

Research Article

Diversity, utilization and economic importance of fuel wood and fruit plants at Tehsil Dir, Pakistan

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Abstract

In this research data was collected through questionnaire from inhabitants of the area from 10 localities regarding diversity, economic importance and utilization of fuel wood and fruit plants adopting *ex-situ* (inventory) and *in-situ* (artifact) methods. Plants were collected, preserved, mounted and identified with the help of Flora of Pakistan. A total of 89 species were collected from the research area belonging to 46 families and 64 genera. The fuel wood diversity showed that 13 families, 17 genera and 19 species, in which 3 were shrubs and 16 were trees were utilized for heating and cooking purposes. Fruit plants diversity showed that 15 families, 25 genera and 43 species are used as fruit plants. Among the fruit plants 4 were herbs, 7 were shrubs, 32 were trees, in which 32 were wild and 11 were cultivated. Eight species (8) were directly used as fresh fruits in the study area. The economic plants diversity showed that 13 families, 17 genera and 21 species are used as economic plants, in which 1 was shrub and 20 were trees. The economic uses data showed that 16 species were used for making agricultural tools, 14 for furniture, 11 for utensils and 2 each for timber and for making doors. The diversity, utilization and economic importance of fuel wood and fruit plants showed that the inhabitants rely upon plants for their livelihood and food security. The fruit plants are facing many threats including anthropogenic activities, over usage for fuel wood, habitat destruction and deforestation and need conservation.

Keywords: Anthropogenic; Deforestation; Economic importance; Fuel wood; Food security; Habitat destruction; livelihood.

Introduction

Pakistan is a country with great altitudinal and topographic variation ranging from 0 to 8611 m and the total diversity of flowering plants explored so far is more than 6000 species. It is estimated that in many developing countries 75% to 90% of the local population obtain their daily needs including medicines, shelter, timber, food, fodder and fuel wood from plants. In the remote areas of Pakistan like Dir Upper the

people are still rely upon plants for supporting their livelihood [1]. Fuel wood and fruit plants are very important for the local people of the research area. The fuel wood and fruit plants are direct sources of income generation for the local people and they sustain their livelihood by utilization of the plant natural resources growing therein. Further, they use plants for fuel wood and heating purposes and they also obtain balance diet by eating fruits. The

area is situated in the northern part of the country and plants are the only source of fuel wood as no gas or solar facilities are available for fuel wood, fruits and other economic uses. The inhabitants are overexploiting and chopped down many precious trees for fuel wood purposes. A considerable decrease in tree cover has happened due to this practice. This research has provided a guideline to the local inhabitants for sustainable utilization of the plant natural resources of the area. The research area is a center for origin of many wild fruit plants and many of them are disappearing with a fast rate. It is feared that if sustainable utilization of these fruit plants are not ensured then loss of genetic diversity and local gene pool may be prevailing. Therefore, this research was carried out to overcome the above research problem and academic gap in the research area.

Previously some attempts have been made by various researchers to study the floristic diversity, taxonomic, ethnobotanical, medicinal, fuel wood, fodder, fruit plants and other aspects of the plants utilized for various purposes in other areas of the country. In a similar Taxo-ethnobotanical study from Dir Kohistan, a total of 469 species were collected, in which local inhabitants used 35 species for fuel wood and fruit purposes. Following the same work, a list of plant species was prepared, which are used for multiple purposes in Dir Kohistan Valley of Khyber Pakhtunkhwa. It comprised of 26 species and 16 families. During this research 100 resource persons in which 15 women and 85 men were interviewed for extraction of the local knowledge regarding these species. In a research 30 herbal species were explored distributed among 16 families growing in Maidan valley, Lower Dir used by the local communities for miscellaneous purposes [2].

The ethnomedicinal studies of 65 species growing in tehsil, Khall Lower Dir was carried out. It was concluded that the inhabitants of the area used 10 trees, 7

shrubs and 48 herbs. The dominant families were Lamiaceae and Asteraceae [3]. Eighty four (84) taxa belonging to 36 genera and 72 species in Shigar valley of Baltistan area were documented. These species were locally used for various purposes by the local communities [4]. The research was conducted, in which 41 families, 60 genera and 64 species from Mohmand Agency, Khyber Pakhtunkhwa were reported, which were used for various purposes by the local communities [5]. The inhabitants of different Balochi tribes reportedly use 446 taxa for various purposes [6]. About 74 species from desert and arid regions of Sindh Pakistan were identified, which the people used to fulfill their daily needs. The inhabitants of such areas also rely upon these species to fulfill their daily needs [7]. This study was conducted to explore the diversity and utilization of fuel wood and fruit plants of Tehsil Dir, as people of the area obtained their daily needs from various plants growing in the research area. The hypothesis of this study was whether inhabitants of the research area depend upon fuel wood and fruit plants to support their livelihood and socioeconomic development.

Study objectives

The following are the objectives of this this research study.

1. To enlist the fuel wood and fruit plants diversity of the research area.
2. To assess the utilization and economic importance of fuel wood and fruit plants diversity.

Materials and Methods

Study area

Upper Dir is located in the northern part of Khyber Pakhtunkhwa and is the last District before Chitral bordering Afghanistan covering a total area of 3699 km². District Swat is situated to the East, Afghanistan to the West, Lower Dir to the South and Chitral to the North and Northwest [8]. Tehsil Dir is the capital of Upper Dir and is situated towards the northern part of the district. The coordinates were from North latitudes 35°04' to 35°46' and East

longitudes $71^{\circ}32'$ to $72^{\circ}22'$. To the East side of Tehsil Dir, Tehsil Kalkot is situated (Fig. 1). The area is bound by Chitral district and Tehsil Barawal Banda on West. To the North is Chitral and Wari Sub-division is located towards the South [8]. The area has a great altitudinal variation ranging from 975 m to 4189 m at Lawari top [9]. The area comprised of small valleys and several peaks [9]. Altitudinal and topographic diversity has resulted into different types of vegetation presenting subtropical, dry temperate, moist temperate and alpine types. The temperature remains low in December till February with frequent snowfall. The pleasant months are September and October and hottest month is June. In January the mean minimum temperature remains below 0°C and mean maximum is 32.3°C in June. In March, maximum rainfall of 242 mm has been

recorded and minimum in November *i.e.*, 50 mm. The minimum relative humidity is recorded in June *i.e.*, 41.7 %, while the maximum in August *i.e.*, 69.7% [10]. The mean maximum precipitation recorded was in January *i.e.*, 111.4 mm, and the minimum was in November *i.e.*, 50.7 mm. The main river of the Upper Dir is Panjkora which has joined by the Dir and Barawal rivers. Small streams are also present in different valleys including Usheri Dara, Nehag Dara and Karo Dara. According to the 2017 census, the area total population is 947,401 comprising 466,594 males and 480,766 females. The rural population was 903,301 (95.35%) and the urban population was 44,100 (4.65%). The male literacy rate was 46.09% and female literacy rate was 64.84%. It was also recorded that 471 people in the district were from religious minorities [10].

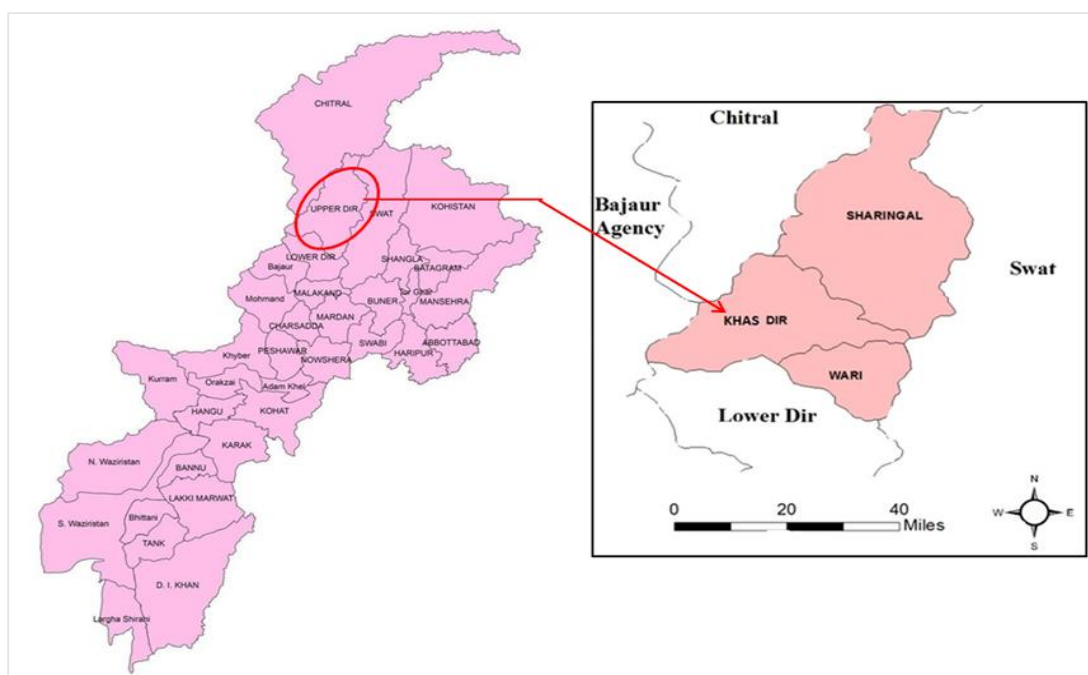


Figure 1: Map of the research area Tehsil Dir [8]

Collection, enlisting and identification

Field visits were arranged to ten (10) different localities of the research area *i.e.*, Bibiour, Darora, Chukiatur, Gandegar, Dir proper, Tarpatar, Palam, Dobando, Qolandai and Panakot and plants collection was made. After this, the plants were

pressed in the newspaper, dried, and then mounted on the herbarium sheet. The collection was properly managed and identification was carried out by consulting reliable literature [11-14]. The preparation of proper vouchers was carried out and

submitted in the Centre of Plant Biodiversity herbarium.

Assessment of fuel wood and fruit plants in the research area

For economic assessment of fuel wood and fruit plants the selected 10 localities *i.e.*, (Bibiour, Darora, Chukiatur, Gandegar, Dir proper, Tarpatar, Palam, Dobando, Qolandai and Panakot) were visited and at least 10 respondents from each site were interviewed through questionnaire. To avoid biased answers, the respondents were divided into five age groups *i.e.*, 20-30, 31-40, 41-50, 51-60 and 61. Standard procedures of ex-situ (inventory) and in-situ (artifact) methods were followed [15-17]. Data was collected through questionnaires from wood depots, furniture industries, fruit markets and local inhabitants and all the relevant information was noted on the spot. The utilization and economic uses data for fuel wood species including rate per mound, sale per month and sale per annum and for fruit plants including rate per kg, sale per month and sale per year was recorded.

Results and Discussion

Diversity, utilization and economic importance of plants in the research area

A total of 89 species were identified from the research area in which 19 species were fuel wood, 43 were fruit plants and 21 were other economic species.

Fuel wood species

The fuel wood diversity showed that 19 species belonging to 13 families and 17 genera are utilized for heating and cooking purposes in Tehsil Dir. Among them 2 species were gymnosperms and 17 were angiosperms, in which 3 were shrubs and 16 were trees. Four species and 3 genera were reported in Moraceae, two species and 2 genera each were reported in Pinaceae and Papilionaceae, 1 genus 2 species in Fagaceae and 1 species and 1 genus each were reported in the rest of the 9 families. The price related data of the fuel wood species showed that some shrubs including *Berberis lycium* Royle, *Indigofera heterantha* Wall. ex Brandis and *Dodonaea*

viscosa (L.) Jacq. were used extensively for cooking and heating purposes. Some species are used by the local people collected from their lands and the extra fuel wood is sold out to the wood depots. The fuel wood is locally used or stored for winter season and the extra fuel wood is sold out at the local markets. Some of the fuel wood is sold at local markets while considerable amount of fuel wood is sent to Warai and Timergara where the demand of fuel wood is more and the rates are on high side as mentioned in (Table 1 & Fig. 2-6).

Fruit plants species

Fruit plants diversity showed that 43 species, 25 genera and 15 families are used as fruit plants in tehsil Dir. Among the fruit plants 4 were herbs, 7 were shrubs, 32 were trees, in which 32 were wild and 11 were cultivated. Species distribution showed 7 genera and 20 species as dominant in Rosaceae, 2 genera and 4 species in Moraceae, 3 genera and 3 species in Apiaceae, 2 genera and 2 species each in Apiaceae, Ebenaceae, Oleaceae and Rhamnaceae. While 1 genus and 1 species each was reported in the rest of the 9 families. The rates of these fruit plant species are listed in.

Eight species (8) were reported in which fresh fruits are used *viz.*, *Myrsine africana* L., *Ziziphus oxyphylla* Edgew., *Cydonia oblonga* Mill., *Potentilla indica* (Andrews.) Th. Wolf., *Rosa micrantha* Borrer ex Sm., *Rubus ellipticus* L., *Rubus fruticosus* L. and *Celtis tetrandra* Roxb. and dried fruit of one species *i.e.*, *Quercus incana* Roxb., are used directly in the study area. Still, they are not collected or sold in market for earning purposes. Fresh fruits of 30 plants, dried fruits of 8 species, and both fresh and dried fruits of 5 species are used. Some of the fruit plants are locally consumed and some are dried and stored. The extra fruits are sold out at the local markets, where some fruits are sold out at local markets and some fruits are sent to other cities. The dried fruits are stored and sold in other cities including Warai, Timergara and Peshawar. Some fresh fruits are sold out in

other cities including Warai, Timergara and Peshawar due to their rates over there as shown in (Table 2 & Fig. 7-11).

Economic uses (furniture, timber, doors, agricultural tools and utensils)

The fuel wood and fruit plants are also used for various economic purposes including furniture, timber, doors, agricultural tools and utensils. The economic plants diversity showed that 13 families, 17 genera and 21 species are used as economic plants in the area. One (1) gymnosperm family Pinaceae with 2 genera and 2 species and 12 angiosperms families with 15 genera and 19 species were documented. Three (3) genera and 5 species were noted in family Moraceae, while Papilionaceae was with 2 genera and 2 species, the Ebenaceae and Fagaceae were with one genus and 2 species each. One (1) genus and 1 species each were present in the remaining 8 families. Among the economic uses the 16 species were used for making agricultural tools, 14 for furniture, 11 for utensils and 2 each as timber and for making doors. The local people use various plants for economic purposes including furniture, timber, agriculture implements, utensils and doors. These products are sold locally or transported to other parts of the province including Lower Dir, Peshawar, Mardan and other Districts (Table 3 & Fig. 12-14). In the far off areas the locals are compelled to use the fuel wood species to overcome their energy needs. Due to the unavailability of alternate sources of energy the people use fuel wood for energy requirements [18]. The local people use the fuel wood species for themselves for heating and cooking purposes and also sold out at the local markets, and the locals generate revenue by selling out the fuel wood. Due to the diverse utilities of the plant species including fuel wood, they are exerting pressure on the local flora [19]. The plants support the livelihood of poor people around the world in many ways [20]. Plants fulfill and support the daily needs of the inhabitants in many areas and are vital

for people living in hilly areas of the country [21].

Since time of Adam's the plants are in use by humans for different purposes including fuel wood, medicinal, nutritional and other purposes [22, 23]. Pakistan is deficient in fuel and timber wood with deficit of 29 million cubic meters. It has been noticed that the tree cover is decreasing because it is a cheap source of energy. Therefore, increasing the trees cover is needed to support the livelihood of the local people living in such areas [24]. The demand and harvesting of fuel and timber wood have increased because domestic utilization is increasing day by day. In the country's Himalayan region, the people fulfill their fuel demand mainly from the fuel wood species [25-28]. The importance and use of fuel wood are increasing quickly especially in the rural areas of the country because of its heating, cooking and commercial value at local markets [29, 30]. Plants are not only supporting the life of humans but also support the animals as they are the source of food and fodder [31]. In poor and developing countries of the world, millions of population use wild edible plants as fruit plants for nutritional and food purposes. The plants are in use by humans as food and medicines. In rural areas the people extract 90% of their requirements from plants including fruits, food and fuel wood [32]. Plants growing in the wild provide organic and inorganic molecules, fibers, minerals, vitamins, antioxidants and many other micro and macro nutrients. The importance and role of fruits plant cannot be ignored. The fruits are an important part of a balanced diet, and fruits play an important role in supporting various metabolic processes. Research has been carried out on plants of Tor Ghar District (Tribe Basikhel) in 15 villages for its cultural uses and 250 species belonging to 90 families were identified, which were used for different purposes including fodder (104 spp.), fuel (76 spp.), food (57 spp.), timber (25 spp.), tools (17 spp.) and furniture (10 spp.) [33]. A study was conducted about the

consumption of fuel wood in Kashmir Himalaya, which showed that fuel wood is the main source of energy in rural areas and the results showed that 16.2 Mg year⁻¹, and 5.9 kg day⁻¹ per capita fuel wood had been utilized per household [34]. In the same way forests of Swat valley, Khyber Pakhtunkhwa were studied which showed that about 19.76 kg of wood was used per household per day and 61.41 cubic feet was consumed per household annually in the area [35]. The consumption of fuel wood species had been recorded on the vegetation of Baffa Town Mansehra, which identified 22 fuel wood species in which the

maximum quantity of wood *i.e.*, 30000 mounds were sold annually. The *Acacia modesta*, *Melia azedarach* and *Olea ferruginea* were found as dominant species [36]. During an ethnobotanical study on Plants of Tehsil Takht Bhai, District Mardan, Khyber Pakhtunkhwa, 162 plant species belonging to 129 genera and 49 families were recorded, in which 45 species were used as fuel wood and 20 species were used as fruit plants [37]. The mentioned studies have similarities with the findings of the current research work in three major aspects including fuel wood, fruit and other economic studies.

Table 1: Showing families, scientific names, rate/mound, sell/day, sell/week, sell/month, sell/year and per year income of fuel wood species at the research area Tehsil Dir

S #	Family	Scientific name	Local name	Habit	Rate/mound	Depots	Sell/Day in mounds	Per week in mounds	Mounds month	Per annum in mounds	Per annum (in Rs.)
1.	Pinaceae	1. <i>Cedrus deodara</i> (Roxb.) G. Don	Diyar	Tree	450	10	5	35	1050	12600	5670000
		2. <i>Pinus roxburghii</i> Sargent	Nakhtar	Tree	500	10	10	70	2100	25200	12600000
2.	Berberidaceae	3. <i>Berberis lycium</i> Royle	Kowaray	Shrub	400	10	14	98	2940	35280	14112000
3.	Betulaceae	4. <i>Alnus nitida</i> (Spach) Endl.	Geeray	Tree	400	10	10	70	2100	25200	10080000
4.	Fagaceae	5. <i>Quercus incana</i> Bartram.	Speen Bunj	Tree	600	10	20	140	4200	50400	30240000
		6. <i>Quercus baloot</i> Griffith.	Serai	Tree	600	10	12	84	2520	30240	18144000
5.	Meliaceae	7. <i>Melia azedarach</i> L.	Toora shandai	Tree	400	10	10	70	2100	25200	10080000
6.	Moraceae	8. <i>Broussonetia papyrifera</i> L.	Gul tooth	Tree	400	10	10	70	2100	25200	10080000
		9. <i>Ficus palmata</i> Forssk.	Inzar	Tree	400	10	8	56	1680	20160	8064000
		10. <i>Morus alba</i> L.	Speen tooth	Tree	450	10	10	70	2100	25200	11340000
		11. <i>Morus nigra</i> L.	Toor tooth	Tree	450	10	10	70	2100	25200	11340000
7.	Myrtaceae	12. <i>Eucalyptus lanceolatus</i> L.	Lachi	Tree	400	10	15	105	3150	37800	15120000
8.	Oleaceae	13. <i>Olea ferruginea</i> Royle	Khoona	Tree	550	10	10	70	2100	25200	13860000
9.	Papilionaceae	14. <i>Indigofera heterantha</i> Wall. ex Brandis	Ghoreja	Shrub	400	10	15	105	3150	37800	15120000
		15. <i>Robinia pseudoacacia</i> L.	Kikar	Tree	400	10	13	91	2730	32760	13104000
10.	Platanaceae	16. <i>Platanus orientalis</i> L.	Chinar	Tree	400	10	10	70	2100	25200	10080000
11.	Sapindaceae	17. <i>Dodonaea viscosa</i> (L.) Jacq.	Ghoraskay	Shrub	400	10	16	112	3360	40320	16128000
12.	Salicaceae	18. <i>Populus euphratica</i> Oliv.	Sufaidar	Tree	400	10	12	84	2520	30240	12096000
13.	Simaroubaceae	19. <i>Ailanthus altissima</i> (Mill.) Swingle	Angreezi shandai	Tree	400	10	10	70	2100	25200	10080000
Total mounds/Rs.										554400	247338000

Table 2: Details regarding fruit plants, their family/botanical name, local name, economic data and annual income in Tehsil Dir

S#	Family/Botanical Name	Local Name	Habit Wild/Culti.	Fresh/Dry	Rate/kg (Rs.)	Selling/Day (in kg)	Selling/Week (in kg)	Selling/month (in kg)	Per annum (in kg)	Per annum (in Rs.)
1	Apiaceae 1. <i>Bonium persicum</i> (Boiss.) Fedtsch.	Zankai	Herb/W	D	450	0.5	3.5	15 x 12	180	81000
	2. <i>Coriandrum sativum</i> L.	Dhania	Herb/C	D	120	1	7	30 x 12	360	43200
	3. <i>Foeniculum vulgare</i> L.	Kagelanay	Herb/C	D	220	0.5	3.5	15 x 12	180	39600
2	Berberidaceae 4. <i>Berberis lycium</i> Royle	Kwary	Shrub/W	F	120	5	35	350 x 1	350	42000
3	Ebenaceae 5. <i>Diospyros kaki</i> Thunb.	Soor Amlok	Tree/C	F	100	15	105	450 x 2	900	90000
	6. <i>Diospyros lotus</i> L.	Duzz Danna	Tree/W	D	140	5	35	150 x 12	1800	252000
4	Fagaceae 7. <i>Quercus incana</i> Roxb.	Purgay/Seeray	Tree/W	D	-	-	-	-	-	0
5	Juglandaceae 8. <i>Juglans regia</i> L.	Ghooz	Tree/W	D	400	20	140	600 x 12	3600	1440000
6	Punicaceae 9. <i>Punica granatum</i> L.	Anangory	Tree/C	F	200	10	70	300 x 2	600	120000
7	Moraceae 10. <i>Ficus palmata</i> Forssk.	Inzar	Tree/W	F/D	120	8	56	240 x 2	480	57600
	11. <i>Morus alba</i> L.	Speen Toot	Tree/W	F/D	100	10	70	300 x 2	600	60000
	12. <i>Morus laevigata</i> L.	Shah Toot	Tree/W	F/D	150	5	35	150 x 2	300	45000
	13. <i>Morus nigra</i> L.	Toor Toot	Tree/W	F/D	80	8	56	240 x 2	480	38400
8	Myrtaceae 14. <i>Psidium guava</i> L.	Amrood	Tree/C	F	100	15	105	450 x 2	900	90000
9	Myrsinaceae 15. <i>Myrsine africana</i> L.	Manro	Shrub/W	-	-	-	-	-	-	0
10	Oleaceae 16. <i>Olea ferruginea</i> Royle.	Khoona	Tree/W	F	500	3	21	90 x 2	180	90000
	17. <i>Olea europaea</i> L.	Farmi Zaitoon	Tree/C	F	700	5	35	150 x 2	300	210000
11	Rhamnaceae 18. <i>Ziziphus jujuba</i> Mill.	Markhany	Tree/W	F/D	220	5	35	150 x 2	300	66000
	19. <i>Ziziphus oxyphylla</i> Edgew.	Wenalai	Shrub/W	-	-	-	-	-	-	0
12	Rosaceae 20. <i>Cydonia oblonga</i> Mill.	Behay	Tree/W	-	-	-	-	-	-	0
	21. <i>Eriobotrya japonica</i> L.	Aoolkat	Tree/W	F	60	15	105	450 x 2	900	54000

	22. <i>Potentilla indica</i> (Andrews.) Th. Wolf.	Balmangy	Herb/W	-	-	-	-	-	-	0
	23. <i>Prunus amygdalus</i> Batch.	Badam	Tree/W	D	1000	4	24	120 x 12	1440	1440000
	24. <i>Prunus armeniaca</i> Marsh.	Khobany	Tree/C	F	60	20	140	600 x 2	1200	72000
	25. <i>Prunus avium</i> L.	Gilas	Tree/W	F	120	8	56	240 x 2	480	57600
	26. <i>Prunus domestica</i> L.	Alocha	Tree/C	F	50	20	140	600 x 2	1200	60000
	27. <i>Prunus persica</i> (L.) Stokes.	Shaftalo	Tree/C	F	60	30	210	900 x 2	1800	108000
	28. <i>Pyrus armeniacaifolia</i> T. T. Yu	Paraawo Tango	Tree/W	F	40	15	105	450 x 2	900	36000
	29. <i>Pyrus boissieriana</i> Buhse.	Naspaty	Tree/W	F	40	10	70	300 x 2	600	24000
	30. <i>Pyrus bourgaeana</i> Decne.	Shna Tangi	Tree/W	F	30	10	70	300 x 2	600	18000
	31. <i>Pyrus calleryana</i> Decne	Khoga Tangi	Tree/W	F	40	10	70	300 x 2	600	24000
	32. <i>Pyrus communis</i> L.	Ghat Tango	Tree/W	F	50	12	84	360 x 2	720	36000
	33. <i>Pyrus cordata</i> (Desv.) Hook. f.	Toora Tangi	Tree/W	F	30	10	70	300 x 2	600	18000
	34. <i>Pyrus malus</i> L.	Maanara	Tree/C	F	100	20	140	600 x 2	1200	120000
	35. <i>Pyrus pashia</i> Buch. Ham. ex D. Don	Tangi	Tree/W	F	40	10	70	300 x 2	600	24000
	36. <i>Pyrus pyrifolia</i> (Burm. f.) Nakai	Mamosay	Tree/W	F	30	10	70	300 x 2	600	18000
	37. <i>Rosa micrantha</i> Borrerex Sm.	Karwara	Shrub/W	-	-	-	-	-	-	0
	38. <i>Rubus ellipticus</i> L.	Koraja	Shrub/W	-	-	-	-	-	-	0
	39. <i>Rubus fruticosus</i> L.	Karwara	Shrub/W	-	-	-	-	-	-	0
13	Rutaceae									
	40. <i>Zanthoxylum armatum</i> DC.	Dambra	Tree/W	D	250	2	14	60 x 12	720	180000
	41. <i>Citrus sinensis</i> (L.) Osbeck	Malta	Tree/C	F	100	10 Dozen	70	300 x 2	600 Dozen	60000
14	Ulmaceae									
	42. <i>Celtis tetrandra</i> Roxb.	Tagha	Tree/W	-	-	-	-	-	-	0
15	Vitaceae									
	43. <i>Vitis vinifera</i> L.	Angoor	Shrub/W	F	100	10	70	300 x 2	600	60000
Total amount (in Rs.)										5174400

Table 3: Showing family, scientific and local names of species used for various economic purposes including furniture, timber, doors, agricultural tools and utensils at the research area Tehsil Dir

S #	Family	Scientific name	Local name	Habit	Furniture	Timber	Doors	Agr. Tools	Utensils
1.	Pinaceae	1. <i>Cedrus deodara</i> (Roxb.) G. Don	Diyar	T	+	+	+	-	+
		2. <i>Pinus roxburghii</i> Sargent	Nakhtar	T	+	+	+	-	+
2.	Betulaceae	3. <i>Alnus nitida</i> (Spach) Endl.	Geeray	T	-	-	-	+	-
3.	Ebenaceae	4. <i>Diospyros kaki</i> Thunb.	Parsimon	T	-	-	-	+	-
		5. <i>Diospyros lotus</i> L.	Duzz Danna	T	-	-	-	+	-
4.	Fagaceae	6. <i>Quercus incana</i> Bartram.	Speen Bunj	T	-	-	-	+	+
		7. <i>Quercus baloot</i> Griffith.	Serai	T	-	-	-	+	+
5.	Hamamelidaceae	8. <i>Parrotiopsis jacquemontiana</i> (Decne) Rehder	Biranj	T	-	-	-	-	+
6.	Juglandaceae	9. <i>Juglans regia</i> L.	Ghooz	T	+	-	-	-	+
7.	Meliaceae	10. <i>Melia azedarach</i> L.	Shandai	T	+	-	-	-	-
8.	Moraceae	11. <i>Broussonetia papyrifera</i> L.	Gul Toot	T	+	-	-	-	-
		12. <i>Ficus palmata</i> Forssk.	Inzar	T	+	-	-	+	+
		13. <i>Morus alba</i> L.	Speen Toot	T	+	-	-	+	+
		14. <i>Morus laevigata</i> Wall. ex Brandis.	Shah Toot	T	+	-	-	+	-
		15. <i>Morus nigra</i> L.	Toor Toot	T	+	-	-	+	+
9.	Myrtaceae	16. <i>Eucalyptus lanceolatus</i> L.	Lachi	T	+	-	-	-	-
10.	Oleaceae	17. <i>Olea ferruginea</i> Royle	Khoona	T	-	-	-	+	+
11.	Papilionaceae	18. <i>Indigofera heterantha</i> Wall. ex Brandis	Ghoreja	S	-	-	-	-	+
		19. <i>Robinia pseudoacacia</i> L.	Kikar	T	+	-	-	+	-
12.	Platanaceae	20. <i>Platanus orientalis</i> L.	Chinar	T	+	-	-	-	-
13.	Punicaceae	21. <i>Punica granatum</i> L.	Anangoray	T	-	-	-	+	-

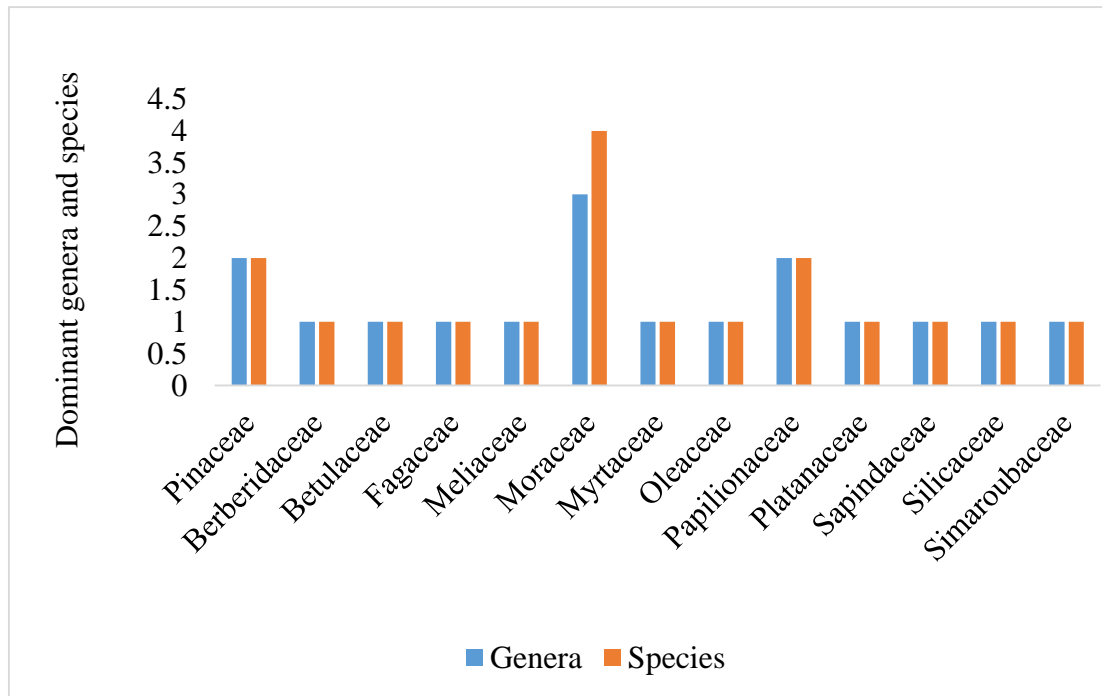


Figure 2: Families of fuel wood species with dominant genera and species

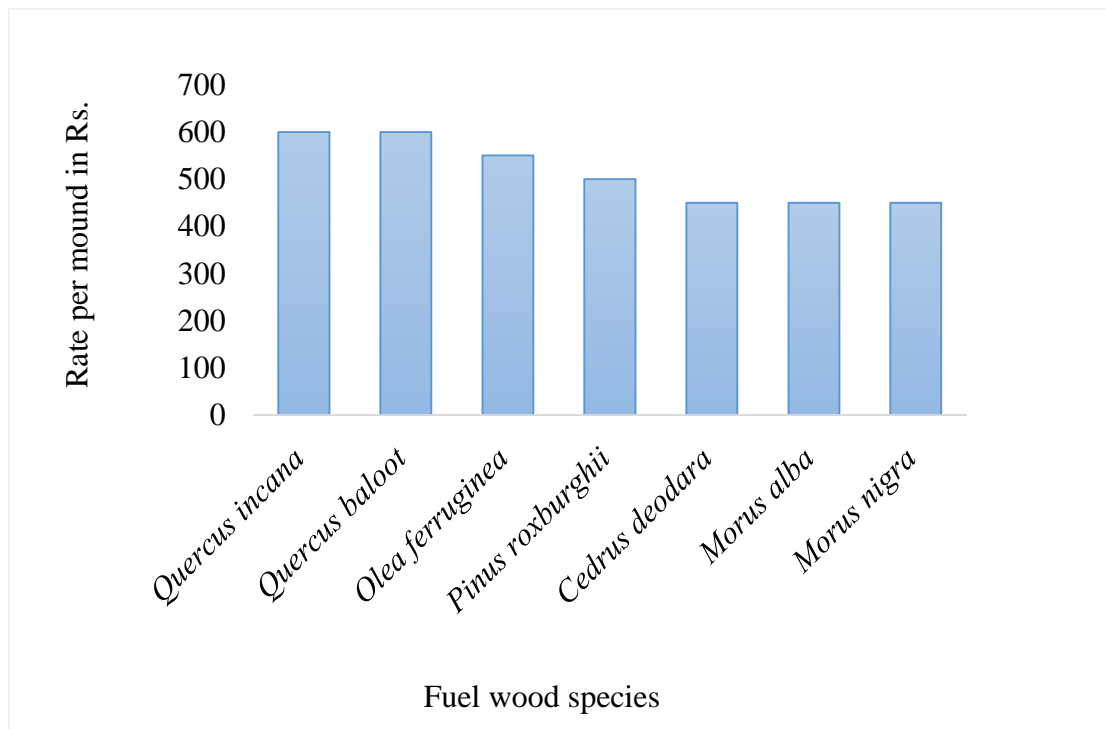


Figure 3: Fuel wood species with highest market rate per mound

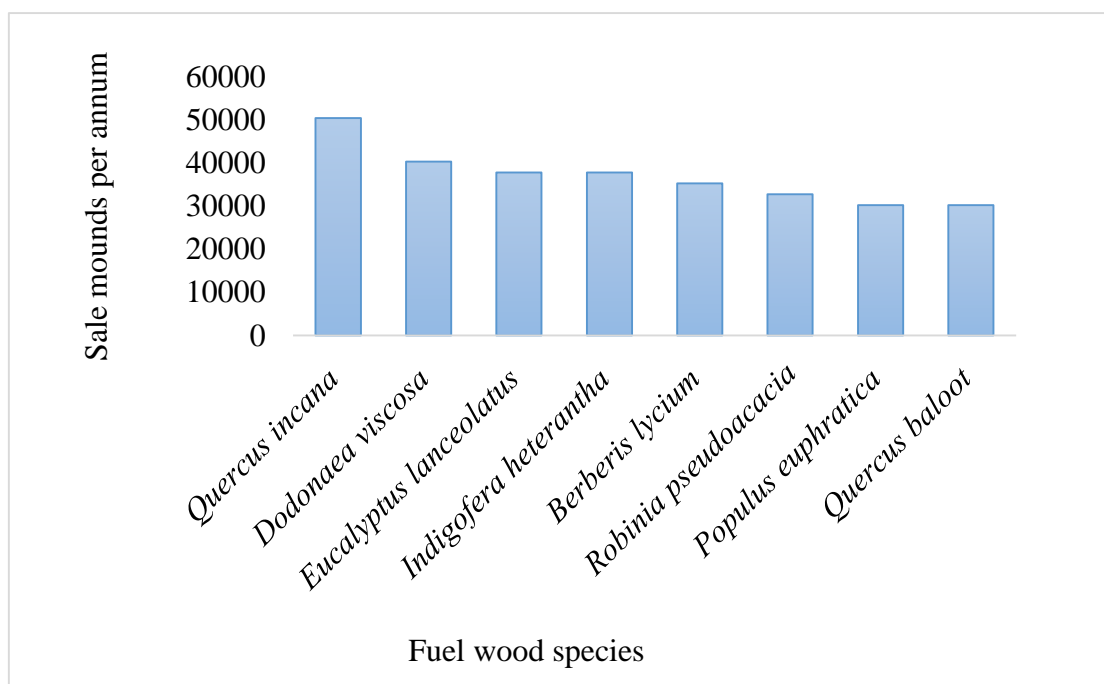


Figure 4: Fuel wood species with highest sales in mounds per annum.

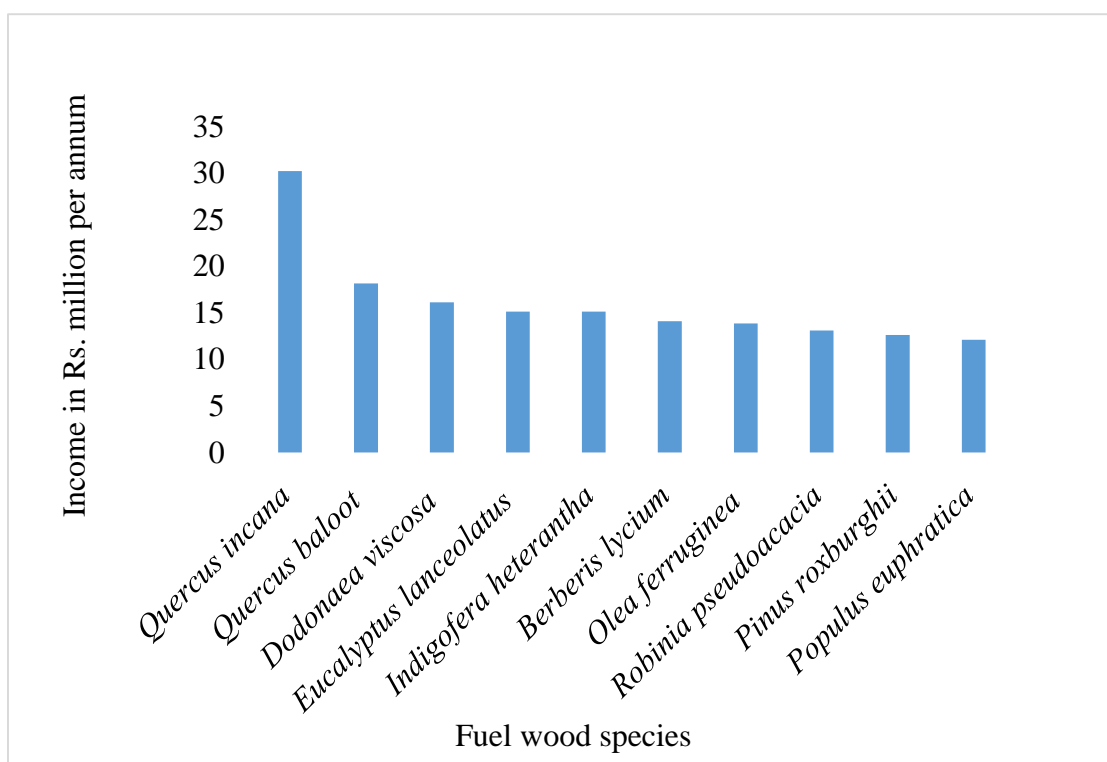


Figure 5: Fuel wood species with highest income in Rs. million per annum

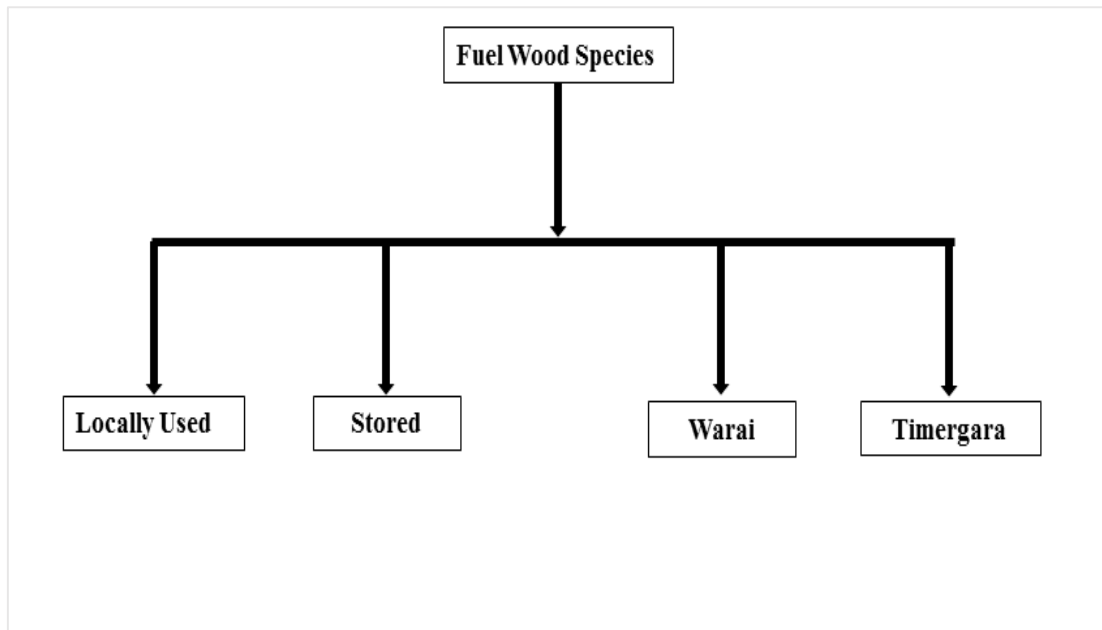


Figure 6: Usage pattern of fuel wood species of Tehsil Dir

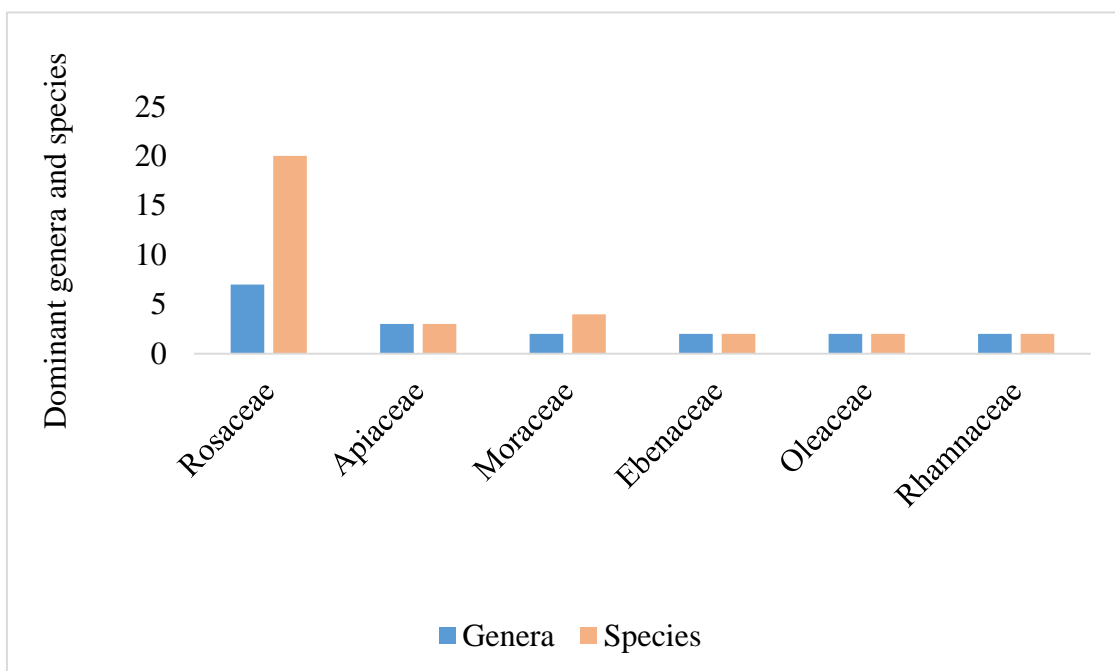


Figure 7: Families of fruit plants with dominant number of genera and species

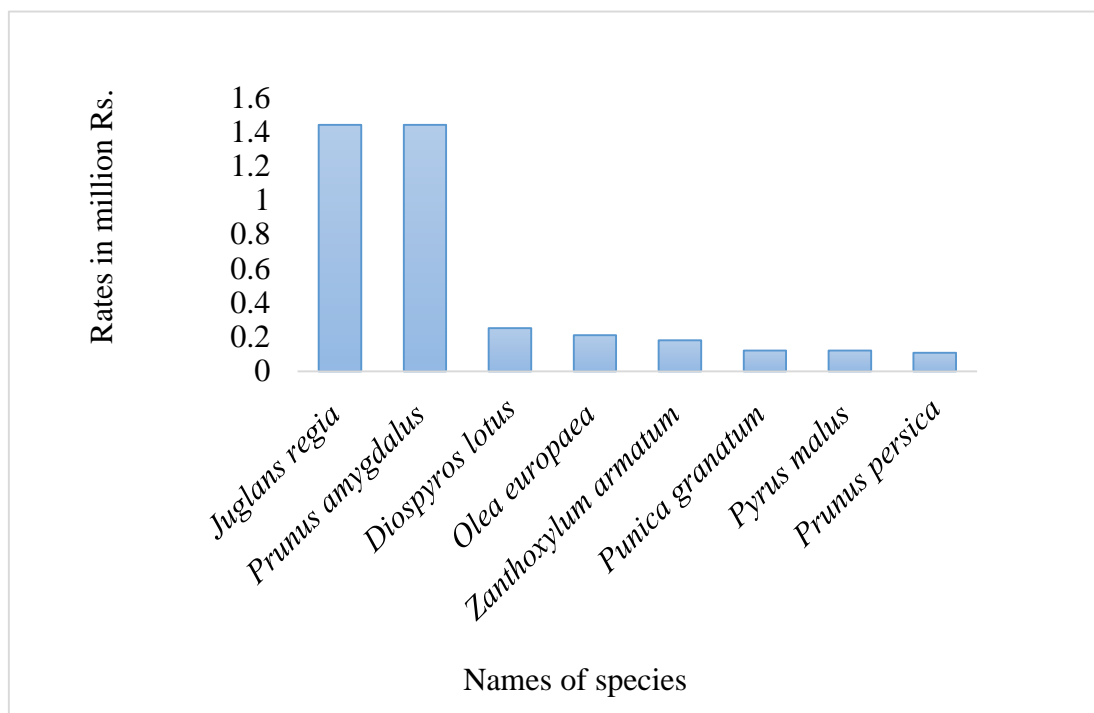


Figure 8: Species of fruit plants with high annual income

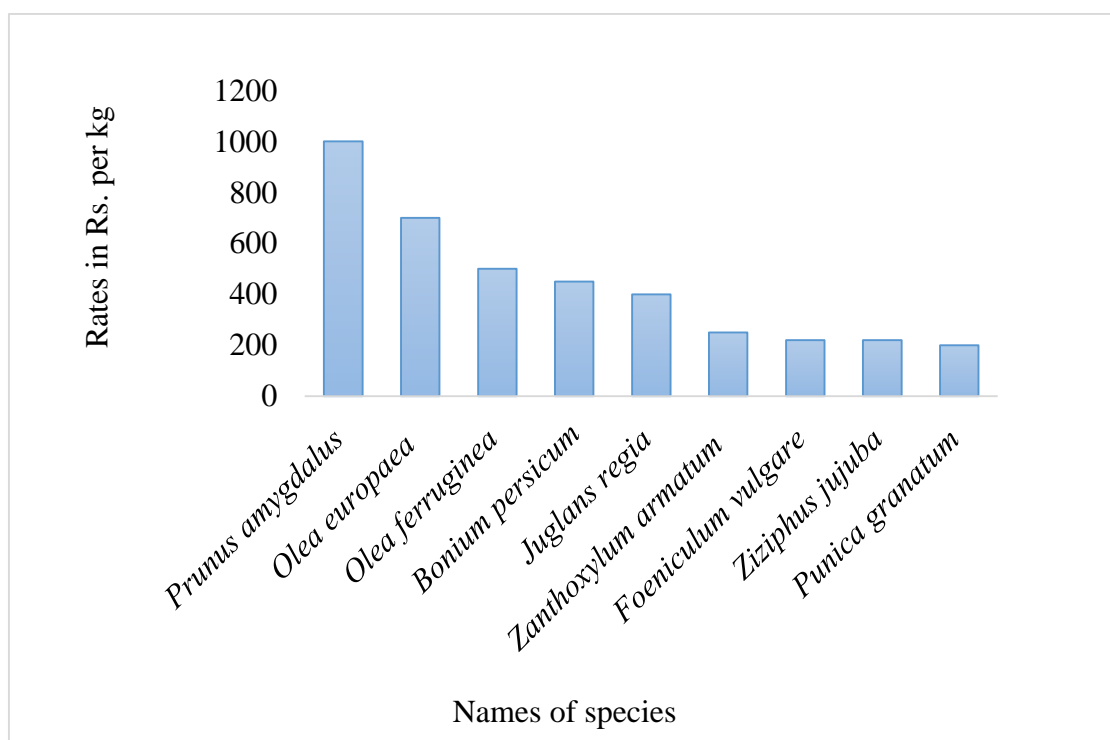


Figure 9: Species of fruit plants with high rate per kg

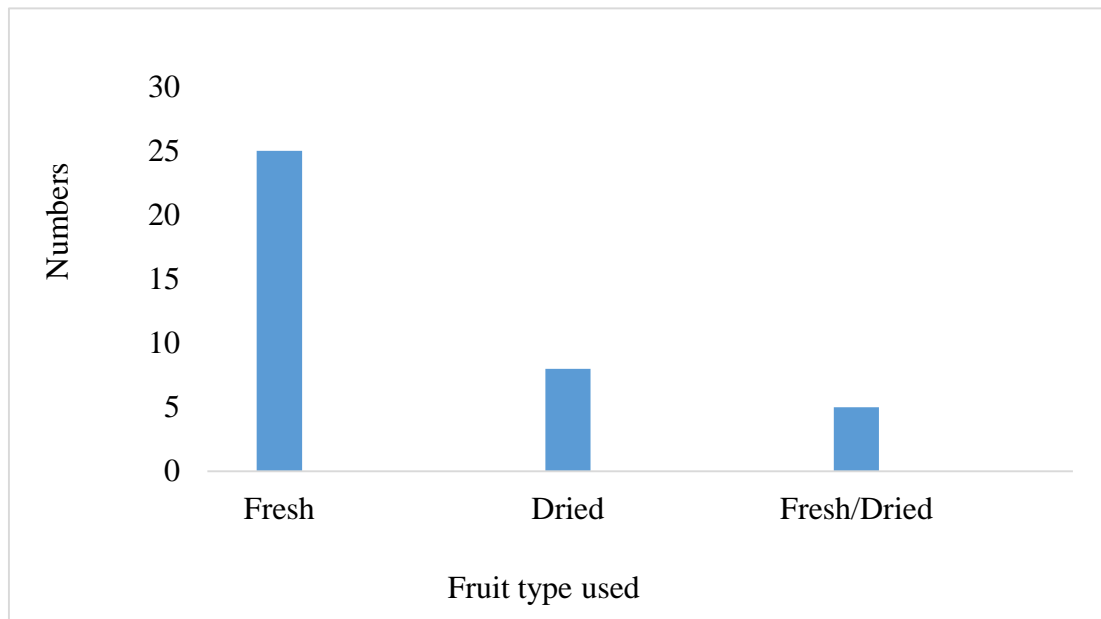


Figure 10: Numbers of fruit forms used growing in the research area

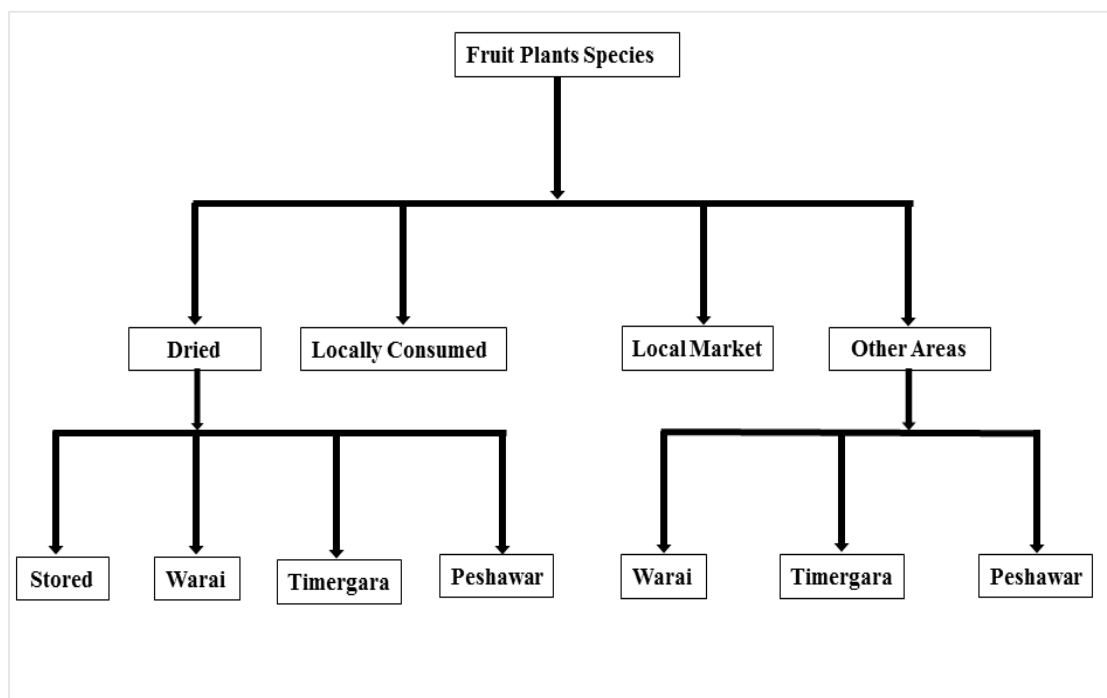


Figure 11: Market chain of fruit plants diversity of Tehsil Dir

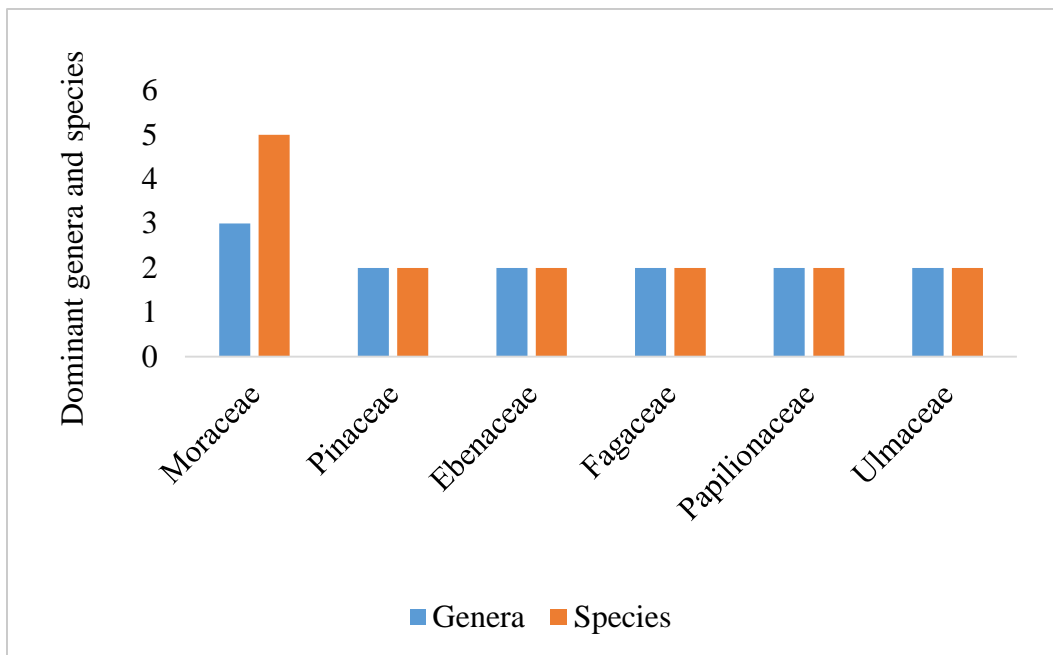


Figure 12: Families of economic plants with dominant genera and species

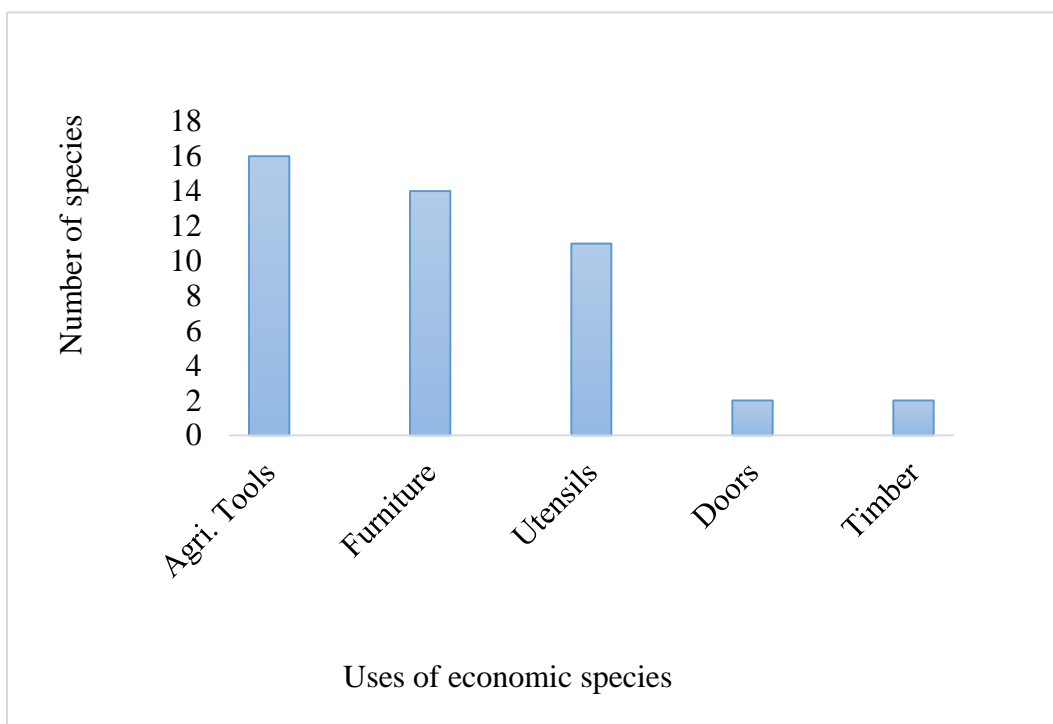


Figure 13: Economic species with highest income in Rs. million per annum

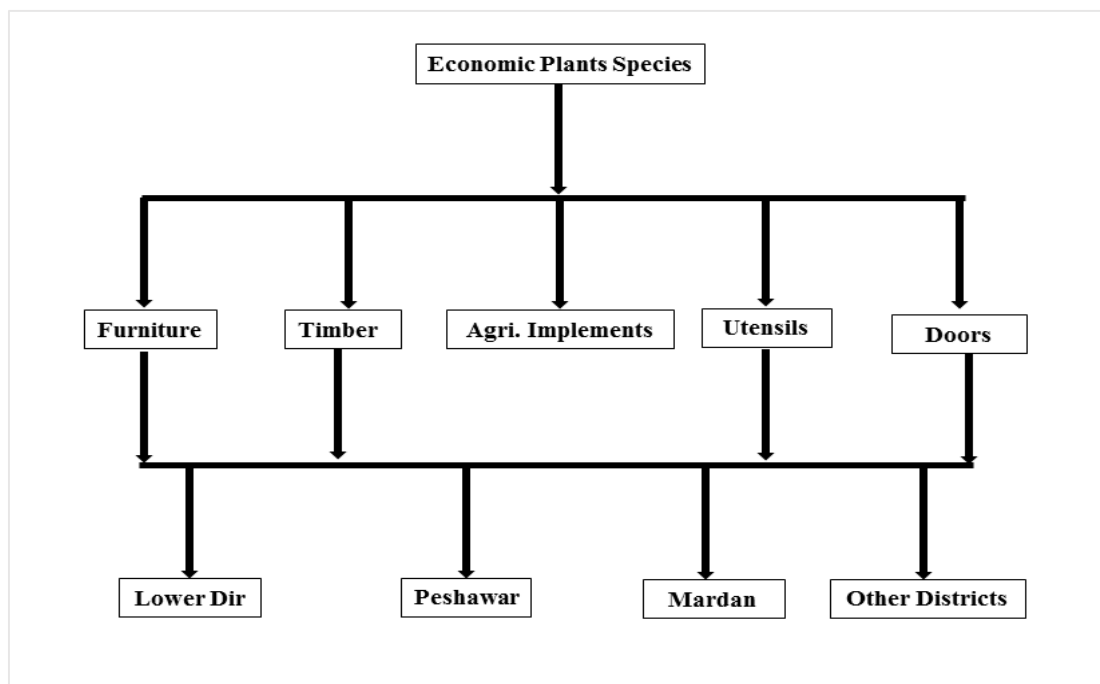


Figure 14: Market chain of economic plant species of Tehsil Dir

Conclusion

In light of the present study it is concluded that sustainable utilization and reforestation of fuel wood, fruit and economic species must be carried out to meet the demand for fuel wood species. Fruit plants provide revenue to the local people and are also an important part of supplementing their diets. Therefore, fruit plants' growth, proper processing, and storage are required. Establishment of small scale furniture industries and local timber markets are recommended for the livelihood support of the local people. The Govt. should initiate afforestation projects in the research area. The plant cutting is increasing da daily, and there is a dire need for conservation and sustainable utilization of fuel wood, fruits and economic species growing in the area.

Author's contributions

Conceived and designed the experiments: A Ullah, Performed the experiments: N Hayat, A Ullah & SG Ali, Analyzed the data: N Hayat, A Ullah & S Parveen, Contributed reagents / materials / analysis tools: N Hayat, A Ullah & SG Ali, Wrote the paper: S Parveen, A Ullah & N Hayat.

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