Chapter 2
Status of Natural Resources in the Uplands of the Swat Valley Pakistan

Habib Ahmad, Münir Öztürk, Waqar Ahmad and Shujaul Mulk Khan

2.1 Introduction

Swat is the focal point of the Hindu Kush Himalayan region of Pakistan and enjoys a central position in the trans-Hindu Kush Himalayan socioeconomic development activities. It is known for its natural beauty and some of the world's concerned biodiversity resources. It spreads over 8220 km^2 of land within 34°30′–3°55′ lat N and 71°45′–72°50′ E. The area can broadly be divided into three physical units, i.e., land, water, and biodiversity. A valley basin, largest among the valleys of the Hindu Kush, represents land of Swat. It is an eolian formation of the Cenozoic era and has highly interrupted the alluvial activities of Swat River. A single watershed of Swat River physically represents the area. The valley has altitudinal variations ranging from 600 m in the south to more than 6000 m in the northern high peaks, and the highest peak being that of Falaksair (6261 m). The area is mainly mountainous and rugged with a wide range of altitudinal variations, ranging from mild relief in the southern parts to very steep relief and high altitudes in the north (Jan and Mian 1971). The ridges are predominantly oriented in the north-south direction. Phytogeographically, most of the area of the valley comes under the Sino-Japanese region (Ali and Qaisar 1986; Ahmad and Sirajuddin 1996) with monsoon rains concentrated mostly in summer (Table 2.1), whereas toward the north (Swat Kohistan), the Irano-Turanian region dominates, having very little or no summer monsoon rains.

The word Swat, unless specified, is synonymously used for the area included in the Swat River catchment. The book introduces Swat in historical perspectives of the natural resources with special emphasis on the land, water, and biodiversity.

H. Ahmad (✉) · W. Ahmad
Department of Genetics, Hazara University, Garden Campus Mansehra, Mansehra, Pakistan
e-mail: Drhahmad@gmail.com

M. Öztürk
Science Faculty, Botany Department, Ege University, Bornova, Izmir, Turkey

S. M. Khan
Department of Botany, Hazara University, Garden Campus Mansehra, Mansehra, Pakistan

M. Öztürk et al. (eds.), *Climate Change Impacts on High-Altitude Ecosystems,*
DOI 10.1007/978-3-319-12859-7_2

Table 2.1 Meteorological data obtained from Agriculture Research Institute North Mingora. (Source: Khan and Khan 1993)

S. No.	Month	Temperature (°C)		Relative humidity (%)	Total rainfall (mm)	Wind velocity (km/h)
		Max.	Min.			
1	July	31.64	20.96	77.84	143.0	4.28
2	August	31.67	20.90	82.58	87.4	2.76
3	September	29.67	15.97	74.77	112.4	2.25
4	October	27.27	10.12	70.51	94.3	2.32
5	November	21.98	6.23	67.80	20.5	1.40
6	December	17.40	4.11	76.80	20.5	0.99
7	January	13.35	1.32	81.12	40.8	1.21
8	February	18.80	4.76	71.32	43.8	1.80
9	March	16.329	5.35	72.45	25.5	2.37
10	April	26.21	11.76	63.76	90.2	3.14
11	May	31.35	16.25	54.41	26.9	4.47
12	June	32.71	18.9	58.50	54.2	1.84
Monthly averages		24.86	11.39	71.16	64.64	2.4

2.2 Administrative Boundaries

The southern extreme of the valley comes under the administrative control of Malakand Agency and Dir district on the left and right banks of the Swat River, respectively. More than 87% of the area of the valley comes under the administrative control of Swat district. The area is bounded at all sides by the lofty Hindu Raj Mountains and is drained by a single watershed, i.e., the meandering river of Swat originating in the high mountains to the north >6000 m.

2.3 Population

Historical reviews supported by archeological evidence show that the Swat valley was inhabited by men in the prehistoric era between 2400 and 2100 BC (Ali and Khan 1991; Stacule 1969). It remained under the powerful domains of a variety of civilizations, the most prominent among which is the Gandhara civilization reported by the well-known Chinese travelers Fa Hien, Song Yun, Hiuen Tsang, and Wiking in the fifth to eighth century AD (Shah 1940; Hussain 1962; McMahon and Ramsay 1901). Fa Hien, who visited Swat area in AD 403, gave its name "Won-Chang" in Chinese, and "park" in English (McMahon and Ramsay 1901). He wrote that the language of the Swat people was similar to that spoken by the people in central India (McMahon and Ramsay 1901). Swat remained for more than 1000 years under Buddhist and Brahmin whose engravings are still preserved on rocks in various parts of the district.

Swat district occupies more than 87% of the area included in the Swat valley. It has a population of more than 1.25 million individuals with a growth rate of 3.9% and in migration of 3.2%. Having been regarded as "an ideal place in summer for kings" (Khalil 1986), it is visited by thousands of tourists from the country and abroad. Its pleasing environment in the hot summer, the chilling water of river Swat, the scenic beauty of its landscape, and the widespread archeological sites provide much attraction to the tourists.

The district is inhabited by three ethnic groups (Barth 1956), i.e., Pathans, Gujars, and Kohistanis. Pathans, who are mainly Yousafzai by descent (McMahon and Ramsay 1901; Hussain 1962; Bellew 1994), depend mainly upon agriculture. They occupy plains, generally extending to a critical ecological threshold of supporting two crops per year. The climate of the valley is generally hot in summer. Vegetation in the area occupied by Pathans is highly degraded scrub.

Gujars, the Indian Aryans (Bowles 1977; Anonymous 1978), are the original inhabitants of the area (Bellew 1994). They generally use the foothills for agriculture and the highland meadows as grazing pastures. Though highly defused among Pathans, they exclusively occupy the mountain slopes and high-altitude areas. These areas comprise forests. The climate is cold, supporting monocrop agriculture at high altitudes of 1900 m and above.

Kohistanis are Dardic in origin (Barth 1956). They have been concentrated in the northern mountain gorges of Swat Kohistan. They mainly occupy areas beyond the reach of monsoon, generally of the subhumid to dry temperate zone. They practice both agriculture and livestock herding. Their area is cold and supports monocrop culture. Transhumance is observed in some of the highland Gujar and Kohistani tribes, whereas the tribal movements of Pathans (*garzenda wesh*) came to an end in 1932 (Barth 1995).

Both the Gujars and Kohistani are fluent in speaking Pukhto, the local Pathan language, besides their mother tongues, Gojri and Kohistani, respectively. Presently, the Swiss-sponsored "Kohistan Integrated Development Project" has greatly improved the Kohistani economy through the development of social organizations and the extension of improved agricultural technologies, especially the off-season vegetables culture. A sketch of the geographical boundaries of the valley is given in Fig. 2.1. Its geophysical and agroclimatic diversity supports the existence of wide variety of terrestrial and aquatic resources of wild and domesticated plants and animals. The area spreads over 8220 km^2 of land within 3430–3555°N and 7145–7250°E. Highly interrupted eolian deposits of Cenozoic origin mainly represent the basin of Swat valley. Its southern extremities come under the administrative control of Malakand Agency and District Dir on the left and right banks of the river Swat, respectively, whereas most of the area of the valley toward the north is included in the Swat district. The area is bound from all the sides by the lofty Hindu Raj Mountains and drained by a single watershed, i.e., the meandering river of Swat originating in the high mountains in the north. The flow of Swat River is mainly determined by the melting snow and ice from March to June and the incident monsoon rains in rest of the year, particularly in July and August. The valley has an altitudinal variation ranging from 600 m in the south to more than 6000 m

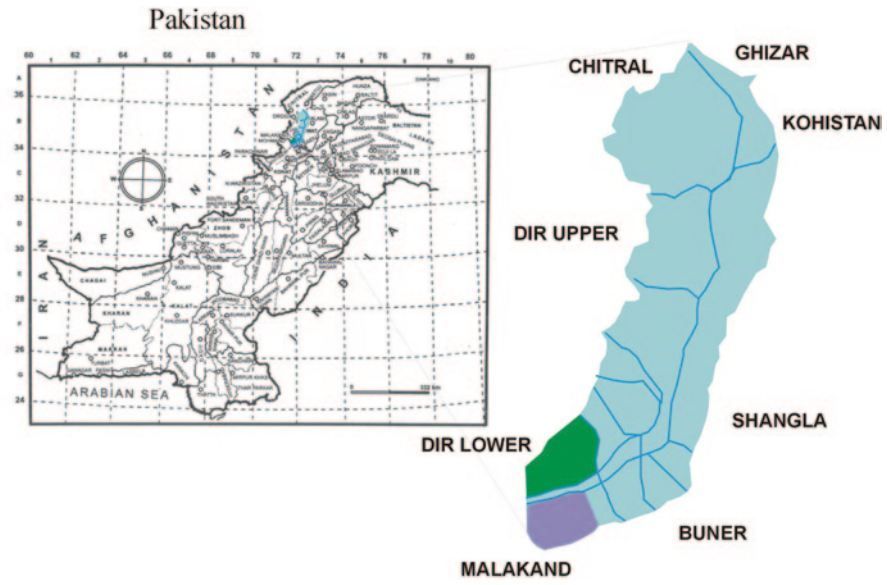

Fig. 2.1 Swat valley, location and administrative boundaries. (Ahmad and Ahmad 2003)

in the north. Mostly the area is rugged, with a wide range of altitudinal variation reaching upto 10,000 ft, within a small distance of 5 miles in the main ridges (Jan and Mian 1971). The ridges are predominantly oriented in the north-south direction. These highly varying topographic conditions affect the flow and thereby the lifestyle of the associated flora and fauna. Geoclimatologically, the Swat River falls under (1) monsoon excluding spating river ecology and (2) the monsoon prevailing sluggish river ecology. The former being restricted to the Kohistan region is represented by trout fish and can therefore be referred to as trout ecology. Whereas the latter that spreads over the entire river in the rest of the valley and is endemic to the *Schizothorax*-associated fish species and can be referred to as non-trout ecology.

Phytogeographically, most of the area of the valley comes under the Sino-Japanese region (Ali and Qaisar 1986; Ahmad and Sirajuddin 1996) with monsoon rains mostly in summer (Table 2.1), establishing a variety of biotic communities within the influence of various temperature and precipitation regimes.

For getting a broader overview of the impact and interaction among physical, chemical, and biological factors, secondary information are reviewed. Details regarding the secondary information is presented in "Reference" section of this chapter. Depending upon the variation in altitude, rainfall, and temperature regimes, the whole catchment is divided into:

- Lower Swat, starting just from Boosaq in the south and extends up to Nagova Spur in the north, prevailing generally over 600–900 m altitudinal ranges.
- Middle Swat, starting from Nagova Spur extending up to Shahgram in the north, generally having more than 900–1400 m altitude.
- Upper Swat, including areas with the altitudinal ranges generally exceeding 1200 m in the side valleys and 1400 m in the main valley of Swat.

- Swat Kohistan, having an altitudinal range of 1500–6000 m, within the prevailing subhumid to dry temperate type of climate.

Floristically, whole of the catchment is broadly divided into the artificial and natural type of forests. Further classification for each of these types is based upon the land-use system in the case of artificial forests and the evident climax vegetation in the case of natural forests. Climatically, the catchment was broadly divided into subtropical, temperate, alpine, and cold desert agroclimatic zones. The land-use system in each of these zones with regard to the cropping pattern, farming system, and the associated wildlife is discussed zone-wise. Direct field observations were made for recording floral and faunal diversity. Historical evidences with regard to the biodiversity situation were reviewed and the impacts of most important ecological factors on the biodiversity situation were elucidated. The direct and indirect role of a man, who is the highly skilled and most important among ecological factors, is also reported separately.

Ecologically, the Swat River was divided into "the torrent trout type" and "the sluggish non-trout type" of ecologies. Both the floral and faunal distribution in each ecological type is described separately. The role of Swat River as a resource base, for variety of socioeconomically productive systems of Khyber Pakhtunkhwa (KP), together with its role as a sink for absorbing and converting the household, agricultural, municipal, and industrial refuse into the precious bioproducts, is elucidated. For limnological aspects, the findings of Ahmad (1999) are reproduced as such.

2.4 Population and Ethnoecology

Historical reviews supported by the archeological evidence show that the valley of Swat was inhabited by men during the protohistoric era of 2400–2100 BC and remained under the powerful domains of variety of civilizations, the most prominent among which is the Gandhara civilization reported by the well-known Chinese travelers Fa Hien, Song Yun, Hsien Tsang, and Wiking in the fifth to eighth century AD (Shah 1940; Hussain 1962; McMahon and Ramsay 1901; Wylly 1998). Fa Hien, who visited Swat area in AD 403, reported its name as "Won-Chang" in Chinese, synonymous to "park" in English and "Udyana" in Sanskrit (McMhon and Ramsay 1901). He also reported that the language of the people of Swat was similar to that spoken by the people in central India (McMahon and Ramsay 1901). Swat remained for more than 1000 years under Buddhist and Brahmin maharajas whose engravings are still preserved on rocks in various parts of the valley. Presently, the area is occupied by more than 1.7 million individuals (Table 2.2), separated into three distinct ethnic groups (Barth 1956), i.e., Pathans, Gujars, and Kohistanis, exploiting different ecological niches and sharing the resources symbiotically. Pathans mainly depend upon agriculture and exploit the deep soil of the alluvial plains generally with irrigation systems. The climate in the plains is rather hot in summer, and generally, two crops a year are harvested from their fields. Vegetation of the Pathans exploiting ecology is generally scrubby.

Table 2.2 Population of Swat valley according to 1998 census

S. No.	Administrative unit	Population	Percentage
1	District Swat	1,249,572	72.03
2	Batkhela Tehsil	247,441	14.16
3	Chakdara Tehsil	235,920	13.80
Total		1,734,933	99.99

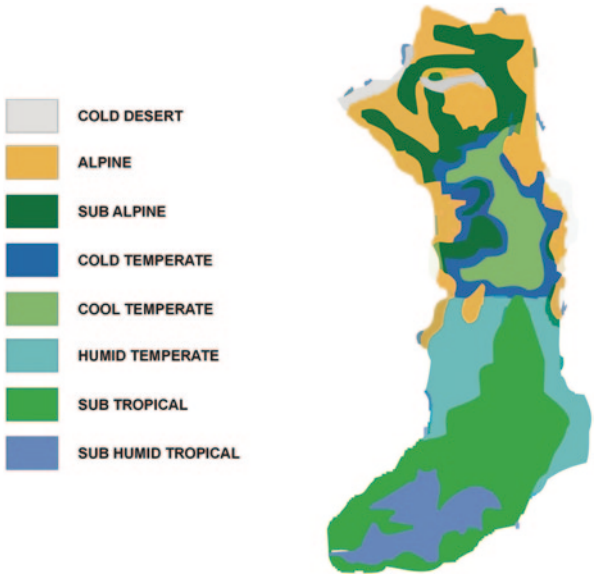

Fig. 2.2 A sketch of the major climatic zones in Swat valley

Gujars, though highly defused among Pathans, exclusively occupy the foothills and high-altitude areas. They practice both agriculture and livestock herding. They mostly comprise forest-associated communities and generally occupy colder climate, mostly supporting the monocrop culture.

Kohistanis are concentrated in the northern mountain gorges of Swat Kohistan. They mainly occupy the monsoon-excluded ecology of the subhumid to dry temperate nature. They practice both agriculture and livestock herding. Their area is too cold, and one crop in a year is generally cultivated. Presently, the Swiss-sponsored "Kohistan Integrated Development Project" has greatly improved the Kohistanis economy through social organization and the extension of the improved agricultural technology, especially through the introduction of the off-season vegetables in the area.

2.5 Geomorphology

The water into Swat River makes its way across a variety of geophysical formations. These formations not only affect the quality of its water and the associated life-forms but also determine the flow and speed of the river generally. The detailed geological surveys regarding the Swat valley show that various forces during the geological history have resulted in the formation of mountains, plains, and outwash deposits. A brief description of these landforms with special reference to its impact on Swat River is the content of this section.

2.5.1 Mountains

Most of the area of the Swat River catchment is mountainous, categorized into plutonic, sedimentary, volcanic, and metamorphic rocks. The subdivision of rock types commonly met within the area is presented in Table 2.3. It has the extreme relief of more than 10,000 ft in a horizontal distance of only 5 miles (Jan and Mian 1971) in the north and comparatively very mild relief in the south of the valley. The surface of mountains is generally rugged. In the northern part, natural vegetation covers most of the mountains that recharge the flow of local streams and ultimately the Swat River. The extinct of erosion is less here and therefore the turbidity and total

Table 2.3 Petrography of open rocks found in Swat. (Source: Jan and Mian 1971)

S. No.	Formation	Rock types	Probable period of origin
1	Dewangar, Matiltan, Lower Swat, and Malakand	Propyritic granite, granite, at places gneisses	Early to middle Tertiary
2	The Gabral plutonites	Quartz diorites, granites, and minor granodiorites	Early to middle Tertiary
3	The Deshai diorites	Quartz diorides, amphibolite, biotite gneisses, granites, and metagabbros	Early Tertiary
4	The Utrore volcanic	Sillicic to intermediate lavas ignimbrites, tuffs, and agglomerates	Cretopleocene
5	The Kohistan basic complex	Norites, diorites, bands of pyroxenites/anorthosites, granites, and minor amphibolites	Late Cretaceous
6	The Kalam group	Micaceous quartzites, siliceous schist, phyllite, siltstone shale, and limestone	Carboniferous to Siluro-Devonian
7	The Lower Swat, Buner Shiston group	Green schists, phyllitic schists, marble calcareous, and siliceous schists	Middle Paleozoic

dissolved solids (TDS) are very low. The natural forests have good humus and excellent fertility. Whereas in the lower valley (southern part), most of the forests have been uprooted and the mountains have lost the water-retention capacity. Runoff in monsoon rain therefore causes accelerated erosion and landslides and results in severe floods in the plains. It also contributes a variety of rock material and organic matters to the running water and therefore affects the quality of water recurrently.

2.5.2 The Outwash Deposits

Three types of depositions, i.e., colluvial, glacial, and alluvial recognized in the Swat River catchment area are described below.

2.5.2.1 Colluvial Deposits

These deposits resulted from the erosion and disintegration of rock surface. The rock particles of various sizes can be observed in this type of soil. It is generally highly drained and is not preferred for cultivation.

2.5.2.2 Alluvial Deposits

Generally, the deposition of gravels and fine rock materials under the influence of water results in alluvial deposits. The soil of this landform is generally coarse gravely to sandy loam with shallow or moderate depth. Most of the streambeds and their floodplains in the lower and southern parts of the valley are alluvial deposits.

2.5.2.3 Glacial Deposits

These landforms are established under the influence of avalanches. The moving glacier have brought and deposited a variety of organic and inorganic materials, including trees and boulders. The soils thus formed are generally unstratified and can very frequently be observed in the Kohistan area.

2.5.3 The Plains

Wind and water are the major factors responsible for the formation of plains in Swat valley. Four types of plains can be recognized here.

2.5.3.1 The Glacio-Alluvial Plains

These are the plains of minor extent and can only be observed in Swat Kohistan. They are generally formed by the joint activities of avalanches and water flow.

2.5.3.2 The Eolian Plains

These landforms represent the wind-borne deposits, of probably Cenozoic in origin. Its soil is characteristically very deep, fine-grained in texture, yellowish brown in color, and fertile in nature. Locally, this type of soil is referred to as *mata khawra*. Usually, this type of soil is free of gravels. This landform is heavily disrupted by the natural forces like the flow of water, glacial activity, and agricultural activities of men everywhere in the valley. Its uninterrupted pieces can only be observed along the mountain spurs downstream the river in the valley. It is susceptible to erosion and causes increased alkalinity and is the main source of inorganic suspended solids in the river water.

2.5.3.3 The Alluvial Plains

Alluvial soil is waterborne in origin, and its nature and composition is generally determined by rock type, the flow of water, and the distance of parent material from the parent rock to the deposition site.

Alluvial soil is generally shallow to moderately deep or deep over the gravel or stone beds, non-gravely and well drained. The relief of this landform is generally level to mildly undulating. Most of the floodplains of river Swat and its tributaries comprise this landform.

2.5.3.4 Eolio-Colluvial Plains

These land morphs are developed due to the transportation of eolian material through floodwater from one place and depositing it in another place. This type of soil, though quite deep in formation, cannot be stratified vertically. It is brown to dark brown in color, silty loam in texture, slightly alkaline, and represented by the rock material throughout the profile.

2.6 Agroecology and Farming Systems

The Swat River originates mainly in the alpine and flows within a variety of temperate and subtropical agroclimatic zones. A brief description of the zones recognized in the catchment (Table 2.4) is given below.

Table 2.4 Agroclimatic zones in the Swat River catchment. (Source: Ahmad and Ahmad 2003)

S. No.	Zone	Altitude (m)	Land use	Typical areas	Prominent features
1	Subtropical	600–1000	Double cropping, some tropical, and temperate fruits	Most of the area of Chakdara, Batkhela, and Barikot Tehsils	*Acacia modesta, Olea ferruginea,* and *Dodonaea*
2	Humid temperate	1000–1500	Double cropping, temperate fruits, and vegetable	Plains and foothills of Matta, Khwazakhela, and Charbagh Tehsils	*Pinus roxberghii, Quercus incana,* and *Pistacia integerrima*
3	Cool temperate	1500–1900	Double cropping and some temperate fruits	The side valleys, e.g., Miandam, Malam, Sangar, Shawar, Sakhra, and Dabargi	*Pinus wallichiana* and *Quercus dilatata* prominent
4	Cold temperate	1900–2300	Monocropping of potato and maize	Upper limits of the side valleys, e.g., Mianbanr, Sulatnnr, Ushu, and Gabral	*Prunus cornuta, Aesculus indica,* and *Taxus wallichiana*
5	Subalpine	2300–3600	No agriculture, livestock grazing, and forest products	The high-altitude forests of Sham Sar, Spin Sar, Daral, and Ladoo	*Abies pindrow, Picea smithiana,* and *Quercus semecarpifolia*
6	Alpine	3600–4600	Mainly used as grazing pastures and medicinal plants collection	The high-altitude meadows of Loi Pandghalae, Daral Sedgai, Boosaro Sar, and Gabhral	*Juniperus, Sibbaldia, Potentilla, Primulas,* and *Aconites*
7	Cold desert	4600–6000	Sources of perennial flow of the river Swat	High peaks of the Chitral adjoining areas, Falak Ser, and Mankial glaciers	Permafrost glaciers and ice caps

2.6.1 Subtropical Zone

Most of the plains in Lower Swat come under this category. It extends from 600 m in plains of Lower Swat upto 1000 m in plains of the Upper Swat. This zone comes under monsoon range and is characterized by mild winter (Table 2.5) with very little to no snowfall in winter, especially in its upper extremes. Summer is generally hot and humid. Tropical fruits like citrus, guava, mango, and banana can be cultivated here.

The prevalent farming system in this zone is cereal based; mainly rice and wheat is cultivated as kharif and rabi crops, respectively. Tobacco, onions, tomatoes,

Table 2.5 Meteorological data recorded in the subtropical zone

Month	Temperature (°C)				Rainfall (mm)	Humidity at	
	Mean daily		Extremes				
	Max.	Min.	Max.	Min.	Mean total	800 h	1700 h
January	14.7	0.8	20.6	10.0	66.0	84	58
February	17.5	2.5	23.9	−13.9	81.5	76	46
March	21.8	9.4	30.6	−4.0	115.6	74	48
April	28.8	13.8	33.0	0.0	59.7	60	36
May	35.1	19.4	38.1	3.9	13.0	48	30
June	38.0	21.7	41.5	8.3	7.1	43	25
July	36.1	23.8	37.7	11.1	80.3	62	45
August	34.1	23.2	37.4	7.9	87.9	77	59
September	33.8	20.1	33.9	3.3	35.3	73	52
October	30.2	13.8	32.2	0.1	12.2	64	39
November	23.6	7.7	28.0	−7.2	5.1	65	47
December	17.3	3.6	22.4	−9.4	18.8	77	52
Annual total	331.0	159.8	379.3	−9.9	582.2	803	537
Mean monthly	27.58	13.32	31.61	−0.83	48.54	66.92	44.75

citruses, and plums are the main cash crops. Turnip rape and lentil are the main rabi oilseed, and legume crops. Income sources like livestock keeping (mostly stalled buffaloes), fishing in the river network, and jobs in the government and nongovernmental organizations subsidize dependence on agriculture.

2.6.2 Temperate Zone

Temperate zone, which generally prefers the deciduous temperate fruits, is characterized by the prevalent winter snow. Depending upon precipitation, temperature, and altitude, this zone can be divided into the following types.

2.6.2.1 Humid Temperate Zone

Extending up to 1500 m in altitude in the main valley, this zone comes under the heavy summer monsoon rains and receives some snowfall in winter. Haronai valley in Upper Swat and the Swat River plain upto Fatehpur comes under this category. A hot humid summer hits the area generally in July but soon the whether becomes warm in August.

Temperate fruits, especially apples, are the most important crops of this farming system. Wheat, lentil, and turnip rape are the important cereal legumes and oilseeds of rabi, whereas maize and rice, black and green gram, and soya bean and sunflower are the major cereals, legumes, and oilseeds of the kharif. Onion agroforestry, peas, crucifers, and fruit plant nurseries are the internal parts of this farming system, besides livestock, particularly buffaloes.

2.6.2.2 Cool Temperate

This agroecological zone is spread over the side valleys and mountains of mid-altitudes extending upto 1900 m. Its typical examples are met within the habitats like Miandam, Malam Jaba, Peochar, Chail, Charma, Lalkoh, and Doughalgai areas. This zone gets considerable amount of snowfall in winter and heavy monsoon rains in summer. A short and warm summer prevails on this zone. It can generally be traced upto an altitude allowing double cropping system. Maize, potato, and wheat are the important crops of this zone. Buffaloes, cows, goats, and sheep herding is the integral part of this ecosystem. Here the landholding is generally small and the people suffice their livelihood through the products from natural forests.

2.6.2.3 Cold Temperate Zone

This zone occupies the altitude ranging from 1900 to 2300 m forming the dense forest. It can be observed in the areas of Sham Sar, Daral, Sedgai, and Ladoo areas. It occupies the last limit of blue pine and a mixed forest of yew, blue pine, horse chestnuts, bird's cherry, and some Himalayan elms. Forest products and grazing animals are the local practices observed in this agroecosystem. It is also exploited for monocrop agriculture of potatoes or maize.

2.6.2.4 Dry Temperate Zone

Basically, cold temperate in nature, it prevails on most of the area under Swat Kohistan. Areas included in this zone receive little summer monsoon rains and heavy snow in winter. This area comes under a short mild summer and permanent snow cover for up to 6 months in winter. It prefers single-crop culture. Potato or maize intermixed with beans and gourds are the common crops of this forming system. Recently, the off-season vegetable culture on commercial scale has improved the economy of the local people of this farming system. Cows, goats and sheep herding, and poultry rearing integrate the farming system in this area.

2.6.3 Subalpine Pastures

These are the high-altitude plains or south-facing screes, retaining snow for 5–6 months annually. But due to their topographic locations, it can grow bumper crops of potato or maize during the short summers. This type of temperate agroecologies where summer monsoon prevails, monocrop culture is visible upto an altitude of 2300–3600 m and can be observed in the high-altitude forests of Sham Sar, Spin Sar, Daral, and Ladoo. Herding livestock and forest products are the main economic activities of this farming system.

2.6.4 Alpine Zone

Alpine is the highest among agroecological regions of the Swat River catchment. The glacial lakes and a variety of beautiful plants represent it. The short summer, heavy winds, strong light, and little rains allow only highly reduced plants to perennate here. This agroecology can only be observed 3600–4600 m and can be easily seen in Spin Sar in Haronai catchment or Bosaro Sar in the Chail catchment, and Desan in Kohistan.

Crop cultivation is not feasible in the alpine. The alpine is mainly exploited for grazing livestock and the collection of medicinal plants, but only in the summer.

2.6.5 Cold Desert Zone

This ecological zone is represented by the highest peaks above the plant line and is marked by the presence of permafrost, ice fields, and glaciers. These habitats can be observed in the northern high mountains ranging from 4700 to 6261 m in Falakser, the high peaks of Chitral adjoining areas and Mankial series. This zone is solely responsible for the continued perennial flow of Swat River.

2.7 Phytogeography and Vegetation Types

Vegetation of the Swat valley can broadly be divided into artificial and natural type of forests. An overview of both of the types is presented bellow.

2.7.1 Artificial Forests

Man is inhibiting Swat back from thousands of years. Being dependent on the surrounding nature he has always interfered with the natural resources especially

forests; either willingly or unwillingly, directly or indirectly, causing modification in floral composition through selective exploitation, replacement of species and introducing genetically uniform monoclones. The centuries old agriculture has resulted in domestication of new crop species, resulting in to two major types of overlapping artificial forests, i.e., cropland forest and agroforest. Each one of these is separately discussed bellow.

2.7.1.1 Cropland Forest

In Swat the cropland forest can broadly be divided into low-lying type and the monocrop type.

The Low-Lying Cropland

These croplands generally occur between 600 and 1600 m and sometimes even rising upto 1900 m of elevation, where two crops per year are harvested and are placed in the category of low-lying cropland forests. The area occupied by low-lying cropland forests is flat or with a mild relief. It enjoys sufficient irrigation and rains, having highly fertile soil. Two crops per year, i.e., rabi (early summer) and kharif (autumn), are grown here. In rabi, wheat is the commonly cultivated cereal, mostly cultivated on irrigated farms, whereas rapeseed and lens are the common oilseed and legume crops cultivated generally on the rain-fed fields. Barley, clover, oats, and *Lolium* are the important fodder cultivated as mixed crop in kharif fallow and irrigated fruit orchards. Peas, radish, cabbage, cauliflower, onion, and tomato are the important rabi vegetable. Rabi generally extends from November upto June. Kharif, which generally extends from July to October, is cultivated mainly for rice and maize as cereals. French bean, black gram, and green gram are the important kharif pulses. Soya bean and sunflower are the emerging oilseeds. Tomatoes, tobacco, pumpkins, gourds, melons, and okra are the important kharif cash crops.

The Monocrop Forest

Monocrop-type forest generally occurs above 1900 m and reaches upto 2700 m. It is generally established on the high slopes with colder climate. Here, one crop, either maize or potato, is cultivated; besides, some pulse legumes and vegetables are also grown as mixed crop. Recently, the successful introduction of the off-season vegetables in the monocrop ecology has boosted the socioeconomic situation of farmers in Swat.

2.7.1.2 Agroforestry

Agroforestry is a land-use system in which the woody perennials are integrated in the agricultural field for economical, social, or ecological purposes. Being highly productive system of sustainable agriculture, it has recently being established in the valley, though its species composition, genetic uniformity, and production capacity may vary from farmer to farmer and area to area. The production cycle and fluctuation in the market prices make it very difficult to classify the agroforestry systems. However, the general trend observed in the establishment of agroforestry can split it into the following types.

Expanding Fruit Orchards

Expansion in the area of fruit orchards is a general observation in plains. In Lower Swat, the cereal cultivated lands, particularly the rain-fed belt, are continuously shifting into the orchards of persimmons, peaches, apricots, plums, and citruses. The same type of land in the Upper Swat is shifted from cereal into apples, persimmons, peaches, plums, and cherries. If this trend continues, it will soon rise into the watershed and will help in conservation of soil and water resources greatly.

Agroforestry is economically the most important and highly preferred agricultural land use, though the detailed statistics of its by-products is not available. The agricultural statistics of NWFP (Abbasi 1996) shows that District Swat stands first in acreage, production per capita, and total fruit production among all the districts of NWFP. In Malakand Division, District Swat occupies more than double the area under fruit cultivation, among all the districts included in the division. It contributes more than 25 % share to the total fruit production of NWFP (Table 2.6).

Table 2.6 District-wise fruits production statistics of Malakand Division. (Source: Abbasi 1996)

			Name of the district				
S. No.	Item	Units	Buner	Chitral	Dir	Malakand	Swat
1	Total geographical area	kilometer^2	1843	14,850	5282	952	5102
2	Population	000, person	467	325	1412	440	1641
3	Area under fruits	000, hectare	0.13	0.41	1.63	0.93	6.16
4	Fruits production	000, tons	1.10	3.74	15.38	8.01	51.36
5	Yield per hectare	Kilograms	8462	9122	49.36	8613	83.38
6	Production per capita	Kilograms	2.36	11.51	10.89	18.20	31.30
7	Share in area to NWFP	Percent	0.53	1.68	6.68	3.81	25.26
8	Share in production to NWFP	Percent	0.46	1.57	6.46	3.36	21.56

Table 2.7 Area under commercial fruit orchards in Matta Tehsil during 1997

S. No.	Major fruits	Area under cultivation	Percentage
1	Apple	3404	83.63
2	Apricot	320	7.86
3	Persimmon	270	6.63
4	Plum	76	1.86

Matta Tehsil of District Swat, rightly termed as "Apple Tehsil," geographically located on 7215–7247°N and 3445–3415°E, occupies 66,580 ha of land with the altitudinal range of 1000–4080 m and a prevalent Himalayan moist temperate climate. More than 95% of the apple production of Swat is harvested from Matta Tehsil. In Matta Tehsil, apple is cultivated on 83.63% of the area under fruit crops. Other important fruit crops in terms of acreage are apricots, persimmons, and plums that represent 7.86, 6.63, and 1.86%, respectively, of the area under fruits in Matta Tehsil (Table 2.7). Cherries and quinces are the emerging commercial fruits and could probably acquire an appreciable acreage with the passage of time.

Smallholder Plantations

Smallholder plantations are in general practice throughout the valley and are extensively observed in most of the farming systems in Upper Swat. In the hill farming system and floodplains, farmers generally spare the marginal lands for agroforestry, resulting in the establishment of a good riverian forest and small patches of subtropical and temperate forests giving some protection to the highly deteriorating representatives of biodiversity in the region.

Tree Integration on Farmlands

Tree integration on the farmlands is another beneficial practice carried out, especially for the purpose of fruits, fuelwood, fodder, and timber demands. In this type of agroforestry, the trees are generally planted on the field boundaries; on the one hand, it gives protection to the crop field, and on the other hand, its economic utilization adds significantly to the farmer's economy. The linear plantation on the orchard boundaries is also a common practice, though this practice has multiple benefits of protection of fodder, fuelwood, and timber and its role in soil fertility through nitrogen-fixing trees. Still this practice has some negative effect, i.e., for example, shading effect, allelopathy, competition, etc. pronounced particularly in the small farms. In some cases, the boundary trees of the neighboring fields drastically affect the cereal yield.

The boundary trees are generally more efficient competitors for space, nutrient uptake, and water absorption, as compared to the fruit trees planted inside the orchards. They generally hamper the bearing, particularly in the small orchards, where the number of boundary trees generally exceeds more than the fruit trees inside the orchard.

Shade Belts

Shade belts (*Soorae, Goodarae,* and *Damazae*) present near the community places and meadows add a little to the area under agroforestry and the community environment in particular. But it has a vital role in introduction and maintenance of the exotic species besides the natural vegetation.

2.7.2 Natural Forests

Phytogeographically, most of the area of the valley comes under Sino-Japanese region. It enjoys plentiful precipitation in the form of monsoon rains. Whereas the northern parts of the valley with marginal summer monsoon and heavy snowfall in winter come under the Irano-Turanian region. The area has established the west Himalayan moist temperate and dry temperate forests in the respective phytoecological regions. Though it is mainly the altitude and rainfall which broadly determine vegetation and general ecology of the area, the effect of exposure, topography, and biotic pressure, especially the interaction of man, have prominent role in determining floral composition and overall physiognomy of the forest locally. In the recent past, whole of the Swat River catchment was densely covered with wetlands, subtropical, temperate, and alpine forest, which remained exposed to the excessive human activities, resulting in to croplands or denuded ruderals with the passage of time, and population growth.

Practically, 95 % of the wetlands have been transformed into croplands. Most of the area under subtropical forests was either converted into cropland of limited floral diversity and genetically uniform stocks. Or its unwise use turned it into highly degraded wastelands. In temperate forests, generally established on the high mountain slopes, wherever terracing was feasible, the forest was uprooted and turned into cropland. The unwise human practices led to accelerated erosion on the one hand, but on the other hand, the recharge capabilities of springs and their depending have generally checked everywhere, especially in highly destroyed subtropical watersheds. The only forest which remained protected in the catchment is the iron oak- and birch-associated forest (2500–3800 m) which can only be observed in the high-altitude ranges of Upper Swat and Swat Kohistan.

Various vegetation types and their floral composition, mainly based upon the prominent climax flora (irrespective of their aspection), are discussed here in the ascending order of altitude considerations.

2.7.2.1 Karr Vegetation (Riverbed Artemisia Scrub)

Karr locally referred to the floodplains, which are highly prone to the frequent floods. It develops highly variable vegetation in spring, mainly due to the transported plant propagules from the high altitudes of the catchment. Permanent feature of the Karr vegetation comprises *Artemisia scoparia, Saccharum spontaneum, Desmostachya bipinnata, Debregeasia hypoleuca, Datisca cannabina, Lotus corniculatus and species of Hypericum, Astragalus*, etc.

2.7.2.2 Subtropical Forest

Subtropical forests are the low-lying highly degraded forests, which rise up to 1500 m in the main valley and can be observed from Malakand Hills in the southern extreme up to Shahgram in the north. Three zones of highly degraded subtropical forests are visible in the valley. A brief description of each is given below.

Acacia–Reptonia Forests

These forests can be established on the southern and eastern faces of the hills mostly up to 1000 m. It can be observed on the roadside hillslopes from Dadhara down to Qalangai. The differentiating feature of this forest is *Acacia modesta* associated with *Reptonia buxifolia. Dodonaea vesica, Ficus glomerata*, and *Bauhinia variegata* also associate the main features in this zone. Shrubs like *Adhatoda vesica,* Ziziphus *numularia, Rhazya stricta, Gymnosporia royleana, Carrisa ophaca, Ehretia obtusifolia, Otostagia limbata, Woodfordia fruticosa, Periploca aphylla*, and *Nannorrhops ritchieana* are also observed in this zone. Due to easy access and high dependency level, most of the forests of this zone have been uprooted. Only its remnants are visible in Malakand, Adinzai, Abakhel, and Shamozai hills. A better patch of this type of forest can be observed in Pirkhel forest near Mekhband.

Acacia–Olea Forests

This zone is also delimited to the main valley and extends up to 900 m. Most of the denuded slopes of the catchment were once covered with this type of forests. The prominent feature of this forest *is Acacia modesta, Olea ferruginea,* and *Dodonaea vesica*. Other associated species include *Zanthoxylum armatum, Mallotus philippensis, Punica granatum, Pistacia integerrima,* etc. *Litsea* spp., *Pavetta tomentosa*, and *Quercus glauca* may be also observed in southern parts of these forests. Bushes of *Rubus* and *Adhatoda vesica, Ziziphus numularia, Rhazya stricta, Gymnosporia royleana, Ehretia obtusifolia, Otostagia limbata, Woodfordia fruticosa,* and *Periploca aphylla* are common. The regenerating patches can be observed in protected

places like Nawab Abad (3 km north of Matta Town on the main road) and Pirkhel forests near Mikh Band and Zalam Kot in Malakand Agency.

Subtropical Chir Pine Forest

The prominent feature of these forests is the evergreen chir pine *(Pinus roxberghii*). It can be seen in a degraded form in the low-lying mountains of Malakand, Moura, Elum, and Laram. It generally rises up to 1500 m or sometimes more as in Shamirae (Tirat). Other associated species are *Quercus incana, Pyrus pahsia, Pistacia integerrima, Rhododendron arboreum, Rosa moschata, Isodon rugosus, Indigofera heterantha, Berberis lycium, Woodfordia floribunda, Rubus fruticosus*, and *R. ellipticus*. On the southern faces of Nepkikhel mountains, the chir pine is generally associated with the dry oak, i.e., *Quercus baloot.*

2.7.2.3 Temperate Forests

The temperate forests in Swat valley can be divided into moist and dry temperate forests.

Moist Temperate Forests

Moist temperate vegetation of Swat is represented by the low-lying oak forests, blue pine forests, fir and spruce forests, and the timberline oak forests.

The Low-Lying Oak Forest

These forests mainly form the dense vegetation of lower hills and were established on the mountain slopes in the Upper Swat. These forests have the pure stand of *Q. incana* generally on the northeastern faces in the deep rich soil. *Quercus dilatata* occupy the same altitudinal range and may rise further high and generally prefer the south and eastern faces. Still they are present in a degraded form in monsoon-prevailing moist mountain terrain of Matta, Khwazakhela, Kabal, and Charbagh Tehsils. Other associated species of these forests are *Pinus wallichiana, Olea ferruginea, Diospyros lotus,* and *Pistacia integerrima*.

In the depression and watercourses of these forests, *Alnus nitida, Salix tetrasperma, Ficus palmata* and *Salix babylonica* are the common species, whereas *Platanus orientalis, Morus alba,* and *Melia azedarach* are also found but generally in the cultivated form. Among the subflora, species like *Berbaris lyceum, Rubus fruticosus, Isodon rogosus, and Rosa brunonii* are frequent. Herb of the genera like *Impatiens, Viola, Polygonum, Potentilla*, and *Geranium* and members of *Graminae* along with the species of ferns, mosses, and liverworts represented the ground flora.

These forests are the main and easy source of subsistence for the local communities in the form of timber, fuelwood, torchwood, fodder, and medicinal and cash herb for the past 30 years. Most of these forests were generally uprooted for agricultural cultivation or burnt for fodder and forage production.

The low-lying oak forests are nowadays becoming rare in the area. They are only preserved in sacred groove or on the land under personal protection. These forests were the main recharge sources of springs and thereby the feeding streams of Swat River. Their uprooting has not only impaired the general environmental health but also deteriorated the breeding sites of migratory fishes.

Blue Pine Forest

These forests are established on the upper limits of low-lying oak forests and were exclusively formed by a single dominant conifer, i.e., *Pinus wallichiana,* with a close canopy. It also has localized distribution of *Parrotiopsis jacquemontiana* and *Juglans regia* forests in the northern slopes. These forests can be observed in pure stand in almost all of the catchment area in between 1500 and 2500 m.

Subflora in this forest comprises the species of *Sarcococca saligna, Indigofera heterantha, Berberis lyceum, Buxus wallichiana, Rubus niveus,* and *Rubus fruticosus* in the lower limits, and species of *Salix, Parrotiopsis jacquemontiana, Viburnum foetens,* and *Skimmia laureola* in the upper limits.

In summer, the forest floor is decorated by the lush green cover of graminaceous herb associated with the species of *Ranunculus, Potentilla, Fragaria, Atropa, Rumex,* and a variety of ferns. *Hedera helix* and *Rosa brunonii* are the common epiphyte and climber, respectively. These forests provide habitat to a number of cash plants like *Morchella, Pteris, Viola odorata, Viola kashmiriana, Adiantum* spp., *Fragaria vesica, Atropa acuminata,* and *Phytolacca*, etc.

These forests are under severe biotic pressure; approximately, one-third area of the blue pine forest have been cleared in the past three decades, while the forest cover in the remaining half is left nearly 50%.

Fir and Spruce Forests

These forests have been established in the upper mountain limits and constitute a dense forest adjacent to the tree line. A very beautiful stand of these forests can be observed around the villages Sulatanr, Miabanr, and Qadar. These forests extend from 2500 to 3000 m; predominantly, spruce (*Picea smithiana*) and fir (*Abies pindrow*) occupy the southern drier faces and northern misty faces in the same altitudinal ranges. Yew (*Taxus wallichiana*) also associates these forests at their lower limits. Blue pine and *Quercus semecarpifolia* also contribute to the forest stand in its lower and upper limits, respectively. Other broad-leaved deciduous trees sparsely distributed in these forests are *Aesculus indica, Prunus cornuta, Salix* spp., *Ulmus wallichiana,* and *Betula utilis,* etc. These forests have a dense subflora in the deep moist soils comprising the species of *Viburnum foetens, Salix* spp., *Indigofera* spp., *Desmodium podocarpum, D. tiliaefolium,* and *Aralia cachemirica*, and *Sorbaria*

tomentosa and herbs like *Sambucus wightiana, Arisaema jacquemontii, Arisaema tortuosum, Rumex nepalensis, Plantago major*, and *Taraxacum wallichii*.

These forests provide habitat for a variety of fruits and culinary, aromatic, medicinal herb; besides the timber and non-timber forest species, these forest also provide shelter for a wide variety of wild animals, including pheasants, snow leopards, and bears.

Tree Line Oak Forests

These forests occupy the tree line (2900–3700 m) and are mainly composed of iron oaks (*Quercus semecarpifolia*), associated with the sparse distribution of *Picea smithiana* and *Betula utilis*. The subflora in these forests is generally like that of fir and spruce forest, including dense vegetation of *Viburnum foetens* and species of *Salix*. Edible ferns are of considerable economic values, which flourish, in early summer, in these forests. The open glacial areas bloom with the species of *Taraxicum, Plantago, Impatiens, Potentilla, Ranunculus, Sambucus, Thymus,* and *Rumex*. Beautiful cobra plants and giant snails are of particular interest of this ecosystem. These forests are established on a narrow belt but hav remain intact due to its inaccessibility and comparatively little economic use of *Q. semecarpifolia*.

Dry Temperate Forests

In the monsoon-excluded region of Kohistan, the vegetation is represented by *Quercus ballota* and associated vegetation. Here the blue pine (*Pinus wallichiana)* is replaced with *Cedrus deodara*. *Pinus gerardiana* associates deodar. On the roadside, it can be seen in mixed stand opposite to Peshmal and can frequently in the Utrore valley. The timberline vegetation of dry temperate forest mainly comprises *Betula utilis*.

2.7.3 Alpine Scrub

This vegetation type can easily be observed in Spin Sar, Boosaro Sar, Loi Pandghalae, Desan, and Falak Ser surrounded areas. Scrubs of *Juniperus communis* are present in patches on rocks, whereas the deep soils are generally dominated by the species of *Sibbaldia cuneata* and *Rumex,* associated with patches of *Senecio chrysanthemoides*, *Aster*, *Euphorbia wallichii, Sambucus wightiana*, *Corydalis govaniana, Thymus linearis, Iris hookariana, Plantigo himaliaica, Geranium collinum, Anemone, Potentila*, and *Polygonum*.

These scrubs possess best grazing potentials and feed thousands of livestock in the summer months. Overgrazing is the strongest biotic factor associated with the deterioration of the subalpine. Most of the plants are seriously exposed to overgrazing. Junipers inhabiting the area are shrinking both in terms of area and cover due

to trampling and its use as the only easily available fuelwood in the alpine. All these and other associated factors have caused severe erosion, which can easily be observed on most of the slopes in alpine.

2.7.4 Alpine Pastures

These are the highest occurring vegetation in the area and can be examined all around the Shago Sarookai, Mankial, and Falak Ser (4600–6000 m). Most of the plants inhabiting this area are herbaceous with a very strong subterranean parenting systems and wide range of pleasing colorful flowers, which always bless the tourist's mind and welcome the grazing animals. It provides grazing pastures to thousands of livestock visiting in the month of July–September every year.

Floristically, the area is represented by the species of *Sibbaldia cuneata, Trollius acaule, Bergenia stracheyi, Potentilla pamiroalaica, P. peduncularis, P. astrosanguinea, Geum elatum, Rhodiola himalayensis, Polygonum viviparum, Viola kashmiriana, Primula denticulata, Primula macrophylla. P. ellipticaa, Plantigo himalayca, Corydalis diphylla*, a species of *Rhododendron,* few edible ferns, and a fair distribution of *Aconitum violaceum*.

2.8 Biodiversity Situation

Neither a complete record of biodiversity of the area exists nor a taxon-wise complete census of floral and faunal composition, along with genetic diversity, comes under the scope of this chapter. However, an effort has been made to elaborate the biodiversity composition of the area based on some authentic literature and my personal observation regarding the area, for the past 30 years. Biodiversity has been very broadly divided into floral and faunal diversity below.

2.8.1 Floral Diversity

Floral diversity is broadly divided into domesticated/introduced and endemic types. The domesticated or introduced floral diversity includes various agricultural crops. More than 66 species (with a wide range of genetic diversity in each) are cultivated in the area, which can be split into nine types of commodities as given in Table 2.8.

Agricultural extension, generally carried out on the fertile lands, has resulted in the creation of homogenous artificial plant assemblages, with high genetic uniformity and low floral diversity. It has generally brought modification of natural

Table 2.8 Species diversity of crop plants commonly cultivated in Swat. (Source: Ahmad and Sirajuddin (1996))

S. No.	Commodities	No. of species
1	Cereal	04
2	Oilseed	07
3	Pulse/legume	07
4	Fruits	20
5	Vegetable	20
6	Condiments	05
7	Fodder	04
8	Starch	02
9	Fiber	01
Total		*66*

species composition and their assemblage. Hence, it may be concluded that the extension of agriculture has delimited the natural species and genetic diversity, especially in the plains and specifically in the wetland. Only 66 species of agricultural or horticultural crops are cultivated in fields.

Available data regarding the natural flora of the area shows that it include 1473 species of angiosperms. Among which 311 are monocots and 1162 being dicots. Ferns identified are 55 and gymnosperms being 13 species. Division-wise breakup of some of the plant species is given in Table 2.9.

Most of these plant resources had its specific and general uses locally and were being exploited and managed through the traditional ways in the past. Economic use of some of the plant resources is given in Appendix. Though no baseline is present on the frequency and cover of biodiversity of the area, visual observation shows that most of the floral diversity is under stress. The stress varies from place to place depending upon access and need of the users, ecological amplitude of the species, habitats losses, palatability of species, regeneration capacity, and limits of tolerance of the species. Some of the important species, which are under severe stress, are given in Table 2.10.

Table 2.9 Species diversity of natural floral recorded from Swat

S. No.	Division	Families	Species	Source
1	Pteridophyta	06	55	Stewart 1967
2	Gymnosperm	03	13	Stewart 1967
3	Monocots	20	311	Stewart 1967
4	Dicots	106	1162	Stewart 1967
5	Diatoms	–	116	Shah 1992

Table 2.10 Some plant species with high ecological stresses

S. No.	Species	Local name	Cause of degeneration
1	*Carex indica*	Taspa bootai	Habitat loss
2	*Reptonia buxifolia*	Gwargwara	overuse
3	*Ehretia obtusiloba*	–	overuse
4	*Litsea monopetala*	Meda chob	Over collection
5	*Quercus glauca*	Banojai	overuse
6	*Colchicum luteum*	Soranjan talkh	Over collection
7	*Acorus calamus*	Skhawaja	Habitat loss
8	*Ulmus chumlia*	Kahae	Habitat loss
9	*Aesculus indica*	Jawaz	Overuse
10	*Podophyllum emodi*	Gangora	Overuse
11	*Acer caesium*	Shin lakhta	Habitat loss
12	*Acer cappadocium*	Tarkana	Habitat loss
13	*Aconitum violaceum*	The ghra zahar Zahar	Over collection
14	*Prunus cornuta*	Changa	Habitat loss

2.8.2 Faunal Diversity

Like plants, no baseline data exists on animal diversity at species or genetic level. However, some historical reports elaborate the situation of biodiversity very well. Khushal Khan Khattak, the celebrated Pashtun poet, visited this area in the seventeenth century AD; his views (Khalil 1986) and feelings regarding the biodiversity of Swat can be elaborated from the following stanzas.

Translation

- Every year, 200–300 very beautiful best quality falcons are trapped in Swat.
- Second, the country has plentiful chackor partridges to be preyed everywhere.
- Waterfowls are found everywhere in Swat River, which are ruthlessly shot by the inefficient locals.
- Three types of ibex and one markhor are severely exposed to shooting locally.

The spontaneous increase in human population associated with the unwise use of natural resources resulted in habitat loss and deterioration of trophic level and food chains, which not only threatened the availability of certain economically important wildlife but also made the existence of other living species impossible. Presently, even a single falcon cannot be trapped per year by hundreds of hunters waiting painfully (for months) in the high mountain ranges. The presence of ibex and markhor remained only a theoretical consideration on the lower reaches. The incidence of chackor partridge and waterfowl has become very rare. They are generally shot in the air and the unchecked shotguns hurt before their landing. It is the broader outlook of the wildlife in the area. Still a number of resident and migratory birds,

mammals, and reptiles can be observed in the area of river Swat catchment. A summary of the important animal life in the area is given below.

Among mammals, snow leopard may be traced in the northern glaciated alpines. Musk dear, markhors, hare, and Himalayan ibex can only be recorded in the tree line birch forests. Black and brown bears of limited incidence can also be observed in the tree line iron oaks and birch forests. Snow cock, snow partridge, monal and koklass pheasants, and gorals, which were common three to four decades back, have become rare. All these animals generally prefer the areas raising more than 2500 m in altitude. Monkeys are still of common incidence in high mountain ranges. Hyenas, jackals, leopards, pigs, porcupines, hares, jungle cats, and hedgehogs are still there but of rare incidence. Other birds like finches, warblers, chats, tirts, yellow beak, and a number of pigeons are found here.

The low-lying mountains and the valley basin, which are easily accessible, are mostly exposed and have highly exploited ecology in the catchment and have a variety of faunal distributions. Black and gray partridges are still found here on the hillside. Many kinds of ducks, waders, white-cheeked bulbuls, paradise flycatcher, rufous-backed shrike, black drongo, and ringdoves and quail also visit the valley. Paradise flycatchers, once common, have diminished with the diminishing natural forests.

Among reptiles, *Diadema, Ladacensis, Mucosus, Ventrimaxulatus,* and *Zamenis* are fairly distributed. Cobras and crates generally prefer the rain-fed plains, whereas vipers can generally be found in the stony floodplains of the Swat River. Lizards of various kinds are found frequently. The most prominent among reptiles is the innocent *Veranus* spp., which grows more than a meter in length. Other animals like jackals, porcupines, and foxes are the common inhabitants of colian cliffs. Goral and Kabul markhor, which were once common, can only be traced in the difficult rocks of Elum, Morah, and Malakand series.

Among resident bird fauna of the valley, house crow, house sparrow, red-vented bulbuls, common myna, rufous-backed shrike, egrets, common kingfisher, white-breasted kingfisher, black tits, crested lark, and black partridges are mostly visible. The migratory birds which visit this area include black drongo, Brahminy myna, paradise flycatcher, house swift, wall creeper, warblers, wagtails, and babblers.

The wildlife in Swat is mostly under threat of unawareness of the local communities, leading to the excessive hunting and poaching, habituat losses due to agricultural extension and forest cutting, unchecked tourism, and pollution of water bodies.

2.9 Avian Fauna

The valley of Swat supports a number of bird species. Unfortunately, very little is known regarding the bird's fauna of Swat. The only birds which are generally referred in the literature are the pheasants and partridges. Other birds have received no attention. Depending upon the migratory behavior, bird's fauna in Swat can be divided in to resident and migratory types; each one are discussed separately.

Table 2.11 Some of the resident bird species of Swat valley

S. No.	Scientific name	Common name	Local name
1	*Acridotheres fuscus*	Common myna	Kharo
2	*Alectoris chukar*	Chakor	Zarka
3	*Alcedo atthis*	Common kingfisher	Shin kwanae
4	*Ammoperdix griseogularis*	See-see	Se-sai
5	*Ceryle rudis*	Pied kingfisher	Kirkirak
6	*Corvus splendens*	House crow	Qargha
7	*Francolinus francolinus*	Black partridge	Taro
8	*Francolinus pondicerianus*	Gray partridge	Tanzarae
9	*Halcyon smyrnensis*	White-breasted kingfisher	Kirkirak
10	*Lanius schach*	Bay-backed shrike	Teghak
11	*Lerwa lerwa*	Snow partridge	Warookay goria
12	*Lophophorus impejanus*	Monal pheasant	Lait
13	*Lophora leucomelaena*	Kaleej pheasant	Zangaly charg
14	*Passer domesticus*	House sparrow	Chanchanra
15	*Pucrasia macrolopha*	Koklass pheasant	Baiger
16	*Pycnonotus cafer*	Red-vented bulbul	Balbala
17	*Pycnonotus leucogenys*	White-cheeked bulbul	Balbala
18	*Streptopelia decaocto*	Collared dove	Korkorai kaotra
19	*Tettaogallus himalayensis*	Snow cock	Goria
20	*Turdoides caudatus*	Common babbler	Sourae
21	*Upupa epops*	Hoopoe	Mula chargak

2.9.1 The Resident Fauna

The species living throughout the year in a particular area are referred to as the resident species. The common resident species in Swat are presented in Table 2.11.

2.9.2 The Migratory Birds Fauna

Some of the birds visit the catchment during their breeding season, and they either come to the valley for breeding or pass through it between their breeding and wintering grounds. A list of the migratory birds generally observed in Swat is given in Table 2.12.

Variety of birds like brown dipper, Ned starts, robins, thrushes, a large number of waterfowls, and waders pass through the valley unknown and still unclassified, which needs to be identified and their status conferred as resident or migratory.

Table 2.12 Migratory birds generally observed in Swat

S. No.	Scientific name	Common name	Local name
1	*Anas acuta*	Pintail	Tarlakay
2	*Anas crecca*	Common teal	Kach shingharae
3	*Anas platyrhynchos*	Mallard	Shin satay
4	*Anas querquedula*	Shoveller	Plan makhokay
5	*Aythya ferina*	Common pochard	Soor sarai
6	*Carpodacus erythrinus*	Common rosefinch	Sper sarai
7	*Coracias benghalensis*	Indian roller	Shintagh
8	*Coturnix coromandelica*	Rain quail	Nwaraz
9	*Dicaeum erythrorhynchos*	Tickell's flower-pecker	Chatae
10	*Dicrurus caerulescens*	Black drongo	Toranraka
11	*Galerida cristata*	Crested lark	Khrara
12	*Gallinago gallinago*	Common snipe	Chaghat
13	*Himantopus himantopus*	Stilt	Chaghat
14	*Hirundo rustica*	Common swallow	Totakarkay
15	*Motacilla alba*	White wagtail	Speerlakay
16	*Motacilla citreola*	Yellow-headed wagtail	Zairaqa
17	*Motacilla flava*	Yellow wagtail	Zairaqa
18	*Motacilla maderaspatensis*	Large pied wagtail	Speerlakay
19	*Oriolus oriolus*	Golden oriole	Pilaoroo
20	*Pericrocotus flammeus*	Scarlet minivet	Liala majnoon
21	*Phipaiura aureola*	White-breasted fantail	Teghstargai
22	*Phylloscopus collybita*	Brown chiffchaff	Tarae
23	*Prinia criniger*	Brow hill warbler	Chatae
24	*Seicerus xantroschistos*	Gray-headed flycatcher	Chatae
25	*Sturnus pagodarum*	Brahminy myna	Jabanai kharo
26	*Sturnus vulgaris*	Common starling	Sakhaka
27	*Tersiphore paradise*	Paradise flycatcher	Poonai

2.10 The Swat River

Swat River is the only drainage basin of Swat valley. It originates in the form of rushing perennial streams of the permanent ice caps and glacial lakes in the lofty mountain ranges in the north extremes of the Swat valley. These streams soon unite to form Gabral River and Ushu Gol in the northern valleys of Gabral and Mahodand, respectively. Both of these rivers flow southwards and, after covering a distance of 35–40 km in their respective valleys, join at Kalam, giving rise to the Swat River.

The Swat River flows in a narrow gorge from Kalam to Shagram in an average course of 35–40 m. Though the gorge is last at Shagram, the narrow course of the river continues upto Talapanr. Hereafter, the river spreads upto 400 m in majority

of location across the course, in the valley. In the extreme south of the valley, the meandering river once again inters into a narrow gorge and joins with the Panjkora River at Boosaq/Sharshamai.

Ecologically speaking, the whole freshwater network of Swat can be split in to:

- The monsoon-excluded spating river ecology.
- The monsoon-prevailing sluggish river ecology.

The monsoon-excluded *spating river ecology*, being restricted to Swat Kohistan, is represented by the torrent cold water. Trouts prefer the rushing cold water ecosystems like the streams and rivers in Kohistan. It is therefore referred to as the trout ecology.

The torrent water currents do not allow angiosperms to be established in the riverbed. The adjoining moist rocks, however, develop a variety of hepatics, mosses, ferns, and cyanophytes. Among angiosperms, horse chestnuts, bird's cherry, maples, *Diospyros,* and poplars are the prominent trees. Deodar, spruce, blue pine, yew, and fir are the common conifers of the slopes.

The monsoon-prevailing *sluggish river ecology,* which spreads over the river in the rest of the valley, particularly in the Lower Swat, is characterized by the cold water with rather sluggish movement. This ecosystem is predominantly occupied by the *Schizothorax*-associated fish species and is not visited by the trouts. It can therefore be referred to as non-trout ecology.

Diverse types of the cyanophytes, chlorophytes, bacillarophytes, lower embryophytes, and tracheophytes inhabit the river and its tributaries. They not only provide oxygen for the submerged life but also maintain equilibrium in the ecosystem. Common among the hydrophytic trees are populus and willows below 1000 m, and adlers and willows are more common above 1000 m. Adlers are nitrogen fixing in nature, adding much to the fertility of soil and nitrogen content of water generally.

2.10.1 Tributaries of Swat River

Precipitation in the form of rain and snow is the main source of water recharge of Swat River. Most of its water makes their way to Swat River, either through direct runoff, melting snow, or seepage and leeching. Though the direct seepage contributes much to the permanent streams and Swat River, these are generally the tributaries which affect the flow, quality, and productivity of the Swat River. Though a large number of seasonal and perennial tributaries contribute to the river, only those tributaries which apparently contribute to the perennial flow of Swat River are described below.

2.10.1.1 Gahil Stream

Downstream, Kalam, the Gahil Stream, is the first large water body which significantly contributes to the flow discharge of Swat River. It emerges in the lofty glaciers of Gahil catchment, providing best site for trout feeding.

2.10.1.2 The Mankial Stream

A perennial stream emerges into the eastnorthern glaciated peaks of the valley and combines with the river Swat near Mankial. The stream has cold water and favors the habitat for trout.

2.10.1.3 Daral River

Daral River is mainly fed by the glacial lakes of Daral and Tarkana located in the western boundaries in between Swat and Dir Kohistan. Its rushing water contributes much to the flow of the Swat River. It joins Swat River on its right bank at the Behrain Town. Its cold rushing water also favors the trout community.

2.10.1.4 Chail Khwar

It originates in the Chail, Beshigram, and Dabargai catchment at the northeastern extreme of the Upper Swat. Chail Khawar joins Swat River on its left bank at Madyan. The stream water is fit for trout culture and feed a number of trout commercial hatcheries established in its basin.

2.10.1.5 Bawari Khwar

It originates in Sakhra catchment and joins Swat River at Kalakot. The stream bares warm water, having mild flow, and the land is rich in organic contents. It prefers warmwater fish and is inhibited by a number of *Schizothorax* species.

2.10.1.6 Haronai River

It originates in Spin Sar at the right side alpine of the catchment and is fed by an area of 46,425 ha. It contributes much to the flow of Swat River and serves as the largest spawning ground for *Schizothorax* and mahseer. It joins Swat River on its right bank near Koza Bamakhela.

2.10.1.7 Manglawar Khwar

It originates in the moist temperate forest of Manglawar catchment. It contributes a little to Swat River, particularly in the winter months. It also serves as a breeding site for *Schizothorax* and mahseer.

2.10.1.8 Jambel Khwar

It originates in the northern face of Mount Elum. On reaching Mingora and Saidu Sharif territories, it becomes highly contaminated with fecal derivatives and industrial and household pollutants, though most of its water is used for irrigation crops. Its filtered seepage again adds to its flow, but the pollutant concentration is so much that it enters Swat River in the form of a dead water body. The stream serves only as a contamination source for the fecal and other noxious substances to the river.

A large number of streams in the Lower Swat, Swat Ranizai, and Adinzai, which were contributing much to the flow of Swat River in the recent past, remained no more productive. It is due to the fact that their catchment has lost the vegetation cover, mainly responsible for conservation of water and the recharge of these streams. The streams are there and serve as drainage basins of monsoon flood.

Limnology

Detailed limnological studies of Swat valley (Ahmad 1999) revealed that the temperature, pH, alkalinity, and hardness of water, whatsoever its source may be, are in the normal potability. Conductivity, which is the measure of mineral contents, everywhere in Swat, is under the permissible limits. Total solid (TS) content of the main river is also within the normal range of potability, whereas in tributaries, the content of TS was generally high, still falling under the maximum limits of potability (Table 2.16).

Total suspended solids generally crossed the normal range of potability, i.e., 30 mg/mL. Its maximum quantity (1000 mg/L) was recorded in the sample collected from Daral Khwar, which might be as a result of the accelerated erosion of rock material due to the high water speed. The TDS were maximum in Barwai Khwar, i.e., 480 mg/L, which comes under the normal limits of drinking water.

Dissolved oxygen, which determines the health and self-purifying capacity of water body, was lowest in Jambil Khwar, i.e., 5.9 mg/L still high than the minimum required limits (5 mg/L) of WHO. Biological oxygen demand (BOD), which is directly proportional to the quantity of oxidizable organic matter, remained under the normal limits (7.5 mg/L) downstream upto Mingora, but at once reaches to 11.6 mg/L at Panjigram after receiving the polluted water of Jambil Khawr. This situation is gradually improved downstream at Gammon Pul and Pul Chwakai, where the quantity of BOD recorded was 9.6 and 5.86 mg/L, respectively. Chemical oxygen demand is a very useful tool for the determination of the quantity of domestic waste in a water body. In Swat River and its tributaries, its value was higher than the normal acceptable limits. Similarly, ammonia determines the quantity of organic pollutants. The concentration of ammonia falls under the acceptable range for Swat River downstream till Mingora, but the addition of effluents from Mingora municipality crosses the acceptable limit of 2.00 mg/L. The nitrite content in all the samples except that collected from Jambil Khwar (12.09 mg/L) proved within the normal range of potability, whereas the concentration of nitrates in all the water bodies was within the acceptable limits of water quality.

Concentration of chlorides and phosphates proved lower, whereas the sulfide contents in all the samples were higher than the WHO standards. Furthermore, the concentration of sulfates was higher than the potable limits, except in the water collected from Jambil Khwar, where it was 330 mg/L, showing the large-scale addition of domestic waste into the water body (Table 2.13).

Among metals, the concentration of sodium, copper, and potassium was generally within the acceptable limits of potability in all the waters. The concentration of potassium in the water of Jambil Khwar and that of cadmium and lead generally exceeded the normal range of potability (Table 2.14).

The *Escherichia coli* counts, which directly determine the fecal contamination of water, were proved to be the level of intermediate risk value at up- and downstream Kalam. While rest of the sampling areas of Swat River and its tributaries were at high risk of fecal contamination, the water of Jambil Khwar proved to be at the very-high-risk level and is therefore not fit for drinking.

2.11 Algal Flora

Microorganisms inhabit a variety of ecological conditions mostly due to their interspecific and intraspecific diversity, enormous numbers, plasticity, and wide ecological amplitudes. They serve both as producers and decomposers, making essential balance in the aquatic ecosystem and food chains, though there is generally a dearth of knowledge regarding the microflora of Swat River. However, the important algal flora reported from the ecosystem is presented in Table 2.9.

2.12 Ecology of Swat River

Depending upon the river flow, climatic conditions, and availability of fish fauna, Swat River network ecologically can be divided in to two types, i.e., the trout and non-trout ecologies.

2.12.1 Trout Ecology

This zoosociological region can be restricted to Swat River and its tributaries occurring in Swat Kohistan and is extended upto Talapanr during winter and colder months of the year. Most of this area do not receive summer monsoon rains and is therefore dry in summer. In winters, most of the precipitation occurring here is in the form of snow.

Due to lack of summer monsoon, the river do not face the recurrent flood situation. Here water temperature rarely exceeds 20 °C in the month of July. The river flows in the narrow gorge in a deep basin of 35–40 m width. The little exposed area

Table 2.13 Chemical characterization of water from Swat River and its tributaries. (Source: Ahmad 1999)

S. No.	Place	Water body	DO (mg/L)	BOD (mg/L)	COD (mg/L)	NO_3+N (mg/L)	NO_2+N (mg/L)	NH_3+N (mg/L)	S (mg/L)	SO_4 (mg/L)	PO_4 (mg/L)	CL (mg/L)
1	Kalam Bridge	Swat River	9.6	1.34	25.0	0.10	1.130	1.34	0.80	88.71	2.34	15.90
2	Peshmal Bridge	Swat River	9.6	2.80	15.0	1.80	1.801	2.80	1.76	76.50	1.57	14.90
3	Bahrain	Tributary	9.8	2.66	15.0	0.20	1.609	2.66	0.80	73.84	9.65	8.90
4	Madyan Hatchery	Tributary	10	3.34	15.0	1.10	0.696	3.24	2.40	36.62	8.62	9.90
5	Ranzra Pul	Swat River	9.65	2.54	5.0	0.60	2.953	2.54	1.70	68.36	1.67	9.90
6	Rahat Kot Bridge	Tributary	7.4	3.48	5.0	1.50	3.565	3.48	0.80	59.0	5.65	5.60
7	Bama Khlea	Swat River	6.2	2.54	15.0	0.80	2.913	2.54	2.40	98.88	9.32	20.80
8	Matta Bridge	Tributary	6.9	2.00	5.0	0.60	3.697	2.00	1.60	92.77	10.85	8.90
9	Kuladher Bridge	Tributary	5.9	6.94	45.0	1.60	12.09	11.60	12.29	330	10.17	21.80
10	Punjiram	Swat River	7	1160	25.0	0.60	2.478	0.94	0.70	89.11	12.71	10.90
11	Grammon Bridge	Swat River	6.9	9.60	5.0	0.60	1.130	9.60	2.40	88.71	11.67	6.90
12	Pul Chaukai	Swat River	7.1	5.86	12.0	0.70	3.565	5.86	0.90	96.84	10.34	10.90

BOD biological oxygen demand, *COD* chemical oxygen demand, *DO* dissolved oxygen

Table 2.14 Concentration of some metals in the water of Swat River and its tributaries. (Source: Ahmad 1999)

S. No.	Place	Water body	Sodium (mg/L)	Potassium (mg/L)	Copper (mg/L)	Cadmium (mg/L)	Lead (mg/L)
1	Kalam Bridge	Swat River	2.44	0.1608	0.2	0.3	0.8
2	Peshmal Bridge	Swat River	2	0.108	0.06	0.132	0.08
3	Bahrain	Tributary	0.88	0.56	0.08	0.08	0.06
4	Madyan Hatchery	Tributary	0.64	0.8	0.06	0.1	0.2
5	Ranzra Pul	Swat River	4	0.106	0.04	0.04	0.2
6	Rahat Kot Bridge	Tributary	1.5	3	0.04	0.04	0.14
7	Bama Khlea	Swat River	2.412	1.6	0.04	0.06	0.1
8	Matta Bridge	Tributary	2.32	6.3	0.04	0.06	0.12
9	Kuladher Bridge	Tributary	8	24.12	0.06	0.04	0.2
10	Punjiram	Swat River	2.44	2.2	0.08	0.04	0.16
11	Grammon Bridge	Swat River	1.28	1.7	0.06	0.08	0.26
12	Pul Chaukai	Swat River	1.7	2.2	0.04	0.04	0.12

Table 2.15 Expected risk situation in river Swat and its tributaries. (Source: Ahmad 1999)

S. No.	Place	Water body	Lead (mg/L)
1	Kalam Bridge	Swat River	17
2	Peshmal Bridge	Swat River	45
3	Bahrain	Tributary	150
4	Madyan Hatchery	Tributary	35
5	Ranzra Pul	Swat River	350
6	Rahat Kot Bridge	Tributary	550
7	Bama Khlea	Swat River	–
8	Matta Bridge	Tributary	–
9	Kuladher Bridge	Tributary	1800+
10	Punjiram	Swat River	900
11	Grammon Bridge	Swat River	275
12	Pul Chaukai	Swat River	550

Table 2.16 Physical characterization of the water of Swat River and its tributaries. (Source: Ahmad 1999)

S. No.	Place	Water body	Temp. (°C)	PH	Cond. (µg/cm)	TS (mg/L)	TSS (mg/L)	TDS (mg/L)	ALK (mg/L)	HAD (mg/L)
1	Kalam Bridge	Swat River	10	7.81	37.6	400	60.0	340	5.00	12.0
2	Peshmal Bridge	Swat River	10	7.90	35.2	200	40.0	160	7.00	12.0
3	Bahrain	Tributary	11	7.90	20.0	1000	580	420	6.50	9.0
4	Madyan Hatchery	Tributary	11	8.23	37.5	600	280	320	5.00	10.0
5	Ranzra Pul	Swat River	10	7.08	35.8	400	200	200	4.00	12.0
6	Rahat Kot Bridge	Tributary	17	7.56	40.7	800	320	480	7.00	23.0
7	Bama Khlea	Swat River	11	7.92	40.2	580	320	260	5.00	10.0
8	Matta Bridge	Tributary	19	7.98	195.1	240	140	100	9.00	40.0
9	Kuladher Bridge	Tributary	20	7.71	310	600	200	120	14.00	61.0
10	Punjiram	Swat River	14	8.07	67.6	300	80	400	5.00	25.0
11	Grammon Bridge	Swat River	14	8.17	54.7	600	140	460	5.00	12.0
12	Pul Chaukai	Swat River	14	7.26	55.8	200	80	120	5.00	11.0

ALK alkalinity, HAD *hardness*, *TDS* total dissolved solids, *TS* total solids, *TSS* total suspended solids

of water from the melting snow and its high speed retains the temperature throughout similar. This area is dominated by the carnivore fish, i.e., trout.

2.12.2 Non-Trout Ecology

This zoosocialogical region extends downstream Talapanr Bridge and spreads over the rest of the Swat River and its tributaries in Upper Swat, Swat, Ranizai, and Adinzai sections of the valley. This area gets through monsoon rains both in summer and winter. In monsoon season, its discharge increases, which is temporary and for short duration. Similarly, in summer, the increase in daily temperature increases snow melt and causes rise in flow everywhere in the perennial streams and Swat River.

The monsoon rains generally results in heavy floods, causing damage to agricultural crops generally. This region is represented by the meandering shallow flow. Its speed becomes mild, and due to a wide exposed area of shallow water, its temperature increases downstream. *Schizothorax* spp. generally prefers this ecology. In summer, warmwater fishes like mahseer from the river Kabul visit this ecology. The river also serves as breeding site for mahseer.

2.12.3 Fish Fauna of Swat River

Fish, the divine gift and most precious among water resources, serves as a major economic activity in rural communities, particularly to the people settled near the river basin. Though the adverse role of human beings in polluting water with organic, inorganic, and biological wastes caused eutrophication in certain cases and brought changes in the floral and faunal composition of water body. Yet these are the electric current, dynamiting, and poisoning, which are becoming threat to the existence of the fisheries. These malpracticing have severally deteriorated the aquatic fauna severely, particularly in the tributaries. If this trend is not checked, it appears that some of the endemic fishes will become extinct soon.

Swat River is represented by a variety of fishes (Butt 1986), among which *Slam* turtle (brown trout) and *S. qaridneri* (rainbow trout) were introduced here in 1928 and 1973, respectively. Their lethal temperature starts from 23 °C upward (Aston and Brown 1978) and hence can only be found in the river and its tributaries occurring in Swat Kohistan.

Tor putitora (Mahseer, Zegai) is the warmwater fish found in the Lower Swat area. Due to its diminishing population, resulting mainly from scarcity of spawning grounds and malpracticing prey, it seldom appears in the market.

Three species of snow trouts which can tolerate temperatures below 8–22 °C (Mirza 1976), viz., *Schizottorax esocinus, Schizothorax richardsonii, Plagiostonus*, and *S. progostus labiatus* are the common delicious Swati fishes. *Garra gotyla* (Deq) are the most common warmwater fishes and can frequently be found particu-

Table 2.17 Incidence of the common fishes in Swat River

S. No.	Species	Incidence (%)
1	*Schizothorax-richardsonii-plagiostomus*	26.13
2	*S. progastus-labiatus*	3.97
3	*S. esocinus*	2.84
4	*Salmo-gairdnerii*	3.97
5	*S. trutta-fario*	2.27
6	*Channa-punctatua*	7.95
7	*Mastacembelus-aromatus*	2.27
8	*Shistura-alepidotus-alepidotus*	1.70
9	*Triplophysa-grifthii-naziri*	7.95
10	*T. stenurus-choprai*	4.54
11	*Crassocheilus-diplocheilus*	3.40
12	*Puntius-ticto*	6.81
13	*Barilius-vagra-pakistanicus*	10.12
14	*Tor-putitora*	10.22
15	*Garra-gotyla*	3.97
16	Glyptothorax-stocki	5.11
17	*Glyptosternum-reticulatum*	2.84

larly in the streams. They become very frequent in the months of May and June. Other frequent fishes are *Triplophysa naziri* (Singi) and *T. choprai*. *Glyptosternum reticutatum, Schizothorax bruclii, Schstura alepidotua,* and *S. naseemi* can commonly be seen in Swat. The incidence of various types of fishes in Swat River is given in Table 2.17.

Chakdara is the only fish reserve in which mainly *Schizothorax, Tor,* and *Cyprinus* (paplate) are the most popular fishes of this reserve. The reserve is established to provide safe ground to the local fish resources. Legally, no fishing is allowed in the reserve area, but the rules cannot strictly be observed due to vested interests of powerful elite class, sharply unmarked boundaries of the reserves, and inadequate monitoring of the staff.

2.13 Man as an Ecological Factor

Man is the most powerful and highly organized ecological factor who interacts with the natural resources directly or indirectly, and willingly or unwillingly. His curses for getting more have disrupted every natural balance globally. On Swat River, the influence man is both direct and indirect, which are discussed as below.

2.13.1 Direct Impact

2.13.1.1 Water Pollution

Most of the settlements established on or near the river dispose their solid and liquid wastes directly to the river. This careless addition cause fecal contamination and increased TS of water, resulting in lowering water quality; with the increased potability risk (Ahmad 1999), water pollution is a problem everywhere in Swat valley, and most of the diseases prevalent here are waterborne in nature.

2.13.1.2 Eutrophication

Eutrophication is a situation when the release of phosphates and nitrates or organic matter in to the water body reaches to such an extent that oxygen level in the water drops, resulting in an evident change in faunal composition of the water body. The apparently eutrophicated water bodies are the Jambel, Thana, and Chakdara streams. The farmer has very high BOD (Ahmad 1999), whereas for the latter, its value is unknown. BOD is actually a standard for determining the oxygen requirement of a water body, or it is used to measure the rate at which the oxygen level of a sealed sample of the water falls when kept in dark for 5 days at 20 °C. The BOD of unpolluted river water is typically less than 5 mg O_2/L/days.

2.13.1.3 Heavy Metal Toxicity

Most of the industrial (particularly the cosmetics) and automobile wastes add nickel, lead, mercury, selenium, and zinc to the water, which certainly cause toxicity. The unplanned growth of industries into workshops and service station on the riverside needs to be checked; otherwise, both their vertical and horizontal growth will cause deterioration of Swat River. Similarly, wastes from the marble industry and that of the emerald mine contribute significantly to alkaline pollution of water in Swat River.

2.13.1.4 The Loss of Wetlands

Wetlands which were once spreading all over the length of Swat River and its tributaries have been converted to agricultural fields. These wetlands not only provided spawning sites to most of the fishes but were also used as resting grounds for a variety of migratory birds. Besides all these, the wetland ecosystem had their own floral and faunal compositions which have been severely disturbed.

One of the important wetland was Chaqar located in the south of Matta Town which was protected as game reserve by the ruler of Swat and was visited by

thousands of waterfowls every year till 1970. It was reclaimed into a cropland. Not only the reserve is lost, but the associated biodiversity, i.e., migratory birds and the plentiful fishes, have gone forever. The magnificent swamps of *Carex indica, Scabiosa* spp., and *Achorus calamus* have been permanently vanished away from the scene. Other such wetlands were the present rice paddies of Udigram/Balogram and Chakdara areas, which were mostly cultivated as monocrop for rice and remained as fallow marshes for the rest of the year.

2.13.1.5 Genocidal Prey

The destructive practices of dynamiting, electrification and poisoning of water, and the unchecked shooting of game birds have broken down the natural ecosystem. Swat River, which generally has high flow and natural fish reserves, has got somewhat protection from the unwise hunters and fishermen. They mostly kill the aquatic fauna of the tributaries during the low-flow season, through the destructive means of dynamiting, poisoning, and electrifying water, which is recurrently supplied by Swat River in the high-flow seasons. Unlike fishes, the innocent game birds got little natural protection and high exposure to the cruel shots of the hunters, that is why a very little percentage (5–10%) may escape from shooting down here.

2.13.2 Indirect Impact

The indirect impact of man on Swat River and its tributaries includes depletion of recharge sources, siltation problem, agricultural seepage, and the depletion of biodiversity. These are summarized as below.

2.13.2.1 Depletion of Recharge Sources

It is a general observation that the mountains having forests have perennial springs and those lost forests have last the springwater. The forest watersheds generally conserve water through retarding the rain runoff and providing more absorption area to the rainwater. The losses of forest cover in the watersheds resulted in increased runoff and hence little water conservation.

2.13.2.2 Siltation Problem

The increased runoff on rainwater or snow melts causes erosion on the open slopes, which on the one hand causes soil erosion, i.e., decreased soil fertility, and on the other hand, the rock material covers the stream basin and impairs the breeding sites of migratory fishes.

2.13.2.3 Agricultural Seepage

The role of Swat River as a sink is generally not recognized, though most of the agricultural wastes are directly disposed off to the river. It is generally the high flow, rushing behavior, and expanded basin that rectify the effect. The leaching fertilizers and pesticides could also cause problem, but it is generally the high relief, heavy rainfall, and low input of farmer which cause practically no problem presently.

2.13.2.4 Depletion of Biodiversity

One of the most permanent features of the aquatic habitat all over the river and its tributaries is its biodiversity. Just from the alpine, the water passes across a variety of herbs, deciduous, and evergreen temperate forest, the low-lying alders, and willows associated with diverse animal fauna. Almost all of the biodiversity contribute in one way or the other to the health and continuity of the water body. One of the beautiful examples is alders growing on the river basin. It contributes a substantial amount of dissolved nutrients such as nitrates to the water. Their leaf contains four times as much as nutrients available in the leaves of other deciduous trees (Goldman 1961; Mills 1980). It also prevents overshading, maintains soil fertility, and controls erosion. Their root provides habitat and excessive oxygen supply for fish breeding. Their leaves enrich the water in available nutrients. Besides providing fuel, timber, and packing material, it also allows access for recreation and stream management. Recently, the modern trend of monoclonal adoption has introduced popular habitats of wallows and alders, thereby not only changing the natural balance of the traditional species but also depleting the role of alder in the ecosystem. Hundreds and even thousands of other examples regarding the positive role of the local biodiversity can be quoted in this regard. It is hurting to know that the natural floral biodiversity is diminishing at the expense of the fast-growing monoclones and the faunal diversity is exposed to excessive use.

2.14 Unplanned Population Growth

Unplanned population growth generally leads to natural degradation. Like most of the areas in the country, the population of Swat increased very fast. It increased both horizontally and vertically, resulting in the enhancement of family number and family size, respectively. The unplanned growth associated with the natural demand for more food, space for habitation, availability of potable water, agricultural and recreational lands, sanitation health, roads, capital, and cultural amenities created pressure on the whole of natural resources, especially on the health of water bodies. Swat River is generally considered as a resource for drinking, irrigation, hydropower, fish catch, watermills, transport, and game birds for prey. Its role as a sink for absorbing and converting all the refuse of animal and plants origin in to useful inorganic

substances processed in to the precious biological products such as herbage or flesh is never recognized. It is clear from the pollution survey of Swat River (Ahmad 1999) that at some places (e.g., Mingora), the unplanned growth adds more refuse than the carrying capacity of the river, resulting in the potability of its water. The said survey concluded that there is a limited potability risk in the water of Swat River and the risk increase downstream, especially downstream Mingora, where it gets the municipality wastes as well from the city. Hence, the unplanned settlements all over the area, especially near the Swat River, need efficient sanitation, so that their waste may not hamper the natural absorbing capacity of the river.

The impact of unplanned population growth on natural resources is evident in the eutrophicated Jambel Khawar, to which all the solid and liquid wastes of the nearby settlements are directly deposed off. A few decades back, neither the population was too much and highly unplanned nor the use of this stream as a resource both for drinking water and fish catch. Presently, neither its water is useable nor fish population can withstand the cruel change. Rather the resource has been changed into a permanent problem.

Besides its direct effects, the unplanned population results in deforestation for both subsistence and terrace formation. To suffice their dietary need, more animals need to be reared which generally result in overgrazing. The increased unplanned population gave rise to deforestation, overgrazing, and more terrace cultivation, resulting in increased runoff of rainwater, accelerated soil erosion, decreased soil fertility, and siltation problems in the valley. All these practices have depleted the water conservation capacity of the mountain ranges and have therefore resulted in reduced recharge and percolation potentials of the area.

2.15 Conclusions and Recommendations

- Historical reports supported by the present demographic data reveal that the unplanned population growth in Swat valley is crossing the limits of sustainable carrying capacity of its natural resources. Which is leading to the deterioration of social as well as natural environment: population management through the processes of effective health education, realistic settlement zoning/planning, redetermining the royalty rights, and immigration control in the catchment?
- The resource base of Swat River is shrinking day by day, through the depleting wetlands, misuse of biodiversity, and denudation of its recharge base. The situation can only be tackled through creating national parks in the watersheds, game, and fish reserves across the river.
- The increased refuse disposal to Swat River is a serious threat, which impedes the carrying capacity the Swat River and the socioeconomic condition of the people of Swat as well. It must be controlled through treating the wastes locally.
- An effective liaison is a real need to integrate the line departments and environment-conscious NGOs and the social activists for evolving effective strategies to protect and conserve nature in the valley.

- Countrymen need to be educated for quantifying their shares towards the deteriorating nature and must be organized for playing their role in the conservation of nature locally.
- Unplanned population growth particularly in or around the watercourses and intact forests needs immediate control and replacement.
- Degraded watersheds not only create problems of siltation and changes of watercourses but also hamper the availability, flow, and quality of water. Its protection and proper management with the endemic flora is unavoidable.
- Extension of agroforestry, especially in the terraced watersheds, will not only protect the biodiversity but also ensure the conservation of water and soil resources. Besides all others, it can also improve per unit farm production and can raise the socioeconomic condition of farmers as well.
- Effluents from Mingora city in the form of Jambil Khwar are presently the largest and most serious threat to the health of Swat River and its dependents downstream Mingora; it needs proper treatment (Table 2.4).

Appendix I: Some Economically Important Plant Species of Swat

Family	Botanical name	Local name	Description of Plant use[a]
Acanthaceae	*Adhartoda vasica* Nees.	Baikar	6, 10
Adiantaceae	*Adiantum cappillus -veneris* L.	Bar Sumbal	6, 13, 27
	A. incisum Forsk	Bar Sumbal	6, 13, 27
	A.venustum D.Don.	Babozae	6, 13, 27
Alismatceae	*Sagittaria sagittifolia* L.	Taqae	4, 32
Alliaceae	*Allium ascalonium* L.	Piazakae	6, 17
	Allium jacquemontii Kunth.	Zangah Paiz	28, 17, 30
Amaranthaceae	*Achyranthus aspera* L.	Buch Kanda	6, 4
	Amaranthus caudatus L.	Chalwaye	2, 4, 5
	A. viridis L.	Ganrkar	2, 4, 5
Amaryllidaceae	*Narcissus tazetta* L.	Gwale Nargas	18, 6
Anacardiaceae	*Cotinus coggyria* Scop.	Miswakae	13, 6, 10, 24
	Rhus simialata Murr.	Thitrae	6, 17, 4
	Rhus punjabinsis Stewart	Rakhkal	7, 6

Family	Botanical name	Local name	Description of Plant use[a]
Araceae	*Acorus calamus* L.	Skha Waja	6, 13, 32
	Arisaema jacquemontii Blume	Wara Marjarai	7, 6
	A.utile Hook.f.ex.Schott	Tora Marjarai	7, 6
	A.tortuosum Roxb.	Ghata Marjari	7, 6
	Sauromatum venesum (Ait) Scoth.	Mar Jarai	7, 6
Araliaceae	*Aralia cachemirica* Decene	The Dadono Binakai	37, 39, 40, 10
	Hedra hilex L.	Palool/Pairwata	4, 6, 10
Ascelpediaceae	*Periploca aphylla*	Barara	6, 45
Balsaminaceae	*Impatiens bicolor* Royle	Writh Athrang	19, 4, 16
	Impatiens brachycentra Kar.& Ker.	Spin Athrang	4, 6, 19
	Impatiens edgeworthii Hook	Ziar Athrang	19, 4, 6
	Impatiens flemingii Hook. f	Gulabi Athrang	19, 4, 1, 6
Berberidaceae	*Brberis lycium* Royle	Kwarai	6, 29, 10, 1
Betulaceae	*Betula jacquemontii* Dene	Braj	12, 30, 22, 37
	Alnus nitida (Spach.) E.	Girae	32, 16, 10, 15
Brassicaceae	*Capsella bursa-pastoris* (L.) Medik	Bambesa	6, 4
	Sisymbrium irio L.	Awrae	6, 4
	Nasturtium officinale R.Br.	Talmira	6, 30
	Nasturtium microphyllum Boen.ex.Reichb.	Talmira	2, 6, 4
Buxaceae	*Buxus Pappilosa* C.K.Schneid.	Shamshad	6, 10, 37
	Sarcococca saligna	Ladanr	6, 10
Cactaceae	*Opuntia dillenii* Haw.	Zookam	13, 36
Caeseplinaceae	*Caesalpinia decapitala* (Roth) Alston.	Jara	36
Cannabidaceae	*Cannabis sativa* L.	Bhang	6, 10
Caprifoliaceae	*Viburnum cotinfalium* Wall ex.D.Don	Ghamzewa	1, 6, 29, 36, 10
	Viburnum grandiflorum	Ghamzewa	1, 6, 29, 36, 10
Caryophyllaceae	*Silene conoidea* L.	Bashka Mashora	4, 5
	Silene vulgaris (Moench.) Garcke	Mataranga	4, 5
	Stillaria media (L.) Chyr.	Tighstargai	2, 4, 5

Family	Botanical name	Local name	Description of Plant use[a]
Chenopodiaceae	*Chenopodium album* L.	Sarmae	2, 6, 4
	Chenopodium botrys L.	Skha Khawra	6
	Chenopodium ambrosoidis L.	Benakae	6
Colchicaceae	*Colchicum luteum* Baker	Suranjan/ Ziargulae	6
Combritaceae	*Thaltictrum falconeri* Leconeri	Mamera	6
Compositae	*Achillea millefolium* L.	Karkara	6
	Artimisia maritima L.	Tarkha	6, 7, 8
	A. scoparia L.	Jaokae	6, 34, 10
	Calendula arvensis L.	Ziar Gulae	6
	Carthamus oxycantha L.	Kareza	6
	Cichorium intybus L.	Han	2, 6
	Cincus benidictus L.	Sharai	4, 5, 2
	Helianthus tuberosus L.	Aloopach	2, 18, 38
	Onopordeum acanthium L.	Wrejakai	6, 4
	Sonchus asper L.	Shawda pai	4
	Taraxicum officinale Weber.	Ziar Gwalae	6
	Xanthium strumarium L.	Gishkae	10, 6
Convolvulaceae	*Cuscuta reflexca* Roxb.	Neladarai	8
Crasulaceae	*Sedum ewersii* Ledeb.	Tha Gat Warkharae	6
Cucurbitaceae	*Melothria madraspatana* (L.) Long.	Kakora	6
	Citrulus colocynthis L.	Karkunday	4, 6
Cupressaceae	*Juniperons communis* L.	Gugar	10
Cyperaceae	*Carex indica* L.	Thaspa Boutai	32, 23,
Dennstaedtiaceae	*Pteridium equilinum* (L.) Kuhn.	Kwanjae	2, 6, 27
Dioscoraceae	*Dioscora deltoides* Wall.	Kanis	31, 6, 27
Ebenaecae	*Diospyrus lotus* L.	Amlok	1, 30, 6, 12, 10, 16
Elaegnaceae	*Elaegnus umbellata* Thunb.	Ghanamranga	1, 10, 36, 29, 6
Equisetaceae	*Equisetum arvense* L.	Bandakae	6
Ericaeae	*Rhododindron hypenantheum* Balf.	Gulnamer	6
Euphorbiaceae	*Euphorbia hirta* L.	Krachae	7
	Euphorbia prostata	Warmaga	6
	Ricinus communis L.	Aseela Harlanda	6, 10

Family	Botanical name	Local name	Description of Plant use[a]
Fagaceae	*Q.incana roxb.*	Banj	10, 4, 1, 12, 29, 43, 38
	Q.semicarpifalia	Kaanar/Mer	12, 10, 38
	Q.Ilex. L.	Serai	10, 43, 38, 29
	Q.dialatta Lindl.	Jaran	10, 4, 38, 29, 43
Guttiferae	*Hypericum perforatum* L.	Shin Chai	3, 6
Sapotaceae	*Reptonia buxifolia* A.DC.	Gwargwara	1, 10, 29
Hamamelidaceae	*Parrotiopsis jacquemontiana* (Done) Rehder.	Beranj	25, 24, 10, 38
Hippocastinaceae	*Aesculus indica* (Wall ex Cambl.) H.K.f	Jawaz	6, 4, 8, 10, 12, 16, 30
Iridaceae	*Gynandrisis sisyrinchium* (L) Parl.	Gandechar	7, 6
	Iris versicolor L.	Oudi Thurai	18, 6
Juglandaceae	*Juglens regia* L.	Ghouz	33, 1, 4, 6, 17, 18, 19, 12, 35, 41, 10
Labiatae	*Stychus parviflora* Benth	Sper bootae	10, 6
	Ajuga bracteosa Wall. ex. Benth.	Khawaga Bouti	6, 31
	A. parviflora Beth.	Tarkha Bouti	6, 31
	Mentha piperita L.	Yakha Podina	17, 6
	Mentha spicata L.	Podina	17, 6, 3
	Mentha sylvestris L.	Yenalae	6, 17, 3
	Micromeria biflora (Ham.) Bth.	Narae Shamakae	6, 39
	Origanum vulgare L.	Shamakae	39, 6
	Salvia moorcruptiana Roxb	Kharghwag	6
	Teucrium incanum Aitch & Hombsl.	Kwandi boutae	6
	Ocimum basilicum. L.	Kashmakae	18, 6, 17, 21
Laliaceae	*Polygonatum verticillatum* All.	Baramola	6
	Asparagus adscendens Roxb.	Thindarae	35, 6
	Astragalus anisacanthus Boiss.	Mamol	35, 6
	A.phyrrhotrichus Boiss.and Hohen.	Mamol	35, 6
	A.psilocentros Fisch		35, 6
	Gaega pseudoreticulata Wed	Qaimath Gulae	7
	Tulipa stillata H.K.	Ghantol	6, 4
Malvaceae	*Malva neglecta* Wallr.	Panerak	2, 4, 5
	Malva officinalis	Sonchal	2, 4, 5
	Malva sylvertris	Panerak	6, 4, 2, 5

Family	Botanical name	Local name	Description of Plant use[a]
Meliaceae	*Cedrela serrata* Royle	Skhawounae	31, 12, 7
	Melia azedrach L.	Shandai	16, 4, 6, 30, 10
Moraceae	*Ficus palmata*	Inzar	1, 4, 10, 6
	Morus alba L.	Baidana	1, 4, 12, 30, 10, 15, 16
	Morus nigra L.	Thooth	1, 4, 12, 30, 10, 15
Myrsinaceae	*Myrsine africana* L.	Marorang	6, 10, 38, 27
Nyctaginaceae	*Mirabilis jalapa* L.	Gule Bada	6, 18
Oleaceae	*Fraxinus excerlsior* L.	Shoom	4, 36, 10, 29
	Jasminum humile.	Rambel Chambel	21, 18, 29, 10
	Jasminum officinale	Ziar Rambel Chambel	21, 18, 29, 10
	Olea ferruginea Royle	Khona	4, 1, 38, 10, 16
Paeoniaceae	*Paeonia emodi* Wall.	Ward, Mamekh	6,
Papaveraceae	*Fumaria indica* (Hausskn) Pugsly.	Papra	6, 4, 5
	Aregemone maxicana L.	Raidae	6, 18
	Corydalis stewarttii Fedde	Mamera	6
Papilionaceae	*Dalbergia sisso* Roxb.	Shawa	30, 37, 38, 10, 12, 41
	Indigofera gerardiana Wall.	Ghwareja	24, 37, 24, 45, 46, 44
	Indigofera weightii	Ghwareja	4
	Lathyrus aphaca L.	Kur Kamanai	4, 2, 5
	Lathyrus cicra L.	Wara Chilo	4, 2, 1, 5
	Lathyrus sativus L.	Ghata Chilo	4, 5, 2
	Lathyrus pratensis L.	Ziara Chilo	4, 5
	Medicago denticulata	Shpeshtarae	4, 14, 6, 5
	Robinia pseudoaeacia L.	Kikar	36, 10, 4, 29
	Vicia faba L.	Marghai Khpa	4, 5, 14, 3
	Vicia hirsuta (L.) S.F.Gray	Mardikakh	4, 5, 14, 3
Phytolacceae	*Phytolacca labthenia* (Mog.) Walt.	Garrar	2, 6, 20, 19
Pinaceae	*Abies pindrow* Royle	Achar	38, 37, 26, 10, 29, 30
	Pinus gerardiana Wall. ex Lamb.	Nakhtar	26, 10, 38, 30, 18
	Pinus roxberghii Sargent	Nakhtar	28, 1, 10, 26, 30, 11, 13, 18
	Pinus wallichiana A.B. Jackson	Sraf	26, 30, 10, 11, 13, 18
Pistaciaceae	*Pistacia integerrima* Stewart	Shnai	6, 4, 10, 29
Plantaginaceae	*Plantigo lanceolata* L.	Jabai	4, 6
	Plantigo major L.	Ghata Jabai	4, 6
	Plantigo ovata Forsk.	Wara Jabai	4, 6
Platanaceae	*Platanus orientalis* L.	Chinar	16, 30, 12, 18

Family	Botanical name	Local name	Description of Plant use[a]
Poaceae	*Aristida adscensionis* Nees	Mashkar	4, 5, 34
	*A.cynantha ex.*Stued.	Mashaanrae	4, 5, 34
	Chrysopogon aucheri	Spin Wakha	4, 5, 24
	Chrysopogon gryllus	Spin Wakha	4, 5, 24
	Chrysopogon montanus Trin.	Spin Wakha	4, 5, 24
	Cenchrus pennisetiformis (Hoechest) Stued.	Pisho Lamae	4, 5
	Cenchrus cilliaris	Pisho Lamae	4, 5
	Cynodon dactylon L.	Kabal	4, 5, 18
	Desmostachya bipinnata (L.) Stapf.	Drab	4, 5
	Phragmites communis Trin	Sharghashae	37
	Sacchrum monja Roxb.	Nal	36, 37, 13
	Sacchrum spontaneum L.	Sharghashe	37, 13
	Sorghum helepense (L.)Pers.	Dadam	4, 5
Podophyllaceae	*Podophyllum emodi* Wall.	Gangora	6
Polygonaceae	*Rumex acetosa* L.	Tarokae	2, 6
	Polygonum aviculare	Palpolak	6, 31
	Polygonum viviparum L.	Anjabar	6, 4
	Rheum webbianum Royle	Ghoutyal	6
	Rumex dentatus L.	Shalkhae	2, 6
	Rumex alpinus L.	Thaghm Shalkhae	2, 6
Portulaceae	*Portulaca oleracea* L.	Warkharai	2, 6
Punicaceae	*Punica granatum*	Anangorae	1, 29, 10, 6, 17
Ranaculaceae	*Aconitum chasmanthum* Stapf. ex Holmes	The Ghra Zahar	7, 6
	Aconitum hetrophyllum Wall.	Zahar mora	7, 6
	A. violaceum Jacq. ex. Stapf.	-do-	7, 6, 13
	Anemone obetusiloba D.Don.	The Spinsar Bouti	4, 13
	A. rupicola Comb.	The Spinsar Bouti	4, 13
	Aquilegia pubiflora Wall.	Woudi Gwalae	6
	Caltha alba Jacq.ex.Camb.	Makhanr Path	2, 6, 4
	Clematis orientalis L.	Zelai	6
	Coptis teeta Wall.	Mamera	6
	Dilphinium roylei Munz.	Oudi Gulae	18
	Dilphinium pyramidale Royle	Oudi Gulae	18
	Galium asperifoleum Wall.	Tha Kargh Makookha	4, 1
	Rananculus muricatus L.	Quazi Ban	4, 6
Rhamnaceae	*Ziziphus jujuba* Mill.	Markhanai	33, 1, 6, 10, 36, 37, 4

Family	Botanical name	Local name	Description of Plant use[a]
Rosaceae	*Cotoneaster affinis* (Lindl.) Schn.	Kharawa	6, 10, 37
	Cotoneaster microphylla Wall.	Kharawa	10, 6, 1, 25
	Cotoneaster numularia Fisah & Mey.	Mamanra	10, 6, 25
	Crataegus oxycantha HK.f.	Tampasa	6, 29, 10, 1
	Fragaria indica Andrews	Tha Zmake Thooth	6, 1
	Fragaria nubicola Lindl.	Tha Zmake Thooth	1, 6
	Prunus cornuta (Wall). Steud.	Changa	4, 1, 29, 33, 29, 10
	Pyrus pashia	Tanga	42
	Rosa brunonii Lindl.	Khwarch	36, 44
	Rubus fruticosus L.	Karwara	36, 29, 1, 6
	Rubus idaeus L.	Baganai	36, 29, 1, 6
	Rubus sanctus	Goraja	29, 1, 6
	Rubus ellipticus	Ziara Karwara	29, 1, 6
	Sorbaria tomentosa (Lindle) Rehder.	Jijrai	4, 10, 29
Rutaceae	*Skimmia laurefola* (DC.) Sieb &Z ucc. ex.Walp.	Nazar Panra	40, 6
	Zanthoxylum aromatum DC.	Dambara	25, 36, 29, 17, 6
Salicaceae	*Populus alba* L.	Watani Sperdar	8, 10, 38
	Populus ciliata Wall.	Parra	10, 38, 16, 13
	Populus euphratica Oliv.	Sperdar	14, 30, 37, 13, 15, 38, 37
	Populus nigra L.	Sperdar	30, 37, 10, 15
	Salix babylonica L.	Aseela Wala	13, 16, 4, 10, 32, 12
	Salix tetrasperma Roxb	Wala	13, 16, 4, 10, 32, 12
	Salix flabellaris Anders	Tha Ghra Wala	4, 10, 13
Sambucaceae	*Sambucus wightiana* Wall. ex Wight & Arn.	Benakai	4, 6
Saxifragaceae	*Berginia ciliata* (Haw.) Scernb.	Gat Panra	6, 18
	Berginia stracheyi (Haw & Thoms) Engl.	Gat Panra	6
Scrophulariaceae	*Varbascum thapsus* L.	Khar Dag	6
	Veronica ciburia (L.) Less	Shamakae	6
Simarubaceae	*Ailanthus altissima* (Mill.) Swingle	Aseela Shandai	10, 4, 13, 15, 30, 29

Family	Botanical name	Local name	Description of Plant use[a]
Solanacae	*Atropa acuminata* Royle ex.Lindl.	Garar/Bargak	7, 6
	Solanum nigrum L.	Kamachoo	2, 6
	Solanum xanthocarpum Schard & Wendl.	Maraghoonae	6
	Withania sommifera Dunal	Kotilal	7, 6
	Datura metel L.	Harhanda	6, 7
	Datura stramonium L.	Harhanda	6, 7
Taxaceae	*Taxas baccata* L.	Banrya	38, 4, 10, 12, 9
Thymeleaceae	*Daphne mucronata* Royle	Leghonae	6, 10
Ulmaceae	*Celtis australis* L.	Thagha	6, 12, 30, 16
	Celtis leavigata Willd.		1, 37
	Ulmus wallichii With.	Kahae	4, 10, 38, 16
Umballiferae	*Eryngium biebersteinianum* Nevski	Tha ManzariMangwal	6, 4
	Anethum sowa Roxb.ex.Flem.	Sowah	6
	Prangos pobularia Lindl.	Kamasle Zankai	6
	Trachyspermum ammi	Sperkai	6
	Carum bulbocatanum	Tore Zankai	6, 30, 17
	Carum carvi L.	Sperkai	6
	Bumium persicum (Prios) Fedtsch.	Zankai	17, 6
Utricaceae	*Utrica dioca* L.	Lawane Sezoonkae	2, 6
	Utrica pilulefora L.	Sezoonkae	2, 6
Valerianaceae	*Valeriana jatamansi* Jones	Shingatai	6
Verbenaceae	*Vitex negundo* L.	Marwandai	8, 6
Violaceae	*Viola serpens* Wall.	Banafsha	6, 2
	Viola kashmiriana W.Bkr.	Banafsha	6, 2
Vitaceae	*Vitis vinifera* L.	Kwar	1, 4, 6
Zygophyllaceae	*Tribulus terristris* L.	Markoondai	6

[a] Key to plant use description

1. Wild fruit	13. Soil binder	25. Sticks/handles	37. Utensils
2. Potherb	14. Soil fertilizer	26. Timber	38. Construction
3. Beverage	15. Windbreak	27. Cushion plant	39. Bee attractants
4. Fodder	16. Shade tree	28. Resin	40. Smoking medicine
5. Hay fodder	17. Spice/flavoring agent	29. Fence	41. Wood carving

6. Medicine	18. Ornamental	30. Furniture	42. Rootstock
7. Poison	19. Dye	31. Fish poison	43. Charcoal
8. Green pesticide	20. Ink	32. Soil reclamation	44. Fishing checks
9. Graveyard things	21. Incense/perfume	33. Dry fruits	45. Snuff ash
10. Fuelwood	22. Paper	34. Brooms	46. Granary/ basketry
11. Torchwood	23. Beads	35. Miswak	
12. Agricultural tools	24. Packing/roping	36. Hedge plant	

References

Abbasi HA (1996) NWFP development statistics 1995–1996. Bureau of Statistics, PE & DD. Government of NWFP, Peshawar

Ahmad H (1999) Swat valley and millennium 2000: a perspective of natural resources. Udyana Today, EPS, Swat 7(4):15–17

Ahmad R (1999) Pollution survey of Swat river. A consultancy report of EPS Swat

Ahmad H, Ahmad R (2003) Agroecology and biodiversity of the catchment area of Swat River. The Nucleus 40:67–76

Ahmad H, Sirajuddin (1996) Ethnobotanical profile of Swat. Pro. First Train. Workshop Ethnob. Appl. Concerv. NARC, Islamabad, pp 202–211

Ali U, Khan MA (1991) Origin and diffusion of settlements in Swat valley. Pak J Geog Soc 1&2:97–115

Ali SI, Qaiser M (1986) A phytogeographical analysis of the phenarogames of Pakistan and Kashmir. Proc Royal Soc Edinburg 89:89–101

Anonymous (1978) Urdu Daera Ma'arif Islamia. Department of Urdu, University of the Punjab Lahore 17:563–565

Anonymous (1986) Paksitan census of livestock 1986. Agricultural census organization, Statistics Department, Government of Pakistan, Islamabad

Aston RJ, Brown DJA (1978) Fish farming in heated effluents. Pastakia C.M.R. (ed) Proc. Conf. Fish form and wastes. 4–5 January London, pp39–62

Barth F (1956) Ecologic relationships and the ethnic groups in Swat, North Pakistan. Am Anthropol 58(6):1079–1089

Barth F (1995) The last wali of Swat. An autobiography as told to Fredrik Barth. White Orchid Press, Bangkok

Bellew HW (1994) A general report on Yousafzais. Sang-e-Meel Publications Lahore, Pakistan

Bhatti MA (1997) Annual progress report for the year 1996–1997 agroeconomic unit. Agricultural Research Station (North) Mingora, Swat

Bowles GT (1977) The people of Asia. Weidenfeld and Nicolson, London

Butt JA (1986) Fish and fisheries of North West Frontier Province (NWFP) Pakistan. Biologia, S.S., pp 21–35

Goldman CR (1961) The contribution of adler trees (*Alnus terrui folia*) to primary productivity of Castle Lake, California. Ecology 42:282–287

Hussain AA (1962) The story of Swat as told by the founder. Feroz Sons Ltd., Peshawar

Jan MQ (1979) Petrography of the amphibolites of Swat and Kohistan. Pak Geo Rev 11:51–65

Jan MQ, Mian I (1971) Preliminary geology and petrography Of Swat Kohistan. Geo Bull Univ Peshawar 6:1–32

Khalil H (1986) Swat Nama, the Khushal Khan Khattak (in pushto). Markazee Khushal Adabi Wa Saqafatie Jerga, Akora Khattak, Pakistan

Khan M, Khan J (1993) Etiology, pathology and control of root rot of apple in Swat. Agricultural Research Station (North) Mingora, Swat NWFP
McMahon AH, Ramsay ADG (1901) Report on the tribes of Dir, Swat and Bajawar together with the Utman-Khel and Sam Ranizai. Saeed Book Bank, Peshawar
Mills DH (1980) The management of forest streams. Forestry Commission leaflet 78, London
Mirza MR (1976) Fish and fisheries of the northern submountain region of Pakistan. Biologia 22:107–120
Shah TV (1940) Ancient India. From 900 B.C. to 100 A.D., vol III and IV. Shashikant & Co. Baroda, India
Stacule G (1969) Excavation near Ghaligi and chronological sequence of protohistorical cultures in Swat valley. East West, IsMeo Ser 20:92 (Cited from Ali & Khan, 1991)
Stewart RR (1967) Chick list of the plants of Swat state, North West Pakistan. Pak J For 17:427–429
Wylly HC (1998) The borderland, the country of the Pathans. Indus Publications, Karachi