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FUEL WOOD AS A SOLUTION TO THE ENERGY CRISIS

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ABSTRACT

Wood is the oldest source of useful chemicals, our first source of energy, and the earliest structural and building material. However, as natural forests are depleted in many parts of the world, fast growing trees are becoming more important as a source of fuel wood. A considerable quantity of wood could be easily made available for the production of energy for commercial and industrial purposes by developing forest plantations. A list comprising 25 tree species, which can serve the purpose, is provided here. The species reported here constitute a part of the exhaustive list of tree species that could be recommended as a source of wood for energy production.

KEY WORDS: fuel wood, energy, economic growth

The inevitable transition from traditional to new and renewable energy sources is now taking place in both the developed and developing countries. Solar energy is emerging as a good answer to the challenge. Heavy initial investments and the yet not perfect technology are the problems to be solved. Fuel wood, charcoal, and biomass are the traditional energy sources. Wind, hydro-power and direct solar energy, such as thermal, thermodynamic and photo-voltaic energy, are the renewable energy sources. All of these resources meet only about 15% of the world's current energy needs.

Draught animals, also a source of energy, are widely used worldwide on farms and as a means of transportation. Further research is needed so that this source can be used more efficiently, thereby reducing the current wastage of animal effort. This will increase the working life of the draught animals and may improve the agricultural production. It is important for the developing countries like Pakistan to conserve energy, as high-energy cost is entailed in mechanization. This does not mean that mechanization should be discouraged. If our traditional ways are made more efficient, this will not only conserve our limited energy resources, but also protect our

Table 1. List of tree species which can be used as renewable sources of energy.

Family	Tree species	Common name
Casuarinaceae		
	Casuarina cunninghamiana Miq.	River she-oak
	C. equisetifolia L.	Beaf wood tree
	C. glauca Sieb. *ex* Spreng.	Casuarina
	C. rigidula Miq.	Casuarina
	C. suberosa Otto & Dietr.	Casuarina
Leguminosae		
Mimosoideae	*Acacia modesta* Wall.	Phulai
	Acacia nilotica (L.) Willd. *ex* Del.	Keekar, Gum Arabic tree
	Albizia julibrissin Durazz.	Siris
	Albizia lebbeck (L.) Benth.	Siris
	Albizia procera (Roxb.) Benth.	Black siris
	Albizia saman (Jacq.) Merrill	Monkey pod, rain tree
	Prosopis cineraria (L.) Druce	Jand
	P. juliflora (Swartz) DC.	Mesquite
Papilionoideae	*Dalbergia lanceolaria* L.*f.*	Shisham
	D. latifolia Roxb.	Shisham
	D. sisso Roxb. *ex* DC.	Shisham
	Leucaena leucocephala (Lam.) de Wit	Ipil Ipil
	Robinia pseudoacacia L.	Ainul asal, Honey locust
	Sesbania grandiflora (L.) Pers.	West Indian pea tree
	S. sesban (L.) Merrill	Dhancha, Jantar
Myrtaceae		
	Corymbia citriodora (Hook.) K.D. Hill & L.A.S. Johnson	Lemon-scented gum
	Eucalyptus camaldulensis Delnh.	Red river gum tree
Rhamnaceae		
	Ziziphus jujuba Miller	Berry
Salicaceae		
	Populus × *canadensis* Moench	Poplar
	P. deltoides W. Bartram *ex* Marshall	Cottonwood

Species are arranged alphabetically within genera.

environment. There is a dire need to keep our traditional ways and develop modern technologies side by side as draught animals will still be in vogue in the decade to come.

Wood is the oldest source of useful chemicals, our first source of energy, and the earliest structural and building material (Mahmood & Athar 1997). It is useful to society in providing good quality timber and as a source of a wide variety of derivatives such as resins, gums and oils, and raw materials for the pulp and paper industry (Ilvessalo-Pfaffli 1995). However, as natural forests are depleted in many parts of the world, fast growing trees are becoming more important as sources of fuel wood, construction materials, and good quality timber. One solution to the problem of dwindling forest resources is to provide economic alternatives for those who depend upon the forest for their fuel wood or livelihood (Brown & Lugo 1994). A major alternative is that of creating new forests of fast growing tree species which can provide a range of vital commodities such as fuel, food, fodder, and fertilizer (Athar & Shabbir 1997; Giller & Wilson 1991; Quraishi *et al.* 1993). Increasing the supply of forest products from fast growing tree species will reduce the pressure on native forest resources and contribute to reversing the trend of deforestation. Forests can also be developed in combination with agricultural crops in agro-forestry systems by small scale planting of fuel wood or industrial wood product plantations (Mahmood 1993; Mahmood & Athar 1997; Newman 1997; Subba Rao & Rodriguez-Barrueco 1993). A list of 25 tree species, which can serve the purpose, is presented in Table 1. The nomenclature and taxonomy are after *Index Kewensis*. The list was also discussed with the taxonomists acknowledged in this report. Author citations are quoted following instructions of Brummitt & Powell (1992) as endorsed by the International Working Group on Taxonomy Database for Plant Science (TDWG).

Extensive research is required on fuel wood as a renewable source of energy. Wood production is not only a reliable source of energy; its production also has numerous intangible benefits to the environment. Design of better external combustion engines and turbines using wood as fuel today accounts for 47% of the world's wood consumption. In developing countries, it accounts for about 80% of total wood used as compared to about 10% in developed countries. More than 95% of the households in our rural areas use fuel wood as a primary source of energy, mostly for cooking and domestic heating, and a small proportion for processing agricultural products. The socio-economic condition of rural populations in the developing countries can be improved by streamlining this renewable energy source.

A considerable quantity of wood could be easily made available for the production of energy for commercial and industrial purposes by developing forest plantations. A plantation of fast growing species in plains initially established to meet the domestic fuel requirement could be subsequently converted into an energy plantation for the production of electricity or for the manufacture of liquid or gaseous fuel. A hectare of *Eucalyptus camadulensis* Delnh. can produce up to 21 cubic meters of wood per annum under irrigated conditions in the plains, which is equivalent to 12.1 tons of oven dried wood. A plantation of 10,000 hectares of this species can produce enough wood to feed an electricity generating plant of about 16 megawatts. Such a plantation can also produce about 20,000 tons of ethanol per annum through the process of hydrolysis. Brazil has the largest liquid biofuel production program for motor vehicles in the world (Boddey 1995). The program is based on the production of ethanol (11

to 13 billion L/year) by fermentation and distillation of sugar cane juice, which is used in its hydrated form (93 to 95% ethanol, 5 to 7% water) to fuel 4 million cars, vans, and small trucks. All other light vehicles are fueled with a gasoline and ethanol mix (gasohol), which has a content of anhydrous ethanol that varies from 10 to 22% (Boddey 1995).

Pakistan has a very small wood based industry. Each year, millions of dollars of foreign exchange are spent on importing wood and wood based products. Wood based industries can be encouraged by increasing the supply of locally produced wood. Development of fast growing forest plantations therefore, can result in industrial development in the country without burdening the national energy supply, which is already in severe crisis.

The species reported here constitute a part of the exhaustive list of tree species that could be recommended as a source of wood for energy production. Further research is required for the identification of suitable species for various agro-climatic zones of Pakistan. Because Pakistan lies primarily within arid and semiarid climatic zones (Quraishi *et al.* 1993), research should also be focused in finding better water conservation techniques (Suleman *et al.* 1995). Identification and plantation of drought tolerant and fast growing tree species may be one economically feasible way to increase wood production in water limited environments. The economics of electricity production from wood should be worked out before implementing any project. The study should include the cost analysis of wood production and per unit cost of electrical energy produced.

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