separate nation on August 14, 1947 Before partition, the subcontinent was ruled by the British Empire. Foundation of Pakistan was laid very earlier when the Muslims of the subcontinent realized the necessity to form a party that could signify and protect their basic interests This idea gave birth to All-India Muslim League in 1906 This party was purely formulated for the benefits of Muslims of subcontinent and its hard work resulted into the resolution passed on March 23, 1940 which is now called Resolution of Pakistan Pakistan constitutes the land which has approximately 4000 year history such as Mohen-jo-Daro and Harrapa Pakistan is ruled by the Muslim leaders from central Asian countries and Afghanistan from the 12th to 17th century (National Institute of Population Studies (NIPS) and Macro International Inc , 2008)

*2.1.2*Location& Extent

Pakistan is geographically located between 24^{0}- 37^{0} N latitude and 62^{0}- 75 E longitude in the western zone of South Asia occupying an area of 80843km (Salma *et al*, 2012) Pakistan possesses a unique geo-strategic position in the region as it is located on the map India in the east, China in the north, Afghanistan in the west and Iran in the south-west (Shaw, 1998) Pakistan lies in subtropical region stretching from Himalayan ranges in the north and ArabianSea

in the south Its breadth is about 885 km and elongation is almost 1600 km Pakistan has four provinces, Punjab, Sindh, Khyber Pakhtunkhwa and Baluchistan. Total area covered by Punjab is 205345km^2 Sindh is 140914km^2 Khyber Pakhtunkhwa is 74521 km^2 and Baluchistan is 347190 km^2 (Pakistan Bureau of Statistics)

Fig 2.1 Location map of Pakistan showing its neighborhood (source: Google maps)

2.1.3 Physiography

Pakistan lies on the western corner of Indus Gigantic plains Himalaya and its branches are extended to the north western, northern and north eastern sides The mountainous area of eastern and southern sides is covered by plateau, deserts and Indus Plain The diversity in physical features can be briefly described as follows (Khan, 1995, Stibig*et al* , 2007)

a) The Mountain Region

- Mountains of western and north western sides

- Mountains of northern and north eastern sides

b) Plateaus of Pakistan

- Potwar plateau and Salt Range
- Baluchistan plateau

c) Plain areas of Pakistan

- Upper Indus plain
- Lower Indus plain
- The Indus Delta
- Western Indus

d) Deserts of Pakistan

- Desert of Cholistan
- Desert of Thar
- Desert of Thal
- Deserts of Chaghi and Kharan

About 59% of the total landmass is covered by mountains and plateaus whereas plains and deserts form rest of the country

2.1.4 Demography

Pakistan was considered to be the 14th most populous country in the world in 1951 and its population was 32 5 million It has been recorded that the population is increasing day by day and has reached to 184 5 million in 2012-13 thus making it the sixth most populous country in the world According to an estimate the current population rate of Pakistan is 2 percent Due to

this rapid growth in population it will become the fifth most populous country in 2050 (Government of Pakistan, 2013)

2.1.5 Climate

The geographical location of Pakistan is in such a way that it lies in one of the key climatic areas of the earth Climatically Pakistan belongs to largely arid and semi-arid region However there wide physiographic, altitudinal and geographic variations from the tropical coast in the south to the high mountains in the north Rainfall ranges from less than 50 mm in arid and semi-arid to 2000 mm in moist areas of the Himalayas annually In summers direction of winds are form south-west to north-east and in winters form north-east to south-west Climate of Pakistan comes under a more typical monsoon regime than other parts of the sub-continent In most parts of the country rainfall is insufficient and due to its variable nature, its usefulness for agriculture has reduced It efficiency has also been reduced because of being evaporated due to is occurrence in hot summer

Seasons of Pakistan can be segregated in to four major sub divisions, the duration from mid-December to March is called as cold weather season, from April to June is called as hot weather season, duration from July to September is called as monsoon season and from October post monsoon season has started which prevails till December Cold weather season is normally characterized by low temperature and high barometric pressure with small precipitation High temperature and drought are major features of hot weather season Temperature rises as the summer season begins and reaches at its peak in May and June The highest temperature is recorded in Jacobabad i e 126^0 F in May and 127^0 F in June The start of monsoon season in May is because of the winds comes from the Indian Ocean due to building up of low pressure It gains strength in in July, remains constant in August and then comes to an end In some years due to

climatic disturbances the monsoon season remains active in September The period that comes right after monsoon is the temporary period between the cold conditions and the monsoon regime In October maximum temperature ranges from 94^0F to 99^0 F and falls further to about 10^0 F in November This period is normally characterized as drier period of the year because the lack of any active wind system

2.1.6 Hydrology

Pakistan is an agriculture country therefore availability of water for agriculture purposes has always been of key importance to it Indus system includes the following five rivers, Chenab, Ravi, Jhelum, Sutlej and Beas and these rivers are the major tributaries of Indus system Almost all agriculture in Pakistan depends upon its river system. Sutlej and Beas combined near Harike in India before entering Pakistan

The vast seasonal monthly fluctuations affect the volume of water in these rivers The volume of water is less in winter and gradually increases with the start of summer mainly because melting of snow in the mountain areas

The volume of water Jhelum and Chenab remarkably increases after March and later comes to the eastern rivers The major supply in the Indus system is from the two large groups of glaciers, the Hindu Kush and the Karakoram The great increase in flow of water is associated with the approach of rainy season in the end of June or start of July This high then terminates in September in Jhelum but continues in for another month in the eastern rivers Floods mostly occur in western rivers in early part of the rainy season and later in the eastern rivers

It has been observed that 60% of the Indus system flow is rigorous in the three rainy months Therefore to regulate this flow and to reduce the risk of floods and provision of more water for the irrigation purposes, there is a great need to make reservoirs and dams

2.1.7 Mineral Resources

Pakistan is rich in mineral resources and coal is one of the major mineral produced Coal produced here is of low quality, and its age ranging from 50 to 60 million years and occurs in lower tertiary sequence Its thickness varies from few inches to few feet and its seams are normally lenticular Pakistan has three major coal fields Salt range and Makarwal Coal fields, Baluchistan coal fields and Sindh coal fields The uses of coal are mainly found in the ceramics industry, ginning mills, brick and lime burning, and briquetting plants and for firing the boilers of power stations and steam engines Coal is also found in other localities but, because of the inferior quality of deposits, mining is uneconomical

2.1.8 Importance of Flora

Pakistan is blessed with variety of plants which have economic importance These are the plants that are important for food, medicine, timber, shelter etc Unfortunately, there was no proper documentation available on which could deal with all the plants of the country when Pakistan came into being "Flora of British India" (1872-1897) by J.D Hooker was the only book available and it was 75 years old at that time Furthermore, it did not cover the whole Pakistan Some of the important areas of Baluchistan and most of North West Frontier Province were not taken into account The method of plan collection in Pakistan was started early from 1820-1822 The person who was involved in collection was W Moorcroft and he collected plants in Ladakh and Kashmir V Jacquemont was the next who collected plants in Punjab and Kashmir in 1828-

1832 The first document of Flora of Pakistan was published in 1970 215 families of plants have been published till now which involves 139 genera and 4758 species (Ali S, 2008)

2.2 Data Acquisition

Data has been collected through research papers, research journals, published reports, and research thesis Total of 566 research papers, published reports and research thesis were studied to develop an inventory for the status of wild medicinal plants in Pakistan

2.3 Data Processing

The acquired data processing was compiled by extracting possible available information form the published literature e plant species name, conservation status, local name,date of publication, medicinal and commercial value and reference In order to generate a database, following additional information was also considered which includes latitude and longitude of the area from where plant species belongs, valid name of a plant species and its habitat Following eight categoriesextinct, critically endangered, endangered, threatened, rare, vulnerable, exploited and extensively usedwere identified on the basis of conservation status and medicinal and commercial values of plants

Extinct Species

A species is considered to be extinct if it is no longer available in the wild or in confinement An extinct species can never be found on earth again The major factors in species extinction include habitat destruction and over exploitation (Anonymous 2)

Critically Endangered

A species which is at a critical level of extinction is defined as "Critically Endangered" species Loss of habitat, over grazing, manmade activities, introduction of new species and population expansion are few of the major factors of species becoming endangered (Anonymous 6)

Endangered Species

A species which is in severe threat of extinction in future is defined as an "endangered species" Loss of habitat, over grazing, manmade activities, introduction of new species and population expansion are few of the major factors of species becoming endangered (Anonymous 1)

Threatened Species

Animals and plant species which are found to at high risk of extinction are termed as "Threatened Species" The major reasons of species getting threatened include habitat degradation, introduction of new taxa, pollution and diseases and climatic variations (Anonymous 5)

Rare Species

Any species which is very uncommon earth is termed as "rare species" Majority of the rare species are considered to be threatened, because they face the threat of quick population decline and cannot be able to recover rapidly from these changes (Anonymous 3)

Vulnerable Species

A species which is at the urge of being endangered is called a "Vulnerable species" Decline in population and habitat loss are the major factors behind species vulnerability (Anonymous 4)

Exploited Species

Exploitation is the over use of any kind of species by people for food, shelter, pets, medicine, and may other purposes (Anonymous 7)

Extensively Used Species

Species which are being used in an excessive manner are termed as "Extensively Used" species The main factor behind are the benefits associated with these species

2.4 Inventory of Medicinal Plants

Keeping in view the importance of medicinal plants, an inventory has been established showing location, habitat, significance and importance of plants

2.5 GIS Based Transformation of Inventory into Maps

After inventory and detailed aspects of the medicinal plants are generated, a GIS based representation of medicinal plants was given This makes use of Arc Map 10 software for processing The maps were generated on the basis of categories derived

2.6 Problem Statement and Significance of Study

Pakistan is blessed with variety of medicinal plants species that are widely spread throughout the country Pakistan's unique climatic conditions and variety of ecological zones helps in flourishing and development of these plant species Unfortunately, the expensive medicinal plant species are lost at an alarming rate because of lack of management practices, conservation methods, handling and involvement of unskilled labor, timber mafia, deforestation, environmental factors like soil erosion, water logging etc Due to the above mentioned factors the medicinal plant species are being lost with the useful indigenous knowledge

The present study will be an effort to identify the current status of wild medicinal plant species in Pakistan The study will focus on the identification of high risk areas by using Geographic Information System (GIS) technologies The study will also provide an insight from where the conservation has to be initiated by clearly identifying the areas though GIS maps

RESULTS AND DISCUSSION

3.1 Conservation Status of Wild Medicinal Plants

Pakistan is blessed with different variations of ecological zones and captivating plant species Many of these plants possess medicinal and economic values and the local people of rural areas are very well aware about their uses for the past several years Out of all these medicinal plants, many of them are being exploited commercially for the extraction of various types of active ingredients like vincristine (used to treat cancer), flavonoids (anti-inflammatory and antiviral actions), minerals, phenols (treat infections) and tannin (Qureshi *et al*., 2008) It has been estimated that approximately 80% of the population settled in the rural areas rely on the local herbal medicines (Ahmed, 1999) According to an estimate the percentage of total world population is 70-80%, who depends upon the herbal medicines for curing their medical illness (Fransworth and Soejarto, 1991)

The present study revealed that conservation status of wild medicinal plants in different areas of Pakistan fall under following eight categories viz., extinct, critically endangered, endangered, threatened, rare, vulnerable, exploited and extensively used medicinal plant species It has been found that 149 medicinal plants are endangered, 59 are extinct, 48 are rare, 50 are vulnerable, 103 are threatened, 15 are exploited, 2 are extensively used and 5 are critically endangered

3.2 Extinct Medicinal Plant Species of Pakistan

The results revealed that there are total 59 wild medicinal plants which fall under the category of extinct medicinal plants of Pakistan Large numbers of extinct medicinal pant species are found in **Azad Jammu and Kashmir** like *Cedrus deodara, Abie spindrow, Picea smithiana, Taxus wallichiana, Bauhinia variegate, Cordia obliqa Wild, Juglans regia* These extinct medicinal plants in AJK are mainly used for their medicinal properties like skin problems, stomach and

intestinal disorders, neurological and muscular problems Commercial properties of these plants include fuel wood, fodder species and furniture making

Same numbers of extinct medicinal plant species are found in **Kaghan, Thandiani, Swat, Buner, and Chitral** including *Colchicum luteum, Pimpinella stewartii, Morchella esculenta, Viola serpens, Valeriana jatamonsi, Berginea ciliate* and *Dioscorea deltoida* They are important for medicinal properties like stomach and intestinal disorders, curing diabetes, neurological disorders, muscular / skeleton disorders and skin problems etc Few of them are also commercially important having edible properties and used in furniture making *Podyphyllum emodi. Paeonia emodi, Skimmia laureola, Berginia ciliate* are the extinct medicinal plant species found in **Siran Valley Mansehra.** They have specific medicinal value which includes ear nose and throat infections, skin problems, stomach and intestinal *disorders* cardiovascular disorders, renal problems and muscular diseases None of them possess any kind of commercial importance *Cedrus deodara, Abies pindrow, Taxus wallichiana* are the extinct medicinal plant species found in **Dir Kohistan** and *Quercus glauca, Ulmus wallichiana* and *Opuntia dilleni* are found in **Battagram.** These plants are important for their medicinal as well as commercial value including stomach and intestinal problems, muscular and skeleton disorders, ear, nose and throat infections, gynecological disorders, fuel wood, furniture making and in food industry

Vetiveria zizanoides and Cedrus deodara are the extinct medicinal plant species found in **Salt Range and Himalayan** region respectively *Vetiveria zizanoides* is used for skin infections, cardiovascular and neurological disorders It is aromatic therefore being used in pot pourris *Cedrus deodara* is used medicinally to cure skin, stomach, intestinal and muscular disorders Wood is used for construction purposes because of its durability

Forest fragmentation and degradation of the habitat due to extensive grazing and deforestation are the primary cause of species extinction in Azad Jammu and Kashmir (Sala et al , 2000) The major factor of extinction of medicinal plants in this area is the dependence of people on them for various purposes (Ahmed *et al* , 2010) The reasons for the environmental degradation in this area includes habitat destruction, excessive pressure on vegetation due to grazing animals, continuous demand of timber and fuel wood, cutting of trees and land conservation in to cultivated areas (Muhammad, 2003, Haq *et al* , 2010) Forest fires, deforestation and shelling of Indian army at LOC is the continuously disrupting the vegetation of Azad Jammu and Kashmir Dependency of people on plants for their fuel and furniture needs causing them to eliminate on alarming rate (Hussain and Chaudary, 2009) It has been reported that the reduction in the population size of natural plant species in this area due to different environmental factors such as destruction of habitat, erosion, high consumption, invasive and introduced species, increased deforestation and occurrence of pathogens (Muhammad, 2003)

The debility in the population size of medicinal flora in District Battagram is due to its area of occupancy, consequences of introduced taxa and occurrence of pathogens, habitat loss and continuous exploitation of resources Destruction in habitat has a key role in extinction of species and the major factors involved in habitat destruction are deforestation, overpopulation, changes in environment, global warming and pollution The reason of plants being extinct in this area is the dependency of people of on the plant diversity for several purposes (Faizan ul Haq, 2012) Due to excessive grazing, high rate of deforestation and less regeneration ability of woody plants, the whole area of Buner is under high biotic pressure (Sher *et al* , 2011) The rich medicinal flora of Buner, Swat and Chitral is under serious threat because of intense grazing and high rate of collection of plant species (Khan *et al* , 2005) It has also been observed that large

number of tress are found dead in Chitral due to natural hazards and some trees are burnt for purpose of making charcoal (Khan *et al*, 2011) According to Haider & Qaiser (2009) the oil extracted from *Chilghoza* is highly valued for its healing and stimulating power Therefore the local inhabitants of Chitral over harvested and in some cases removed all the cones The depletion in population of wild medicinal plants is because of the ignorance of local people especially regarding their rarity and unsustainable means of collection of these plants

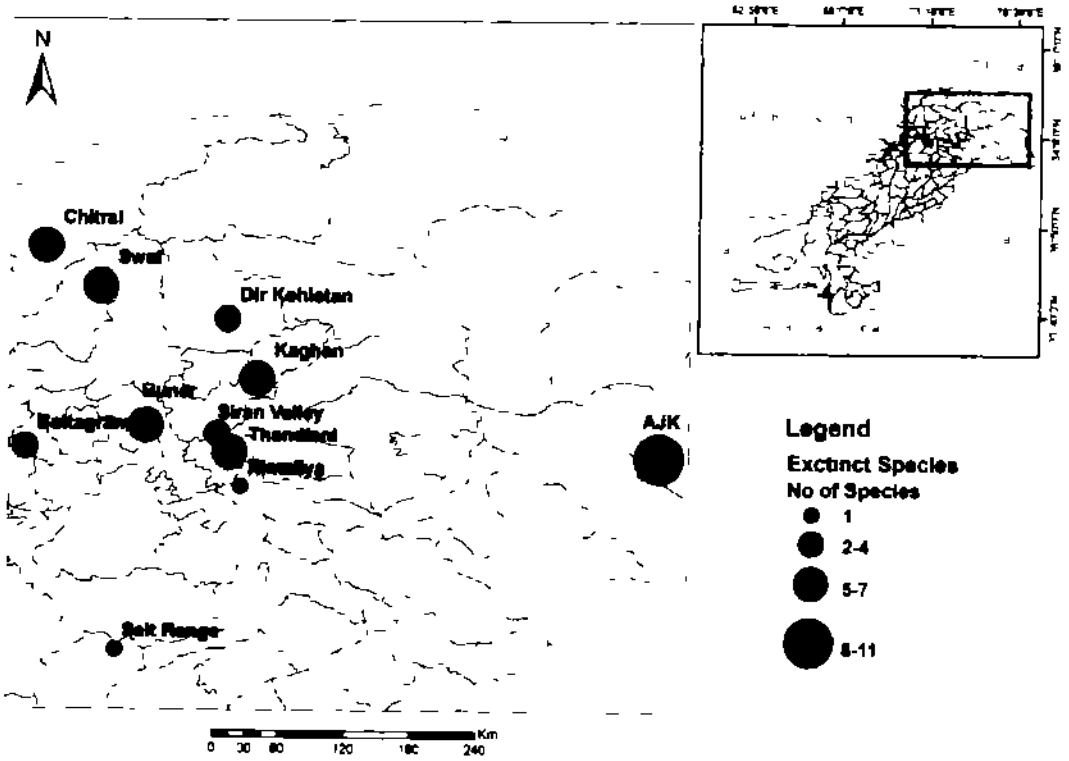

Fig 3.1 · Map showing the areas having extinct medcinal plant species in Pakistan

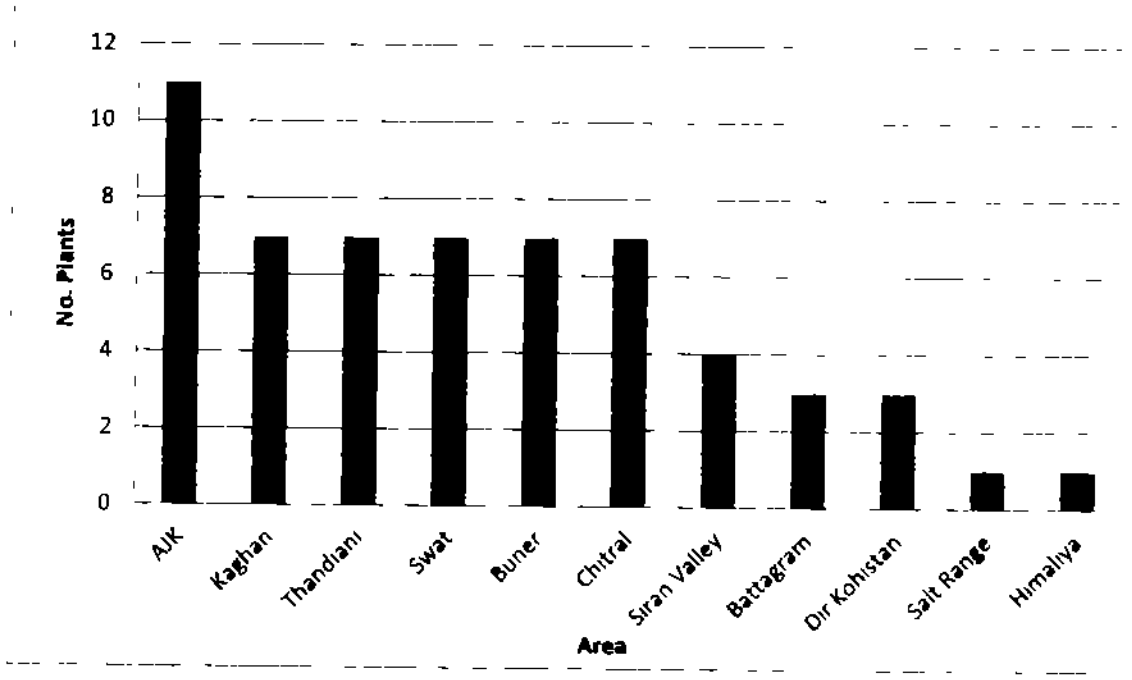

Fig 3.2 Graph showing the number of extinct medicinal plant species in different areas of Pakistan

S. No.	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
1	Battagram	*Quercus glauca*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✓
2	Battagram	*Ulmus wallichiana*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓
3	Battagram	*Opuntia dillenii*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗
4	AJK	*Abies pindrow*	✓	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✓	✗	✗	✓
5	AJK	*Cedrus Deodara*	✗	✓	✗	✗	✗	✗	✗	✗	✓	✓	✗	✓	✗	✗	✗
6	AJK	*Juglans regia*	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓
7	AJK	*Pinus roxbergii*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗
8	AJK	*Pinus wallichiana*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✓
9	AJK	*Picea smithiana*	✓	✓	✓	✗	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗	✓
10	AJK	*Taxus wallichiana*	✓	✗	✗	✓	✗	✗	✗	✓	✗	✓	✗	✓	✗	✗	✗
11	Samahni Valley AJK	*Bauhinia variegata L*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✓
12	Samahni Valley AJK	*Cordia obliqua Wild*	✓	✗	✓	✓	✗	✗	✗	✗	✓	✓	✓	✗	✓	✗	✗
13	Samahni Valley AJK	*Ficus bengalensis L*	✗	✓	✗	✓	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✓
14	Samahni Valley AJK	*Juglans regia L*	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓
15	Kaghan	*Morchella esculenta*	✗	✗	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗
16	Kaghan	*Colchicum luteum*	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
17	Kaghan	*Bergenea ciliata*	✓	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
18	Kaghan	*Pimpinella stewartii*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	
19	Kaghan	*Valleriana jatamansii*	✗	✗	✗	✓	✗	✗	✗	✗	✓	✓	✓	✗	✓	✗	✗
20	Kaghan	*Viola serpens*	✓	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
21	Kaghan	*Dioscorea deltoidea*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
22	Thandiani	*Morchella esculenta*	✗	✗	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗
23	Thandiani	*Colchicum luteum*	✗	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗
24	Thandiani	*Bergenia ciliata*	✓	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
25	Thandiani	*Pimpinella stewartii*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗
26	Thandiani	*Valleriana jatamansii*	✗	✗	✗	✓	✗	✗	✗	✓	✓	✓	✓	✗	✓	✗	✗
27	Thandiani	*Viola serpens*	✓	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
28	Thandiani	*Dioscorea deltoidea*		✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗
29	Swat	*Morchella esculenta*	✓	✗	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗
30	Swat	*Colchicum luteum*	✗	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗
31	Swat	*Bergenea ciliata*	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
32	Swat	*Pimpinella stewartii*	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗
33	Swat	*Valleriana jatamansii*	✗	✗	✗	✓	✗	✗	✗	✗	✓	✓	✓	✗	✓	✗	✗
34	Swat	*Viola serpens*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
35	Swat	*Dioscorea deltoidea*	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗
36	Buner	*Morchella esculenta*	✓	✗	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗
37	Buner	*Colchicum luteum*	✗	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗
38	Buner	*Bergenea ciliata*	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
39	Buner	*Pimpinella stewartii*	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗
40	Buner	*Valleriana jatamansii*	✗	✗	✗	✓	✗	✗	✗	✗	[illegible]	[illegible]	[illegible]	✗	✓	✗	✗
41	Buner	*Viola serpens*	✗	✗	✓	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
42	Buner	*Dioscorea deltoidea*	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗
43	Chitral	*Morchella esculenta*	✓	✗	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗
44	Chitral	*Colchicum luteum*	✗	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗
45	Chitral	*Bergenea ciliata*	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
46	Chitral	*Pimpinella stewartii*	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗
47	Chitral	*Valeriana jatamansii*	✗	✗	✗	✓	✗	✗	✗	✗	✓	✓	✓	✗	✓	✗	✗
48	Chitral	*Viola serpens*	✗	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
49	Chitral	*Dioscorea deltoidea*	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗
50	Chitral	*Ephedra*	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✓	✓	✗	✗	✗
51	Dir Kohistan	*Cedrus deodara*	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✓
52	Dir Kohistan	*Abies pindrow*	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗
53	Dir Kohistan	*Taxus wallichiana*	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓
54	Siran Valley Mansehra	*Podophyllum emodi*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
55	Siran Valley Mansehra	*Paeonia emodi*	✓	✓	✗	✓	✗	✗	✓	✗	✓	✗	✓	✗	✗	✗	✗
56	Siran Valley Mansehra	*Skimmia laureola*	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
57	Siran Valley Mansehra	*Berginia ciliata*	✓	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
58	Salt Range	*Leuverte cyanoides*	✓	✓	✗	✗	✗	✗	✓	✗	✗	✓	✗	✗	✓	✗	✗
59	Himalaya	*Cedrus Deodara*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓

Table 3.2 Showing medicinal and commercial values of extinct medicinal plants in Pakistan

Key: (Medicinal Value) 1=ENT, 2=Skin, 3=General Infection/Weakness, 4=Stomach/Intestinal disorders, 5=Gyneacological disorders, 6= Antidiabetic, 7=Cardiovascular diseases, 8= Anticancer, 9= Renal disorders, 10= Neurological disorders, 11= Muscular/ Skeleton disorders.
(Commercial Value) 1= Fuelwood/fodder, 2= Cosmetic, 3=Edible, 4= Furniture/Tools

3.3 Critically Endangered Medicinal Plant Species of Pakistan

The critically endangered medicinal flora of Pakistan is found in District Kotli of Azad Jammu and Kashmir *Jasminum officinale, Mallottus philippinensis, Micromeria biflora, Butea monosperma* and *Zanthoxylum armatum* are found to be critically endangered medicinal plants specifically because of their high medicinal value People of this area depends on them for treating diseases like asthma, sore throat, abdominal pain, chest pain, hepatitis, skin problems etc (Table 3 7) Besides of medicinal importance they are also used commercially as fuel wood species and in cosmetic industry

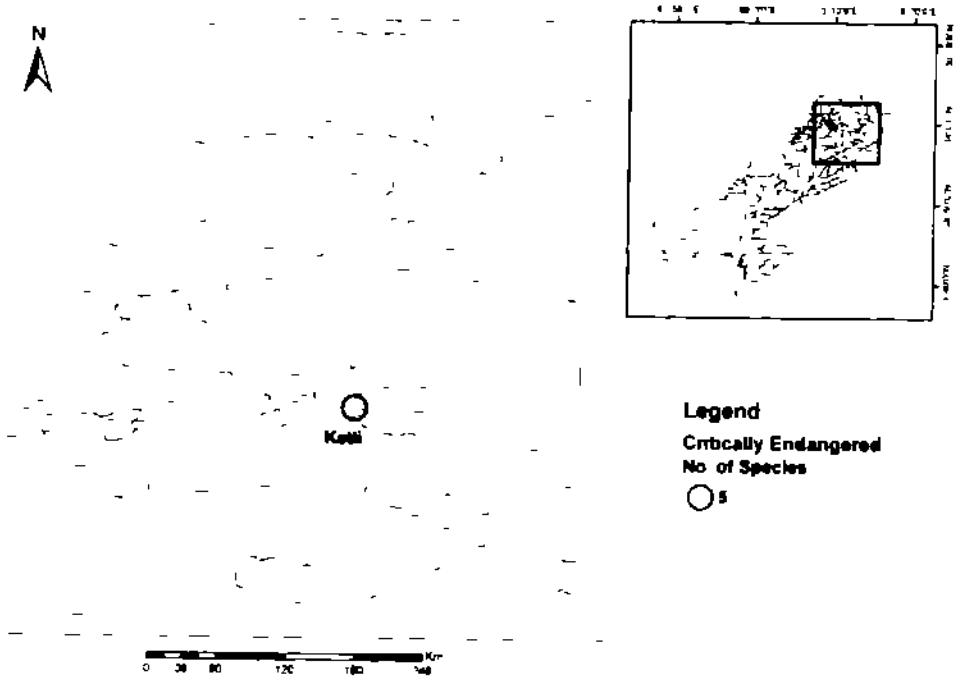

Fig 3.3 Map showing the areas having critically endangered medicinal plant species of Pakistan

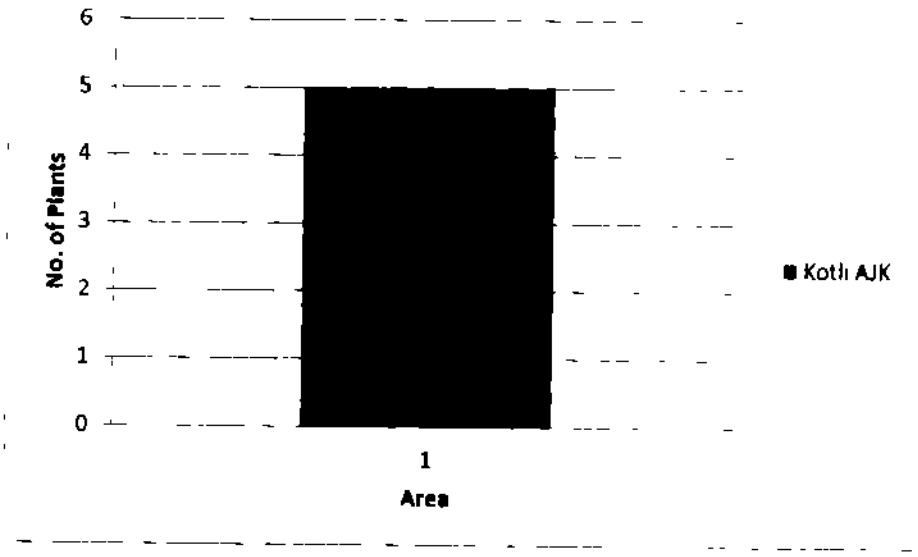

Fig 3.4 Graph showing the number of critically endangered medicinal plant species in different areas of Pakistan

S. No	Area	Plant Species	Medicinal Value												Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	Sehra, Kotli AJK	*Dioscorea deltoidea*	✓	✓	x	x	✓	x	x	x	x	✓	x	x	x	✓	x	x
2	Sehra, Kotli AJK	*Viscum album*	x	✓	x	x	x	x	x	x	x	x	x	✓	x	✓	x	x
3	Sehra, Kotli AJK	*Ephedra gerardiana*	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	✓	x
4	Sehra, Kotli AJK	*Picea smithiana*	✓	x	x	✓	x	x	x	x	x	✓	x	x	x	x	x	✓
5	Sehra, Kotli AJK	*Zanthoxylum armatum*	✓	x	x	x	x	x	✓	x	x	x	x	x	x	x	✓	x

Table 3.3 Showing medicinal and commercial values of critically endangered plant species in Pakistan

Key: (Medicinal Value) 1=ENT, 2=Skin, 3=General Infection/Weakness, 4=Stomach/Intestinal disorders, 5=Gynecological disorders, 6= Antidiabetic, 7=Cardiovascular diseases, 8= Anticancer, 9= Renal disorders, 10= Neurological disorders, 11= Muscular/ Skeleton disorders.

(Commercial Value) 1= Fuelwood/fodder, 2= Cosmetic, 3=Edible, 4= Furniture/Tools

3.4 Endangered Medicinal Plant Species of Pakistan.

The results showed that there are total 149 wild medicinal plants which are found to be endangered in different areas of Pakistan

These include ***District Battagram*** with the highest number of endangered wild medicinal plants i e 58, District Swat has 25, Gilgit has 21, District Sensha has 14 endangered species,Neelum Valley AJK has 13, Kotli has 10 , Upper Siran has 03 and 01 has been found in Bagh, Kaghan and Khyber Pakhunkwa These areas support large number of medicinal plants recorded up till now The main reason is attributed to conservation of these areas by the local people and use of traditional knowledge for the use of plants as medicinal and commercial purposes Few of the medicinal values specifically found in plants of District Battgaram are *Pistacia integerrima Bauhinia verigata, Betula utillis, Rhodenderon arboratum, Quercus glauca, Viola canescens, Acer ceasium, Berberis lyceum, Acnitum heterophyllum. Ferula narthex, Juglans regia, Onosma hispidum, Podyphylum emodi, Podyphyllum hexandrum, Opuntia dillem, Populus alba* and *Viscum album* These include cure for skin problems (like inflammation, skin burns, astringent, healing of cuts and wounds, acne problems and eczema), for ENT disorders (like ear ache, throat infections, clearing of nasal cavity, chest infections like bronchitis and asthma etc), for stomach and intestinal disorders (like ulcer, diarrhea, bile duct problems and colic pain etc), for gynecological disorders (like infertility, uterine diseases, contraceptive etc), for renal disorders (like urinary infections, diuretic etc) and for neurological and muscular disorders (like hysteria, epilepsy, rheumatism, joint pain, fractures etc) Some of the plants in the District Battagram are also used for cancer treatment and cardiovascular diseases Few of them are also used for treating diabetes Majority of the endangered medicinal plants like *Populus alba, Aesculus indica,*

Opuntia dillenı, *Acer Caesium*, *Betula utilis* and *Cedrus deodara* ın District Battagram are commercially used as fuel wood, timber, detergent, instrument making, furniture making etc

District Swat has the second highest number of endangered medicinal plant species mainly includes *Berberis lyceum*, *Dioscorea deltoida*, *Paenia emodi*, *Acorus calamus*, *Berberis vulgaris*, *Podyphyllum hexendrum*, *Valeriana Jatamansi etc* The medicinal importance these pants includes treatment of wounds, joint and body pain, uterine problems urinary infections, brain stimulant, colic pain, blood purifier, toothache, diarrhea, jaundice etc Few of them also have commercial importance like oil *Acorus calamus* is aromatic and used in candle making, wood of *Berberis vulgaris* sis used for fuel purposes and also popular for making toothpicks, carvings and mosaics

In **Gilgit** the endangered medicinal plants like *Ferula narthex*, *Saussurea lappa*, *Tamarix gllica*, *Valeriana Wallichi*, *Podypyllum emodi*, *Epehra gerardiana* are important for their medicinal value like respiratory infections, rheumatism, sore throat, carminative, antispasmodic, gastric problems, constipation, asthma, laxative etc These plants also possess commercial values like fuel wood, used as gum, detergent, dye, tannin etc **District Sensha** has the medicinally and commercially important endangered plant species like *Pinus roxburgii*, *Rosa brunonii*, *Trichodema indica*, *Ajuga bracteosa*, *Juglan sregia* having medicinal properties like skin diseases, ulcer, eye diseases, constipation, menstrual disorders and inflammation etc Commercial properties of these plants include cosmetics, fuel wood, timber, furniture making, mango production etc

In **Azad Jammu and Kashmir,** *Betula utilis*, *Morchella esculenta Cedrus deodara Bergnia ciliate*, *Abies pindrow Royle* are some of the endangered medicinal plant species They are mostly use for skin diseases, urinary problems, cardiovascular diseases, antiseptic etc

The medicinal value of endangered medicinal plant species of **Ditrict Kotli** like *Zizipus oxypylla*, *Ajuga bracteosa*, *Butea monosperma*, *zanthoxylum armatum* and *Olea ferruginea* includes fever, tonic, astringent, osteoporosis, sore throat, chest pain and laxative etc Few of them are also important for their commercial values like making of gum, as timber, fodder, in pharmaceutical industry, perfumes etc

Very few endangered medicinal plant species are found **in Upper Siran, Chitral, Kaghan, Kyber Pakhtunkwa and Bagh (AJK)** having high medicinal and commercial value

The major threats to the flora being endangered includes deforestation due to illicit cutting and smuggling of trees in District Battagram, are clearance of forests for cultivation, grazing and browsing for all kinds of domestic animals, forest fires, snow drifts lopping, avalanches at high altitudes and steep slopes, erosion and landsides (Haq, 2012) Other threats to the flora of Battagram are deforestation, over grazing, erosion, change of environment, habitat destruction, unplanned collection, occurrence of pathogens, and consequence of introduced taxa (Haq *et al*, 2012) Over exploitation, occurrence of pathogens, consequence of introduced taxa and changing environment are responsible for making these species endangered (Sala et al , 2000) It has also been observed that due to environmental destruction and over grazing, number of endangered species is increasing day by day (Vesk and Westoby, 2000) Over feeding of animals, land clearing due to agricultural purposes, excessive cutting of trees for development of grass for fodder, unrestrained bush fires, malpractices due to untrained staff and lack of proper training and education, soil erosion, lack of community interest in management practices and techniques and smuggling of forest resources are the major reasons of habitat destruction and degradation in the area of Azad Jammu and Kashmir (Rehman, 2007) It has been observed that the fuel wood kept throughout the year results in the constant destruction of natural forest and vegetation

(Khan, 2008) It has been reported that destruction in the medicinal plants resources is because of the involvement of local community in its collection Approximately 500 tons of medicinal plants are being collected annually (Chaudary *et al* , 2000) Some wild medicinal plant species in Chitral are endangered due to past over-harvesting by the local communities inhabiting nearby and also due to over grazing by domestic animals (Khan et al , 2011) In Gilgit, medicinal plants are being extensively exploited by the local people for valuable timber and other requirements A number of trees and shrubs have been have been over exploited for fuel and commercial purposes by the inhabitants of this area (Khan & Khatoon, 2007)

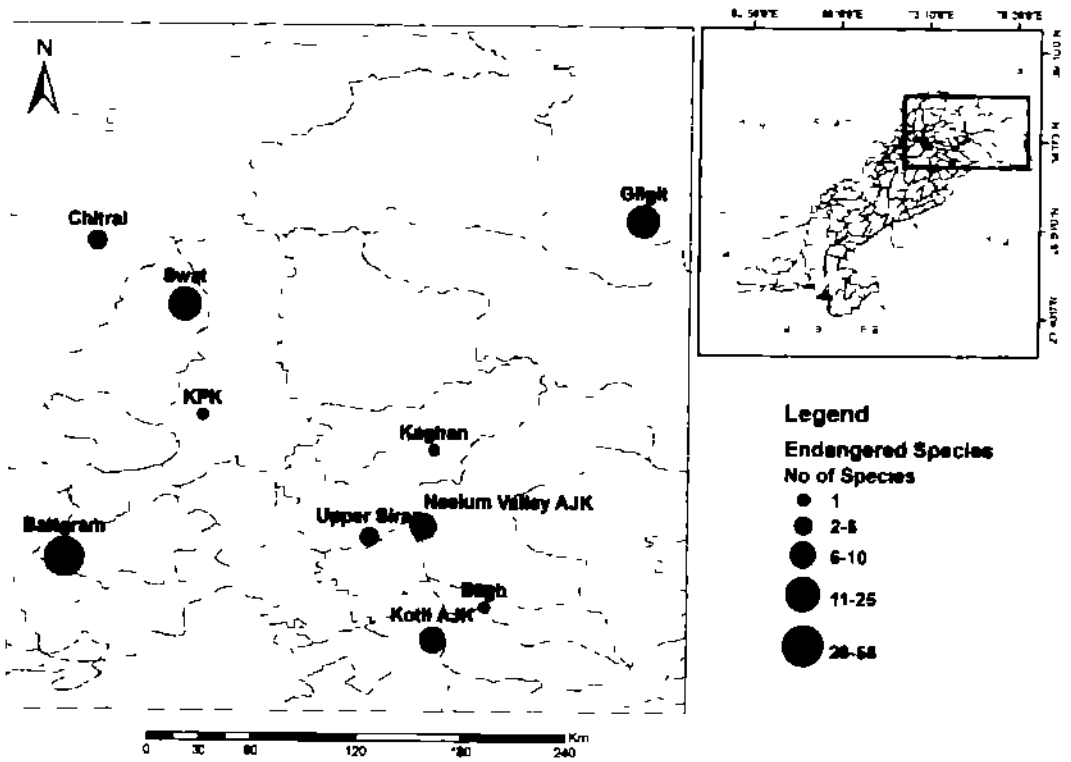

Fig 3.5 : Map showing the areas having endangered medicinal plants of Pakistan

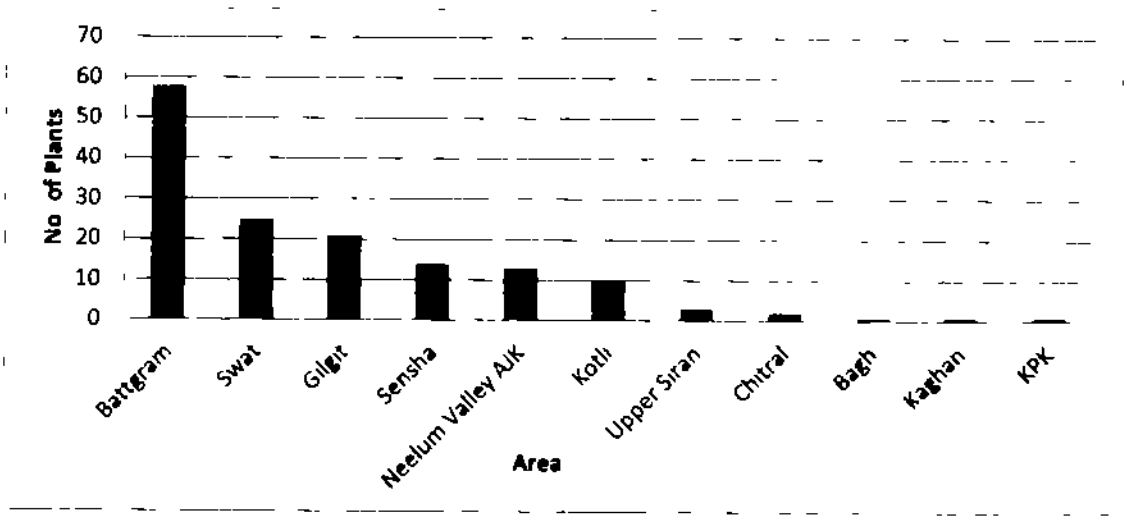

Fig 3.6 Graph showing the number of edanngered medicinal plant species in different areas Pakistan

S No	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
1	Battagram	*Pistacia integerrima*	✓	x	✓	✓	x	x	x	x	x	x	x	✓	x	x	x
2	Battagram	*Ficus carica Linn*	✓	x	✓	✓	x	x	x	x	x	x	x	✓	x	x	x
3	Battagram	*Acer Caesium Wall*	x	✓	x	x	x	x	x	x	x	x	✓	✓	x	✓	x
	Battagram	*Asparagus officinalis Linn*	x	x	✓	x	x	x	x	x	✓	x	✓	x	x	x	x
5	Battagram	*Pyrus harmaloides Linn*	x	x	x	x	x	x	x	x	x	✓	x	x	x	x	x
7	Battagram	*Opuntia dillenii Haw*	x	x	x	✓	x	✓	x	x	x	x	x	x	x	✓	x
8	Battagram	*Bauhinia variegata Linn*	✓	✓	✓	x	x	x	x	x	x	x	✓	✓	x	x	x
9	Battagram	*Berberis lycium D. Don*	x	x	✓	✓	x	x	x	x	x	✓	x	✓	x	x	x
10	Battagram	*Cornus macrophylla Wall*	x	✓	x	✓	x	x	x	x	x	x	x	✓	x	x	x
11	Battagram	*Dioscorea deltoidea Wall ex Grieb*	x	✓	✓	x	x	x	x	x	x	x	x	x	✓	x	x
12	Battagram	*Rhododendron arboreum Sm*	x	✓	✓	✓	x	✓	x	x	x	x	x	x	x	✓	x
13	Battagram	*Geranium wallichianum*	x	✓	x	x	x	x	x	✓	x	x	x	✓	x	x	x
14	Battagram	*Quercus glauca Thunb*	x	✓	x	✓	x	x	x	x	x	x	x	✓	x	x	x
1	Battagram	*Quercus semecarpifolia Sm*	x	x	x	✓	x	x	x	x	x	✓	x	✓	x	x	✓
16	Battagram	*Aesculus indica Wall ex Camb Hook f*	x	x	✓	✓	x	x	x	x	x	x	x	✓	x	x	✓
17	Battagram	*Colebrookea oppositifolia Sm*	x	✓	✓	x	x	x	x	x	x	✓	✓	✓	x	x	x
18	Battagram	*Viscum Album Linn*	x	x	x	x	✓	x	x	✓	x	x	x	x	x	x	x
19	Battagram	*Ampelocissus parviflora Linn*	✓	x	✓	✓	✓	x	x	x	x	x	x	x	x	x	x
20	Battagram	*Paeonia emodi Wall ex Hook f*	✓	x	x	✓	✓	x	x	x	x	✓	x	x	x	x	x
21	Battagram	*Cedrus deodara Roxb ex Lamb*	x	✓	x	✓	x	✓	x	x	x	x	✓	✓	x	x	x
22	Battagram	*Podophyllum hexandrum Wall ex Royle*	✓	✓	✓	x	✓	✓	x	x	✓	x	x	x	x	✓	x
23	Battagram	*Crataegus songarica C. Koch*	x	x	x	x	✓	x	✓	x	x	x	x	✓	x	x	x
24	Battagram	*Prunus padus Hook*	✓	✓	x	✓	x	x	x	x	✓	✓	x	✓	x	x	x
25	Battagram	*Skimmia laureola DC*	✓	x	✓	x	x	x	x	x	x	✓	x	x	x	x	x
26	Battagram	*Populus alba Linn*	x	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	x	x	
27	Battagram	*Salix babylonica Linn*	✓	✓	✓	x	x	x	x	x	x	x	x	✓	x	x	✓
28	Battagram	*Withania somnifera Linn Dunal*	x	✓	✓	x	x	x	x	✓	✓	✓	x	x	✓	x	x
29	Battagram	*Taxus baccata L. subsp. Wallichiana (Zucc.) Pilger*	x	x	✓	x	✓	x	x	x	x	x	x	✓	✓	x	x
30	Battagram	*Ulmus Wallichiana Planch*	x	x	x	x	x	x	x	x	x	x	✓	✓	x	x	✓
31	Battagram	*Sorbus canescens Wall ex Roxb*	✓	x	✓	x	x	x	x	x	x	✓	x	x	x	x	x
32	Battagram	*Acer Caesium Wall*	✓	✓	x	x	x	x	x	x	x	x	✓	✓	x	x	x
33	Battagram	*Berberis lycium D. Don*	✓	✓	✓	✓	x	x	x	x	x	✓	x	✓	x	x	x
34	Battagram	*Cedrus Deodara Roxb ex Lamb*	x	x	x	✓	x	x	x	x	x	x	x	✓	x	x	x
35	Battagram	*Opuntia Dillenii Haw*	✓	✓	✓	✓	✓	x	x	✓	✓	✓	x	x	x	✓	x
36	Battagram	*Paeonia Emodi Wall ex Hook f*	✓	x	x	✓	✓	x	x	x	x	✓	x	x	x	x	x
37	Battagram	*Pistacia integerrima J. L. Stewart Brch*	✓	x	x	✓	x	x	x	x	x	x	x	✓	x	x	✓
38	Battagram	*Populus alba Linn*	✓	✓	✓	✓	x	x	x	x	✓	x	✓	✓	x	x	x
39	Battagram	*Quercus Glauca Thunb*	✓	✓	x	✓	x	x	x	x	x	x	x	✓	x	x	x
40	Battagram	*Skimmia Laureola DC*	✓	x	✓	x	x	x	x	x	x	✓	x	x	x	x	x
41	Battagram	*Taxus Baccata L. Subsp. Wallichiana (Zucc.) Pilger*	x	✓	x	x	✓	x	x	x	x	x	x	✓	x	x	x
42	Battagram	*Ulmus Wallichiana Planch*	x	x	x	x	x	x	x	x	x	x	✓	✓	x	x	✓
43	Battagram	*Viscum Album Linn*	x	x	x	x	x	x	x	x	x	✓	✓	x	x	x	x
44	Battagram	*Betula utilis*	x	✓	✓	✓	x	x	x	x	✓	✓	x	x	x	x	✓
45	Battagram	*Dioscorea deltoidea*	x	x	✓	✓	x	x	x	x	x	x	x	x	x	x	x
46	Battagram	*Acer caesium*	✓	✓	x	x	x	x	x	x	x	x	✓		x	x	✓
47	Battagram	*Pinus abies*	x	✓	✓	✓	x	x	x	x	✓	x	✓	✓	x	x	x
48	Battagram	*Pistacia integerrima*	✓	✓	✓	✓	x	x	✓	x	x	x	x	X	x	x	x
49	Battagram	*Cornus macrophylla*	✓	✓	x	✓	x	x	x	x	x	✓	x	x	x	x	x
50	Battagram	*Paeonia emodi*	✓	x	x	✓	✓	x	x	x	x	✓	x	✓	x	x	x

S. No	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
51	Battagram	*Cedrus deodara*	x	✓	x	✓	x	✓	x	x	x	x	✓	✓	x	x	✓
52	Battagram	*Skimmia laureola*	✓	x	✓	x	x	x	x	x	x	✓	x	x	x	x	x
53	Battagram	*Taxus wallichiana*	✓	x	x	✓	x	x	x	✓	x	✓	x	✓	x	x	x
54	Battagram	*Aesculus indica*	x	✓	x	✓	x	x	x	x	x	✓	✓	x	✓	x	✓
55	Battagram	*Dioscorea deltoidea*	x	x	✓	✓	x	x	x	x	x	x	x	x	x	x	x
56	Battagram	*Rhododendron arboreum*	✓	✓	x	✓	✓	x	x	x	x	✓	x	✓	x	✓	✓
57	Battagram	*Podophyllum emodi*	✓	x	✓	✓	x	x	x	✓	x	x	x	x	x	x	x
58	Battagram	*Viola canescens*	✓	x	✓	x	x	x	x	x	x	✓	x	x	x	x	x
59	Sharda, Neelum Valley AJK	*Saussurea lappa* (Falc.) Lipsch.	✓	x	x	x	x	x	x	x	✓	✓	x	x	✓	x	x
60	Sharda, Neelum Valley AJK	*Jurinea dolomiaea* Boiss	x	x	x	✓	x	x	✓	x	x	x	x	x	✓	x	x
61	Sharda, Neelum Valley AJK	*Berberis lycium* Royle	✓	x	x	✓	x	x	x	x	x	x	x	x	x	✓	x
62	Sharda, Neelum Valley AJK	*Betula utilis* D. Don.	x	x	✓	✓	x	x	x	x	x	x	x	✓	x	x	x
63	Sharda, Neelum Valley AJK	[illegible] *bulbifera* Decne	x	x	x	✓	x	x	x	x	✓	x	x	x	x	x	x
64	Sharda, Neelum Valley AJK	*Geranium wallichianum* D. Don	x	✓	✓	x	x	x	x	x	x	x	x	x	✓	x	x
65	Sharda, Neelum Valley AJK	*Morchella esculenta* L.	x	x	x	x	x	x	x	x	x	✓	✓	x	✓	x	x
66	Sharda, Neelum Valley AJK	*Abies pindrow* Royle	✓	x	✓	x	x	x	x	x	x	✓	x	x	x	x	✓
67	Sharda, Neelum Valley AJK	*Cedrus deodara* (Roxb. ex Lamb.)	x	x	✓	x	x	x	✓	x	✓	✓	x	✓	x	x	x
68	Sharda, Neelum Valley AJK	*Pinus wallichiana* A.B. Jackson	x	x	x	✓	x	x	x	x	x	x	x	✓	x	✓	x
69	Sharda, Neelum Valley AJK	*Bistorta amplexicaulis* (D. Don) Greene	x	x	x	x	x	x	x	x	x	✓	x	✓	x	x	✓
70	Sharda, Neelum Valley AJK	*Aconitum heterophyllum* Wall. ex Royle	x	✓	✓	x	x	x	x	x	x	✓	x	x	x	x	x
71	Sharda, Neelum Valley AJK	*Bergenia ciliata* (Haw.) Sternb.	x	✓	x	x	x	x	x	x	✓	✓	x	x	x	x	x
72	Sehnsa, Kotli AJK	*Ajuga bracteosa*	x	✓	x	x	x	x	x	x	x	✓	x	x	✓	x	x
73	Sehnsa, Kotli AJK	*Albizia lebbek*	✓	✓	x	✓	x	x	x	x	x	x	x	✓	x	x	✓
74	Sehnsa, Kotli AJK	*Dalbergia sissoo*	x	✓	x	x	✓	x	x	x	x	x	x	✓	x	x	x
76	Sehnsa, Kotli AJK	*Juglans regia*	x	✓	x	x	x	x	x	x	x	x	x	x	x	x	✓
77	Sehnsa, Kotli AJK	[illegible]	x	x	x	✓	✓	x	x	x	x	x	x	✓	x	✓	x
78	Sehnsa, Kotli AJK	*Olea ferruginea*	✓	x	x	x	x	x	x	x	x	✓	x	x	x	x	✓
79	Sehnsa, Kotli AJK	*Pinus roxburghii*	x	✓	x	✓	x	x	x	x	x	x	x	✓	x	x	x
80	Sehnsa, Kotli AJK	*Punica granatum*	x	x	✓	✓	x	x	x	x	x	x	x	x	✓	x	✓
81	Sehnsa, Kotli AJK	*Phyllanthus emblica*	x	✓	x	✓	x	x	x	✓	x	x	x	x	✓	x	x
82	Sehnsa, Kotli AJK	*Rosa brunonii*	✓	x	x	x	x	x	x	x	x	x	x	x	✓	x	x
83	Sehnsa, Kotli AJK	*Grewia tenax*	x	x	✓	✓	✓	x	x	x	x	x	x	✓	x	x	x
84	Sehnsa, Kotli AJK	*Trichodesma indica*	x	✓	x	x	✓	x	✓	x	x	x	x	x	✓	x	x
85	Sehnsa, Kotli AJK	*Viola canescens*	✓	x	✓	✓	x	x	x	x	x	✓	x	x	x	x	x
86	Kotli AJK	[illegible]	x	✓	x	✓	x	x	x	x	✓	x	✓	x	x	x	x
87	Kotli AJK	*Ziziphus oxyphylla* Edgew	x	x	✓	x	x	x	x	x	x	x	x	✓	x	x	x
88	Kotli AJK	*Carissa opaca* Stapf ex Haines	x	x	x	✓	x	x	x	x	x	x	x	x	x	✓	x
89	Kotli AJK	*Ajuga bracteosa*	x	✓	x	x	x	x	x	x	x	✓	x	x	x	x	x
90	Kotli AJK	*Mallotus philippensis*	x	✓	x	x	x	x	x	x	x	x	x	x	✓	x	x
91	Kotli AJK	[illegible]	x	x	x	x	x	x	x	x	x	x	✓	✓	✓	✓	x
92	Kotli AJK	*Zanthoxylum armatum*	✓	x	✓	x	x	x	✓	x	x	x	x	x	x	✓	x
93	Kotli AJK	[illegible]	x	✓	x	x	x	x	x	x	x	x	x	x	✓	x	x
94	Kotli AJK	*Juglans regia*	x	✓	x	x	x	x	x	x	x	x	x	x	x	x	✓
95	Kotli AJK	*Olea ferruginea*	✓	x	x	x	x	x	x	x	x	✓	x	x	x	x	x
96	Gilgit	*Betula utilis*	x	✓	✓	✓	x	x	x	✓	✓	✓	✓	✓	x	x	x
97	Gilgit	*Ferula narthex*	✓	x	x	✓	x	x	x	x	x	x	x	x		✓	x
98	Gilgit	*Podophyllum hexandrum*	x	x	x	✓	x	x	x	x	x	✓	x	x	✓	x	x
99	Gilgit	*Saussurea lappa*	✓	x	x	x	x	x	x	x	✓	✓	x	x	✓	x	x
100	Gilgit	*Tamarix gallica*	✓	✓	x	x	x	x	x	x	✓	✓	x	✓	✓	x	✓

S. No	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
101	Chitral	*Viburnum grandiflorum*	x	✓	✓	✓	x	x	x	x	x	x	x	x	x	x	x
102	Chitral	*Juglans regia*	x	✓	✓	x	x	x	x	x	x	✓	x	x	x	x	x
103	Chitral	*Berberis lycium Royle*	✓	x	x	x	x	x	x	x	x	x	x	x	✓	x	x
104	Chitral	*Artemisia maritima*	✓	x	✓	✓	x	x	x	x	x	✓	x	x	✓	x	x
105	Chitral	*Taxus wallichiana*	x	✓	✓	x	✓	x	x	x	✓	✓	✓	x	x	x	x
106	Chitral	*Bergenia himalaica*	x	✓	x	x	x	✓	x	x	x	x	x	x	x	x	x
107	Chitral	*Carum carvi*	✓	x	✓	✓	x	x	x	x	x	✓	✓	x	✓	x	x
108	Chitral	*Ananas Hippodum*	x	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x
109	Chitral	*Ephedra gerardiana*	x	x	✓	✓	x	x	✓	x	✓	✓	✓		x	x	x
110	Chitral	*Glycyrrhiza glabra*	✓	✓	x	x	x	x	x	x	✓	✓	✓	✓	x	x	x
111	Chitral	*Hippophae rhamnoides*	x	✓	✓	x	x	x	✓	✓	✓	✓	x	✓	✓	✓	✓
112	Chitral	*Paeonia browniana*	x	x	✓	✓	x	x	x	x	x	x	x	x	x	x	x
113	Chitral	*Podophyllum emodi*	✓	x	✓	✓	x	x	x	x	x	x	x	x	x	x	x
114	Chitral	*Skimmia laureola*	✓	x	✓	✓	x	x	x	x	✓	x	✓	✓	✓	x	x
1	Chitral	*Taxus wallichiana*	✓	✓	✓	✓	x	x	x	x	x	✓	✓	x	✓	x	x
116	Chitral	*Valeriana wallichii*	x	x	✓	✓	x	x	x	x		✓	x	x	x	x	x
117	Swat Kohistan	*Juniperus communis*	x	x	x	✓	x	x	x	x	x	x	✓	x	x	✓	✓
118	Swat Kohistan	*Berberis lycium*	x	x	✓	x		x	x	x	x	✓	✓	x	✓	x	✓
119	Swat Kohistan	*Valeriana hardwickii*	x	x	x	✓	x	x	x	✓	x	✓	✓	x	x	x	x
120	Swat Kohistan	*Polygonatum verticillatum*	x	x	x	x	✓	x	x	x	x	x	✓	x	x	x	x
121	Swat Kohistan	*Dioscorea deltoidea Wall*	✓	x	x	x	✓	x	x	x	✓	✓	x	x	x	x	x
122	Swat Kohistan	*Paeonia emodi Wall ex Hook f*	x	x	x	✓	✓	x	✓	x	x	✓	x	x	x	x	x
123	Swat Kohistan	*Podophyllum emodi Wall*	✓		✓	✓	x	x	x	x		x	x	x	x	x	x
124	Swat Kohistan	*Valeriana jatamansi Jones*	x	x	✓	x	x	x	x	x	x	x	✓	x	x	x	x
125	Swat	*Juniperus communis*	✓	x	x	✓		x	x	x	x	✓	x	x	x	✓	✓
126	Swat	*Berberis vulgaris*	x	x	✓	✓	x	x	x	x	✓	x	x	✓	x	x	✓
127	Swat	*Taxus wallichiana*	x	✓	✓	✓	x	x	x	x	x	x	✓	x	x	x	x
128	Swat	*Dioscorea deltoidea*	✓	x	x	x	✓	x	x	x	✓	✓	x	x	x	x	x
129	Swat	*Paeonia emodi*	✓	x	✓	✓	✓	x	x	x	x	✓	x	x	x	x	x
130	Swat	*Podophyllum hexandrum*	x	x	x	✓	x	x	x	x	x	✓	x	x	x	x	x
131	Swat	*Polygonatum verticillatum*	x	x	x	x	✓	x	x	x	x	x	✓	x	x	x	x
132	Swat	*Valeriana jatamansi*	x	x	✓	✓	x	x	x	x	✓	✓	✓	x	✓	x	x
133	Swat	*Taxus wallichiana*	✓	x	x	✓	x	x	x	x	x	✓	x	x	x	✓	✓
134	Swat	*Berberis vulgaris Linn*	x	x	✓	✓	x	x	x	x	✓	x	x	✓	✓	x	x
135	Swat	*Dioscorea deltoidea Wall*	✓	x	x	x	✓	x	x	x	✓	✓	x	x	x	x	x
136	Swat	*Podophyllum wallichianum*	x	x	x	x	✓	x	x	x	x	✓	x	x	x	x	x
137	Swat		x	x	x	✓	x	x	✓	x	x		✓	✓	✓	x	x
138	Swat		x	x	x	✓	✓	x	✓	x	x	x	x	x	✓	x	x
139	Swat	*Delphinium roylei D. Don Greene*	x	x	x	✓	x	x	x	x	x	x	x	x	x	x	x
140	Swat	*Bergenia ciliata Haw. Sternb*	✓	x	✓	✓	x	x	x	x	✓	✓	✓	x	x	x	x
141	Swat	*Saussurea obvallata (DC)*	x	x	x	✓	x	x	x	x	x	✓	✓	x	x	x	x
142	Upper Swat	*Podophyllum emodi*	✓	x	✓	✓	x	x	x	x	x	x	x	x	x	x	x
143	Upper Swat	*Skimmia laureola*	✓	✓	x	x	x	x	x	x	x	x	✓	x	x	x	x
144	Upper Swat	*Taxus wallichiana*	✓	x	x	✓	x	x	x	✓	x	✓	x	✓	x	x	x
145	Chitral	*Ferula narthex*	✓	x	x	✓	x	x	x	x	x	x	x	✓	✓	✓	x
146	Chitral	*Paeonia emodi*	✓	x	x	✓	✓	x	✓	x	x	✓	x	x	x	x	x
147	Kagh AJK	*Saussurea obvallata*	✓	x	x	x	x	x	x	x	✓	✓	x	x	✓	x	x
148	Laghman	*Taxus wallichiana Zucc*	✓	x	✓	x	x	x	x	x	x	✓	x	✓	x	x	x
149	AJK	*Gymnospermium peltatum*	✓	x	x	x	x	x	x	x	x	x	x	✓	x	x	✓

Table 3.4 Showing medicinal and commercial values of endangered medicinal plants in Pakistan

Key: (Medicinal Value) 1=ENT, 2=Skin, 3=General Infection/Weakness, 4=Stomach/Intestinal disorders, 5=Gyneacological disorders, 6= Antidiabetic, 7=Cardiovascular diseases, 8= Anticancer, 9= Renal disorders, 10= Neurological disorders, 11= Muscular/ Skeleton disorders.
(Commercial Value) 1= Fuelwood/fodder, 2= Cosmetic, 3=Edible, 4= Furniture/Tools

3.5 Threatened Medicinal Plant Species of Pakistan

The present study provides that there are total 103 threatened medicinal plant species found in different areas of Pakistan including Himalayan region, Malaknad Division, Azad Jammu and Kashmir, Swat, Chitral, Buner, Islamabad and Narowal (Fig 5 1)

Highest numbers of threatened medicinal plants are found in **Himalaya** including *Colchicum luteum, Paeonia emodi, Rheum webbianum, Taxus wallichiana, Saussurea lappa, Atropa belladonna, Onosma bracteatum, Berggmia ciliate, Viola serpens, Geranium wallichianum, Bunium persicum, Arnebia spp, Bistorta amplexicaule, Thymus serphyllum Hypericum perforatum, Polygonotum multiflorum, Asparagus adscendens, Pinus gerardiana* and *Acacia modesta* etc These plants species are rich in medicinal as well as commercial values like used for treating stomach and intestinal problems, ear, nose and throat infections and cardiovascular problems, used as fodder and fuel wood species and in cosmetic industry etc (Table 3 5)

Chitral is at the second highest number in having the threatened medicinal plant species like *Bunium persicum, Delphinium nordhagenii, Ferula narthex, Paeonia emodi, Pinus gerardiana, Aesculus indica Anthemis cotula* and *Delphinium nordhagenii* etc People of Chitral use these for curing diseases related to throat infections, stomach disorders, intestinal problems and neurological problems etc These plants are also important for their commercial properties like many of them are used as fuel wood species

Azad Jammu and Kashmir and Malakanddivison have the same number of threatened medicinal plant species which mainly includes *Bauhinia vareigata, Berberis lyceum, Calotropis*

procera, Olea ferruginea, Pinus roxburgii, Aconitum chasmanthum. Aconitum heterophyllum, Ajuga bracteosa, Angelica cyclocarpa, Arnebia benthami, and *Berberis lyceum etc* Majority of them are used to cure skin and gynecological problems Commercially they are important for fuel wood, timber, furniture making and in cosmetic industry

In **District Swat,** *Morchella esculenta, Viola biflora, Podyphyllum hexandrum, Valeriana wallichi, Berberis lyceum, Valeriana jatamansi, Saussurea spp, Paenia emodi, Podyphyllum hexandrum, Morchella spp* and *Berginea ciliate* are the threatened medicinal plant species They are rich in medicinal and commercial value Very few medicinal plants species are found threatened in **Buner, Islamabad and Narowal** having medicinal and commercial properties (Table 3 5)

It has been observed that the medicinal flora of the area is under serious threats due to involvement of unskilled community The basic threats includes excessive grazing of livestock, non-scientific methods of collection of natural vegetation, habitat degradation, effect of new introduced species, urbanization and deforestation (Haq et al , 2010) In Azad Jammu and Kashmir, the biggest problem caused by the human population is the habitat degradation fragmentation causing serious threats to the medicinal plants in these areas Local people haphazardly damage the medicinal plants while cutting them for timber and fuel wood causing tress to fell from the steep slopes thus exposing the soil for erosion ultimately leading towards gullies and land sliding Cutting grass for the fodder purposes for livestock also poses threats on the medicinal plants of the area (Qamar et al , 2010) Majority illiterate people are living in AJK and they are ignorant about biodiversity loss and its effects on their livelihood (Qamar et al , 2010) It has been recorded that about 700 plant species are used for aromatic and medicinal purposes in Himalayan region (Shengji, 1992) According to a study it has been obersved that

the young generation living in the lower part of Neelum Valley (AJK) is almost unware of the indigenous value of medicinal flora due to its over and brutal exploitation (Qamar and Minhas, 2006) Special attention is needed in the moist temperate Himalaya of Pakistan in order to conserve its environment and sustainable use of natural resources A significant decline has been noticed in indigenous medicinal plant resources and their traditional knowledge due to the reduction in total forest area and linked major changes in community composition (Ibrar, 2003) Over grazing, over cutting of the forests and unsustainable harvesting of medicinal and aromatic plant species are some of the reasons for the plants to get threatened, endangered or vulnerable in this area (Sher *et al*, 2012) It has also been observed that medicinal flora in District Swat is at high risk of being threatened because of non-scientific and unsustainable methods of plant collection and habitat destruction (Sher *et al*, 2005) It has been observed that native flora of Barroha, Maanga and Bhara Kahu is continuously damages by the invasive species because these species are growing very fast and dominating over the native useful plant species (Rauf *et al*, 2012) The medicinal plants are also reported to be threatened in Indian Kashmir mainly because of over exploitation for their medicinal use (Badola& Aitken, 2003, Rana & Samant, 2011)

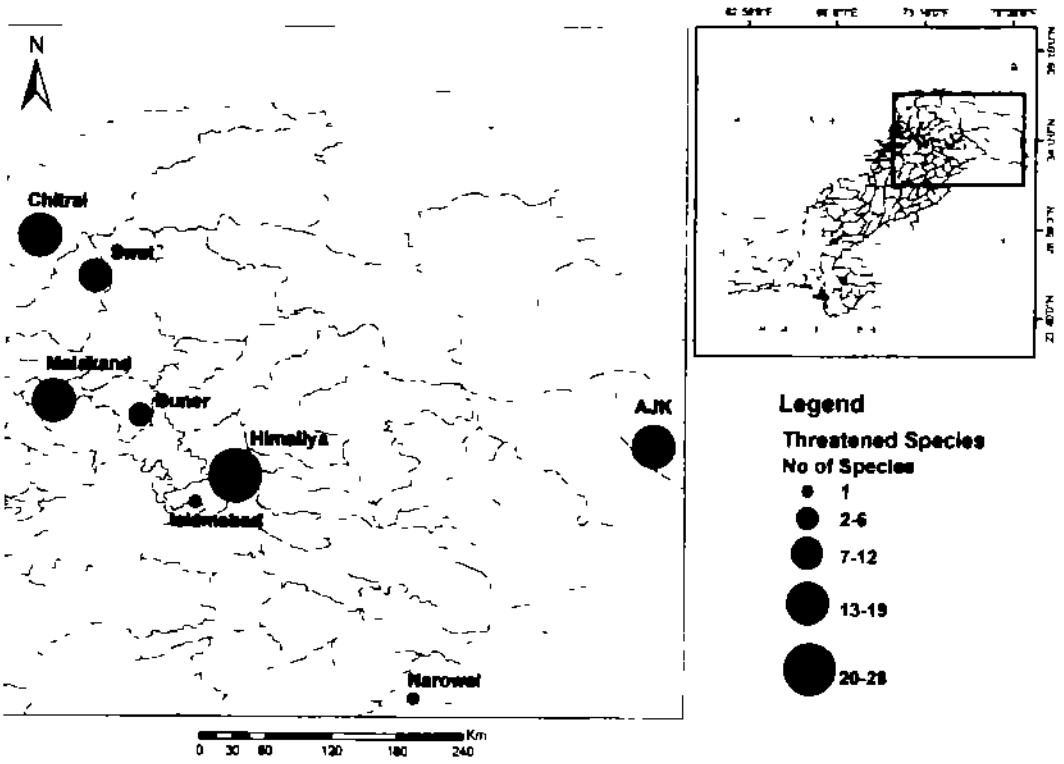

Fig3.7 : Map showing the areas having threatened medicinal plant species of Pakistan

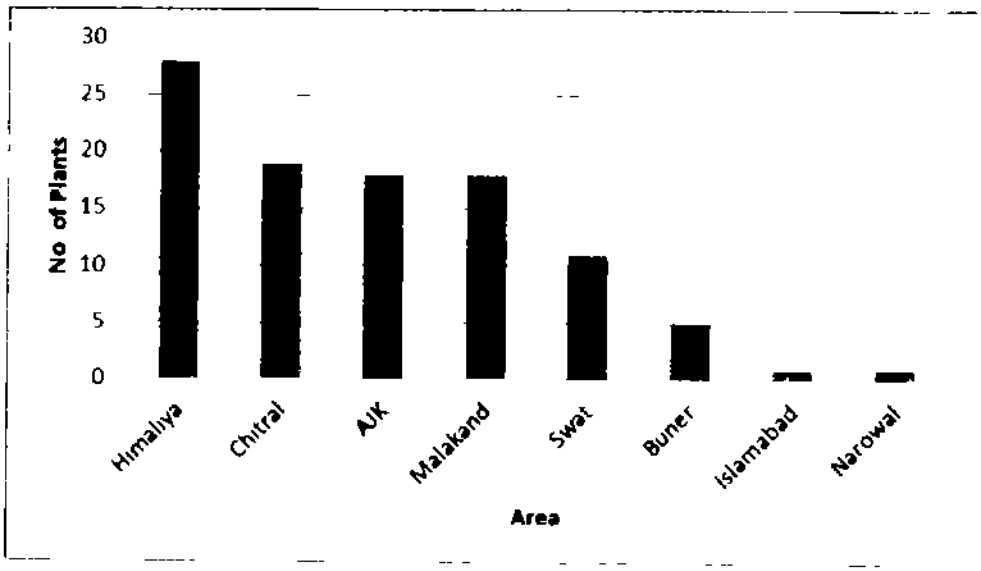

Fig 3 8 Graph showing the number of threatened medicinal plant species in different areas of Pakistan

S No	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
1	Neelum Valley AJK	*Aconitum chasmanthum*	✗	✓	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✓
2	Neelum Valley AJK	*Aconitum heterophyllum*	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
3	Neelum Valley AJK	*Ajuga bracteosa*	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
4	Neelum Valley AJK	*Angelica cyclocarpa*	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗	✓	✗	✓	✗	✗
5	Neelum Valley AJK	*Arnebiabenthata*	✓	✓	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗
6	Neelum Valley AJK	*Berberis lyceum*	✓	✓	✓	✗	✓	✗	✗	✗	✗	✓	✓	✗	✓	✗	✗
7	Neelum Valley AJK	*Bergenia ciliata*	✗	✓	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗	✗
8	Neelum Valley AJK	*Dioscoreadeltoidea*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
9	Neelum Valley AJK	*Ephedra gerardiana*	✗	✓	✓	✗	✗	✗	✓	✗	✓	✓	✓	✓	✗	✗	✓
10	Neelum Valley AJK	*Inulacra leana*	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
11	Neelum Valley AJK	*Jurineadulcoides*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
12	Neelum Valley AJK	*Podophyllumhexandrum*	✓	✓	✓	✗	✓	✗	✗	✗	✓	✗	✗	✗	✓	✗	✗
13	Neelum Valley AJK	*Rheum emodi*	✗	✗	✓	✓	✗	✗	✗	✓	✓	✗	✗	✗	✗	✓	✗
14	Neelum Valley AJK	*Rheum webbianum*	✗	✗	✗	✗	✗	✗	✓	✗	✓	✓	✗	✗	✓	✗	✗
15	Neelum Valley AJK	*Saussurealappa*	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗	✗
16	Neelum Valley AJK	*Taxuswallichiana*	✓	✗	✗	✓	✗	✗	✗	✓	✓	✓	✗	✓	✗	✗	✗
17	Neelum Valley AJK	*Valerianajatamansi*	✗	✗		✓	✗	✗	✗	✗	✓	✓	✓	✗	✗	✓	✗
18	Chitral	*Valeriana jatamansi*	✗	✗	✗	✓	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗	✗
19	Chitral	*Saussurea spp*	✓	✗	✓	✓	✗	✗	✗	✗	✗	✓	✓	✓	✗	✗	✗
20	Chitral	*Paeoniaemodi*	✗	✗	✗	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗
21	Chitral	*Podophyllumhexandrum*	✗	✗	✓	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
22	Chitral	*Morchellaspp*	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✓	✗
23	Chitral	*Aesculus indica*	✗	✓	✗	✓	✗	✗	✗	✗		✓	✓	✗	✓	✓	✗
24	Chitral	*Allium barszewskii*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗
25	Chitral	*Anthemis cotula*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
26	Chitral	*Buxusn persicum*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗
27	Chitral	*Delphinium nordhagenii*	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
28	Chitral	*Ferula narthex*	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
29	Chitral	*Paeonia emodi*	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
30	Chitral	*Pinus gerardiana*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✓	✗	✓	✗	✗	✗
31	Chitral	*Aesculus Indica*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✓	✓	✗	✗
32	Chitral	*Anthemis cotula*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✓	✗	✗
33	Chitral	*Buxusn persicum*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗
34	Chitral	*Delphinium nordhagenii*	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
35	Chitral	*Ferula narthex*	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
36	Chitral	*Paeonia emodi*	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
37	Himalaya	*Acorus calamus*	✓	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✓	✓
38	Himalaya	*Aconitum ieave*	✗	✓	✗	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗
39	Himalaya	*A. violaceum*	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
40	Himalaya	*Berberis lyceum*	✓	✓	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✓	✗	✓
41	Himalaya	*Ephedra gerardiana*	✓	✗	✗	✗	✗	✗	✓	✗	✓	✓	✓	✓	✗	✗	✗
42	Himalaya	*Hyoscyamus niger*	✗	✗	✓	✓	✗	✗	✗	✓	✓	✓	✓	✗	✓	✗	✗
43	Himalaya	*Morchella esculenta*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗
44	Himalaya	*Corydalis govaniana*	✗	✓	✓	✓	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗
45	Himalaya	*Dioscorea deltoidea*	✓	✗	✗	✗	✓	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗
46	Himalaya	*Podophyllum hexandrum*	✗	✗	✓	✓	✗	✗	✗	✗	✗	✓	✗	✓	✗	✗	✗
47	Himalaya	*Valeriana jatamansi*	✗	✗	✗	✓	✗	✗	✗	✗	✓	✓	✓	✗	✓	✗	✗
48	Himalaya	*Colchicum luteum*	✗	✓	✗	✓	✗	✗	✓	✗	✓	✓	✓	✗	✗	✗	✗
49	Himalaya	*Paeonia emodi*	✓	✗	✗	✓	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗
50	Himalaya	*Rheum webbianum*	✗	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗	✓	✗
51	Himalaya	*Taxus wallichiana*	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✓

S. No	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
52	Himalaya	*Saussurea lappa*	✓	x	✓	✓	x	x	x	x	x	✓	✓	✓	x	x	x
53	Himalaya	*Atropa belladonna*	x	x	x	x	x	x	x	x	✓	✓	✓	x	x	x	x
54	Himalaya	*Rheum brassicum*	x	✓	x	✓	x	x	x	x	✓	✓	✓	x	x	x	x
55	Himalaya	*Bergenia ciliata*	✓	x	x	x	x	✓	x	x	x	x	x	x	x	x	x
56	Himalaya	*Viola serpens*	✓	x	✓	x	x	x	x	x	x	✓	x	x	x	x	x
57	Himalaya	*Geranium wallichianum*	✓	✓	x	✓	x	x	x	x	x	x	x	x	✓	x	x
58	Himalaya	*Bunium persicum*	x	-	x	✓	x	x	x	x	x	x	x	✓	x	x	x
59	Himalaya	*Arnebia spp*	✓	✓	-	✓	x	-	✓	-	x	-	x	x	✓	x	x
60	Himalaya	*Rheum emodi*	✓	✓	-	-	x	x	x	x	x	x	✓	x	-	x	x
61	Himalaya	*Thymus serphyllum*	x	✓	✓	✓	x	x	-	x	x	✓	✓	x	✓	x	x
62	Himalaya	*Hypericum perforatum*	x	-	x	x	x		x				✓	x	✓	x	x
63	Himalaya	*Polygonatum multiflorum*	x	✓	x	-	x	x		-	x	✓	x	x	✓	x	x
64	Himalaya	*Asparagus adscendens*	x	✓	x	✓	✓	x	x		x	✓	x	x	x	x	x
65	Himalaya	*Pinus gerardiana*	x	x	-	✓	x	-	x	x	x	✓	x	✓	x	x	x
66	Malakand	*Acacia Modesta*	x	x	x	✓	x	x	x	x	x	x	✓	✓	✓	x	x
67	Malakand	*Acacia nilotica*	✓	x	x	✓	x	x	x	x	x	x	x	✓	✓	x	✓
68	Malakand	*Asparagus plumosus*	x	x	x	✓	x	x	x	x	x	x	x	x	✓	x	x
69	Malakand	*Bauhinia variegata*	x	✓	x	✓	x	x	✓	x	x	✓	x	x	✓	x	✓
70	Malakand	*Berberis lycium*	✓	✓	x	✓	x	x	x	x	x	x	✓	x	✓	x	✓
71	Malakand	*Calotropis procera*	x	✓	✓	✓	x	x	✓	x	x	✓	✓	x	x	x	x
72	Malakand	*Olea ferruginea*	✓	x	x	x	x	x	x	x	x	x	x	✓	x	x	✓
73	Malakand	*Pinus roxburgii*	✓	✓	x	✓	x	x	x	x	✓	x	x	x	✓	✓	x
74	Malakand	*Phoenix dactylifera*	✓	x	✓	✓	x	x	x	x	x	✓	x	✓	x	x	✓
75	Malakand	*Rhazya stricta*	✓	x	✓	x	✓	x	x	x	x	x	✓	x	x	x	x
76	Malakand	*Viola canescens*	x	✓	✓	x	x	x	x	✓	✓	x	x	x	x	x	x
77	Malakand	*Ziziphus nummularia*	x	✓	✓	x	x	✓	x	x	x	x	x	✓	x	x	✓
78	Malakand	*Morchella esculenta*	x	x	x	x	x	x	x	x	x	✓	✓	x	x	✓	x
79	Malakand	*V. serpens*	x	✓	✓	x	x	x	x	✓	x	x	x	x	x	x	x
80	Malakand	*Acorus calamus*	x	x	x	✓	x	x	x	x	x	x	x	x	✓	x	✓
81	Malakand	*Taraxacum dubium*	✓	x	✓	x	x	x	x	x	x	x	x	x	x	x	x
82	Malakand	*Lotus corniculatus*	x	x	x	x	x	x	x	x	x	x	✓	✓	✓	x	x
83	Malakand	*Zanthoxylum armatum*	✓	x	✓	x	x	x	x	x	x	x	x	x	✓	x	✓
84	Swat	*Morchella esculenta*	x	x	x	✓	x	x	x	x	x	✓	✓	x	x	✓	x
85	Swat	*Viola biflora*	✓	x	✓	x	x	x	x	x	x	✓	x	x	x	x	x
86	Swat	*Podophyllum hexandrum*	x	x	✓	✓	x	x	x	x	x	✓	x	x	x	x	x
87	Swat	*Valeriana wallichi*	x	x	✓	✓	x	x	x	x	✓	✓	✓	x	x	x	x
88	Swat	*Berberis lycium*	✓	✓	x	✓	x	x	✓	x	x	x	✓	x	✓	x	✓
89	Swat	*Valeriana jatamansi*	x	x	x	x	x	x	x		✓	✓	x	x	x	x	x
90	Swat	*Saussurea spp*	✓	x	✓	✓	x	x	x	x	x	✓	✓	✓	x	x	x
91	Swat	*Fagonia cretica*	x	x	x	✓	✓	x	x	x	x	x	✓	x	x	x	x
92	Swat	*Podophyllum emodi*	x	x	x	✓	x	x	x	x	x	x	x	x	x	x	x
93	Swat	*Morchella spp*	x	x	x	x	x	x	x	x	x	✓	x	x	✓	x	x
94	Swat Kohistan	*Bergenia ciliata*	x	✓	✓	✓	x	x	x	x	x	x	✓	x	x	x	x
95	Buner	*Valeriana jatamansi*	x	x	x	x	x	x	x	x	✓	✓	✓	x	✓	x	x
96	Buner	*Saussurea spp*	✓	x	✓	x	x	x	x	x	x	✓	✓	✓	x	x	x
97	Buner	*Fagonia cretica*	x	x	x	✓	✓	x	x	x	x	x	✓	x	x	x	x
98	Buner	*Podophyllum emodi*	x	x	✓	✓	x	x	x	x	x	✓	x	x	x	x	x
99	Buner	*Morchella spp*		x				x		x		✓		x	✓	x	x
100	Islamabad	*Asparagus adscendens Roth*	x	✓	x	✓	x	x	x	x	x	✓	✓	x	x	x	x
102	Narowal Punjab	*Buxus wallichiana*	✓	x	x	✓	x	x	x	x	x	✓	x	✓	x	x	x
103	Kotli AJK	*Fumaria indica*	x	✓	x	✓	x	x	x	x	x	x	x	x	✓	x	✓

Table 3.5 Showing medicinal and commercial values of threatened medicinal plant species of Pakistan

Key: (Medicinal Value) 1=ENT, 2=Skin, 3=General Infection/Weakness, 4=Stomach/Intestinal disorders, 5=Gyneacological disorders, 6= Antidiabetic, 7=Cardiovascular diseases, 8= Anticancer, 9= Renal disorders, 10= Neurological disorders, 11= Muscular/ Skeleton disorders.

(Commercial Value) 1= Fuelwood/fodder, 2= Cosmetic, 3=Edible, 4= Furniture/Tools

3.6 Rare Medicinal Plant Species of Pakistan

The present study has shown that there are total 48 numbers of rare medicinal plants found in different areas of Pakistan including Swat (14), Soone Valley (12), Azad Jammu and Kashmir (7), Barroha (3), Manga (3), BharaKahu (3), Salt Range (1), Abbotobad (1), Himalayan (1) and Balochistan (1)

In **Swat,** *Cuminum cyminum, Rheum austral, Thymus linearis Bunium persicum Skimmia laureola, Plantago lanceolatum, and Viola biflora* are few of the rare medicinal plant species The specific medicinal values found in these plants include stomach, intestinal and neurological disorders Few of them are important for their commercial properties like as flavoring agent in food and beverages, making aromatic candles and in pickles

Acacia hydaspica, Prosopis juliflora, Dicliptera bupleroid, Fagonia indica, Pagamum harmala, Solanum incanum and *Withania somnifera* are few of the rare medicinal plant species found in **Soone Valley** Their medicinal properties include ear nose and throat infections, skin problems, neurological disorders and stomach and intestinal disorders Some of them possess commercial value like *Solanum incanum* is used in soap making and tanning of leather, wood of *Prosopis juliflora* is used in furniture making and *Acacia nilotica* is used as fodder, cosmetic and furniture making

Taraxacum officinale, Achilleam illefolium, Cynoglossum lanceolatum Forssk, Diospyros lotus , Ailanthus excelsa, Morus alba ,and *Olea ferruginea Royle* the rare medicinal plant species of **Azad Jammu and Kashmir** which are used for treating diseases related to skin, ear , nose, throat, nervous and muscular system Their commercial importance includes fodder and fuel wood, cosmetic industry and furniture making **BharaKahu, Maanga and Barroha** are the

neighboring areas lies in Islamabad *Adiantum insicum Forssk, Calotropis procera* and *Cassia fistula* are the medicinal plant species rarely found in these areas and are used for curing problems like skin inflammation, stomach and intestinal disorders, cardiovascular problems and muscular problems They do not have any commercial importance

Rare medicinal plant species of **Salt Range of Pakistan** are *Tecom aundulata, Pistacia integrimma, Monotheca buxifolia* having medicinal value used for curing skin problems, stomach and intestinal disorders and renal diseases *Pistacia integrimma* is also used commercially as root stock for pistachio nut and *Monotheca buxifolia* as fodder and timber specie

Prunus amygdalus, Verbascum scrophulariaceae and *Olea ferruginea* are the rare medicinal plant species found in **Himalaya, Abbottabad** and **Baluchistan** respectively Specifically they are medicinally used for treating stomach and intestinal disorders Commercially they are used as fodder species and in cosmetic industry

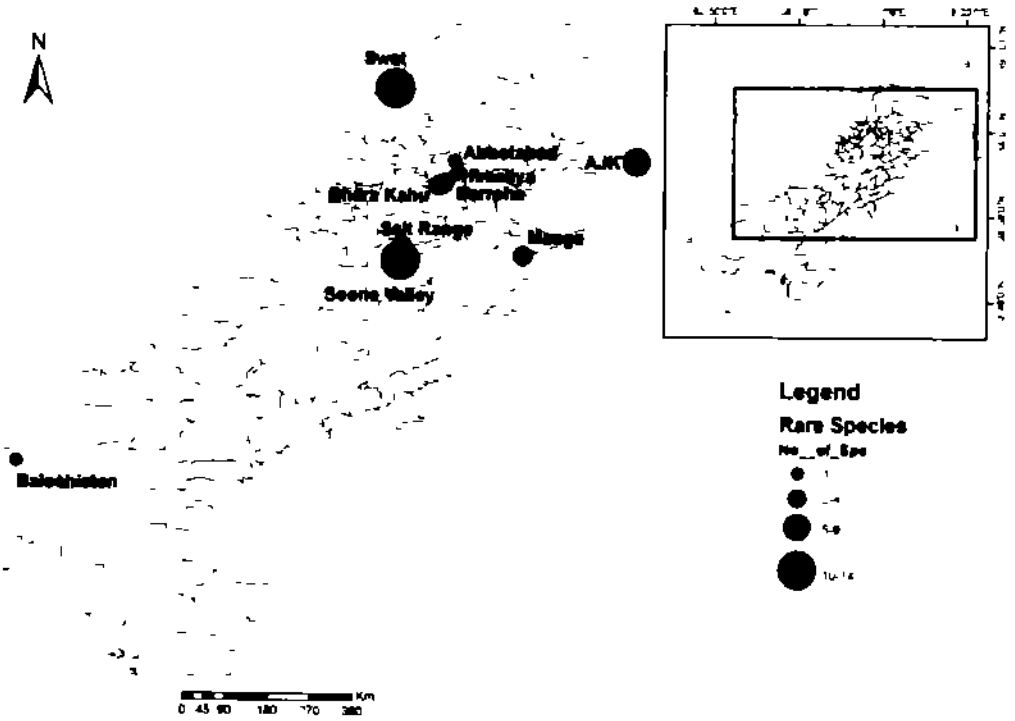

Fig 3.9 : Map showing the areas having rare medicinal plant species of Pakistan

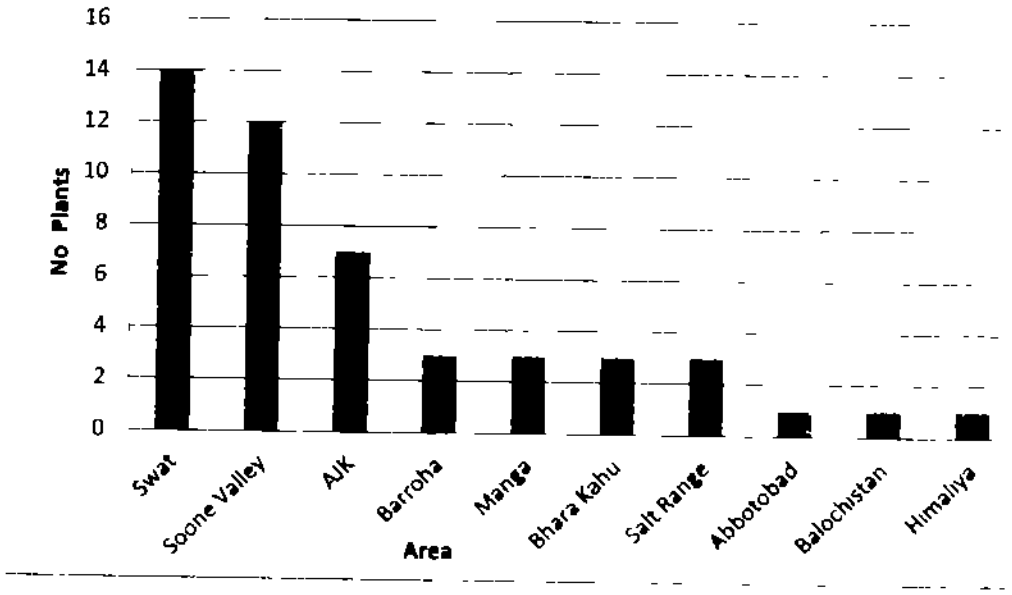

Fig 3.10 Graph showing the number of rare medicinal plant species in different areas of Pakistan

S No	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
1	Sharda, Neelum Valley AJK	*Taraxacum officinale L*	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Sharda, Neelum Valley AJK	*Achillea millefolium L*	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	
3	Sharda, Neelum Valley AJK	*Cynoglossum lanceolatum Forssk*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
4	Sharda, Neelum Valley AJK	*Diospyros lotus L*	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
5	Sharda, Neelum Valley AJK	*Ailanthus excelsa Roxb exWilld*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	Sharda, Neelum Valley AJK	*Morus alba L*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
7	Sharda, Neelum Valley AJK	*Olea ferruginea Royle*	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓
8	Swat	*Bergenia ciliata*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9	Swat	*Cuminum cyminum*	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
10	Swat	*Morchella esculenta*	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
11	Swat	[illegible]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12	Swat	*Skimmia laureola*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
13	Swat	*Thymus linearis*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
14	Swat	*Bunium persicum B*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
15	Swat	*Morchella esculenta*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
16	Swat	*Mentha longifolia L Huds*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17	Swat	*Thymus linearis Benth*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
18	Swat	*Plantago lanceolata L*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
19	Swat	*Viola biflora L*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
20	Swat	*Ficus* [illegible] *ex Roxb*	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		
21	Swat Kohistan	*Geranium Wallichianum*	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
22	Barrila	*Adiantum incisum Forssk*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
23	Barrila	*Calotropis procera*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
24	Barrila	*Cassia fistula*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		
25	Maanga	*Adiantum incisum Forssk*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
26	Maanga	*Calotropis procera*	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
27	Maanga	*Cassia fistula L*	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
28	Bhara Kahu	*Adiantum incisum Forssk*		✓	✓	✓	✓			✓			✓	✓	✓	✓	✓
29	Bhara Kahu	*Calotropis procera*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
30	Bhara Kahu	*Cassia fistula L*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
31	Abbottabad	*Verbascum scrophulariaceae*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
32	Balochistan	*Olea ferruginea*	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
33	Salt Range	*Tecoma undulata*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
34	Salt Range	*Pistacia integerrima*	✓		✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
35	Salt Range	*Monotheca buxifolia*	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓
36	Himalaya	*Prunus amygdalus L*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
37	Soone Valley	*Acacia Hydaspica*	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
38	Soone Valley	*Acacia nilotica*	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
39	Soone Valley	*Prosopis cineraria*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
41	Soone Valley	*Buxus Papillosa*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
41	Soone Valley	*Dicliptera bupleuroides*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
42	Soone Valley	*Fagonia indica*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
43	Soone Valley	*Mentha longifolia*	✓		✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
44	Soone Valley	*Peganum harmala*	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓
45	Soone Valley	*Solanum incanum*	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
46	Soone Valley	*Sophora tomentosa*	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
47	Soone Valley	*Withania somnifera*		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
48	Soone Valley	*Adiantum capillus veneris*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 3.6 Showing medicinal and commercial values of rare medicinal plants in Pakistan

Key. (Medicinal Value) 1=ENT, 2=Skin, 3=General Infection/Weakness, 4=Stomach/Intestinal disorders, 5=Gynecological disorders, 6= Antidiabetic, 7=Cardiovascular diseases, 8= Anticancer, 9= Renal disorders, 10= Neurological disorders, 11= Muscular/ Skeleton disorders.

(Commercial Value) 1= Fuelwood/fodder, 2= Cosmetic, 3=Edible, 4= Furniture/Tools

3. 7 Vulnerable Medicinal Plant Species of Pakistan

According to the results total 50 numbers of vulnerable medicinal plants have been found in different areas of Pakistan Swat has the highest number i e 17, 6 in Malam Jabba, 11 in Azad Jammu and Kashmir, 3 in Upper Siran, 2 in Islamabad and 1 in Abbottabad (Fig 4 1*)*

Aconitum hreterophyllum, Aconitum violaceum, Adiantum venestum, Berberis lyceum, Colchicumluteum, Bunium persicum and *Epehdra intermedia* are few of the vulnerable medicinal plant species found in **District Swat.** They are specifically used to treat ear nose and throat infections, stomach and intestinal problems, cardiovascular diseases, neurological disorders and muscular and skeleton disorders Commercially they are used in cosmetic industry and in furniture making

Malam Jabba is the capital of Swat District and is rich in biodiversity In Malam Jabba, *Artemisia martima, Bergmia ciliate, Bunium persicum, Dioscorea deltoidea, Paeonia emodi, Podyphyllum hexandrum, Valeriana jatamansi* are few of the vulnerable medicinal plants mainly used for treating stomach and intestinal disorders, neurological disorders and ear, nose and throat infections and commercially as timber species and cosmetic industry

In **Azad Jammu and Kashmir,** Dryopteris *stewartii ,Quercus incana, Quercus hallota, Aesiculus indica , Ajuga bracteosa, Plectranthus rugosus, Acacia nilotica, Eucalyptus camaldulensis ,Impatiens glandulifera, Viburnum cotinifolium and Dryopteris stewartii* are the vulnerable medicinal plants species Their medicinal properties are used mainly curing of skin problems, cardiovascular diseases and neurological problems These plants are used commercially as fodder species and in cosmetic industry

Very few medicinal plant species are found vulnerable in **Islamabad, Upper Siran and Abbotabad** having medicinal value without having any commercial importance In Azad Jammu and Kashmir, appropriate land for agriculture and is very rare and livelihood is supplemented through livestock rearing Pastures and adjacent forest areas being used to meet the requirements of livestock Natural regeneration of medicinal plants is highly affected and is under great negative impact by the annual practice of grass cutting (Qamar et al , 2010) It has been observed plant resources are being consumed on a large scale due to haphazard deforestation in order to acquire cultivated lands, exploitation of plant resources for economic purposes, increased population, improved tourism and increased trends toward industrialization and urbanization (Hamayun et al , 2006) In Malam Jabba the medicinal plant species are vulnerable because of their high medicinal value and will be threatened in future They were widely extended in the area in past but are now limited in a small confined area It has been reported that the loss of biodiversity and reduction of wild natural resources occur due to uncontrolled method of collection (Hassan Sher and Muhammad Al yemini, 2011) Same findings were reported by Lange (1998), stated that people who are involved in the trade and collection of medicinal plants are normally unskilled resulting in damaging of valued medicinal plant species due to non-scientific methods of collection Moreover, damaging harvesting techniques, over extraction and habitat degradation are serious fears to aromatic and medicinal plants in Europe Major reasons behind the vulnerability of medicinal plants in Islamabad are their use in curing various types of illness, rate of their development, extent of consumption and pressure like soil erosion and over grazing and are precisely required to be preserved by regeneration and domestication practices (Shinwari & Khan, 2000)

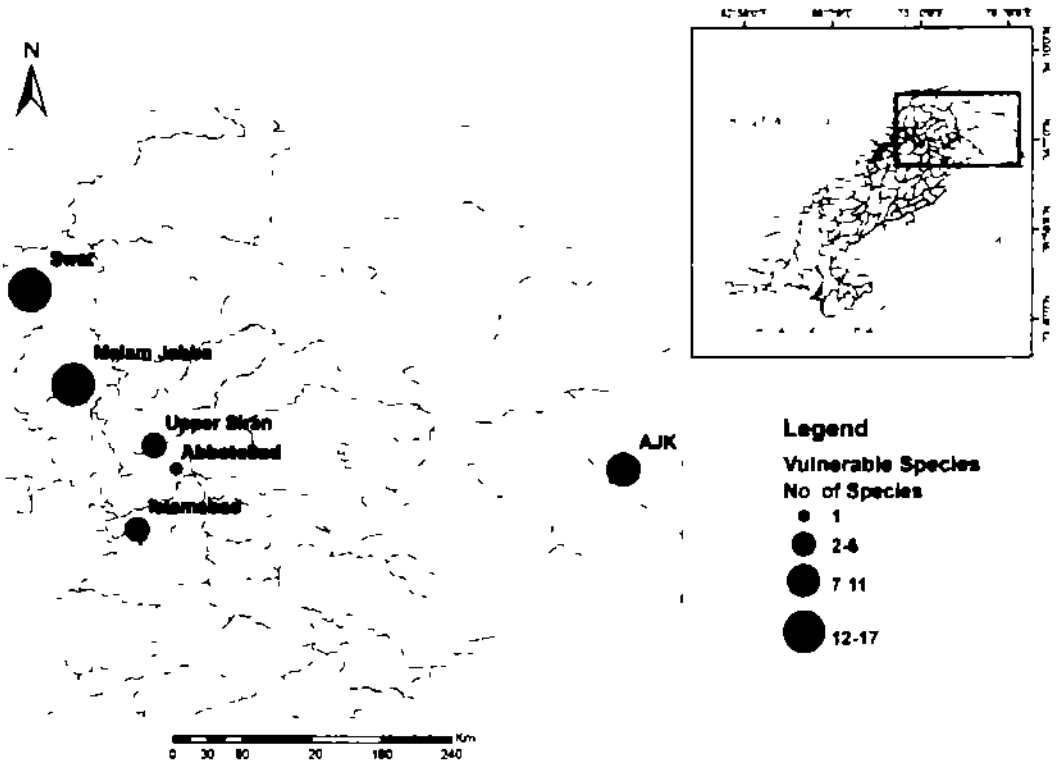

Fig 3.11 : Map showing the areas having vulnerable medicinal plant species of Pakistan

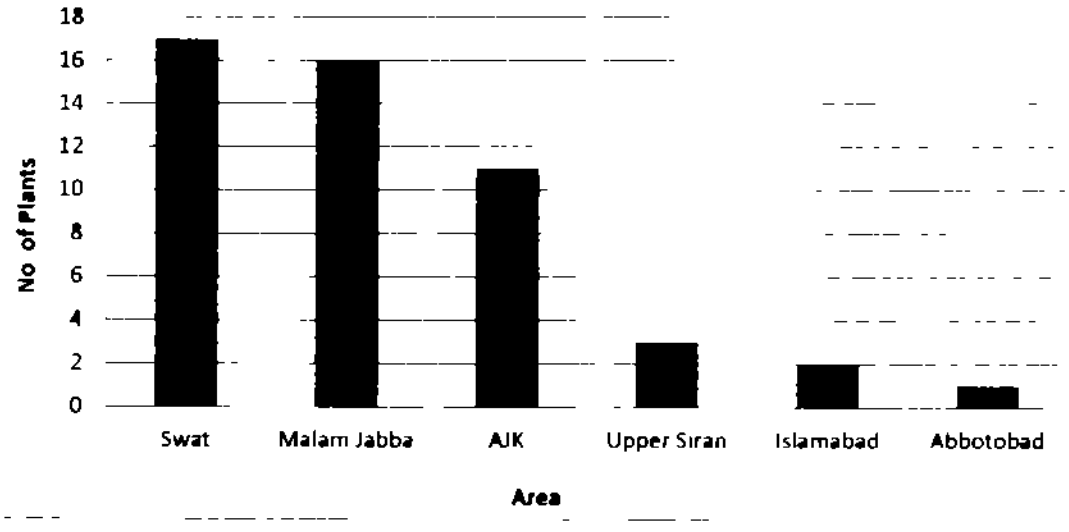

Fig 3 12 Graph showing the number of vulnerable medicinal plant species in different areas of Pakistan

S.No.	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
1	Sharda, Neelum valley, AJK	*Impatiens glandulifera Royle*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Sharda, Neelum valley, AJK	*Viburnum cotinifolium D. Don*	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
3	Sharda, Neelum valley, AJK	*Dryopteris ramosa L.*	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓
4	Sharda, Neelum valley, AJK	*Dryopteris stewartii*	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓	✓
	Sharda, Neelum valley, AJK	[illegible]		✓	✓	✓	✓						✓	✓			
6	Sharda, Neelum valley, AJK	*Quercus baloot Griff. ex DC*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Sharda, Neelum Valley, AJK	*[illegible] Wall. ex. Camb. Hook*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
8	Sharda, Neelum valley, AJK	*Ajuga bracteosa Wall. ex Benth.*	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	
9	Sharda, Neelum valley, AJK	*[illegible] Wall. ex Benth.*	✓	✓	✓	✓	✓				✓	✓	✓	✓		✓	
10	Sharda, Neelum valley, AJK	*Acacia modesta Wall.*		✓	✓		✓					✓	✓	✓	✓		
11	Sharda, Neelum Valley, AJK	*Eucalyptus camaldulensis Hook. f.*	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓	✓	✓
12	Malam Jabba	*Aconitum heterophyllum*	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
13	Malam Jabba	*Artemisia maritima*	✓	✓	✓	✓	✓		✓			✓	✓		✓	✓	✓
14	Malam Jabba	*Bergenia ciliata*	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓
15	Malam Jabba	*Bunium persicum*	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	
16	Malam Jabba	*Dioscorea deltoidea*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
17	Malam Jabba	*Paeonia emodi*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	
18	Malam Jabba	*Podophyllum hexandrum*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
19	Malam Jabba	*Valeriana jatamansi*	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
20	Malam Jabba Swat	*Aconitum heterophyllum*	✓	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓
21	Malam Jabba Swat	*Artemisia maritima*	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
22	Malam Jabba Swat	*Bergenia ciliata*	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
23	Malam Jabba Swat	*Bunium persicum*		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
24	Malam Jabba Swat	*Dioscorea deltoidea*	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	
25	Malam Jabba Swat	*Paeonia emodi*	✓	✓	✓	✓	✓	✓				✓	✓				✓
	Malam Jabba Swat	*Podophyllum hexandrum*	✓	✓		✓	✓					✓	✓		✓		
27	Malam Jabba Swat	*Valeriana jatamansi*	✓			✓	✓	✓				✓					✓
28	Swat	*Aconitum heterophyllum*	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
29	Swat	*Aconitum violaceum*	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓
30	Swat	*Adiantum venustum*	✓	✓		✓	✓			✓	✓	✓	✓		✓	✓	
31	Swat	*Berberis lyceum*	✓		✓	✓	✓			✓	✓		✓	✓	✓		
32	Swat	*Colchicum luteum*	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓
33	Swat	*Bunium persicum*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
34	-	*Ephedra [illegible]*	✓	✓	✓		✓				✓	✓	✓				
35	Swat	*Pistacia integerrima*	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	
36	Swat	*Adiantum capillus veneris L.*	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓		
37	Swat	*Pistacia integerrima*	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓	✓	✓
38	Swat	*Berberis lyceum Royle*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓
39	Swat	*Ephedra gerardiana Wall. ex Stapf*	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓		✓
40	Swat	*Colchicum luteum Baker*	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓
41	Swat	*Aconitum violaceum Jacq. ex Stapf*	✓	✓	✓	✓	✓			✓		✓	✓	✓		✓	✓
42	Swat	*Daphne mucronata Royle*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		
43	Swat Kohistan	*Aconitum heterophyllum*	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
44	Swat Kohistan	*[illegible] amplexicaulis*	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓	✓
45	Upper Swat	*Colchicum luteum*	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓		✓
46	Upper Swat	*Dioscorea deltoidea*	✓		✓	✓	✓				✓	✓	✓	✓		✓	
47	Upper Swat	*Ephedra gerardiana*	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
48	Islamabad	*Asparagus adscendens Roxb.*	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
49	Islamabad	*Viola canescens Wall. Ex Roxb.*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓
50	Abbottabad	*Paeonia emodi*	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓		✓

Table 3.7 Showing medicinal and commercial values of vulnerable medicinal plants in Pakistan

Key: (Medicinal Value) 1=ENT, 2=Skin, 3=General Infection/Weakness, 4=Stomach/Intestinal disorders, 5=Gynecological disorders, 6= Antidiabetic, 7=Cardiovascular diseases, 8= Anticancer, 9= Renal disorders, 10= Neurological disorders, 11= Muscular/ Skeleton disorders.

(Commercial Value) 1= Fuelwood/fodder, 2= Cosmetic, 3=Edible, 4= Furniture/Tools

3.8 Exploited Medicinal Plant Species of Pakistan

According to the results found that in Pakistan some of the medicinal plant species are being exploited specifically in Abbottabad and Cholistan (Fig 3.6). They include *Prosopis cineraria*, *Plantago ovata*, *Cymbopogon jwarancusa*, *Calotropis procer* and *Berberis spp*. The major reason behind their exploitation is medicinal value of these plant species. They are used by local people in treatment diseases related to skin, stomach, heart, nervous system and for general infection like temperature. Commercially they are used as timber species and in tanning industry (Table 3.6). Human existence, grazing and cultivation exert tremendous pressure on the vegetation and results in environmental degradation.

It has been reported that Abbottabad is rich in medicinal plants and the knowledge of medicinal value is restricted to traditional healers and elderly persons, who are living in the rural areas (Abbasi et al., 2010). The medicinal plants are continuously being used by the local people of this area in variety of ways like for food, shelter, treatment of various diseases, fodder and their dependency on the medicinal flora is increasing day by day (Qureshi et al., 2008). The Cholistan Desert can be considered a unique habitat due to its biodiversity (Akhtar and Arshad, 2006). Intensive agricultural practices cause habitat degradation which is a severe risk to the diversity of medicinal valued plant species (Hameed et al., 2011). According to the study the medicinal plants of Cholistan desert have slow growth rates, less population densities and narrow geographic allocations. They are being over exploited continuously and are at great risk of being extinct in future (Kala *et al*., 2004).

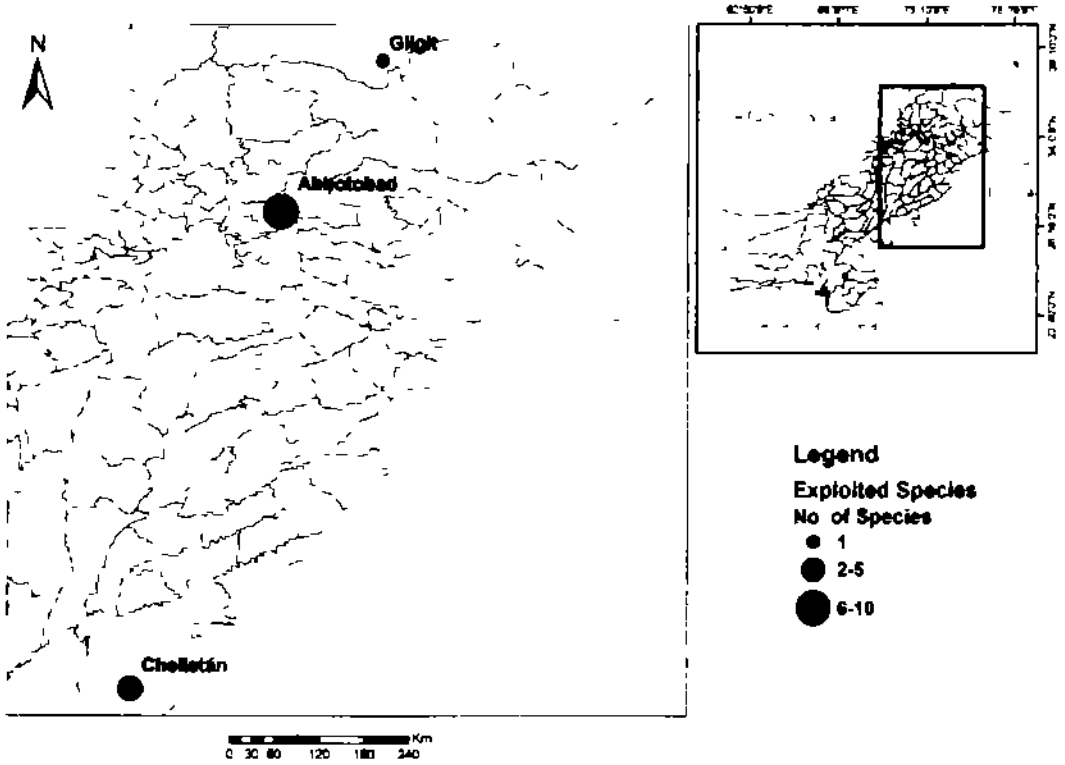

Fig 3.13 Map showing the areas having of exploited medicinal plant species of Pakistan

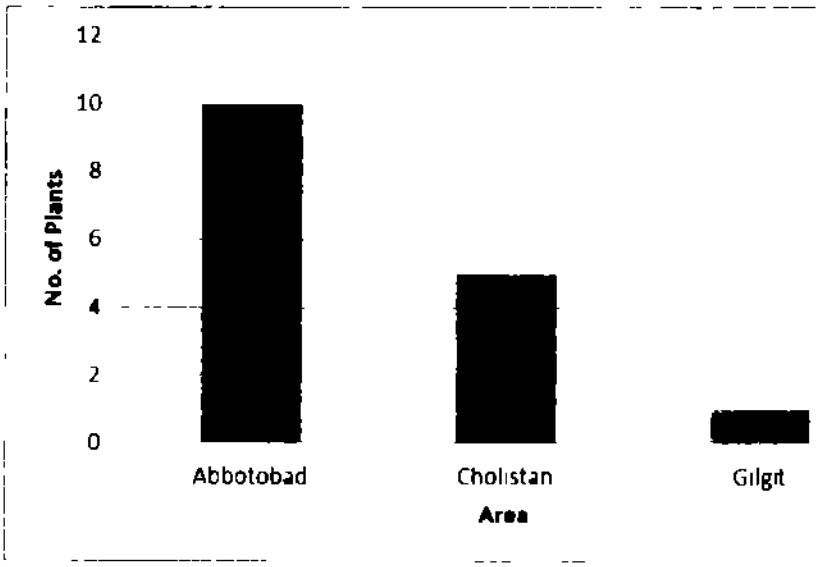

Fig 3.14 Graph showing the number of exploited medicinal plant species in different areas of Pakistan

S No	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
1	Abbottabad	*Ajuga bracteosa*	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
2	Abbottabad	*Argyrolobium roseum*	✗	✗	✗	✓	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗
3	Abbottabad	*Berberis lyceum*	✓	✓	✗	✓	✗	✗	✓	✗	✗	✗	✓	✗	✓	✗	✗
4	Abbottabad	*Justicia adhatoda*	✓	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
5	Abbottabad	*Mentha longifolia*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
6	Abbottabad	*Myrsine Africana*	✗	✓	✗	✗	✗	✗	✓	✗	✓	✗	✗	✗	✗	✗	✓
7	Abbottabad	*Pistacia integerrima*	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
8	Abbottabad	*Punica granatum*	✗	✗	✓	✓	✗	✗	✗	✗	✓	✗	✗	✗	✓	✗	✓
9	Abbottabad	*Trifolium repens*	✓	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✓	✗	✗
10	Abbottabad	*Woodfordia fruticosa*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
11	Chelistan	*Prosopis cineraria*	✗	✓	✗	✗	✗	✗	✓	✗	✗	✓	✗	✓	✓	✗	✗
12	Chelistan	*Plantago ovata*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✓	✗	✗
13	Chelistan	*Cymbopogon jwarancusa*	✗	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
14	Chelistan	*Calotropis procera*	✓	✓	✓	✓	✗	✓	✗	✗	✗	✓	✗	✓	✓	✗	✗
15	Gilgit	*Berberis spp*	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗

Table 3.8 Showing medicinal and commercial values of exploited plant species in Pakistan

Key: (Medicinal Value) 1=ENT, 2=Skin, 3=General Infection/Weakness, 4=Stomach/Intestinal disorders, 5=Gyneacological disorders, 6= Antidiabetic, 7=Cardiovascular diseases, 8= Anticancer, 9= Renal disorders, 10= Neurological disorders, 11= Muscular/ Skeleton disorders.

(Commercial Value) 1= Fuelwood/fodder, 2= Cosmetic, 3=Edible, 4= Furniture/Tools

3.9 Extensively Used Medicinal Plants of Pakistan

The study showed that *Picea smithiana* and *Fraxinus hookeri* are extensively used medicinal plant species found in **Gilgit.** *Picea smithiana* is used for treating diseases related to skin, throat and general infection (fever and body pain) It is also used commercially for making of gum, resin and charcoal Wood is used for furniture making *Fraxinus hookeri* is specifically used for treating typhoid fever and pneumonia and its wood is used for making agriculture tools and as fuel purpose The major reason of their extensive use in the area is because of their rich medicinal and commercial value It has been observed that number of shrubs and trees have been over exploited for fuel and other commercial purposes by the local people (Khan &Khatoon, 2007)

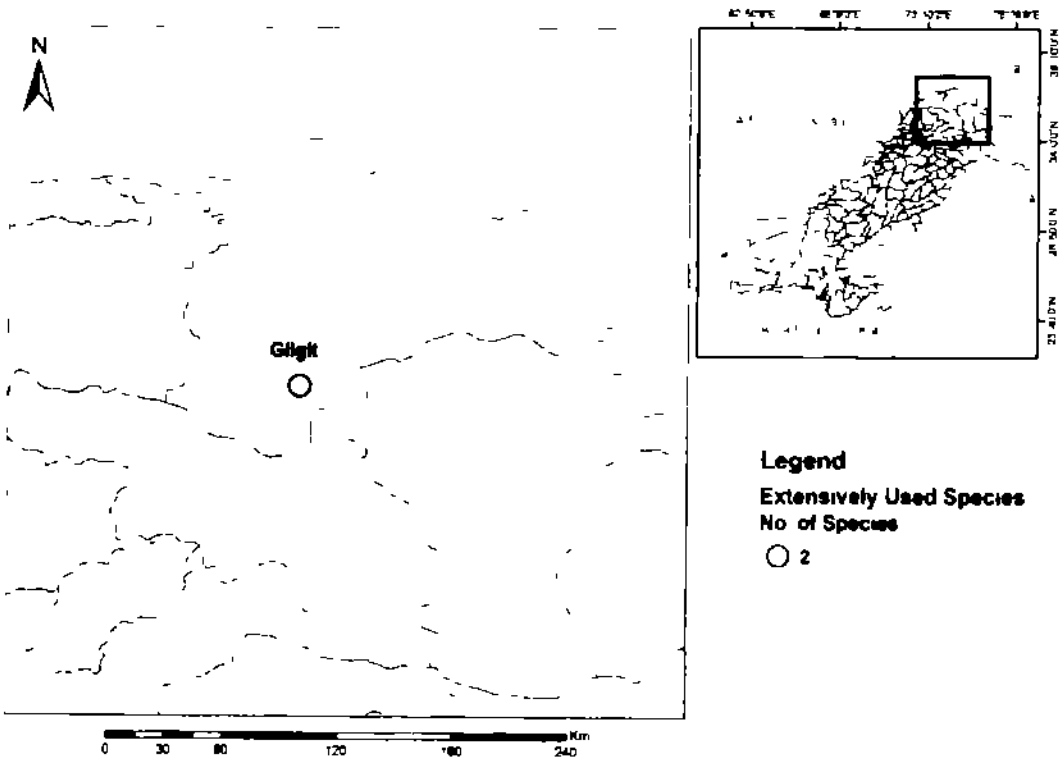

Fig 3.15 Map showing the areas having extensively used medicinal plant species of Pakistan

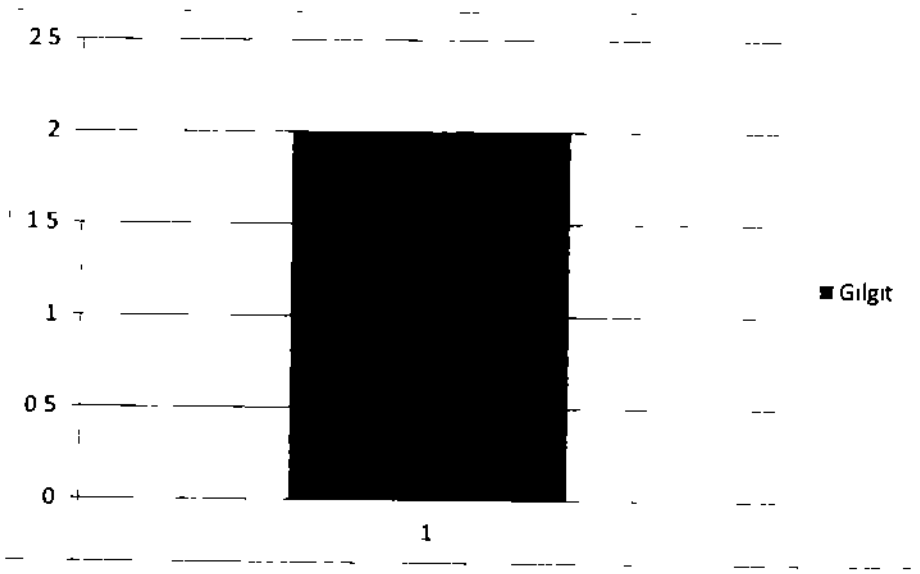

Fig 3 16 Graph showing the number of extensively used medicinal plant species in different areas of Pakistan

S. No.	Area	Plant Species	Medicinal Value											Commercial Value			
			1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
1	Gilgit	*Prunus armeniaca*	✓	✓	✓	x	✓	x	x	x	x	✓	x	x	✓	✓	✓
2	Gilgit	*Prunus kooleri*	x	x	✓	x	x	x	x	x	x	x	x	✓	x	x	✓

Table 3.9 showing the medicinal and commercial value of extensively used medicinal plant species in Pakistan

Key: (Medicinal Value) 1=ENT, 2=Skin, 3=General Infection/Weakness, 4=Stomach/Intestinal disorders, 5=Gynecological disorders, 6= Antidiabetic, 7=Cardiovascular diseases, 8= Anticancer, 9= Renal disorders, 10= Neurological disorders, 11= Muscular/ Skeleton disorders

(Commercial Value) 1= Fuelwood/fodder, 2= Cosmetic, 3=Edible, 4= Furniture/Tools

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