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Assessment of anthropogenic activities and exotic flora of Lolab valley, Kashmir, India

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Abstract: The present study is an attempt to analyze and assess the anthropogenic pressure and status of exotic species in the forests of Lolab Valley, Kashmir (India). Because of continuous and heavy grazing, and illegal encroachments, the pastures and forest-areas are deteriorated to critical levels. The pressure is also developing on the most favorite and preferred fuel wood tree species that include *Cedrus deodara, Pinus excelsa,* and *Abies pindrow*. The Kashmir Himalaya, known for its indigenous and endemic flora, also provides home to a large number of exotic plants, which exhibit a wide taxonomical and distributional stretch. The inventorization and documentation of its exotics have received a little or negligible attention. The present study has revealed that the exotic flora of Lolab valley is represented by a total of 30 species belonging to 22 families. The family Salicaceae (39%) proved to be the largest family fallowed by Rosaceae (31%), Rununculaceae (15%) and Moraceae (15%). Contribution of different geographical regions in terms of nativity shows that highest number of alien species have come from the continental Europe (42%) followed by Asia (31%) and North America (13%). In contrast, European flora contributed maximum percentage of species (42%) to the alien flora of Lolab valley.

Key words: Anthropogenic Pressure; Exotic Flora; Kashmir Himalaya; Lolab Valley; Temperate Forests.

INTRODUCTION

In the Himalayan temperate zone, the rapid population growth in the recent decades and various activities by man have caused several environmental problems. The traditional practices of livestock grazing, harvest of commercially important species and demand for fuel-wood and fodder are the major anthropogenic activities throughout the north western Himalaya (Singh and Rawat, 1999). The anthropogenic pressure includes livestock grazing, and extraction of medicinal plants. Besides grazing, encroachment and firewood collection, other pressures like stone querying, military activities, camping sites, collection of minor forest products, and encroachment have reduced the net pasture area considerably. There is the control of elevation (altitude); relief and drainage on the spatial distribution of vegetation cover (Mahajan and Kale, 2006). The biotic factors are also responsible for the spatial distribution of vegetation (Mahajan and Kale, 2006). In Kashmir Himalaya, pasture area of 0.143 and 0.064 ha per capita of livestock was available during 1972 in Kashmir and Jammu divisions respectively. This area got reduced to 0.103 and 0.034 ha per capita of livestock in Kashmir and Jammu respectively during 1982 (Mir, 1992). Even in Central Himalaya the area of the pastures is declining because of various biotic interferences (Ram and Singh, 1994). The Himalayan forests have experienced exceptional land-use changes during the past few decades, driven by rapid human population growth and intensifying anthropogenic activities, such as agriculture and expanding human settlements (Nayar & Sastry, 1990; Tikader 1983). The Himalayan region is inhabited by a large number of ethnic communities, many of them with distinct tradition, culture and life style. A large proportion of high-altitude landscapes in the Himalaya have been transformed over a long period of time by humans' presence and their diverse activities, including agro-pastoralism and extraction of natural products (Aumeeruddy *et al.,* 2004). The hostile climatic conditions and steeper mountains have restricted human settlements to the flatter valley bottoms. As a result, quite a few interior pockets of Himalaya are relatively less influenced by man and support rich natural vegetation (Singh and Rawat, 1999).

Traditionally, people of the Himalayan region have been fulfilling their energy needs almost entirely from forests (Bhatt *et al.,* 1994). At lower altitudes the forests meet the fuel-wood, fodder and timber demand of the local people while steeper and frequently burnt grassy slopes are left for the fodder grasses (Singh and Rawat, 1999). Other temperate grassy slopes and alpine meadows are used as summer grazing grounds by local people as well as several migratory pastoral communities (Phillimore, 1981; 1989; Tucker, 1986; Rawat and Uniyal, 1993). According to one estimate, firewood accounts for over 54% of all global harvests per annum, suggesting a significant forest loss (Osei, 1993; Wahab *et al.,* 2008). The uncultivated lands around Kashmir villages present a pathetic scene as the outcome of intensive grazing (Shaheen, *et. al.*, 2011). Local herdsmen need wood for fuel, thus they seriously damage shrubs and trees of the alpine forest zone (Polunin and Stainton, 1984). In many rural regions fuel wood is the most important energy source (Broadhead *et al.,* 2001) and many people rely on fuel-wood extraction from natural forests for cooking and heating (Anonymous, 2002). The amount of wood harvested for fuel-wood is much more than harvested volumes for industrial and other purposes. In contrast to logging for timber, fuel-wood harvesting usually occurs continually in the same place and does not rely on heavy machinery for transportation. The impacts of timber harvesting on forest biodiversity and wildlife have been subject to extensive research (Fimbel *et al.,* 2001; Putz *et al.,* 2001; Zarin *et al.,* 2004; Meijard *et al.,* 2005; Asner *et al.,* 2006). Deforestation is mainly caused by heavy uncontrolled grazing, commercial logging and local use of trees for firewood, clearance for cultivation, and stone querying. Himalayan forests are very much degraded due to nomadic activities, sedentary livestock overgrazing, and legal as well

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as illegal tree cutting (Ahmed *et al*, 1990; 1991; 2006). Medicinal plant species become less available due to extensive grazing (Bhat *et al.,* 2014).

Distribution of Exotic Species

A form of degradation that is less known is the invasion of forests by alien species. An alien species is a plant that originates from another continent or a remote biogeographically regions (Pysek *et al.,* 2004). Introduced purposely or accidentally (Stein and Flack, 1996), it manages to grow up in new environments and develops rapidly, often at the expense of native species. The invasion of indigenous plants by alien species has become one of the most serious threats to the biodiversity and the functioning of ecosystems worldwide (Vitousek and Walker, 1996; Williamson, 1999). According to Simberloff (2003), alien species invasion represent the second cause of biodiversity disappearance in addition to the destruction of natural habitat. Even there was a shift in macrophytic community structure that was evidenced by the local extinction of *Nelumbio nucifera* and the near-disappearance of some economically important plants (*Euryale ferox*). The investigation of various aspects of wetland ecology of Hokera reveals that species composition has witnessed great variations (Mir *et al.,* 2009).

According to Pysek *et al.,* (2004), alien species also called exotic, introduced, non-native species and defined as plant species in a given area outside the native distributional range, whose presence is due to intentional or unintentional human involvement. Globalization of trade, with enhanced transport, resulted in amplified intercontinental translocation of species (accidental as well as deliberate), causing homogenization or globalization of floras (Drake *et al.,* 1989). This has greatly altered the composition of biodiversity in different ecosystems (Vitousek and Walker, 1996; Mack *et al.,* 2000).

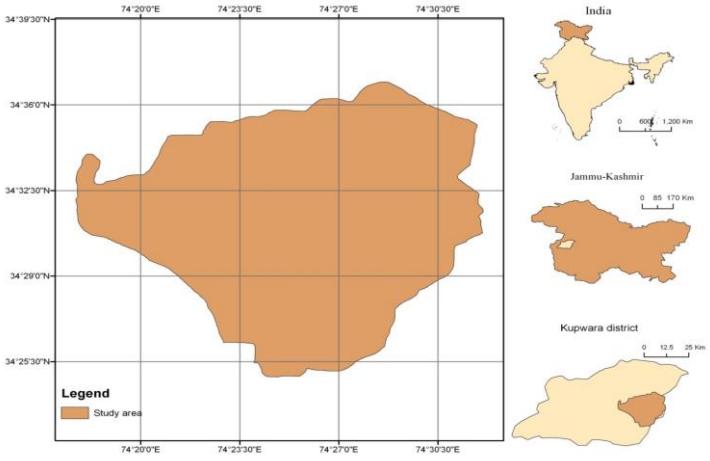
These introduced or exotic species can adversely affect the ecosystem. In India, large variety of exotic animal and plant species has been introduced from other parts of the world through the ages. Some exotic plants have turned into weeds, multiplying fast and causing harm to the ecosystem. The introduction of Russian Poplar has caused nuisance by dispersing its cottony seeds which caused severe allergy and asthma in the urban and rural populations in Kashmir. Owing to its apparent unhealthful impact, people recently in Srinagar criticized the government and so called experts for introducing it to Kashmir.

MATERIAL AND METHODS

The study area of Lolab valley (Fig. 1) is in north of Kashmir and is cup shaped, starting from Zangli neck surrounded with lush green forests, majestic and snowcapped mountains having unparalleled scenic beauty and is popularly called "Land of love and beauty". It is situated between geographical coordinates 34^0 25' and 34^0 42' N latitudes and $74^0$15' and 74^0 32' E longitudes. The valley roughly 350 km^2 and traversed by stream Lahwal, which flows down from the surrounding serpentine hills. Lolab has many pasture lands and a rich forest cover. Lolab valley has its own charm and is an eye-catching, small, compact region.

The findings in this study was related to various aspects like grazing pressure, deforestation, encroachment, stone quarrying, forest fires and distribution of exotic species, *etc.* in the area. The role of biotic and abiotic factors prevailing in the forests of Lolab valley was also taken into consideration. The data collected regarding above parameters was obtained through field survey and questionnaire method (Ogunkunle and Oladele, 2004). The surveys were basically aimed to assess both the anthropogenic pressure and distribution of exotic species in the area.

Figure 1: Location map of Lolab valley.



Systematic surveys were conducted for floral inventory covering all the habitat types and seasons. List of plant species within an area was framed and scanned for exotics. Some species were photographed to serve as permanent record of a species, as it occurred at a given time and place. All possible habitats for exotic species, were surveyed. The exploration was carried out in every nook and corner of the Lolab valley. The information regarding their taxonomic affinity, local distribution, native origin was collected. A species was listed as alien or exotic following Pysek *et al.,* (2002 and 2004) which envisages that there is no evidence that it has any area in the subcontinent (India) where it is native. Following Pysek *et al.,* (2002), the nativity of the species was recognized at the continental level *viz* Asia (barring the subcontinent India), Africa, North America, and Europe.

The native range for each species was primarily obtained from the secondary literature; and to cross-check the native range records, the native ranges for all the species were verified with data from the internet sources (http://apfisn.net/country-reports; www.kfri.org; www.plantquarantineindia.org; www.fsiorg.net; www.envfor.nic.in) and some other recently published papers (Khuroo, *et al.,* 2012; Rajanna & Seetharam, 2012; Gattoo, 2012; Pergl, *et al.,* 2012; Chandra Sekar, 2012; Montero-Castan˜o and Vila, 2012; Chaudhry, *et al.,* 2011; Zenni, *et al.,* 2011; Keith, *et al.,* 2011; Khuroo, *et al.,* 2011;

Hua, *et al.,* 2011; Singh, 2011; Tewari, *et al.,* 2010; Strayer, 2010 Harini & Gopal, 2010; and Singh, *et al.,* 2010).

RESULTS AND DISCUSSION

The natural forests of Himalaya have deteriorated alarmingly due to illicit felling, encroachment, grazing, *etc.* The plantations raised artificially could not be protected to their rotation ages. Constraint to protection of forests is mainly due to the close vicinity of the forest with human habitations. The forest areas have also depleted considerably and more and more areas are going out of management every year. The result of deterioration and depletion of forests is that an acute crisis of timber, firewood and other forest produces. The forests are subjected to injuries by the two main agencies: biotic and abiotic. Effects of anthropogenic pressure on the vegetation of the Lolab valley have been reviewed. Impacts on forest by over-grazing, stone querying, defense and development operations, and road building activities, are severe in the region. This has created an alarming situation for conservation of forests.

Biotic Agencies

Lopping: Tree lopping is the process of trimming various sections of a tree. The lopping may involve clearing away branches or limbs, or even shortening trunks. The incidence of lopping the trees to meet fire wood requirement is high enough in the forests near the habitation. The fireplace is kept burning round the clock in the villages. The lopping is done to such an extent that trees get almost completely deprived of its branches excepting a few at the top which are beyond reach. Lopping results in retarded growth and affecting the physiological activities of the plants. The lopping injuries expose the plant surface to pests and parasites which harbor the studs and reduce the commercial value of timber. The data collected regarding the species used for firewood is given in **table 1**. It provides elevation wise status of the species. Both *Cedrus deodar* and *Pinus* was under pressure and *Abies pindrow* was fair because on low elevations these species were used for firewood by local people for meeting their daily needs. Fuel wood still serves as a major source of energy for people living in the Lolab valley and business of fuel wood collection is the livelihood option.

Table 1: Status of species used for fuel wood.

Sr. No.	Botanical Name	Local Name	Elevation Range	Status
1	*Pinus excelsa*	Kail	2000-3000	Under pressure
2	*Cedrus deodara*	Deodar	1600-2300	Under pressure
3	*Abies pindrow*	Fir	2500-3200	Fair

Deforestation / Illicit damage / Timber harvesting: The people residing near the forests besides various other concessions are granted timber on concessional rates from sale depots. In spite of all these facilities alarming damage of forest crop is caused by the villagers by way of illicit felling of trees for timber and firewood purposes or to gain money. The forests are still considered no man's property and every one spreads his limbs over it reveals the deforestation caused during 1990s. Besides illicit felling, most serious type of damage was done through extracting torch wood by scooping out the tree trunks at their base. Such trees ultimately fell by wind or snow pressure. The debarking and girdling are other malpractices causing horrible damage to forest crop. These practices cause extensive death of trees over vast areas. Despite liberal concession and free grants of timber, the illicit damage done to these forests recorded and un-recorded has reached it this damage can be controlled by strict vigilance by the field forest staff and awareness among local people regarding the importance of forests. In addition to these damages the most serious damage is in the form of girdling, debarking and scooping the torch wood. Extensive Deodar area have been debarked in the valley by the village cobblers. The other cause of damage is clearing the forests for the purpose of laying the electric lines and poles. The bark is use for tanning purpose. The trees are girdled at the trunk base and the tree is killed completely. If the place of damage along with the other damage continues, it is going to destroy these forests.

Timber harvesting / extraction are being carried out by the forest department every year in the range 60000 to 80000 cft's. The extracted timber is being supplied to various depots of the Kashmir and Lolab valley for sale to the local people through proper system of sanction.

Fire: The fire is the most destructive of all destructive agencies. It causes colossal damage to forest flora and fauna. Very rarely it is caused by natural agencies like lightening but is almost always due to human actions deliberate or accidental or due to carelessness and negligence. Fortunately such hazards are not very common in the valley. The fire breaks outs commonly in dry months of autumn as a consequence of carelessness.

Some of them are set deliberately by villagers for better grass growth in the following season. The grazers and way farms during cold days collect dry lops and tops in heap and set them on fire for warming up themselves. They leave it flaming which some time spreads. The charcoal manufactures are other common cause of forest fire. The forest fire besides causing large scale destruction of trees, young seedling, seed and wild life deteriorate the site as well. They destroy all life forms, cause serious soil erosion, kill all the microorganisms and destroy the ecosystem that had been built up over a long period of time. Repeated fires arrest progressions of vegetation by process of degradation. They also denude soil paving way for massive soil erosion and siltation of dams, besides causing atmospheric pollution. Timely prevention and suppression is the key to fire control.

Fires in the forests start from June continuing up to the month of October every year. The interface of the forests with the human interests in enclosures and among the peripheral dwellers has increased with the increase in boundary length and these are the sources of fire. Farming, rehabilitation, Gujjar and Bakarwal settlements and regularized encroachment areas in and around the forests are the sources of most of the forest fires.

Fires are caused by trespassers and forest users by careless slinging of burning cigarette butts and matches on to the forest floor; campers in forests who do not put out campfires and fires lit for cooking, before leaving; and fires willfully set by people for burning vegetation either for collection of Non Wood Forest Products (MFP) or for hunting lesser animals or by the grazers for getting new flush of grass. Fires caused by the unemployed youth seeking employment as firewatchers are also common.

Grazing: The excessive forest grazing results in heavy damage to forests in various ways. The floor is tripped-off of its cover and sub-soil drainage gets impeded thus making it vulnerable to soil erosion which results in formation of rill, gullies and at places rock-out crop. The over grazing is hostile to regeneration. The criss-cross by herds of cattle compact surface soil. On such soil, germination of seed and their establishment becomes very difficult. The established seedlings are trampled over or browsed, so that even if they grow, they are stunted, branchy and malformed. The ground is also exhausted of its manorial ingredients by cattle. If over- grazing is persisted in for several successive years, complete denudation is the inevitable result.

The grazing in the forest is not prohibited nor is there any limitation regarding number of cattle and season of grazing excepting for the areas which are specifically closed for this purpose. The grazing of goats in deodar forest and there entry from outside the state is however, not allowed. The unrestricted grazing adversely affects the forest conservancy by posing serious problems like failure of adequate natural regeneration and higher soil erosion. It is evident that cattle population is increasing and area of pasture land is decreasing day by day (table 2 and 3). This is because the Lolab valley is being developed as a tourist destination hence pasture lands are being utilized for the infrastructure and other developmental activities. On the other side encroachment and shifting cultivation is also on peak which leads to tremendous pressure on the forest of the area.

Table 2: Livestock population of the area.

Species	Number of Heads.			
	1992	1997	2003	2010-11
Cattle	220330	247900	182300	256160
Buffalo	4220	5627	2100	3517
Sheep	162600	291000	73500	---
Others	12420	16813	59500	10285
Total	459570	669340	317400	269962

Source: Chief Animal Husbandry (Kupwara).

The grazing is regulated under Kahcharari Act 1954 and rules made there under. The schedule of grazing fee amended vides S.R.O. No. 147 of 1978 dated: 11-3-1978 is given below in (table 4). Livestock rearing is an important occupation for village folks in general. The district accounts for 3.174 lakhs of livestock population during 2003.

Table 3: Pasture and Grazing land (ha).

Year	Permanent pastures & other grazing land
1996-97	7107
1997-98	7107
1998-99	7107
1999-00	7107
2000-01	7107
2001-02	7000
2002-03	7101
2003-04	7101
2004-05	7101
2005-06	5191
2006-07	5191
2007-08	5191
2008-09	5191
2009-10	5191
2010-11	5191

Source: Kamraj Forest Division (Kupwara).

Table 4: The grazing regulated under Kahcharari Act 1954

Sr. No	Kind of animal	Rate A	Rate B	Rate C
1	Pen Block	0.80	0.80	0.80
2	Teli Block	0.50	1.00	2.00
3	Buffaloes	1.80	3.15	11.25
4	Riding Ponies	2.50	3.75	7.50
5	Pack Ponies, Mules	2.80	2.80	5.00
6	Donkeys	0.65	0.65	0.65
7	Sheep of Ladakh	0.15	0.20	0.60
8	Camels	5.00	10.00	15.00
9	Goats imported for commercial purpose	-	-	2.50
10	Sheep imported for commercial purpose	-	-	0.20

Source: Kamraj Forest Division Kupwara.

Encroachment: The menace of encroachments is marching ahead throughout the valley, while villagers have started it along the base of the forests; the Gujars have devastated huge area along the mountain tops for cultivation. It is common feature to see trees around such holdings give scooped, burnt and debarked to clear the ground for further encroachments. The problem is socio politics unless tackled by effective legislation, it is likely to continue.

Shifting cultivation is also practiced in some regions of the Lolab valley by some tribes in the forested highlands. The shifting agricultural system is an ecosystem modified by man's activities at a relatively low level in comparison with other forms of agricultural activities. The chief cultural practices include the activities like clearing the forest, growing crops, and abandoning the clearing.

The tribe first selects a small patch of forest. To create a clearing on the forest, the tribe selectively slashes the natural vegetation by simple tools and burns the logs, so the nutrients are released as ash which dissolves and is washed by rain into the soil as natural fertilizers. A variety of food crops are grown on the land such as rice, maize. The crops grow very quickly; some are ready to harvest after four to six months. After 2 or 3 years, due to decline in soil fertility, the yield of successive crops declines and weeds grows extensively. The site is abandoned and cultivation moves to another site, where another patch of the forest will be cleared for a new cultivation. They will try not to return to the former clearings for at least 50 years.

Encroachment of the forest land for cultivation is a persistent and alarming problem.

The forest trees adjoining the holding are girdled, scooped at the base and finally burnt or felled by the villagers and ground is cleared for extending their land within forest area. The boundary pillars are also removed or dislocated to camouflage the illegal acts. The regularization of some encroachments in past and in-effective laws has encouraged the offenders to continue their evil activities. Moreover, construction of roads through forest area is being done through various government schemes in order to enhance the tourism industry in the Lolab valley. This has further damaged the forests by providing easy accessibility to damage the doers. It will also cause the soil erosion in the form of landslides.

Fungi, Parasites and Insect damage: The damage by fungal attack is not heavy in the area. The *Fomes pini* is common fungi causing considerable damage to *Cedrus deodara* and *Pinus excelsa* trees. The attack is generally more on over-matured and lopped trees, which become clear after cutting a tree**.** It causes heart-rot disease in *Pinus excelsa* and ring-rot in *Cedrus deodara,* thus making the timber unfit for commercial purposes. The rotten and fallen trees serve as its harboring centers. The other fungi like *Bercalayell adeformans* occasionally damages in *Abies pindrow* and *Picea* trees, while *Fomes fomentorius* attacks the unhealthy broad leaved species like *Juglans regia*. Parasites draw whole or part of their nourishment from host plant and thereby cause damage to it. The parasite attack is however, not wide spread in the area. The common parasites generally belong to family Loranthaceae; species of *Viscum, Loranthus* and *Arcenthobium minutissimun* (Armi) are the example. The Armi attack is noticed on *Pinus* trees. The branches of infected trees get clustered to form commonly known as "witches broom" which gradually get dry along with needles. The attacked trees lose their vitality and finally die. The *Viscum alba* attacks on walnut and some other broad leaved species but the incidence and extent of damage is low. The only control is to cut the infected branches and burn them.

The insect damage is insignificant in these forests. The *Euzophora cedrella* sometime attacks deodar cones, turn them pale and their further growth gets stopped. *Scolytidea* insect attacks diseased and dead deodar trees. The *Tomicus sp.* and *Cicadids* attack Kail trees. The less vigorous trees are more susceptible to their attack. The broad leaved species like *Aesculus indica* gets sometime attacked by Lepidopterous cater-pillars and walnut by Long corn beetles which form tunnels in trunks. There are number of other insects present in forest but are economically not so important.

Damage caused by wildlife: The bears and monkeys inflict damage to forest trees. The bears strip-off the *Pinus* and deodar bark to lick up the sap. The monkeys damage the cones and *Aesculus indica* nuts. The Deer nibbles-off tender shoots of regeneration. The Squirrel and wood-peckers also damage walnut and coniferous cones. Besides all these pressures stone quarrying and military activities was also matter of concern. Stone quarrying was on peak in the areas of Daradpora, Doorusa, and Wolkul of south Lolab area. The villagers mostly extract stones from the forest area and use them for construction purpose which becomes inexpensive for them. Stone quarrying will result in to heavy damage of forests because it exposes the whole area and leads to landslides as the slope of these areas is very steep.

Abiotic Agencies:

The abiotic factors also cause physical damage to the vegetation. Appreciable damage is caused to young deodar crop by the snow and wind, large number of trees, poles in particular gets uprooted every year in the South and North Lolab. Avalanches and landslips are restricted to upper un-commercial zone only. The atmospheric agencies like snow, wind, frost, lightening and land-slips cause sometime appreciable damage to forest trees. The sliding snow cause erosion and uproots the forest trees on precipitous slopes. The sliding snow accumulates on the crown of trees and by its weight bends, breaks and up-root them. The strong winds on higher reaches also break and up-root trees. The frost damages the young plantations by causing canker and cracks in stems and seedling by frost lifting. Similarly the land slips and lightening damage by way of up-rooting the plants and causing fires respectively.

Exotics: Large scale agricultural and forestry activities are responsible for conversion of natural landscapes to agriculture fields and plantation areas. Due to this, large numbers of people are migrating to a new geographic area and also because of economic opportunities created by industrialization (Nebel, *et al.,* 1998). The development of major infrastructures and buildings resulted in the alteration of natural ecosystems into anthropogenic ecosystems (*i.e.* agriculture fields, gardens, parks, lawns, *etc.*) which resulted in the establishment of exotic (exotic or invasive) plant species that replaced native species (Zerbe, *et al.,* 2004). Horticultural and Silvicultural practices are used to put more exotics in the Lolab Valley. We have reported following exotic species in the Lolab Valley. Punalekar (2010) showed that an inappropriate plantation practice has significantly affected the composition of native vegetation and noticed the declining status of native species.

The exotic flora of Lolab valley is represented by a total of 30 species belonging to 22 families (table 5). The family Salicaceae (39%) proved to be the largest family fallowed by Rosaceae (31%), Rununculaceae (15%) and Moraceae (15%) (Fig. 2). Habit wise analysis of the alien flora revealed that herbs were (11 species), shrubs (3), trees (14) and climbers (2) in number. Plant species with tree habit were (47%), dominate the alien flora of Lolab valley as the percentage of herbaceous flora was (36%), shrubs (10%) and climbers (7%). Thus habit-wise classification of alien species shows a preponderance of trees (Fig. 3). Habitat (forests, open, margs, *etc*) where a given species was most abundant was also noted which showed highest number in open (78%), followed by forests (19%) and pastures (margs) (3%) (Fig. 4). Contribution of different geographical regions in terms of nativity is shown in (Fig. 5). The highest number of alien species have come from the continental Europe (42%) followed by Asia (31%) and North America (13%). In contrast, European flora contributed maximum

percentage of species (42%) to the alien flora of Lolab valley. Khuroo *et al.,* (2007) have argued that predominance of European elements in the alien flora of Jammu and Kashmir could be due to successful introduction owing to more or less similar climate. The details of major exotic plantation species are as below.

Table 5: Exotic flora of Lolab Valley.

Botanical Name	Origin	Habit	Locality	Family
Cuscuta reflexa Roxb.	MD	C	Open	Convolvulaceae
Vitis vinifera	EU, AS	C	Cultivated	Vitaceae
Amaranthus caudatus L.	NAM	H	Open	Amaranthaceae
Chrysanthemum cinerariaefolium L.	EU	H	Margs	Asteraceae
Canabis sativa Lam.	AS	H	Forest	Cannabaceae
Iris nepalensis L.	EU	H	Open	Iridaceae
Papaver dubium L.	EU, AF	H	Open	Papaveraceae
Indigofera heterantha L.	NAM	H	Open	Papilionaceae
Portulaea oleracea Juss.	NAM	H	Open	Portulacaceae
Anagallis arvensis L.	EU	H	Forest	Primulaceae
Anemone falconeri L.	EU	H	Rocks	Ranunculaceae
Aquilegia vulgaris Wallich ex. Royle	EU	H	Open	Ranunculaceae
Viola odorata L.	EU	H	Forest	Violaceae
Salix alba L.	EU, AS, AF	S	Nalla	Salicaceae
Salix babylonica L.	EU, AF	S	Nalla	Salicaceae
Datura stramonium L.	NAM	S	Open	Solanaceae
Robina pseudoacacia L.	NAM	T	Forest	Fabaceae
Juglans regia L.	AS	T	Forest	Juglandaceae
Morus nigra L.	AS	T	Forest	Moraceae
Morus alba	As	T	Open	Moraceae
Fraxinus excelsior Walter	EU, AS	T	Forest	Oleaceae
Platantus orientalis. L.	EU, AS	T	Open	Platanaceae
Prunus cerasus L.	EU, AS	T	Forest	Rosaceae
Prunus pashia (Wall. ex. Royle)	AS	T	Open	Rosaceae
Pyrus communis Linn.	EU, AS	T	Open	Rosaceae
Populus alba Linn.	EU, AS, AF	T	Open	Salicaceae
Populus deltoids	NAM	T	Open	Salicaceae
Populus nigra Linn.	EU, AS, AF	T	Open	Salicaceae
Taxus baccata L.	EU, AF, NAM	T	Forest	Taxaceae
Celtis australis L.	EU, AS	T	Forest	Ulmaceae

Figure 2: Dominant exotic families of the Lolab valley

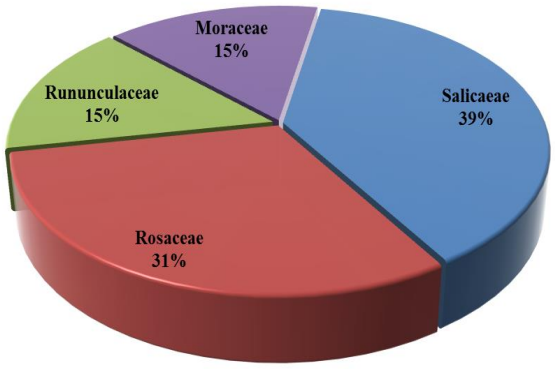


Figure 3: Habit-wise distribution of exotic species of Lolab valley.

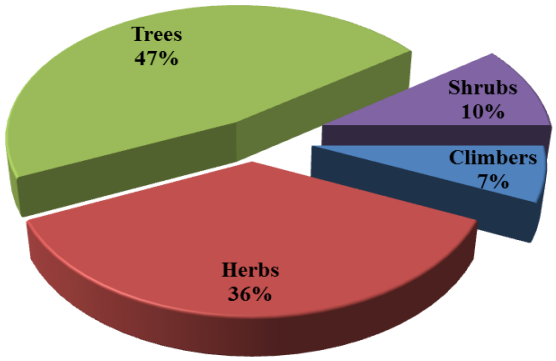


Figure 4: Habitat-wise distribution of exotic flora of Lolab valley

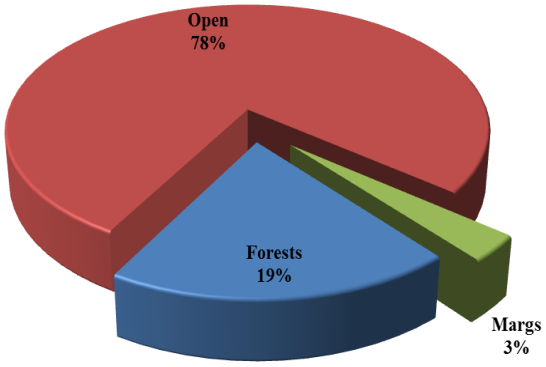
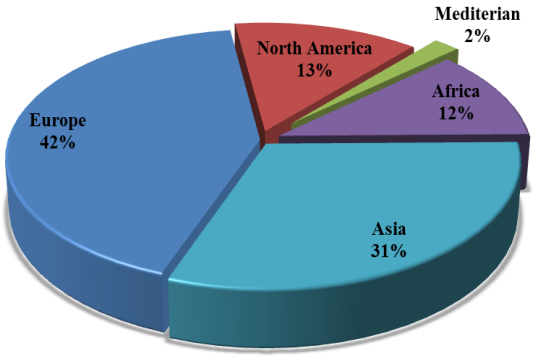


Figure 5: Nativity of exotic species of Lolab valley



***Salix alba* (Willow):** Willows have been growing in Kashmir Valley and other adjoining temperate areas of India since time immemorial. The willow constituted an important tree species to mankind in view of its multipurpose usage. Historical facts relating to planting of willows by Guru Nanakdev Ji in Leh and by other personalities elsewhere and also willow footwear used by saints and rishis of Kashmir are treated as relics.

Introduction of wicker and bat willows from England during early 20th century and their multiplication in suitable areas of Kashmir valley acted as a boon to the willow based cottage industry. The first head of the Jammu and Kashmir Forest department, JC Mac Doonnell and his associate Redcliff and also on the recommendation of Sir Walter Lawrence 1895, the first Settlement Commissioner of Kashmir, bat willow (*Salix alba*) plant materials were

introduced in 1917. It readily fitted in the agro-climatological niche to serve its present objectives. Extensive planting of willow in the past perhaps has been preferred because of its fast growing nature, easy method of vegetative propagation through cuttings that route readily in moist soil irrespective of age.

The willows are multipurpose trees utilized by mankind in a number of ways it is mainly cultivated for fuel wood, plywood and hardboard industry, artificial limbs, furniture, agricultural implements, toothpicks, tooth brush and construction purposes. Leaves are fed to cattle during winter, charcoal tar, and dyes are also obtained from willow leaf and bark extracts have anti-inflammatory properties and yield salicin, a substance that chemically resembles aspirin. It temporarily relieves headache, stomachache, and other body pain. The trees are known to help in checking pollution, water logging and soil erosion, willow is used for bio-filtration, constructed wetlands, ecological wastewater treatment systems, stream bank stabilization (bioengineering), hedges, landscaping, phytoremediation, slope stabilization, soil erosion control, shelterbelts and windbreaks, soil building, soil reclamation, tree bog compost toilet, and wildlife habitat.

***Salix babylonica*:** It is a species of willow native to dry areas of northern China, but cultivated for millennia elsewhere in Asia. It grows rapidly, but has a short lifespan. The shoots are yellowish-brown, with small buds. The leaves are alternate and spirally arranged, narrow, light green, 4-16 cm long and 0.5-2 cm broad, with finely serrate margins and long acuminate tips; they turn a gold-yellow in autumn. The flowers are arranged in catkins produced early in the spring; it is deciduous, with the male and female catkins on separate trees. *Salix babylonica* is a popular ornamental tree and is also grown for wood production and shelterbelts.

Populus nigra: *Populus* is a genus of 25–35 species of deciduous flowering plant in the family Salicaceae; native to most of the northern hemisphere. English names variously applied to different species include poplar, aspen and cottonwood. The genus has a large genetic diversity, and can grow from anywhere between 15–50 m (50 to 165 ft) tall, with trunks of up to 2.5 m (8 ft) diameter. The bark on young trees is smooth, white to greenish or dark grey, often with conspicuous lenticels; on old trees it remains smooth in some species, but becomes rough and deeply fissured in others. The shoots are stout, with (unlike in the related willows) the terminal bud present. The leaves often turn bright gold to yellow before they fall during autumn.

Poplars form a very important part of basic forest biology, and its cultivation in India has a very long history with exotic poplars being grown in Kashmir valley since times unknown. The genus *Populus* consisting of more than thirty species occurs throughout the forests of temperate and cold regions of northern hemisphere. The species *Populus ciliata*, the only native poplar of India, is endemic to the Himalayan belt and has been an important tree for the forest breeders of India. Around 1950, a large number of exotic clones of *Populus* were introduced and grown in North India mainly for increasing the wood availability for match and plywood industries.

Black poplar timber was much in demand during the 17th and 18th centuries as it has certain desirable properties. It was used for the flooring near fireplaces where its fire resistance was an advantage. The wood is shock absorbent and was the timber of choice for wagon bottoms, rifle butts, stable partitions and brake blocks. It was used for clogs, furniture and fruit boxes because of its lightweight and white colour. Poles from pollarded trees were used for thatching spars, sheep hurdles, and bean poles and in the manufacture of matches.

The forked trunks formed the structural support of cruck-framed buildings and branches were used as cattle fodder. It was planted because of its distinctive form to delineate parish and county boundaries. Today, it is largely grown as an amenity tree in parks, where male trees are favored because they do not produce the seed fluff which is considered to be unsightly.

***Plantanus orientalis* (Chinar):** *Plantanus* is a deciduous tree, native to temperate regions. The bark may flake in patches on older branches, leaving a flecked surface. On the oldest wood and trunk flaking may occur less frequently leaving a fissured broken bark surface. On some trees burrs can occur on the trunk and these may resemble tubers and branches are often sinuous or contorted. Branch tips and shoots may be ascending, especially on upper branches. The widespread branches of many trees can however droop to ground level. Chinar is called *Booune* in the Kashmiri language, the Chinar tree is an integral part of Kashmiri culture. Almost every village in the valley has a Chinar tree. You can experience a cool breeze under the shadow of this majestic tree which is very conducive to health.

Large scale plantation of Chinar was patronized by benevolent king namely Zain-ul-ab-din. After the arrival of Mughals, Akbar and Shahjahan also showed keen interest in using Chinars as attractive shade bearing landscape tree. Mughals got these trees planted in famous Mughal Gardens of Kashmir like Naseem bagh, Nishat bagh, Shalimar garden, Harwan and at places like Bijbehara, Budgam, Kokernag and Anantnag. Largest tree seen in Darashikoh bagh at Bijbehara has been measured 19 m at ground level. The largest Chinar has also been reported from Chittergam, Chadoora which measures 31.85 m at ground level and 14.78 m at breast height. All this reflects the deep aesthetic sense of Mughal Emperors. Kalhana, the great historian of Kashmir however does not mention *Bouin* but mentions a large tree called *Vata* as a sacred tree resembling Chinar. Sir Walter Lawrence in his book "Valley of Kashmir" published in 1895 mentions this as royal tree of Kashmir. He has put on record bole of Chinar in Lolab valley having a circumference of 63 feet 5 inches at about 5 ft from ground level.

At present Jammu and Kashmir has declared Chinar as state tree and provided full legal protection under

law but Chinar trees are dwindling fast due to drying because of ongoing developmental activities and increasing vehicular pollution. Chinar tree has special cultural and religious significance among Kashmiris Hindus. Several articles of handicrafts decorated with motifs of Chinar leaves are source of curiosity for the tourists and pilgrims who visit Jammu and Kashmir. Autumn season presents enchanting orange red glow to the falling foliage and great splendor of matchless beauty for the attraction of visitors.

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