UTILIZATION POTENTIAL OF SOME LOW VALUE WOOD SPECIES FOR VARIOUS WOOD PRODUCTS

Zahid Rauf[1], G. M. Nasir[2] and Sohaib Ahmed[3]

ABSTRACT

Twelve different low value wood species grown in Khyber Pakhtunkhwa were tested to determine their physico-mechanical properties and evaluate their utilization potential for manufacturing of various wood products. Testing of the standard wood samples prepared from each species was carried as per ISO standards. Results showed that the studied wood species also are used as substitute for the commercial wood species for manufacturing of various wood products.

INTRODUCTION

In Pakistan forest area covers 5.1% (4.55 m. hectares) of the total land area of the country. Out of this, coniferous and natural forests constitute 54% and are the main source of construction wood (Bukhari *et al*., 2012). Per capita forest area in Pakistan is only 0.03 hectare and is declining due to growth in population (NIPS, 2009).

In 2010, the estimated shortage of wood was about 34.12 million m^3 that was 70% of the total wood consumption. Out of the total imports of wood and wood based products, the imports of timber constitute 76% while the imports of wood products constitute 20% (GOP, 1992; GOP, 1994; GOP, 2005; Zaman and Ahmad, 2012). Hence, there is a dire need to explore more wood species on the bases of properties for utilization in the wood and wood based industries as substitutes for commercial wood species.

Bodig and Jayne (1982) indicated that the strength properties of wood are designed almost exclusively for predicting the performance of wood during service. The mechanical strength properties measured depend on the specific uses to which the timber is to be put. Timber is probably stressed in bending more than in any other mode and there are very many examples of timber being used in bending, (Desch and Dinwoodie, 1996), examples are when the timber is used as floor and ceiling joists and roof trusses, shear strength parallel to grain is the most important property that comes into play in structural use of timber in jointing. High Strength in compression parallel to the grain is required in timber used as columns, posts etc. Hardness is an important property when the timber is used for paving blocks, floors decking and bearing blocks (Ofori *et al*., 2009).

According to Wilson and White (1986), the mechanical properties of wood

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1 AWSPO, Pakistan Forest Institute, Peshawar
2 Logging Officer, Pakistan Forest Institute, Peshawar
3 LIF, Pakistan Forest Institute, Peshawar

are largely determined by the distribution of the anatomical structures of the wood. A comprehensive knowledge about the anatomical, chemical, mechanical and physical properties will help in the effective utilization of a species and also assist in the establishment of safety values and design functions, especially when it is used for structural purposes.

In this study, a number of low value wood species grown in Khyber Pakhtunkhwa have been tested for their properties with the objective to find out their better utilization other than the traditional so that, these can also be used as substitute for the commercial wood species for manufacturing of various wood products.

MATERIAL AND METHODS

To study the physico-mechanical properties, the butt end logs of about 12 species were collected and converted into planks. The material was stacked in seasoning shed to attain equilibrium moisture content. The samples of each wood species of the following sizes were prepared according to standards (ISO Standards).

S. No.	Property	Sample Size
1.	Static bending	30 cm x 2 cm x 2 cm
2.	Impact bending	30 cm x 2 cm x 2 cm
3.	Compression parallel to grain	6 cm x 2 cm x 2 cm
4.	Tensile strength perpendicular to grain	7 cm x 2 cm x 2 cm
5.	Cleavage	4.5 cm x 2 cm x 2 cm
6.	Hardness	10 cm x 2 cm x 2 cm
7.	Density	6 cm x 2 cm x 2 cm

The prepared wood samples of each species were then tested on Amsler Universal Wood Testing machine with a total loading capacity of 4000kg and an accuracy of 1% of its total loading capacity and data were collected for various strength tests of each species.

RESULTS AND DISCUSSION

Results given in the following Table showed that Ber *(Zizyphus mauritiana)* wood is a high density wood. Upper class Modulus of rupture and Modulus of elasticity values make this wood good for construction works. Compressive strength is low which means that the wood can’t be used as poles. Cleavage is good and enables this wood good for nailing, carving etc. Tensile strength perpendicular to grain is good and contributes to its better machining properties. Hardness values are medium and enable it to be used in machining works and products making where medium hardness is required.

Ghaz (*Tamarix aphylla*) wood can be classified as upper class density wood according to TRADA classification (650-725 Kg/m³). Modulus of elasticity and Modulus of rupture values suggest that this wood can be used in construction works where medium strength is required i.e (80-100 MoR) and (8500 – 11000 MoE). Compression parallel to grain value makes this classify as low strength compression wood. It means that it can't be used as poles, vertical beams etc. Similarly, tensile and hardness properties are medium and suggest this wood to be having normal, machining, boring, carving, properties.

Dhrek (*Melia azedarach*) wood can be classified as high density class wood according to TRADA classification. Modulus of rupture, Modulus of elasticity and compression values reveal that the wood is low strength in compression and medium strength in Modulus of rupture & Modulus of elasticity properties. Cleavage value is fairly well and enables this wood to be used in joints bolted timber etc. hardness and impact bending values show not much more significance.

Toot (*Morus alba*) wood can be classified as High density class wood. Modulus of rupture and compression parallel to grain values suggest this wood to be upper strength wood i.e. in between medium and high strengths. It means that wood can be used as posts, poles and rafters. Cleavage, tensile strength and hardness properties are excellent. These properties make this wood to be good for carving, screwing, nailing, machining.

Kangar (*Pistacia integerrima*) wood may be less common in utilization and has high density. Impact bending is high and the wood can be used where sudden shock resistance is required cleavage is good and tensile strength is high which indicates that the wood can be used where resistance to splitting is required.

Ipil Ipil (*Leucaena leucocephala*) wood, the MoR is exceptionally high which means the wood can bear high loads. MoE is also high and makes the wood of high strength. Compression parallel to grain enables the wood to be classified as upper strength class wood. On the basis of high strength properties and density, the wood can be suggested to be used in construction works. Cleavage and tensile strength values are high and make the wood good for carving, cutting nailing; screwing etc. Hardness value of the wood is also very high. i.e. the timber has high resistance to indentation.

Siris (*Albizzia* sp.) is high density class wood. Low Modulus of elasticity, high Modulus of Rupture, medium compressive strength makes this wood to be generally used in construction works where medium strength is required. High cleavage and tensile values make it best for carving work, nailing etc. and hardness value contributes to better machining properties of the wood. Thus the wood can be easily recommended for construction works where medium strength is required, furniture making, carving, nailing, screwing works etc.

Anjir (*Ficus palmata*) wood can be classified as upper density class wood. Modulus of rupture, Modulus of elasticity and compression values suggest that this wood may be used in construction works where medium strength is required i.e. can't be used in mega structures. Cleavability and end hardness values are good and enable it to be used the wood in carving and joinery works.

Chinar (*Platanus orientalis*) wood has the values of MOE and MOR considered to be medium. Impact bending is also not very high however cleavage value is fairly well. Results reveal that the wood is suitable for making light wooden/ furniture articles where high strength is not requisite. Further, better cleavage value has made the wood better for carving, boring, cutting etc.

Willow (*Salix tetrasperma*) wood can be classified as medium density wood as per density classification. The Wood is of low strength in terms of MoR, MoE, compression, properties which implies that it can't be used in construction works. Cleavage and tensile strength perpendicular to grain values are moderate and suggest the utility of the wood in furniture making where low to medium strength is required.

Batkar (*Celtis eriocarpa*) wood may be classified as high density wood. Therefore, the other strength properties are also high. The wood is of high strength with respect to its MOR and of upper strength in terms of its MOE. It can be used in construction works where high strength is required. Based on the compression parallel to grain value, the wood may be classified as medium strength. So the wood may be used in structures as poles and posts, where medium load is to be borne by the wood. Compression perpendicular to grain is good, while tensile strength and cleavage are excellent. Based on these properties, the wood is expected to be having good machining, carving, cutting, boring, routing and grooving properties.

Lachi (*Eucalyptus camaldulensis)* wood is a very high density wood. It has good machining, routing, nailing and boring properties owing to its moderate hardness, cleavage and tensile strength values and can be used in furniture making. On the other hand, in terms of MoR, MoE and compression properties, the wood may not be suitable for construction purposes particularly as beam etc.

Table 1. Physico-Mechanical properties of some low value wood species grown in Khyber Pakhtunkhwa

S.No	Wood species	Modulus of rupture (kg/cm²)	Modulus of elasticity (kg/cm²)	Maximum compression parallel to grain (kg/cm²)	Maximum compression perpendicular to grain (kg/cm²)	Cleavage (kg/cm)	Tensile strength perpendicular to grain (kg/cm²)	Impact bending (m-kg/4 cm²)	Hardness (kg)		Density (Kg/m³)
									Side	End	
1	Ber (*Zizyphus mauritiana*)	1147	116634	412	107	33	30	-	530	633	839
2	Ghaz (*Tamarix aphylla*)	934	89137	328	70	28	32	-	471	663	712
3	Dhrek (*Melia azedarach*)	995	95088	360	76	33	34	3.87	630	720	771
4	Toot (*Morus alba*)	1400	117186	540	118	41	48	4	849	990	769
5	kangar (*Pistacia integerrima*)	1591	96168	425	112	30	45	5.30	626	736	867
6	Ipilpil (*Leucaena leucocephala*)	1608	146927	558	120	37	44	3.6	801	903	812
7	Siris (*Albizziasp*)	1372	82849	477	90	37.5	46	-	765	920	887
8	Anjir (*Ficus palmata*)	855	66458	281	95	33	28	2.5	580	790	721
9	Chinar (*Platanus orientalis*)	674	53036	439	-	34	41	3.2	634	689	640
10	Willow (*Salix tetrasperma*)	619	44891	227	55	24	24	1.15	342	410	504
11	Bhatker (*Celtis eriocarpa*)	1406	1,25460	428	99	46.5	48	2.75	-	-	827
12	Lachi (*Eucalyptus camaldulensis*	788	74168	356	111	27	26	0.2	583	636	857

CONCLUSIONS

Based on the results it can be concluded that:

- Ber, Toot, Ipil ipil, and Batkar woods can be used in construction works. Toot and Ipil Ipil can also be used as poles & posts and Batkar wood can also be used in medium compression works.

- Ghaz & Dhrek are of the same quality with utility in construction works of medium strength in addition to furniture and agricultural tools making etc.

- Anjir & chinar can also be used in making furniture articles and construction works of medium strength however these are of lower quality than the Ghaz and Dhrek woods.

- Willow can be used for furniture, carriages, toys etc. in addition to its traditional use i.e. cricket bat making. Kangar wood is good for carving, nailing, screwing, cutting etc. It can also be used in sports goods making.

- Lachi wood can also be used for furniture making however, it may not be suitable for construction purposes like beam etc.

REFERENCES

Bodig J. and B.A Jayne. (1982). Mechanics of Wood and Wood Composites. Van Nostrand Reinhold Company, New York 402pp.

Bukhari BSS, Haider A and Laeeq MT. 2012. Land cover atlas of Pakistan, Pakistan Forest Institute, Peshawar.

Desch, H.E and J.M. Dinwoodie (1996). Timber, Its Structure, Properties and Utilization Seventh Edition. Mac Millan press limited, London. 306pp.

Government of Pakistan. 1992. Forestry sector management plan, Ministry of Environment, Government of Pakistan.

Government of Pakistan. 1994. *Agricultural statistics of Pakistan 1993-94,* Government of Pakistan Islamabad.

Government of Pakistan. 2005a. *Compendium on environment statistics of Pakistan – 2004*, Federal Bureau of Statistics, Government of Pakistan, Statistics Division, Islamabad.

Government of Pakistan. 2005b. *Supply and demand of fuel wood and timber for household and industrial sectors and consumption pattern of wood and wood products in Pakistan*, Ministry of Environment, Government of Pakistan.

Zaman S B, Ahmad S. 2012. Wood supply and demand analysis in Pakistan – key issues, Managing Natural Resources for Sustaining Future Agriculture, Research Briefings Volume (4), No (22).

ISO 3129, 1975.Wood Sampling methods and general requirements for physical and mechanical tests.

NIPS. 2009. National Institute of Population Studies, Ministry of Population and Welfare, Pakistan.

Ofori, J., Mohammed, A. I., Brentuo, B., Mensah, M., and Boamah-Tawiah, R.(2009) Properties of 10 Ghanaian high density Lesser-Used Species of potential importance to bridge construction. Part 2: Mechanical strength properties. Ghana Journal of Forestry, 25:77-91.

Wilson and White D.J.B (1986). The Anatomy of Wood, its Density and Variability.Stobart and on Ltd. Worship Street, London EC2A 2EL.