

Multipurpose Tree Species of Western Himalaya with an Agroforestry Prospective for Rural Needs

Vishwapati Bhatt¹, Vijay Kant Purohit², Vineeta Negi³

¹Department of Botany, Govt P G College, Gopeshwar, 246401, Chamoli, Chamoli-246 401, Uttarakhand, India

²High Altitude Plant Physiology Research Centre, HNB Garhwal University, Srinagar (Garhwal), 246 1 74 Uttarakhand, India

³Uttarakhand Parvatiya Aajeevika Sanvardhan Company (UPASaC), Gopeshwar, Chamoli-246 401, Uttarakhand, India

vishwapati_bhatt@rediffmail.com, vijaykantpurohit@rediffmail.com, negivineeta@rediffmail.com

Abstract: The Western Himalaya is rich in multipurpose tree species (MPTs) which are traditionally preferred in agro-forestry. Indigenous plants remained excluded in all reforestation and afforestation programmes run by the Govt. agencies due to lack of the knowledge of local MPTs and planting material. In present paper a list of 70 MPTs is presented with their brief notes on their uses and distribution, suitable for agroforestry plantation. There is need to study the propagation behaviour of these short listed plants so that suitable planting material may be made available for the successful agroforestry programme to ensure people participation. [Journal of American Science 2009;5(7):73-80]. (ISSN: 1545-1003).

Key words: Agroforestry, Himalaya, Propagation behavior, Peoples participation, Rural needs.

1. Introduction

Agro-forestry can play major role in the protecting environment and forest (Khurana and Khosala 1993; Gaur 1993; Quli, 2001). The agro-forestry practice in the Garhwal of Uttarakhand in Western Himalaya is permanent feature of agricultural landscape (Semwal and Maikhuri 1996; Maikhuri et al. 1996; Bhatt and Badoni, 1995; Bhatt and Todaria, 1999; Semawal et al. 2001). However, this system is practiced in unplanned manner. People have little choice in selection of plants and what ever grows naturally is accepted. The planting of sapling by conscious efforts is unknown because people have no knowledge of how to raise a particular plant nursery (Vashishtha, et al. 2005). The farmers have integrated crops, trees and animals in their farming and land management systems

reasonably for solving the problem of acute shortages of fuel wood, fodder and other forest produce (Bhatt, 2002).

Spread over 18% of the total area of the country, the Himalaya has had a great influence on the life and culture of Indian people (Boserup, 1965; Gaur et al. 1985; Nand and Kumar, 1989; Swaroop, 1993). The mountainous belt of Himalaya present unique environment concern owing to their young age, origin of the major rivers and complex and fragile ecosystem (Gaur et al. 1985; Ramakrishnan, 1994; Kumar et al. 1996; Purohit, 1997; Gaur, 1993; Dhar et al. 2000). Therefore, the main objective of the action oriented research in Himalayan region is to promote the socio-economic development of the hill people in harmony with preservation of ecological balance. It should envisage

conservation and utilization of ecosystem of Himalayan region under the thrust area such as, creation of nurseries and seedling banks, study of ecosystem and optimal utilization of local resources (Semwal and Maikhuri, 1996).

Promotion of agroforestry can be another step to check deforestation in the hills. It can meet the demand of fodder, and fuel locally and thus lessen the dependence on the forest. Ecological hazards originating from denudation of mountains have generally encouraged attempts to reclaim the barren landscape by reforestation. However, selection of species remained an ignored aspect in these programmes because information is lacking on indigenous species and large numbers of exotics are being introduced, which may constitute a threat to the ecological security of the region and unfit for the local needs. So far in the annual plantation activity, *Bamboos*, *Eucalyptus*, *Acacia*, *Albizia*, *Prosopis*, *Dalbergia*, *Delonix*, *Grevillea*, *Melia* etc. constitute 90% of plantation programmes, which could very well be replaced by local tree species of the region. We cannot reverse this trend unless we know the indigenous MPTs suitable for agroforestry and their propagation behaviour. This should help in raising the saplings of desired tree species in nurseries for plantation purposes and also accommodate the local preference by the farmers.

In this paper, the study presented a list of MPTs which are indigenous to Garhwal region of Western Himalaya and suitable for agroforestry particularly and other forestry programmes in general and Model developed by community for fulfillment of daily needs (Fig. 1).

2. Material and Methods:

The study covers the entire Garhwal of Western Himalaya, which lies in between 29°31.90' N to 31°26.50' N lat and 77°33.50' E to 80°60' E long. Physiographically, the whole terrain is mountainous and can be divided in to three zones-lower Himalayan zone (300-500masl); middle Himalaya (600-1000masl); and upper Himalaya (1100-2500masl). Extensive surveys were made during different seasons in various zones of the study area. A tentative list of MPTs was compiled which included more

than 70 trees species with notes on folk knowledge regarding multipurpose trees (MPTs), their adaptation and use. The methods of collection, preservation and Herbarium preparation were followed as usual practices adopting by Jain and Rao (1977). The identification of specimens was done with the help of regional floras (Babu, 1977; Hara et al. 1978; Naithani, 1984 and 1985; Gaur, 1999). The description includes botanical names of plants followed by some important citations such as Hooker (1872-97), Duthie (1903-29), Babu (1977), Hara et al. (1978), Naithani (1984-1985) and Gaur (1999).

3. Results and Discussion:

On the basis of survey conducted, it is quite evident that agroforestry is though practiced but by and large is an unplanned activity in Garhwal of Western Himalaya. People prefer to collect fodder for their livestock around their agricultural land, but seldom plant a tree. They harbour and patronise trees which naturally grow and have no choice on their selection. Generally, the rule of natural selection and adaptability governs the distribution. On the basis of survey most commonly used 70 MPTs were identified in the entire Garhwal of Western Himalaya of which 13 species are growing in lower region, 24 species are growing in middle Himalaya and rest 31 species in upper Himalayan zone. The brief description of the plants is presented as following:

List of Plants:

1. *Adina cordifolia* Roxb. Vern. Haldu, F. Rubiaceae, upto 800m; Fl. May-Jul., Fr. Mar-May; Fuel, Timber, Medicine.
2. *Aesendra butyrcea* Roxb. Vern. Chiura, F. Sapotaceae, Fl. Jan-Mar; Fr. Jun-Jul., upto 800m; edible oil, medicine, bee forage, timber.
3. *Aegle marmelos* L., Vern. Bel, F. Rutaceae, Fl. Feb.-Mar., Fr. May-Aug.; upto 1200 m; Fuel, Fruit, Medicine.
4. *Albizia lebbeck* L., Vern. Siris, F. Mimosaceae, Fl. Feb. ó Apr., Fr. Oct-Dec., upto 1200 m; Fuel, Timber, Nitrogen Fixing.

5. *Albizia procera* (Roxb.) Benth., Vern. Karah, F. Mimosaceae, Fl. May - Aug., Fr. Oct-Dec., upto 800 m; Fuel, Timber, medicine N₂ Fixing.
6. *Alnus nepalensis* D., Vern. Ust, F. Betulaceae, Fl. Oct.-Nov., Fr. Oct-Jun., upto 1000-2500m; Fodder, Fuel, Timber, Nitrogen Fixing.
7. *Artocarpus lacucha* Buch.-Ham., Vern. Dheu, F. Moraceae, Fl. Mar. ó Apl., Fr. May ó Aug. upto 1000m; Fodder, medicine, Ghee, Fuel,
8. *Bauhinia purpurea* L., Vern. Guiral, F. Caesalpiniaceae, Fl. Sept.-Nov., Fr. Jan-Mar., upto 700m; Fodder, Fuel, Timber, Medicine, Nitrogen Fixing.
9. *Bauhinia variegata* L., Vern. Kwiriyal, F. caesal piniaceae, Fl. Feb.-Apr., Fr. May-Aug., upto 800-2000 m.; Fodder, Fuel, Timber, Medicine, Nitrogen Fixing.
10. *Bauhinia semla* Wunderlin. Vern. Kanda F. Caesalpiniaceae, Fl. Sept.-Nov., Fr. Feb-Apr., upto 1000-1500m; Fodder, Fuel, Timber, Medicine, Nitrogen Fixing.
11. *Bauhinia racemosa* Lam. Vern. Jhingora F. Caesalpiniaceae, Fl. Mar. - Jun., Fr. Jan. - May, upto 1000-1600m; Fodder, Fuel, Fibre, Timber, Medicine.
12. *Bauhinia vahlii* Wight & Arn. Vern. Malu F. Caesalpiniaceae, Fl. Apl. - Jun., Fr. Jun. - Sept., upto 1300m; Fodder, Fuel, Fibre, Cup-plats.
13. *Betula alnoides* Buch. ó Ham., Vern. Saur, F. Betulaceae, Fl. & Fr. Mar-Jun., upto 2000-3000m, Fodder, Fuel, Timber, Nitrogen Fixing.
14. *Boehmeria regulosa* Wedd., Vern. Genthí, F. Urticaceae, Fl. & Fr. July-Nov., upto 1000-1600 m; Fodder, Fuel, Medicine.
15. *Bombax ceiba* L., Vern. Semal, F. Bombacaceae, Fl. Jan-Mar., Fr. Apr-May; upto 1200m; Fuel, Fibre, Timber, Medicine.
16. *Butea monosperma* Lam., Vern. Dhak, F. Fabaceae, Fl. & Fr. March-May, upto ó 1500 m; Fodder, Fuel, Timber, Medicine.,
17. *Cassia fistula* L., Vern Kirala, F. Caesalpiniaceae, Fl. Feb.-Apr., Fr. May-June, upto 1400m; Fodder, Fuel Timber, Medicine, Nitrogen fixing.
18. *Celtis australis* L., Vern. Khairk, F. Ulmaceae, Fl. Mar-Apr, Fr. Sept.-Oct., upto ó 2400 m; Fodder, Fuel Fruit, Timber, Medicine .
19. *Cordia dichotoma* Forster f, Vern. Lisora, F. Ehretiaceae, Fl. Mar-Apr; Fr. May-Jul., upto ó 1800 m; Fuel, Fruit, Timber.
20. *Desmodium elegans* DC., Vern., Chamlai, F. Fabaceae, Fl. Apr-Jun, Fr. Jul-Oct., upto ó 2000-3500m; Timber, Nitrogen Fixing .
21. *Debregeasia salicifolia* D. Dun, Vern. Syanry, F. Urticaceae, Fl.& Fr. Feb-Aug, Fuel.
22. *Daphniphyllum himalense* Benth; Vern. Ratniyalu, F. Daphniphyllaceae, Fl. Mar-Apr., Fr. Jun-Aug., upto 1600-2800 m; Fodder, Fuel, Timber, Nitrogen Fixing.
23. *Embllica officinalis* Gaertner, Vern. Amla, F. Euphorbiaceae, Fl. Feb-Apr, Fr. Sept-Nov.,
24. *Ficus glomarata* Roxb., Vern. Umra, F. Moraceae, Fl. Mar-May, Fr. Jun-Aug; Fodder, Fuel, Fruit, Medicine.
25. *Ficus hispida* L.f., Vern, Bhumra, F. Moraceae, Fl. Mar-Apr, Fr. May-Jun., upto ó 600m; Fodder, Fuel, Fruit, Fibre, Medicine.
26. *Ficus nemoralis* Wallich ex Miq., Vern., Thelku, F. Moraceae, Fl. Mar-Apr. Fr. Aug-Sep., upto ó 1200-2200 m; Fodder, Fuel, Fruit.
27. *Ficus palmata* forsk; Vern. Bedu, F. Moraceae, Fl. May-Jun, Fr. Jun-Aug., upto 900-1200m; Fodder, Fuel, Fruit, Medicine.
28. *Ficus semicordata* Buch. óHam., Vern. Khaina, F. Moraceae, Fl. May-Jun, Fr. Jun-Oct., upto 900-1200m; Fodder, Fuel, Fruit, Fibre, Medicine.
29. *Ficus subincisa* Buch. ó Ham., Vern. Chanchri, F. Moraceae, Fl. & Fr. Mar-Jun., upto 900-1200m; Fodder, Fuel, Fruit, Medicine.

30. *Ficus auriculata* Lour, Vern. Timla, F. Moraceae Fl. Mar-May, Fr Jun-Jul, upto 900-1200m; Fodder, Fuel, Fruit, Medicine.
31. *Fraxinus micrantha* Lingeisheim, Vern. Angu, F. Oleaceae, Fl. Mar-Apr., Fr. Jul-Sept., upto 1800-2600 m; Fodder, Timber, Medicine.
32. *Grewia asiatica* L. Vern. Dhaman, F. Tilliaceae Fl. Apr-May, Fr. Jun-Aug., upto 1000-1500m ;Fodder, Fuel, Fruit, Fibre, Medicine.
33. *Grewia eriocarpa* A.L. Juss, Vern. Pharasain, F. Tilliaceae, Fl. May-Jun, Fr. Jul-Aug. Fodder, Fuel, Fruit, Fibre, Medicine.
34. *Grewia oppositifolia* Buch.-Ham., Vern. Bhimal, F. Tilliaceae, Fl. Apr-Jun, Fr. Aug-Nov., upto 800-1600m; Fodder, Fuel, Fruit, Fibre, Medicine.
35. *Holarrhena pubescens* Buch.-Ham, Vern. Kura, F. Apocynaceae, Fl. Apr-Jul, Fr. Oct-Feb, upto 1250 m, Fodder, Fuel.
36. *Litsea glutinosa* Lour., Vern. Maida-lakari, F. Lauraceae, Fl. Jun. ó Aug., Fr. Sept. - Oct., upto 600m; Fodder, Fuel, Timber Medicine.
37. *Litsea monopetala* Roxb., Vern. Kadwai, F. Lauraceae; Fl. Mar-July, Fr. July-Nov., upto 800-1600m; Fodder, Fuel, Timber Medicine.
38. *Lyonia ovalifolia* Wallich, Anyar, F. Ericaceae, Fl. Mar-Jul, Fr. Jul-Nov., upto 800-1600m; Fuel, Timber, Medicine.
39. *Madhuca longifolia* Koenig; Vern. Mahwa, F. Sapotaceae, Fl. Mar-Apr, Fr. Jun-Jul. upto 500m; Fuel, Timber, Medicine.
40. *Mallotus phillippensis* Lam., Vern. Ruina, F. Euphorbiaceae, Fl. Sept-Nov, Fr. Mar-May, upto 800-1600m; Fodder, Fuel, Timber, Medicine.
41. *Melia azedarach* L. Vern. Dainken, F. Meliaceae, Fl. Mar-Apr, Fr. Apr-May upto 1400m; Fodder, Fuel, Timber, Medicine.
42. *Milletia extensa* Benth. Vern. Gauj; F. Fabaceae, Fl. Apl. ó May, Fr. Jul. ó Aug., upto 1500m, Fodder, Medicine, Soil binding, Fibre.
43. *Moringa oleifera* Lam., Vern. Sainjna, F. Moringaceae, Fl. Feb-Apr, Fr. May-Jun. upto 1200m; Fodder, Fuel, Medicine.
44. *Morus alba* L. Vern. Sahtoot, F. Moraceae, Fl. & Fr. Feb-Jan. Fodder, Fuel, Fruit, Fibre, Medicine.
45. *Myrica esculenta* Buch. ó Ham. Vern. Kaphal, F. Myricaceae, Fl. Aug-Oct, Fr. Apr.-Jun., upto 900-2000m; Fuel, Fruit, Timber, Medicine.
46. *Neolitsea pallens* D. Don., Vern. Belaru F. Lauraceae, Fl., Mar-Apr, Fr. Sep. ó Oct., upto 1500-3000m ; Fodder, Fuel, Timber, Medicine.
47. *Neolitsea cuipala* Buch ó Ham, Vern. Lampatiya, F. Lauraceae, Fl. Mar-Apr., Fr. Sep-Oct., upto 1000-2500m; Fodder, Fuel, Timber, Medicine.
48. *Ougeinia oojeinensis* Roxb., Vern. Sandan, F. Fabaceae, Fl. Mar-Apr, Fr. May-Jul. upto 1500m, Fodder, Fuel, Medicine, Timber.
49. *Prunus cerasoides* D. Don, Vern., Panya, F. Rosaceae, Fl. Oct-Dec., Fr. Feb-Mar, upto 2400 m; Fuel, Timber, Medicine.
50. *Persea duthiei* King ex.Hook, Vern. Kaula, F. Lauraceae, Fl. Feb-Apr, Fr. Jun-Sept. upto 2200 m; Fodder, Fuel, Timber, Medicine.
51. *Phoenix humilix* Royle., Vern. Khajoor, F. Are Caceae, Fl. March- Apr, Fr. May-Jun., upto 1600m; Fodder, Fuel, Fruit, Fibre, Medicine.
52. *Premna barbata* Wallich., Vern. Bakrya, F. Verbenaceae, Fl. Mar-May, Fr. Jun-Jul. upto 1500m; Fodder, Fuel.
53. *Pyrus pashia* Buch. ó Ham., Vern. Mole, F. Rosaceae, Fl. Feb.-Mar, Fr. May-Dec., upto 2400m. Fuel, Fruit, Timber, Medicine.
54. *Quercus leucotrichophora* A., Vern. Banj, F. Fagaceae, Fl. Mar-Apr, Fr. Oct-Jun., upto 2000m; Fodder Fuel, Timber, Medicine.
55. *Quercus floribanda* Lindley, Vern. Moru; F. Fagaceae, Fl. Apr-May, Fr.

- Aug-Oct., upto 2000-2800m; Fodder, Fuel, Timber, Medicine.
56. *Quercus glauca* Thumb., Vern. Harinj, F. Fagaceae, Fl. May-June, Fr. Jun-Aug., upto 800-2000m; Fodder, Fuel, Timber, Medicine.
57. *Rhododendron arboreum* Smith, Vern. Burans F. Ericaceae, Fl. March-May, Fr. Apr. ó Nov; Fuel, Timber, Medicine.
58. *Rhus parviflora* Roxb., Vern, Tungla, F. Anacardiaceae, Fl. May-Jun, Fr. Jul-Nov, upto 1800m; Fuel, Fruit, Medicine.
59. *Salix babylonica* L. Vern. Majnu, F. Salicaceae Fl. & Fr. Feb-Jul; Fodder, Fuel, Timber, Medicine.
60. *Schleichera oleosa* (Lour.) Oken. Vern. Kusum, F. Sapindaceae, Fl. Mar. ó Apl., Fr. Jul. ó Aug., upto 1200m, Medicine, Fodder, Bee forage.
61. *Sesbania bispinosa* Jacquin., Vern. Dhaincha, F. Fabaceae, Fl. & Fr. Sept-Jan, Fodder, Fuel, Fibre, Medicine.
62. *Spondias pinnata* L.F., Vern. Amra, F. Anacardiaceae, Fl. Feb-Apr, Fr. Sept.-Nov., upto 1400m; Fuel, Medicine.
63. *Swida macrophylla* Wallich, Vern., Khagsi, F. Cornaceae, Fl. Apl. ó Jun., Fr. Jul. ó Oct., 1400-2500m, Fodder, Fruit, Bee forage, Agri. Implements.
64. *Syzygium cumini* L., Vern. Phalenda, F. Myrtaceae, Fl. Mar-May, Fr. Jun-Jul. upto ó 900m. Fuel, Fruit, Timber, Medicine,
65. *Terminalia alata* Roxb., Vern. Asin, F. Combretaceae, Fl. Jun-Jul. Fr. Feb.-Mar. upto 1500m. Fodder, Fuel, Timber, Medicine.
66. *Terminalia bellirica* Roxb., Vern. Bahera, F. Combretaceae, Fl. Apr-Jun, Fr. Jun-Jul. upto 1200m. Fodder, Fuel, Fruit, Timber, Medicine.
67. *Terminallia chebula* Retz. Obs., Vern. Haira, F. Combretaceae, Fl. Apr.-Jun, Fr. Jun-Mar. upto 1600m; Fodder, Fuel, Fruit, Timber.
68. *Toona ciliata* Roemer, Vern. Tun, F. Meliaceae Fl. Mar-Apr, Fr. Jun-Jul. upto 1000m; Fuel, Timber.
69. *Wrightia arborea* Dennstaeff. Vern. Darula, F. Apocynaceae, Fl. May-Jun, Fr. Mar-Apr. upto 1200m. Fodder, Fuel, Timber, Nitrogen Fixing.
70. *Woodfordia fruticosa* L. Vern. Dhaula, F. Lythraceae, Fl. Jan-Apr., Fr. Apr-Jun., upto 1500m; Fodder, Fuel, Medicine.

There are large numbers of multipurpose trees which grow indigenously in Garhwal region of Western Himalaya and are used by the people for their needs traditionally for fodder, fuel and also as cheap timber. It has been noted that those plants which are not used as construction material in plains are quite adequate to meet the demands in hills because in colder climate the wood is insect resistant. This cheap wood and fuel comes from non-timber MPTs which are equally good as provider of fodder.

It is remarkable that the lower Himalayan region has predominance of the multipurpose trees *Bauhinia semla.*, *B. purpurea*, *Bombax ceiba*, *Phyllanthus emblica*, *Ficus hispida*, *F. glomerata*, *Albizia lebbeck*, *Adina cordifolia*, *Acacia catechu*, *L. chinensis*, *Madhuca longifolia.*, *Mallotus philippensis*, *Syzygium cumini*, *Dalbergia sissoo*, *Melia azedarach*, *Moringa oleifera* etc. while the middle Himalaya have the MPTs such as *F. auriculata*, *F. subincisa*, *Boehmeria rugulosa*, *Grewia eriocarpa*, *Litsea monopetala*, *Terminalia sps Ougeinia oojeinensis*, *Bauhinia variegata*, *Pyrus pashia*. In the upper Himalayan ridges *Ficus nemoralis*, *Salix babylonica*, *Alnus nepalensis*, *Betula alnoides*, *Quercus leucotrichophora*, *Q. gluaca*, *Q semicarpifolia* etc are quite common.

There has been noticeable reflection of striking cultural diversity in the agroforestry too. While in Pauri, Rudraprayag and Chamoli district of Garhwal the most commonly preferred agroforestry plants are *Ficus auriculata*, *F. palmata*, *F. nemoralis*, *F. subincisa*, *Quercus sps*, *Celtis australis*, *Grewia oppositifolia*, *G. eriocarpa*, *Boehmeria rugulosa*, *Litsea monopetala* etc., in Tehri and Uttarkashi district the plants of choice are *Bauhinia sps.* such as *Bauhinia vahlii*, *B. variegata*, *B. purpurea* and

Albizia lebbeck, *Mallotus phillippensis*, *Premna barbata* etc.

The preference of MPTs at different altitude is also different. For example the *Ficus* sps. are considered highly valuable fodder in the higher altitude (1000-18000m asl) area whereas *Celtis australis* and *Grewia oppositifolia* are considered the best fodder in the lower altitude (300-1400m asl) of Garhwal of Western Himalaya. The other striking observation was that agroforestry was kept away willingly and wittingly from irrigated land. Here the main consideration was maximum crop yield. Any plant around the field was considered unwanted. Hardly any plant was seen in and around the fields in irrigated area (as has been revealed during the survey in different localities, Barsu, Agustyamuni, Tilwara, Gholtir in Rudraprayag; Gauchar, Maldhar-Saikot in Chamoli; Purola, Barkot, Uttarkashi in Uttarkashi District). The agroforestry was promoted on the marginal and unirrigated land and treated as welcome supplement to the poor crop yield. The people depended more on livestock in these areas (Guptkashi, Ukhimath, Kandara, Bhanaj in Rudraprayag and Gpeshwer, Joshimath, Gairsain, Naryanbagar, Tharali in district Chamoli).

At present, the plants which Government agencies use in forestry and social forestry are commonly *Acacia auriculiformis*, *Albizia lebbeck*, *Dalbergia sissoo*, *Eucalyptus* sps., *Grevillea robusta*, *Jacaranda* sps., *Leucaena leucocephala*, *Mangifera indica*, *Melia azadirach*, *Morus alba*, *Salix* sps., *Vitex negundo*. However, these plant species are not native to Garhwal, still they may have been preferred mainly because the propagation of these plants is well known and planting material is easily available. But this shall be a short cut approach and might be largely responsible for failure to make it people programme. People wisely think of a plant well known to them ethnically and socially. Therefore there is need to know the local MPTs so that they may be involved in agroforestry. They also make it better from the point of view of crop-plant interaction, since their trial through ages. Further, the community agroforestry may hold a new promise to the conservation of ecology and prosperity of

people. Any such movement would involve a requirement of suitable planting material. Here we have selected and identified most commonly used multipurpose trees giving complete details of their uses and habitat. From the list presented, plants can be chosen for particular location altitude wise. There are some plants such as *Ficus auriculata*, *F. nemoralis*, *F. palmata*, *Litsea monopetala*, *Celtis australis*, *Grewia oppositifolia*, *Boehmeria rugulosa*, *Debregeasia salisifolia*, *Pyrus pashia*, *Toona ciliate*, *T. serrata* which grow over from very low altitude in valley to very high altitude while other group have very restricted habitat. Plants such as *Ficus hispida*, *F. semicordata*, *Terminalia alata*, *T. bellirica*, *T. chebula*, *Wrightia arborea*, *Litsea chinensis*, *Artocarpus lacoocha* can only be selected for plantation in lower heights (300-800m asl)

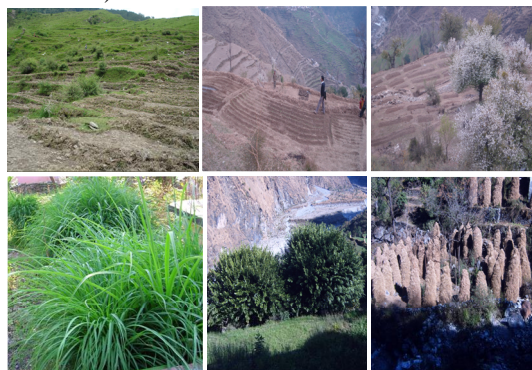


Figure 1. Agroforestry model developed through peoples participation for fulfilling rural needs.

Women folk have to walk miles to get fodder and fuel leaving little time for child care and other household duties; least is to be said about their own emancipation. If agroforestry is adopted, it has a potential to shed off waste of time and efforts. However, it has to be a planned activity and people should have a choice of MPTs and opportunity of sapling availability. In this way the present study may prove to be a turning point. This shall prove especially helpful for Government agencies involved in agroforestry and forestry.

Thus the agroforestry can play a major role in restoring the ecological imbalance by

meeting the demand of fuel, fodder and timber of the rural community locally around their fields in Himalayan hills. To make it popular programme, there is a need to include indigenous MPTs of the area. Indigenous MPTs has other advantages also, besides providing fodder, fuel and many of them provide high quality fibre (*Ficus semicordata*, *Grewia oppositifolia*, *G. asiatica* etc) and edible fruits (*Celtis australis*, *Grewia oppositifolia*, *G. asiatica*, *Ficus auriculata*, *Ficus palmata*, *Ficus semicordata*, *Ficus*

Acknowledgements:

Authors gratefully acknowledged the Head, Department of Botany, HNB Garhwal University, Director, High Altitude Plant Physiology Research Centre, Principal Govt. P.G. College Gopeshwar, and Project Director Aajeevika project for encouragement and support throughout the study periods.

*Correspondence to:

V. P. Bhatt, Ph.D.
Assistant Professor
Department of Botany,
Govt P. G. College, Gopeshwar, 246401,
Chamoli, Uttarakhand, India.
E- Mail: bhattvp3@yahoo.com,
vishwapati_bhatt@rediffmail.com
Phone: 9412364460

References

- [1] Babu CK. *Herbaceous Flora of Dehradun*. CSIR, N. Delhi, 1977.
- [2] Bhatt BP, Badoni AK. Remarks on fodder plants of Garhwal Himalaya. In Chadha, S K (ed) *Echoes of Environment 1995*, pp52-75, Himalaya Publishing House, New Delhi.
- [3] Bhatt BP, Todaria, NP. *Agroforestry Operational Research and Training Project for Development of Non-Forested Wastelands in Garhwal Hills*. Progress report submitted to Ministry of Rural Areas and Employment, Department of Wasteland Development, Govt. of India, New Delhi 1999, pp 25.
- [4] Bhatt VP. Germination behavior of ficus species in Garhwal Himalaya. Ph D thesis, HNB Garhwal University, Srinagar Garhwal 2002.
- [5] Boserup E. The condition of agricultural growth; The economics of agrairain change under population pressure. Allen & Unwin, London 1965.
- [6] Duthie JF. *Flora of the Upper Gangetic Plain and the Adjacent Siwalik and Sub-Himalayan tracts*. 3 vols. Calcutta, 1903-1929.
- [7] Gaur RD, Silas RA, Purohit VP. Land use pattern and settlements in the Benu valley in Garhwal Himalaya. *Mountain Chronicles* 1985, 7: 91-94.
- [8] Gaur RD, Bisht MK, Tiwari JK, Todaria NP. Some potential agroforestry tree species of the U P Himalaya. In Khurana and Khosla (eds) *workshop proceedings, Agroforestry for Rural Needs 1993*, 714-717pp.
- [9] Gaur RD, Barthwal BS. A contribution to the forest flora of Pauri district- Garhwal Himalaya. *Higher plants of Indian Subcontinent 1995 Vol. V*: 1-134.
- [10] Gaur RD. *Flora of the District Garhwal: NW Himalaya (With Ethnobotanical Notes)*. TransMedia, Srinagar Garhwal 1999.
- [11] Hara H, Stearn WT, Williams LHJ. *An Enumeration of the Flowering Plants of Nepal*. vol.1. London vol.2 1979 (Hara, William eds.) 1978 vol.3.1982 (Hara & Chater Williams eds.). London.
- [12] Hooker JD. *The Flora of British India*. Oxford 1872-1897.
- [13] Jain SK, Rao RR.. *A Handbook of Field and Herbarium Methods*. Today & Tomorrow's, N.Delhi 1977.
- [14] Khurana DK, Khosla PK. *Agroforestry for Rural Needs. Workshop Proceedings (IUFRO) Vol. II*, Published by ISTS, Solan, India 1993.

- [15] Kumar K, Dyani PP, Palni, L M S. Land utilization in Central Himalaya: Problems and Management Option, HIMVIKASH Publication No. 8, Indus Publishing Co. New Delhi 1996.
- [16] Maikhuri RK, Rao KS, Saxena KG. Traditional crop diversity for sustainable development of Central Himalayan agroecosystem. *International Journal of Sustainable Development and World Ecology* 1996, 3: 8-31.
- [17] Naithani BD. *Flora of Chamoli*, BSI, Howrah 1984-1985.
- [18] Nand N, Kumar K. *The Holy Himalaya: A Geographical Interpretation of Garhwal*. Daya Publishing House New Delhi 1989.
- [19] Purohit AN. Medicinal plants: A need for upgrading technology for trading the tradition. In: Nautyal et. al. *Harvesting Herbs 2000: Medicinal and Aromatic Plants: An action plan of Uttarakhand* 1997.
- [20] Quli SMS. Agroforestry for NTFPs conservation and economic upliftment of farmers. *Indian Forester*. 2001, Vol. 127: 1251-1262 pp.
- [21] Ramakrishnan PS, Purohit AN, Saxena KG, Rao KS. *Himalayan Environment and Sustainable Development*. INSA, Diamond Jubilee Publication, New Delhi 1994.
- [22] Semwal RL, Maikhuri RK. Agroecosystem analysis of Garhwal Himalaya. *Biological Agriculture and Horticulture*. 1996, Vol. 13: 267-289pp.
- [23] Semwal RL, Maikhuri RK, Rao KS. Agriculture: Ecology, practices and Productivity. In Kandari and Gusain (eds) *Garhwal Himalaya: Nature, Culture and Society*. Published by Transmedia, Srinagar Garhwal, Uttaranchal 2001, 261-276pp.
- [24] Swaroop R. Agriculture economy of Himalayan region with special reference to Garhwal Himalaya. Vol. 2 *Gyanodaya Prakashan*, Nainital 1993.
- [25] Vashishtha DP, Bhatt VP, Saklani Mala. Study of propagation behaviour of some multipurpose trees of Garhwal Himalaya with an agroforestry prospective. Final technical report submitted to GB Pant Institute of Himalayan Environment and Development, Kosi-Katarmal Uttaranchal, Govt. of India 2005.

7/5/2009