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Borassus flabellifer L. A tree behind the forest with multiple uses in rural areas: A case study from Nellore district, Andhra Pradesh, India.

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Abstract: *The multipurpose Palmyra (Borassus flabellifer* L.*) tree is an important natural resource in rural India. These trees grow behind the forest area, generally seen along with agricultural boundaries edges, waste land, secondary forest places and costal line. The tree is an important ecological resource to local people for various purposes along with being of rich social value and great economical importance in rural India. Palmyra is a unique example of one tree richly associated with human needs in agro biodiversity or agro ecosystem since eons. The present study has been under taken in south costal district (Nellore) of Andhra Pradesh. The paper discusses the species richness, socio-ecological importance, various uses, threats and conservation methods.*

Keywords*: Palmyra Tree, Socio-Ecological-Economic Importance, rural area, Conservation.*

1. TAXONOMICAL CHARACTERS

Palmyra trees are tall with a cylindrical stem that has scars due to fallen leaves. The trees are 15 to 20 meter tall and the base of the trunk has a circumference of around 1.5 to 3 meters. It leaves are fan shaped, plicate, margins, and split in to lanceolate segments having a length of 1 to 2 meter and width of 1 to 1.5 meter,. Inflorescence (male and female flowers) appears in two different plants, spadices up to 1 meter length. The flowers are small, pale yellow in colour and bloom in clusters. Fruits are drupes, subglobose, 15-30 cm across, and black when ripe (18).

2. INTRODUCTION

Cultivation of tree species on agricultural boundaries in association with field crops is an age old practiced system in Indian agriculture system (1). The types of trees grown on agricultural boundaries are dependent on the climatic conditions of the region and the agro climatic zone it falls under. Palmyra (*Borassus flabellifer*) is one of the trees which are found in large numbers in the boundaries of agricultural fields and has been associated with farmers and local people since olden days. This palm tree is not limited in its presence in India only, instead spans widely, extending its range from West Africa and Madagascar to eastern Indonesis and Papu Guinea (12). In India the species are distributed in all agroecological regions but mainly present in the states of Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, Maharashtra, Madhya Pradesh and Chhattisgarh. Jambulingam and Fernandes (6) estimated that about 40 million trees of *Borassus flabellifer* grow only in the plains of Tamil Nadu area. The species grow naturally in most places and are also cultivated in other regions (12). The tree is commonly distributed in the coastal belt, agricultural margins, waste lands and secondary forests. In addition, farmers traditionally grow Palmyra on their farm land boundaries and have been doing so since eons. Palmyra tree is a versatile tree because of its immense benefits to mankind in a manner that no part of the tree can be considered as a waste (12). bringing it on the same lines of coconut or Kalpavriksh as it is commonly known in India. The tree is highly associated with human needs since ancient times having great importance not only socio-ecological but also economically. Due to the large multipurpose use of this tree, Tamil Nadu government has declared it as a "State tree" (15). and 801 uses of the tree has been acclaimed in a Tamil poem (9). The tree is a large tree running up to 15 to 20 meter tall, and having a circumference of around 1.5 to 2 meters at the base. Leaves are large up to 2 meter long with long and strong stalk of up to 2 meter wide. Leaves are fan shaped, leathery, green, and thick. They are smooth on the upper surface and rough in the lower surface. Leaves are folded with thick mid rib, spring at the top in a clump.

3. STUDY AREA AND GEOGRAPHICAL LOCATION

For the present study, we selected the Nellore district of Andhra Pradesh as our study region. The district is bounded in the east by Bay of Bengal, in the north by Prakasam district, in the south by

Chittoor district and Chengalpattu district of Tamil Nadu State and on the west by Kadapa district of Andhra Pradesh (Figure 1). The district spreads over an area of 13076 sq.km with a coastal belt of 169 Kms, covering 12 taluks. The district coordinates are latitude 14.43^{o} N, longitude 79.97^{o} E and at an elevation of 59 ft.

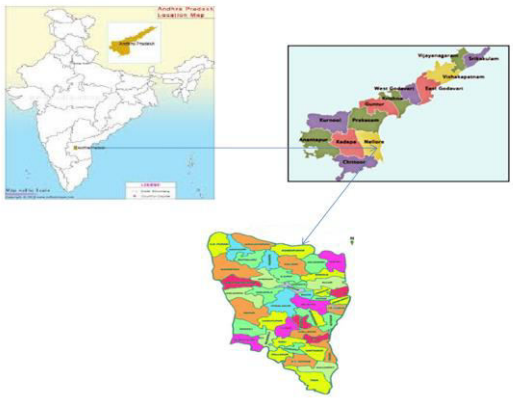

Figure 1: Geographical location of the study area

4. CLIMATIC FEATURES

The study area is situated in southern Deccan plateau region and falls under semi arid region of southern India. Climatically the study area is very hot with moderate rain fall and high temperature during summer periods. The average rain fall recorded in the district is 1018 mm in both seasons (4).

5. METHODOLOGY

Extensive field survey was carried out during the study period. The study was conducted during the months of January 2014 to December 2016 in different seasons. Both primary and secondary data were collected from the study region. Primary data was collected by visiting the field sites while secondary data was collected from the local people by interviewing them through questionnaire. The data sheet included many details like species name, locality, person name, age groups and uses in different period of time. The data was collected in randomly selected villages and data was collected for the past four decades by interviewing the local people.

6. RESULT AND DISCUSSION

The study shows that the species have in the past been of great importance in rural India to human needs and continue to be of equal importance from ancient time till today. Each part of the tree is of great importance economically. The species density and abundance was recorded high in the study region. The different parts of the plant are highly useful for both local and commercial purpose. Its major uses are timber, thatching material, fiber, drinks, fire wood and medicine (10).

7. ECOLOGICAL, SOCIAL AND ECONOMIC IMPORTANCE

Palmyra is one of the trees highly associated with the Indian agro-forestry system. The trees provide many ecological benefits to the farmers; it includes use of plant parts for many purposes such as timber, fuel wood, beverages and as a delicacy. Agro-forestry species play an important role in controlling natural disasters, soil erosion, soil fertility maintenance, water conservation, landscaping, ecosystem services, carbon sequestration and biodiversity conservation (3 and 1), agrobiodiversity system contributes to biodiversity promotion and conservation (19). All this highlight that though there are many economic benefits of the tree, it is not limited to these and the species is of great ecological importance too.

7.1. Leaves

Palmyara tree have 20-25 large fresh looking leaves, gray green in color, that are fan shaped with a length of 1-2 meter and folded along the midrib. The leaf is divided into 30-40 linear-lanceolate and ends with marginal spiny segments. Leaves have strong, woody stalk up to 2 meter long, margins with hard spines, smooth on upper surface and rough in lower area (11).

The leaves obtained from trees have myriad uses; including social uses like used for thatching for kutcha houses, fencing, and also to create livelihood options for local people by making mats, baskets, hand held fans, hats, rain coats. In addition the local people also use the leaves to make playing kits for children play. Palmyra leaves have great ecological, economical, spiritual and cultural importance since olden days; the most significant of which is that these leaves were used for writing manuscripts. Many manuscripts in Hindu culture were written using this leaves (8). Used leaves of thatching and fencing are used as organic manure in their farm lands (20). Leaf stalks are used as fuel wood and in many villages this is one of the major fuel wood sources. The fleshy shoot apex of the tree is edible and is consumed frequently by local people growing the tree.

By selling the leaves local people earn their income; as discussed previous section the leaves are used to

thatching for kutcha houses in rural areas and peri-urbans. The analysis has carried form past three decades by interviewing the local people and based on observation present scenario. Figure.. is showing the input and output cost analysis by selling leaves. Total 200 families were interviewed during the study period; input and output were estimated the based on expenditure, time and energy and net profit to the local people. Figure 2 shows that the income on palm leaves is gradually increased past three decades.

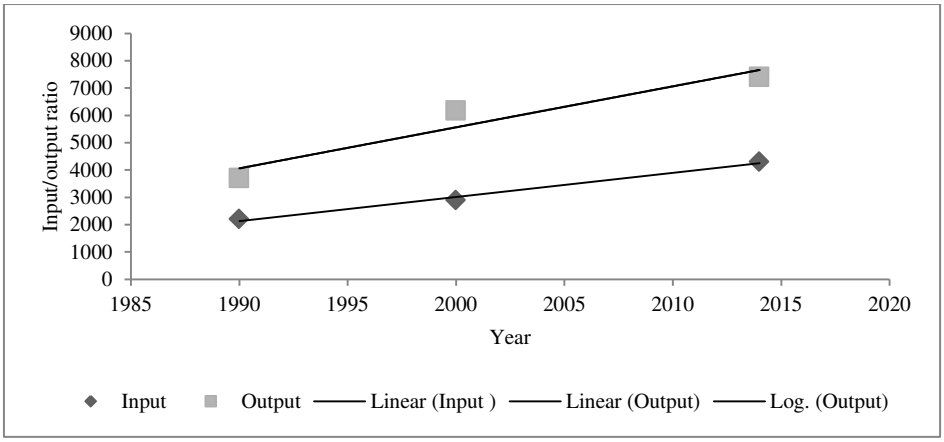

Figure 2: Input/output ratio of Leaves

7.2. Trunk

The trunk is tall going upto a height of 30 meter. It is strong, cylindrical and black in color, with a circumference of approximately 1.5 to 2.5 meter at the base and approximately 1 meter at middle and tail parts. The hard outer wood of the trunk is used as pillars, furniture and supporting tool for kutcha houses. The trunk is also used as pipes to supply water in agricultural land and streams. The wood is used to make walking sticks and windows grills. Dried and holed trunk is used for make boats in coastal region (13). In a nutshell, the trunk is used appropriately depending on the size, texture and condition of the trunk and in no condition does it go completely waste. The tree wood will be stronger an old age trees. The old age trees are good income for the local people; the single tree cost around 700 rupees. Figure 3 shows that input/output cost of timber products; to estimate the cost benefits from past three decades the average tree numbers were selected as 10 individuals.

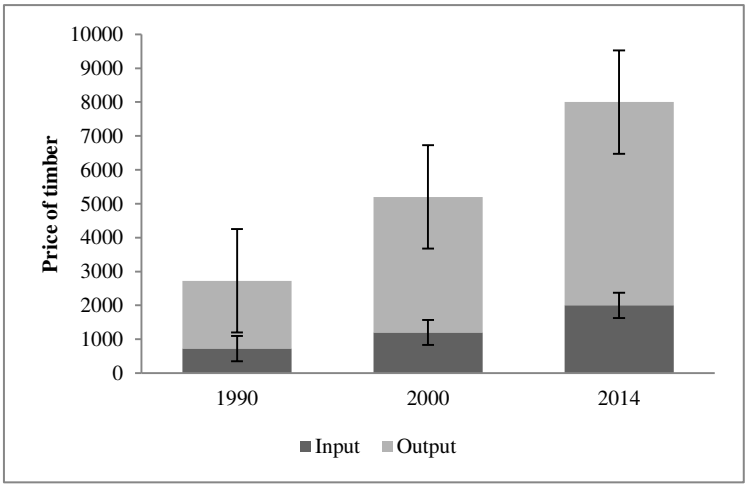

Figure 3: Input/output ratio of Trunk

7.3. Fruits

Palmyra fruits are edible in all the stages (5). The male and female flowers are always produced in two different plants. The flowers are small, and pale yellow growing in clusters with a white string like inflorescences. Fruits are subglobose, and again in clusters. Usually a single tree will produce anywhere between 50 to 300 fruits. The size of the fruits range from 4-8 inches

diameter, and are black, greenish white and black when ripe. The upper part of the fruit must be cut off to reveal the sweet jelly seed sockets to eat; there are one to a maximum of five jelly sockets in a single fruit although it is most commonly found to have three sockets. The kernel which is soft as jelly and translucent like ice is accompanied with sweetish water. This liquid has medicinal properties and is used by the local people to treat skin diseases. The ripened fruit of outer layer also can be eaten raw or boiled. The fresh fruits are used as wheels for playing by children.

Fruits are the second highest income material in the tree during peak season. The study has conducted for the three decades to understand the socio-economic importance of the Palmyra tree. As compare to past two decades (1990, 2000) consumption of palmyra fruits is become high in present period. Figure 4 shows that in present days the output cost is high as compare to past two decades.

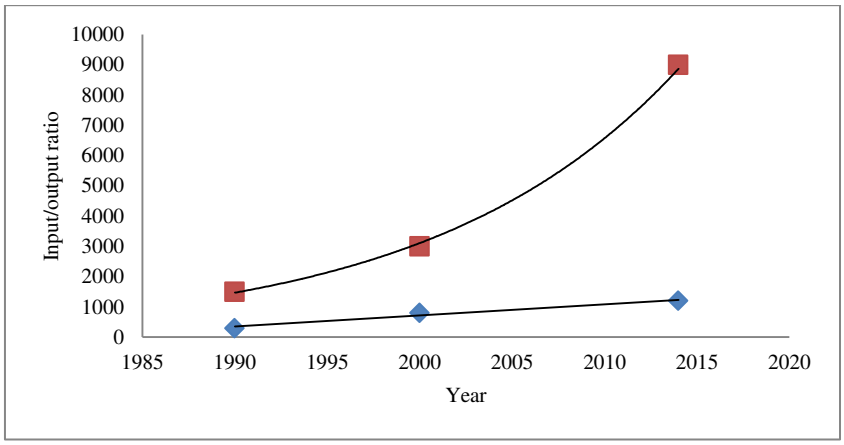

Figure 4: Input/output ratio of Fruits

7.4. Palmyra sprouts

Palmyra sprouts are edible, prepared during winter season (7). The seeds grow both naturally and planted by local people for commercial sale. Its taste is sweeter and is locally called as "Tyagalu". Selling sprouts is a good commercial business for local people during peak season (Figure 5). The dried fruits are used as fuel source locally.

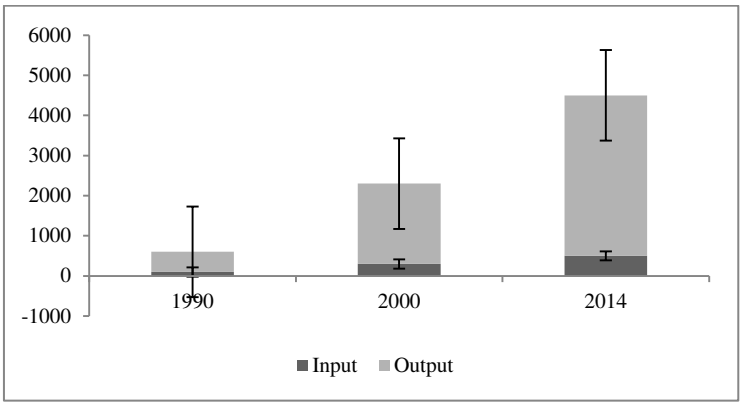

Figure 5: Input/Output ratio of sprouts

7.5. Beverages (Toddy)

The chief product of the Palmyra is the sweet sap (toddy) or palm wine, locally called as "Tati Kallu" or "Nera" obtained mainly from the female plants though these are at times also obtained from their male counterparts by tapping the tip of the inflorescences. However, female plants give a more toddy yield when compared to the male plants (10). The drink is locally very popular as a beverage; the drink is chiefly available and commercialized. The drink has high nutrient value and is good for health. The fresh drink has no side effects and is a popular drink in the region (16). The drink is especially helpful to reduce the body heat or high temperature, and it is because of

this prime reason that the beverage is of high value (22). Jaggery is another important food item prepared by toddy; Jaggery prepared from toddy is locally called as "Tati bellam" (Jaggery). The highest profit material in the Palmyra tree is Toddy; however due to limited access for tapping, all the people are not getting equable shares and benefits. Since, Toddy has considered as local liquor the actual profit details were not shred from the study region. However, the secondary data source showed as below (Figure 6).

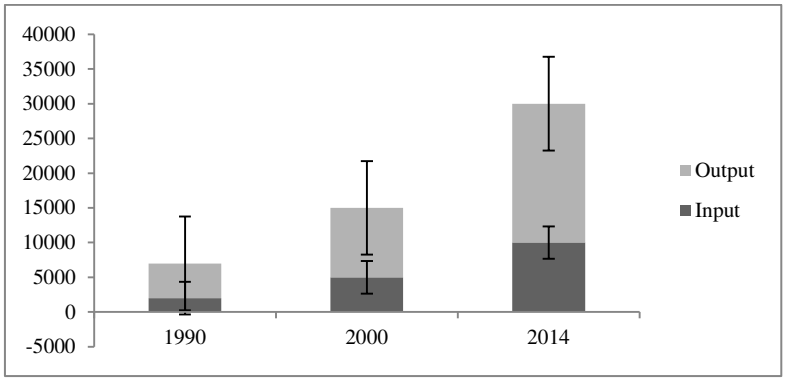

Figure 6: Input/Output ratio of Toddy

7.6. Fuel wood

All parts of the Palmyra tree is used for fuel sources, cooking and other purposes. Leaves, stalk, trunk and dried fruits are mainly used as fuel source. In the study area, parts of Palmyra are the major source of fuel wood in some of the villages (3).

7.7. Fibers

Villagers take out the fibers from the fresh leaf stalk which is used to make rope, and threads. The fiber separate from the leaf stalk by hand beating or crushing then removing pith by hands or used tools (21). Leaf stalks are also used as painting brush and brooms.

7.8. Medicinal properties

There have been several scientific studies which reveal the medicinal uses of the Palmyra trees. To give few examples on scientific studies highlighting the medicinal properties of Palmyra trees, recently Sudhakar et al (17) extracted anti oxidant of methanolic from female Palmyra tree in Andhra Pradesh. In Sandhya et al (14) reported in their study that fresh pulp and fresh sap of Palmyra trees from their study region of Andhra Pradesh are rich in vitamins A, C and vitamin B-complex,. (2) discoverent the diuretic activity of the ethanolic and aqueous extract of Palmyra seedlings in Tamil Nadu. Jaggery from the toddy of Palmyra trees are used to treat digestive problems, bone fracture. In addition it is also used to prepare local medicine for pregnant women and payasam or sweet porridge, a popular sweet delicacy of Southern India.

Figure 7 shows the different parts of Palmyra tree preferred for usage in the study region based on interviews conducted with the local people of the study region. The results have been listed based on a total one hundred (100) families that were interviewed during the study period. Based on the responses of local people, it was found that maximum numbers of families are using partially some part from the tree, but in the figure we have considered maximum usage families of the particular part from the tree. Leaves are the maximum used material for different purpose like thatching, mats, rain coats, hand fans etc. This was followed by fruits which are used extensively mainly because they are edible and the beverages are used as a popular drink by the local community without around 70 families using the fruits either for eating directly or an a beverage. fourty five families sell the sprouts while thirty five families extract the fibers. Forty two families used the different parts of the tree for fuel wood and twenty five families were recorded who used dried leaves for painting and used the different parts of the tree for medicinal purposes.

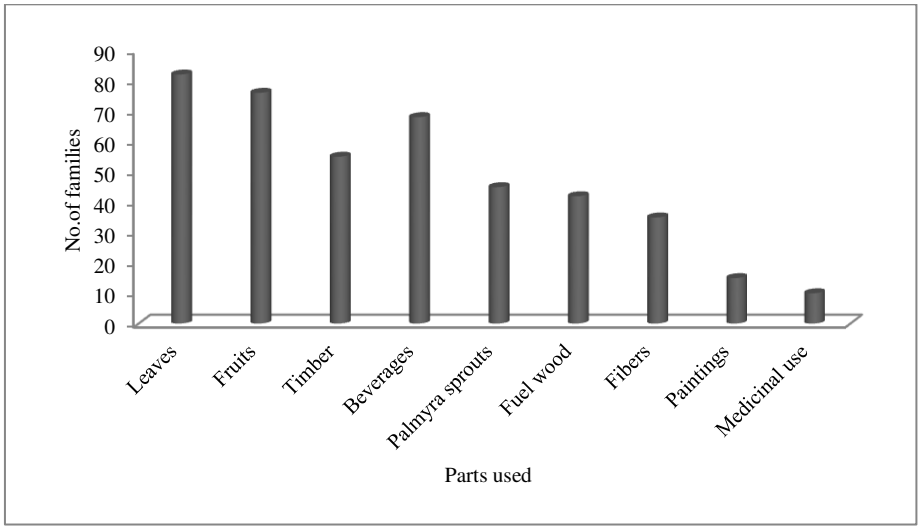

Figure 7: Palmyra uses in rural areas

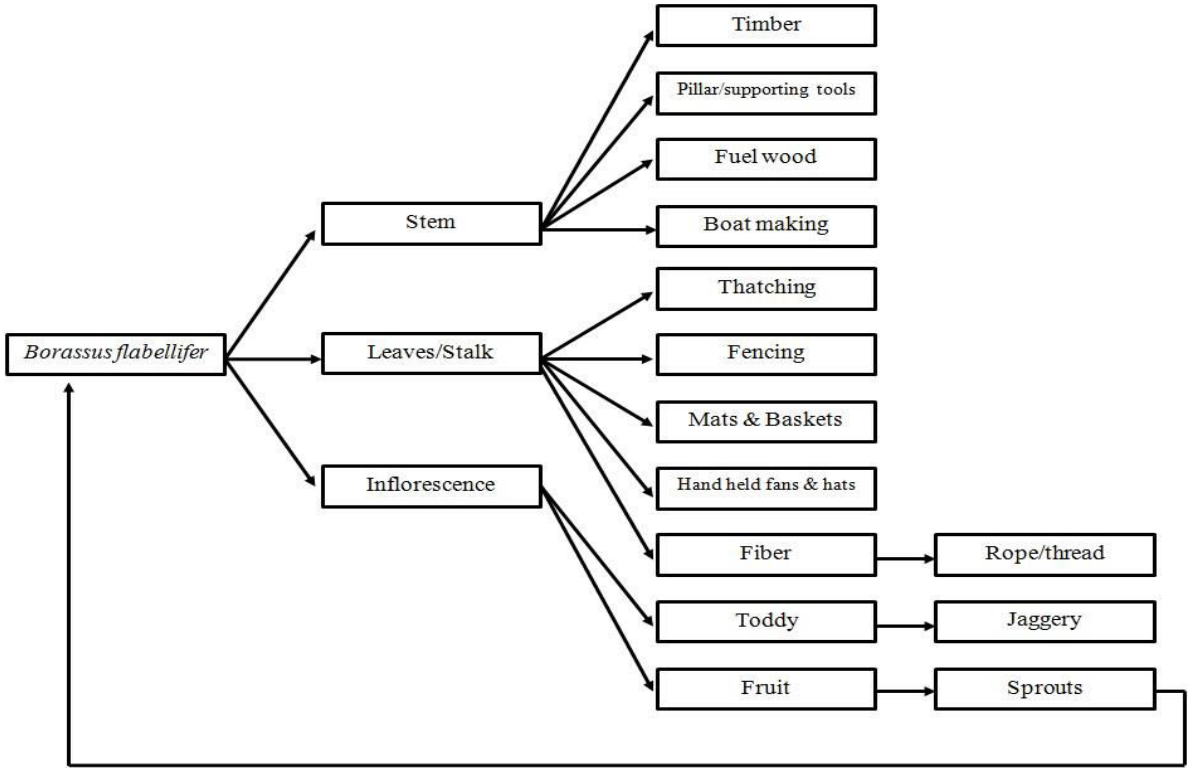

Figure 8: Flow chart of Palmyra tree species

8. THREATS AND CONSERVATION

When compared to the past five decades the species richness is highly reduced currently in the study region. The data was collected from the villagers by questioning and live experiments. The major reason for the decline of the tree species in the study region was attributed to many farmers cutting the trees in their farm lands to expand their agricultural areas. Habitat loss is another reason for the reduction in number. More and more waste lands are getting converted to agricultural land and other developmental activities. This modernization and change in land use pattern is having a drastic impact on the density of trees in the study region due to reduction in the dependency of local people on Palmyra trees. There are a few families who are mainly dependent on this plant species for their livelihood. These are mainly toddy sellers. Apart from them, many other families are dependent on

these tree species for their extra income through selling fruits during summer and selling sprouts during winter. This emphasizes the need to take stringent steps to conserve Palmyra species for feature generation not only for its myriad uses through its different parts but also to conserve the animal diversity which is highly dependable on these plants.

9. CONCLUSION

Palmyra tree is highly beneficial to rural Indian people; especially poor people are highly depending on it for their resources. It has a strong history of the usage of different parts of the tree which has not perished or changed with time. All the plant parts are dominantly used for many purposes such as timber, fuel wood, beverages, roofs, edible, building materials, handcrafts and medicine. The trees are economically and ecologically beneficial to the local people and commercialized in many parts of the country to ensure the sustenance of the trees. Conserving and promoting this tree species is essential as it is an alternate livelihood for most local people where they are grown. This will ensure economic stability of the local people while simultaneously reaping the ecological benefits of the tree species making it an important aspect in ensuring sustainable development of the local people in the region. The tree's immense medicinal value adds significance to its need for conservation. Considering these aspects of the tree's usefulness, the author suggests that the Palmyra tree can be called as "Poor man's tree" in rural India.

Image of *Borassus flabellifer:*

Borassus flabellifer is on Agricultural boundaries and fields

Palmyra on River edges

Palmyra along with road side

Palmyra fruit

	
Palmyra sprouts	Holy manuscripts on Palmyra leaves

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