DISTRIBUTION PATTERN AND PHYTOSOCIOLOGICAL STUDY OF AGROFORESTRY TREES IN POONCH DISTRICT OF JAMMU AND KASHMIR, INDIA

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Abstract

This study focuses on distribution pattern, diversity and phytosociology of tree species associated with traditional agroforestry in Poonch district of Jammu and Kashmir, India. Data was collected from fifty quadrats (10×10m) sized thrown randomly in agriculture fields. Twenty six tree species belonging to 16 families and 21 genera were encountered. *Grewia optiva, Pyrus persica* and *Celtis australis* were the dominant tree species. *Grewia optiva* was the most dense tree species 3.88 stem/ha followed by *Pyrus persica* with 3.74 stem/ha. *Buxus wallichiana* was recorded as the least dense species (0.82 stem/ha). The study revealed that the area has vast potential sites for the plantation of various agroforestry tree species to solve fuel, fodder and timber.

***Key words*:** Agroforestry; Phytosociological study; Poonch; Agricultural fields; Traditional use.

INTRODUCTION

To meet the growing need of the human population and livestock, various unsustainable agricultural and allied activities have taken place in the recent past resulting in overexploitation of natural resources. Overexploitation and depletion of natural resources has led many environmentalists, agriculturists and animal scientists to search for more sustainable food, fodder and fuel production systems. In addition to food which is a basic need, fuel wood, timber and fodder have equal importance to meet the needs of the growing populations of India (Kanaujia *et al*. 2018). Agroforestry offers an alternate solution in this regard. Agroforestry is a collective term used for various practices including trees on farm boundaries, croplands, fallow lands and village settlement etc. (FAO 2005). Farming communities incorporate different woody perennials in their cropping system along with the animal units depending upon the physiographic and climatic conditions (Pandey 1998). Depletion of agricultural lands due to changing rainfall pattern, landslide, run off, leaching of nutrients, drying up of natural springs and lack of irrigation facilities have resulted in uneconomical agricultural activities in the mountain regions of India, and these are severe in Jammu and Kashmir. Most of the villages in the mountainous region of Jammu and Kashmir have witnessed mass migration resulting in waste, fallow and unproductive land due to which rural livestock based livelihood has got affected.

Agroforestry plays an important role in supporting local livelihood and economy by providing various products and services. Trees farming provide food, fuel wood, fodder, timber, medicines, replenish organic matter, control erosion and conserve water etc. and also in generating additional income. Tree-based fodder plays an important role in the traditional farming system in reducing the fodder shortage problems in mountainous regions of India especially in the Himalayas during the lean period, when fodder becomes scarce. Agroforestry is promoted widely as sustainability enhancing practice that combines the best attributes of forestry and agriculture. From an ecological point of view, sound agroforestry systems such as intercropping and mixed arable-livestock systems can increase the sustainability of agricultural production (Rasmussen 1988). Poonch is one of the hilly districts of Jammu and Kashmir, India. It is rich in biodiversity particularly in floral diversity. The main occupation of the people is agriculture and cattle rearing. Various developmental activities in the area have resulted in the overexploitation of natural resources which directly impact on agricultural and livestock based

livelihood in the region. Keeping this in view a phytosociological study was conducted to assess the potential of agroforestry in the region.

MATERIAL AND METHODS

The present study was carried out in Poonch district of Jammu and Kashmir, India. It is located in the foothills of Pir Panjal mountain range of the Western Himalayas and has an average elevation of 981 meters above sea level. It lies within 33.77^0 N Latitude and 74.1^0 E longitudes. Climate of the study area ranges from sub-tropical to temperate with a temperature range of 20-39 ^{0}C in summers and 3-19 ^{0}C in winters. Topographically, Poonch is steep, hilly and undulated with a few plain valleys, drained by several small rivulets and nallahs (drains). The average annual rainfall in the study area was recorded to be 929.2mm. Poonch district is bordered by Kashmir valley in the northeast, Rajouri district in the south, and Pakistan occupied Kashmir in the west (Anonymous 2012). The study area has three notable seasons winter, summer and rainy, respectively. The vegetation of the study area is primarily subjected to the monsoon rainfall and varies from humid zone to temperate zone. Agriculture is the primary occupation of people, followed by Pastoralism. Agriculture system in the area mainly depends on rainfall. Sub-mountainous, alluvial and loamy soils are present in the area.

The study was conducted in the Poonch district of Jammu and Kashmir from May to October 2018. Observations were made regarding the current status, distribution pattern and diversity of tree species grown in agricultural fields and other adjoining areas. To study the tree composition, a random quadrat survey method was used. A total of fifty quadrats of 10×10 m size were thrown randomly throughout the agricultural fields to get the most representative composition of trees. The samples were taken at an interval of 5 km. The plants having girth of more than or equal to 30 cm were considered as trees and their circumference at breast height (1.3 meters above the ground) was measured. Raw data was analysed to get frequency, density, abundance and importance value index (IVI) using the formulae given below (Curtis 1951, Misra 1968).

$$\text{Frequency} = \frac{\text{Number of quadrats in which species occurs}}{\text{Total number of quadrats}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Frequency of individual species}}{\text{Frequency of all species}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individuals of the species}}{\text{Total number of quadrats studied}}$$

$$\text{Relative density} = \frac{\text{Density of individual species}}{\text{Density for all species}} \times 100$$

$$\text{Abundance} = \frac{\text{Total no.of individual of a species in all quadrats}}{\text{Total no.of quadrats in which species occurred}}$$

$$\text{Relative Abundance} = \frac{\text{Abundance of individual of a species}}{\text{Abundance of all species}} \times 100$$

Importance Value Index = Relative Frequency + Relative Density + Relative Abundance

RESULTS AND DISCUSSION

The distribution pattern and species composition of various tree species associated with traditional agroforestry was studied. A total no of 26 plant species belonging to 16 families and 21 genera were reported from agricultural fields and other adjoining area. Rosaceae was the most dominant family with 07 species followed by Moraceae with 03 Species (Table 1). The phytosociological analysis revealed

that *Grewia optiva* was the most frequent tree species with 96 followed by *Pyrus persica* and *Celtis australis*. *Platanus orientalis* was found to be the least frequent tree species with a frequency value of 20. *Salix alba* was the most abundant tree species with a value of 4.07 followed by *Pyrus persica* and *Pyrus pashia* with 4.06. *Buxus wallichiana* was found to be the least abundant tree species in the area with a value of 2.15.

Table 1. List of common agroforestry tree species found in Poonch district.

Name of the species	Family	Common Name	Uses
Acacia nilotica (L.) Willd.	Fabaceae	Kikar	Fuel, Fodder
Buxus wallichiana L.	Buxaceae	Chikri	Fuel,Furniture
Celtis australis L.	Ulmaceae	Khirk	Fuel, Fodder
Dalbergia sisso Roxb.ex DC	Fabaceae	Tali	Fuel, Furniture
Diospyros lotus L.	Ebenaceae	Malook	Fuel, Fruits
Ficus hispida L.	Moraceae	Tossi	Fruits
Ficus palmata Forssk.	Moraceae	Phagwara	Fruits
Grewia optiva J.R.Drumm.	Tiliaceae	Thaman	Fodder
Juglans regia L.	Juglandiaceae	Khor	Fruit, Fuel
Mallotus philippinensis (Lamk.) Muell.	Euphorbiaceae	Kamila	Fodder
Malus pumila Mill.	Rosaceae	Seb	Fruits
Melia azedarach L.	Meliaceae	Dareek	Fuel, Fodder
Morus alba L.	Moraceae	Toot	Fruit, Fodder
Olea cuspidata Wall ex DC.	Oleaceae	Kahu	Fodder
Pinus roxburghi Roxb.	Pinaceae	Chir	Fuel, Furniture
Platanus orientalis L.	Platanaceae	Chinar	Aesthetic, Fodder
Prunus armeniaca L.	Rosaceae	Khari	Fuel, Fruits
Prunus domestica L.	Rosaceae	Plump	Fruits
Punica granatum L.	Punicaceae	Dharuna	Fruits
Prunus persica (L.) Batsch	Rosaceae	Rawara	Fruits
Pyrus communis L.	Rosaceae	Nakh	Fruits
Pyrus pashia Buch-Ham.	Rosaceae	Batangi	Fuel, Fruits
Pyrus persica Pers.	Rosaceae	Dandali	Fuel, Fruits
Salix alba Boiss.	Salicaceae	Beesa	Fuel, Fodder
Ulmus wallichiana Planch.	Ulmaceae	Mannu	Fuel, Fodder
Ziziphus mauritiana Lamk.	Rhamnaceae	Ber	Fruit, Fodder

The density of different tree species encountered in the study area ranges between 3.88 and 0.82.The maximum density was revealed by *Grewia optiva* (3.88) followed by *Pyrus persica, Celtis australis* and *Melia azedarach* with a value of 3.74, 3.7 and 3.62, respectively. *Buxus wallichiana* revealed the maximum density with a value of 0.82 (Table 2.)

Table 2. Phytosociological attributes of tree species associated with traditional agriculture.

Species	Frequency	Density	Abundance	A/F
Acacia nilotica (L.) Willd.	62	1.82	2.93	0.047
Buxus wallichiana L.	38	0.82	2.15	0.056
Celtis australis L.	94	3.7	3.93	0.041
Dalbergia sisso Roxb.ex DC	38	1.12	2.94	0.077
Diospyros lotus L.	26	0.98	3.76	0.144
Ficus hispida L.	54	1.56	2.88	0.053
Ficus palmata Forssk.	82	3.3	4.02	0.049
Grewia optiva J.R.Drumm.	96	3.88	4.04	0.042
Juglans regia L.	50	1.52	3.04	0.060
Mallotus philippinensis (Lamk.) Muell.	42	1.24	2.95	0.070

Malus pumila Mill.	22	0.84	3.81	0.173
Melia azedarach L.	90	3.62	4.02	0.04
Morus alba L.	84	3.4	4.04	0.048
Olea cuspidata Wall ex DC.	88	3.54	4.02	0.045
Pinus roxburghi Roxb.	44	1.34	3.04	0.069
Platanus orientalis L.	20	1.1	5.5	0.275
Prunus armeniaca L.	88	3.5	3.97	0.045
Prunus domestica L.	80	2.46	3.07	0.038
Punica granatum L.	86	3.48	4.04	0.046
Prunus persica (L.) Batsch	76	2.26	2.97	0.039
Pyrus communis L.	86	2.56	2.97	0.034
Pyrus pashia Buch-Ham.	88	3.58	4.06	0.046
Pyrus persica Pers.	92	3.74	4.06	0.044
Salix alba Boiss.	72	3.18	4.07	0.056
Ulmus wallichiana Planch.	78	2.36	3.02	0.038
Ziziphus mauritiana Lamk.	74	2.18	2.94	0.039

The importance value index for different tree species encountered in the study area was found to vary from 16 to 6.71. IVI value was found to be maximum (16) for *Grewia optiva* with a relative frequency, relative density and relative abundance of 5.48, 6.15 and 4.37, respectively whereas *Malus pumila* has the least IVI value of 6.71 with 1.25, 1.33 and 4.13 values of relative frequency, relative density and relative abundance, respectively. The A/F ratio was found to be in the range of 0.275 (*Platanus orientalis*) to 0.04 (*Melia azedarach*) (Table 3.).

Table 3. Phytosociological attributes of tree species associated with traditional agriculture.

Species	Relative frequency	Relative Density	Relative Abundance	IVI
Acacia nilotica (L.) Willd.	3.54	2.88	3.17	9.59
Buxus wallichiana L.	2.17	1.29	2.33	5.79
Celtis australis L.	5.37	5.86	4.26	15.49
Dalbergia sisso Roxb.ex DC	2. 17	1.77	3.18	7.12
Diospyros lotus L.	1.48	1.55	4.07	7.1
Ficus hispida L.	3.08	2.47	3.12	8.67
Ficus palmata Forssk.	4.68	5.23	4.36	14.27
Grewia optiva J.R.Drumm.	5.48	6.15	4.37	16
Juglans regia L.	2.85	2.40	3.29	8.54
Mallotus philippinensis (Lamk.) Muell.	2.4	1.96	3.19	7.55
Malus pumila Mill.	1.25	1.33	4.13	6.71
Melia azedarach L.	5.14	5.73	4.36	15.23
Morus alba L.	4.8	5.38	4.38	14.56
Olea cuspidata Wall ex DC.	5.02	5.61	4.35	14.98
Pinus roxburghi Roxb.	2.51	2.12	3.29	7.92
Platanus orientalis L.	1.14	1.74	5.96	8.84
Prunus armeniaca L.	5.02	5.54	4.30	14.86
Prunus domestica L.	4.57	3.89	3.32	11.78
Punica granatum L.	4.91	5.51	4.38	14.8
Prunus persica (L.) Batsch	4.34	3.58	3.21	11.13
Pyrus communis L.	4.91	4.05	3.21	12.17
Pyrus pashia Buch-Ham.	5.02	5.67	4.40	15.09
Pyrus persica Pers.	5.25	5.92	4.40	15.57
Salix alba Boiss.	4.11	5.04	4.41	13.56
Ulmus wallichiana Planch.	4.45	3.74	3.27	11.46
Ziziphus mauritiana Lamk.	4.22	3.45	3.18	10.85

The distribution pattern of different tree species in the agricultural field and other adjoining areas was random and contagious. Out of the 26 species reported *Acacia nilotica, Celtis australis, Ficus palmata, Grewia optiva, Melia azedarach, Morus alba, Olea cuspidata, Prunus armenica, Prunus domestica, Punica granatum, Pyrus persica, Ulmus wallichiana* and *Ziziphus mauritiana* show random distribution whereas the rest show contagious distribution. In similar types of studies conducted in Jammu and Kashmir (Rashid and Sharma 2012, Kour and Sharma 2014, Hussain *et al*. 2014) and other parts of the western Himalays (Singh and Singh 2019) both random and contagious distribution was reported. Moreover contagious distribution is commonest pattern in nature and results due to variation in the environment (Odum 1998).

The study revealed that the trees in agricultural fields are sparse. There is wide scope and potential for agro-forestry in the area due to the availability of vast agricultural land, fallow lands, wastelands which can be used for the plantation of various agroforestry and multipurpose trees to solve the problems of fuel, fodder and timber at the local level. Mass awareness among the farmers must be created regarding agroforestry and its benefits by mobilizing local resources.

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