

ORIGINAL ARTICLE

Decline in timber and fuel wood species diversity driven by anthropogenic disturbance: A multivariate approach in Sarban Hills (Abbottabad), Pakistan

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Humans use plant resources for various purposes. However, there is often an exacerbated use of these plants, directly influencing the floristic composition of the site Sarban Hills (Abbottabad) is an unexplored area of Pakistan, which seems to be a place with intense use of plants. Then it is imperative to investigate the flora of this region, as well as the use of the plant, by the local residents, and observe if there is an intensive use of the local flora.. Field surveys of study area were carried out during 2012-13 to document the timber and fuel wood species. Specimen of each plant species were collected, dried, pressed, poisoned, mounted on standard herbarium sheets and identified with the help of Flora of Pakistan. The local inhabitants were interviewed through semi structured questionnaire. Data noted and transferred to the excel spreadsheet (MS-2010) were used for multivariate analyses. The results showd that, a total of 26 plant species belonging to 23 genera and 16 families were recorded from study area. Out of these, 61% were cited as fuel wood and 39% as timber wood plant species. Tree dominated the plant habit with 69%, and Moraceae was the most dominant family with 5 species. Twenty-six plant species clearly depicted by two main hierarchal branches which further represent three clusters of plant species. Plot matrix reveals the presence and absence of species in both cultural categories i.e., fuel wood and timber wood. Study reflects the overall cultural use scenario with special reference to multivariate approaches cultural terms for the first time. They extensively cut down the trees, and due to this, the pressure on natural resources increases day by day leading the local floral diversity to destruction. Then, conservation strategies must be implemented in the study area to reduce man-made impacts and to try to protect those remote areas that do not present such detailed study of local biodiversity.

Keywords: Biodiversity; timber wood; fuel wood; Sarban Hills; Pakistan

Introduction

Biodiversity is the presence of all sorts of life on land, where more than 1.75 million species of plants, animals, bacteria, fungi and other microbes have been reported. It is not an object to be conserved but an integral part of human existence, in which utilization is part of the celebration of life (Ijaz, 2014). The flora of Pakistan including Azad Kashmir contains nearly 6,000 species of flowering plants (Ali and Qaiser, 1986), and each of them presents a different utility for humans.

Wood, for instance, is one of the oldest source of energy and the commonest service material known to man and has been used for over 0.5 million years. Wood in rough form obtained from the trunk and branches of trees can be used for fuel purposes such as cooking, heating and power generation. In rural areas, local inhabitants harvest fuel wood by collecting fallen wood or cutting down dry and diseased trees countries by cutting shrubs, by lopping branches off mature trees, or by felling whole trees as the source of domestic energy in many developing countries (Ijaz, 2014), often directly influencing the floristic composition of the site.

Sarban Hills, Pakistan, seems to be a place with intense use of plants like timber and fuel. Therefore, we aimed to investigate the flora of this region, as well as the use of timber and fuel wood by the local residents of Sarban Hills, Pakistan, and observe if there is an intensive use of the local flora. The results of this study may be used in the future for conservation measures.

Materials and methods

Field surveys of Sarban Hills, Abbottabad, Khyber Pakhtunkhwa, Pakistan were carried out during 2012-13 to document the timber and fuel wood species. Specimen of each plant species were collected, dried, pressed, poisoned and mounted on standard herbarium sheets (Ijaz, 2014; Rahman et al., 2016b, 2016c). The collected specimens were identified with the help of Flora of Pakistan (Nasir and Ali, 1971-1994; Ali and Qaiser, 1995-2004) and were deposited in the Herbarium of Hazara University Mansehra, KP, Pakistan. The local inhabitants were interviewed through semi structured questionnaire. Data noted during field work was transferred to the excel spreadsheet (MS-2010) and used for multivariate analyses through various softwares. PC-ORD version 5.10 was used for TWCA classification, correlation and regression (McCune and Mefford, 2006), and PAST 3.02 was used for Detrended correspondence analysis (DCA), Plot Matrix (PM) and Neighboring joining clusters (NJC).

Results and discussion

Sarban Hills local inhabitants depend on the plants as a source of timber and fuelwood. After field surveys, a total of 26 plant species belonging to 23 genera and 16 families were recorded from study area (Table 1). Out of these, 61% were cited as fuel wood and 39% as timber wood plant species (Figure 1).

Table 1. List of Timber and fuel wood plant species of Sarban Hills, Abbottabad, Pakistan.

| Botanical Names | Vernacular Names | Habit | Family Names | Timber wood | Fuel wood |
|---|------------------|-------|---------------|-------------|-----------|
| <i>Albizia lebbbeck (L.) Benth.</i> | Siris | T | Fabaceae | + | + |
| <i>Arundo donax L.</i> | Naar | H | Poaceae | - | + |
| <i>Aesculus indica (Wall. ex Camb.) Hook.</i> | Ban korh | T | Sapindaceae | + | + |
| <i>Berberis lycium Royle</i> | Sumbal | S | Berberidaceae | - | + |
| <i>Broussonetia papyrifera (L.) L'Hér. ex Vent.</i> | Jangle toot | T | Moraceae | - | + |
| <i>Callistemon citrinus (Curtis) Skeels</i> | Bottle brush | T | Myrtaceae | + | + |
| <i>Cannabis sativa L.</i> | Bhang | H | Cannabaceae | - | + |
| <i>Conyza canadensis (L.) Cronquist</i> | Pleet | H | Asteraceae | - | + |
| <i>Cupressus sempervirens L.</i> | Saru | T | Cupressaceae | + | - |
| <i>Dalbergia sissoo DC.</i> | Tahli | T | Papilionaceae | + | + |
| <i>Dodonaea viscosa Jacq.</i> | Sanatha | S | Sapindaceae | - | + |
| <i>Eucalyptus globulus Labill.</i> | Gond | T | Myrtaceae | + | + |
| <i>Ficus carica L.</i> | Phugwara | T | Moraceae | + | + |
| <i>Ficus sarmentosa Buch.Hem. ex Sm.</i> | Doda bail | T | Moraceae | + | + |
| <i>Grewia optiva J.R.Drumm. ex Burret</i> | Tambar | T | Malvaceae | + | + |
| <i>Indigofera heterantha Brandis</i> | Kainthi | S | Papilionaceae | - | + |
| <i>Juglans regia L.</i> | Akhrot | T | Juglandaceae | + | + |
| <i>Melia azedarach L.</i> | Dreik | T | Meliaceae | + | + |
| <i>Morus alba L.</i> | Safaid toot | T | Moraceae | + | + |
| <i>Morus nigra L.</i> | Kala toot | T | Moraceae | + | + |
| <i>Pinus roxburgii Sarg.</i> | Chirr | T | Pinaceae | + | + |
| <i>Punica granatum L.</i> | Daruna | T | Lythraceae | - | + |
| <i>Rydingia limbata (Benth.) Scheen & V.A. Albert</i> | Koibui | S | Lamiaceae | - | + |
| <i>Senegalia modesta (Wall.) P.J.H.Hurter</i> | Phulai | T | Papilionaceae | + | + |
| <i>Ziziphus nummularia (Burm. f.) Wight & Arn.</i> | Bair | S | Rhamnaceae | - | + |
| <i>Ziziphus jujuba Mill</i> | Shingle | T | Rhamnaceae | + | + |

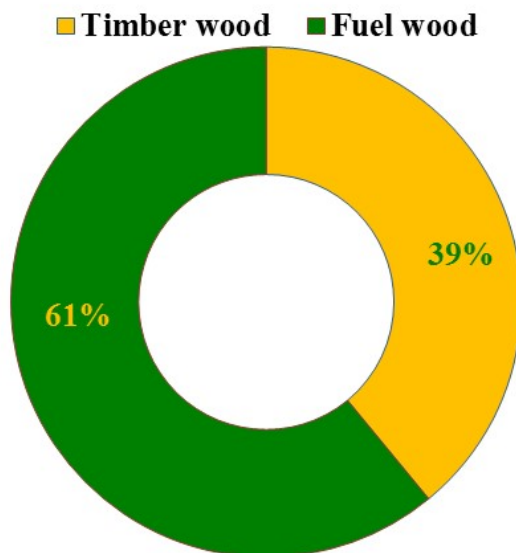


Figure 1. Percentage of fuel wood and timber wood plant species recorded from study area.

Regarding fuel and timber wood species, the local informants cited tree species as the most dominated one with 69%, followed by shrubs with 19% species and herbs with 12% species (Figure 2). Our findings are in congruent with many researchers of allied, neighboring and national regions (Ijaz et al., 2015; Khattak et al., 2015; Rahman et al., 2016a).

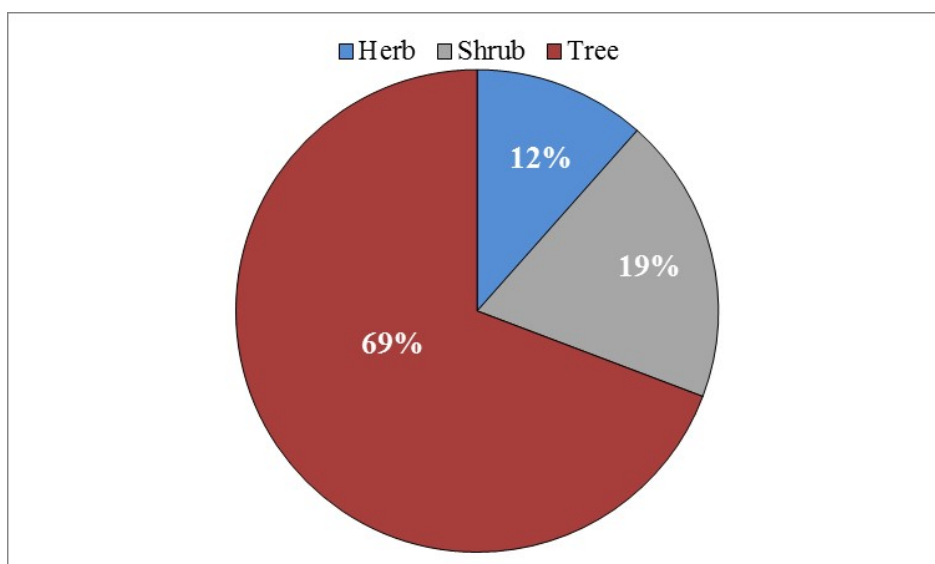


Figure 2. Growth habit of fuel wood and timber wood plant species recorded from study area.

Among all 16 families, Moraceae was found to be the most dominant family with 5 species, followed by Papilionaceae with 3 species, Mytaceae, Rhamnaceae and Sapindaceae with 2 species each. Ijaz et al. (2016) reported Asteraceae as the most leading family and Rahman et al. (2016a) from Swat reported Poaceae as the leading families. Nonetheless, the remaining 11 families viz. Asteraceae, Berberidaceae, Cannabaceae, Cupressaceae, Fabaceae, Juglandaceae, Lamiaceae, Lythraceae, Malvaceae, Meliaceae and Pinaceae had 1 species each (Figure 3).

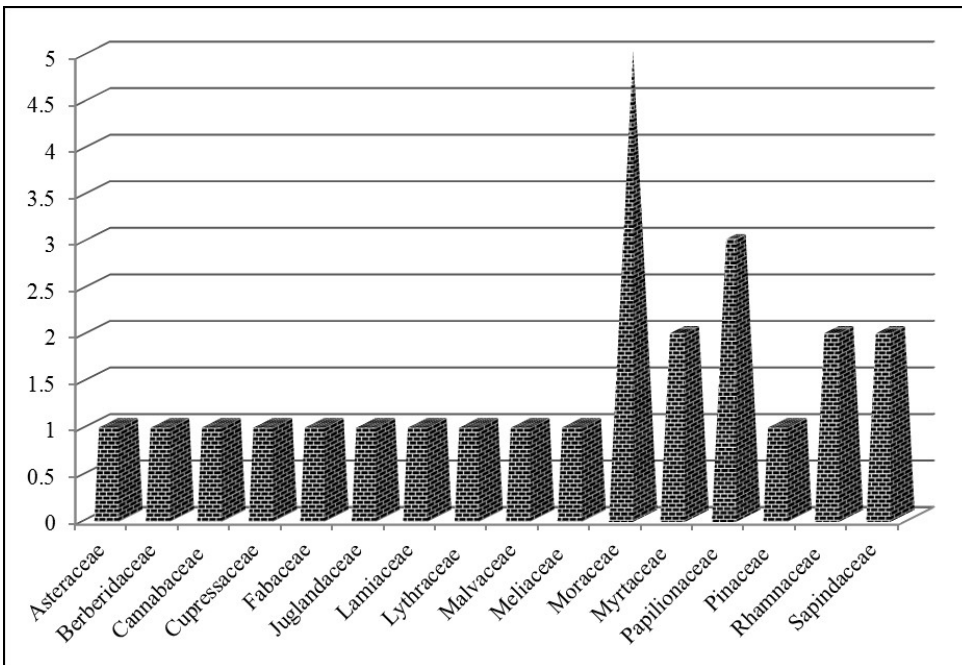


Figure 3. Taxonomic distribution of fuel wood and timber wood plant species recorded from study area.

The TWCA categorizes 2 cultural uses of 26 species into 3 clusters on the basis of presence or absence of fuel wood in comparison with timber wood. Twenty-six plant species clearly depicted by two main hierarchal branches which further represent three clusters of plant species. The first main cluster consists of fifteen plant species i.e., *Albizia lebeck*, *Aesculus indica*, *Callistemon citrinus*, *Cupressus sempervirens*, *Dalbergia sissoo*, *Eucalyptus globulus*, *Ficus carica*, *Ficus sarmentosa*, *Grewia optiva*, *Juglans regia*, *Melia azedarach*, *Morus alba*, *Morus nigra*, *Pinus roxburgii*, *Senegalia modesta* and *Ziziphus jujube* representing with highest number of categories (fuel wood and timber wood). While the second main cluster consists of ten plant species *Arundo donax*, *Berberis lycium*, *Broussonetia papyrifera*, *Cannabis sativa*, *Conyza canadensis*, *Dodonaea viscosa*, *Indigofera heterantha*, *Punica granatum*, *Rydingia limbata* and *Ziziphus nummularia* representing the fuel wood category. Furthermore, third main cluster is comprised of single plant species i.e., *Cupresses semipervensis* for timber wood category (Figure 4).

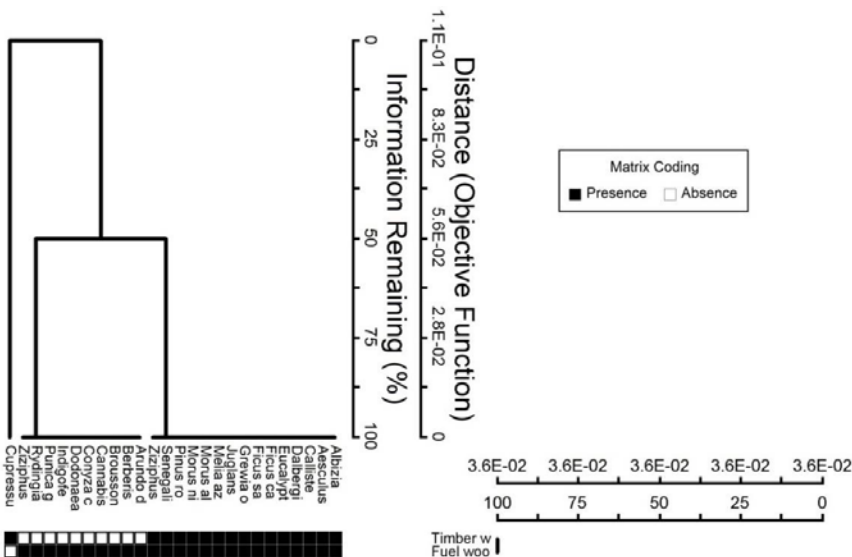


Figure 4. TWCA of plant species between cultural uses.

The DCA plot illustrates the distribution of plant species on the basis of cultural uses and shows three distributional points (Figure 5A). *Cupressus sempervirens* is the only plant species used as timber wood, blue point at 60 encircled in yellow shows its distribution. While on both the axes point located at 30 encircled in green shows the distribution of 15 plant species used for two cultural aspects (fuel wood and timber wood). Moreover, blue point at zero encircled in red is comprised of ten fuel wood plant species. Plot matrix reveals the presence and absence of species in both cultural categories i.e., fuel wood and timber wood (Figure 5B). Furthermore, neighbor join clustering illustrates the categorization pattern of plant species on the basis of their cultural uses. The first cluster (green encircled) consists of maximum number of plant species (15) used for both categories i.e., fuel wood and timber wood, followed by second cluster (red encircled) consists of ten plant species and that are used as fuel wood. Furthermore, third cluster (yellow encircled) is comprised of single plant species i.e., *Cupresses semipervensis* for timber wood category (Figure 5C).

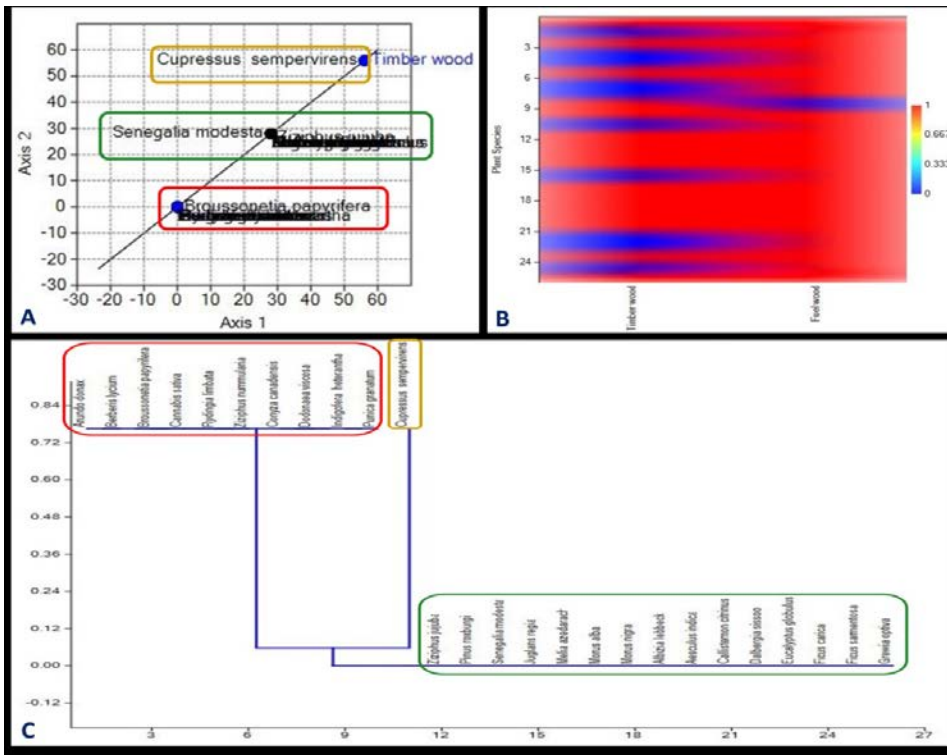


Figure 5. Distribution of plant species between cultural uses: (A) Detrended correspondence analysis (B) Plot matrix shows the presence (red color) and absence (blue color) of plant species, (C) Neighbor joining clusters.

The cultural variables behave differently on different axes. On axis 1, maximum positive correlation (0.854) and positive tau value (0.707) was recorded for timber wood while on axis 2, maximum negative correlation value was recorded for timber wood (-0.935) and maximum negative tau value (-0.708) was logged for timber wood (Figure 6B). Further, on axis 1, minimum positive correlation (0.649) and minimum positive tau value (0.280) was recorded while on axis 2, minimum positive correlation value (0.202) and minimum positive tau value (0.056) was logged for fuel wood (Figure 6A) in comparison with timber wood. Both the axes were dominated by timber wood (Figures 6A and 6B).

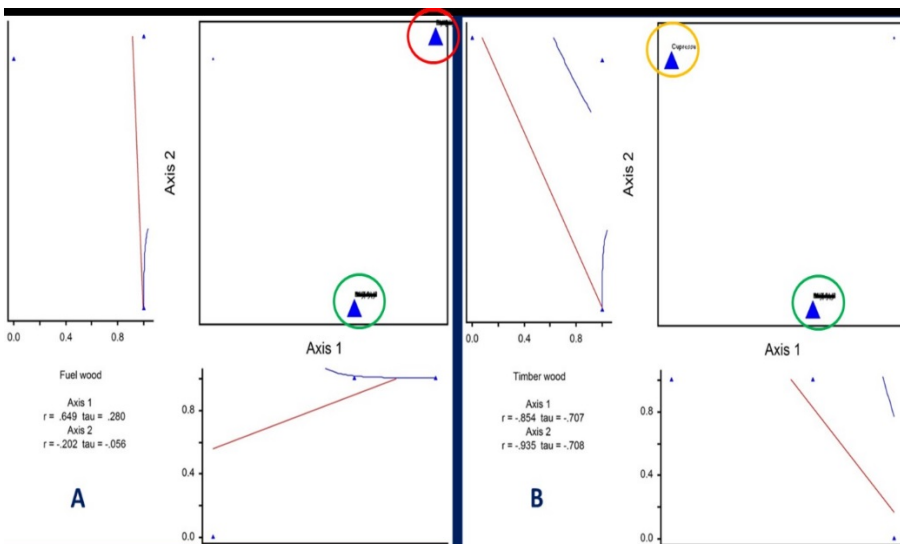


Figure 6. Correlation and regression coefficient of altitude on different axis.

About 17 plants in the collections were used as fuel wood. The local community of the upper areas of Sarban still depends upon the wood as the source of fuel. For this purpose they regularly cut down the trees by which decrease in number of trees and shrubs occurs. Mostly for the winter season people stored the huge amount of wood in the summer by which they cutting down the trees and shrubs and destroy the diversity of plants. Martin (1995) proposed that main threats to the shrubs and trees are basically the fuel deficiency at Sulaiman Range Mountains. In severe and long winter season, a massive quantity of wood for fuel purpose is used and about 13000 people span their life on selling *Pinus gerardiana* plant seeds in a good yielding year. Khan et al. (1996) investigated that in Hindu-Kush Himalayas biodiversity was badly affected by the deficiencies of fuel. Different solutions were recommended for the harmful impact of fuel insufficiency by applying certain strategies at state, regional and local level. Exploration of different other fuel sources, Plantation of rapid growing trees and endangered plant species conservation were also recommended.

About 20 plant species collected from the Sarban Hill are used as source of timber wood which is used for making furniture, instruments, doors, windows and used in constructions of houses. Many of plants perform two functions at a time like *Acacia modesta* wood used for fuel and its gum used for back pain and for weak bones. *Zanthoxylum armatum* fruits are used for stomachache, stem as miswaak, and dry wood as a source of fuel. Similarly an ethnobotanical survey was conducted by Hamayun and Khan (2003) to study shrubs and trees of District Buner since the area has diverse flora and high ethnobotanical potential. It was found that 94 different plant species are used for medicinal, timber, fuel wood, and fodder, ornamental, agricultural tools, thatching, fencing, naming (folk lore) and fruit yielding purposes. Shinwari and Khan (1998) studied 24 species of shrubs and 27 species of trees used by the locals of Margalla Hills National Park, Islamabad, as food, shelter, fodder, cultural purposes and local medication.

Best quality furniture is also made from the wood of *Dalbergia sissoo*, which is also used as the source of fuel by the local community. *Pinus roxburgii* is used as timber wood for construction and also as a source of fuel. *Cupresses semipervensis* is used to made door and windows of the houses. In the summer season, people of the area, after cutting the wood, make stock in their houses for cold/winter season, because in the winter season due to moisture wood is not able to use as fuel source.

Conclusions

The residents living in the area of forests have an easy access to plants and that's why they prefer wood as source of energy. They extensively cut down the trees, and due to this, the pressure on natural resources increases day by day leading the local floral diversity to destruction. Then, conservation strategies must be implemented in the study area to reduce man-made impacts and to try to protect those remote areas that do not present such detailed study of local biodiversity..

Conflict of interest

The authors declare that they have no conflict of interests.

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