A Traditional Irrigation System Using Palmyra Palm (*Borassus flabellifer*) in Kerala, India

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1. A landscape of a typical village in Palghat showing palmyra palms and rice fields.

The multipurpose palmyra palm, *Borassus flabellifer* L., is still very important in village culture in India. This paper describes a hitherto undocumented traditional water engineering system prevalent in the Palakkad District of Kerala, India, involving the palmyra palm.

The genus *Borassus* is one of the most widely distributed palm genera, extending its range in a broad belt from western Africa and Madagascar to eastern Indonesia and Papua New Guinea (Davis & Johnson 1987). Species of the genus are commonly cultivated in India, Southeast Asia and occasionally elsewhere in other warm regions of the world, as an ornamental (Morton 1988).

Borassus flabellifer L., the palmyra palm, is a versatile tree of immense use to mankind of which no part is wasted. In this respect, *B. flabellifer* can be equated with the coconut tree (*Cocos nucifera* L.), the well-known *'Kalpavriksh.'* The palmyra palm is found along the coastal belts of India, N. Sri Lanka, the mainland of SE Asia (Davis & Johnson 1987), and eastern Indonesia and is most abundant in sandy drier plains, open savannahs and secondary forests. It avoids the perhumid areas of southeast Asia and West Malesia. The species exists both in the wild as well as in cultivation, ranging from sea level up to 760 m (Fischer 1931). In India, the cultivated populations are widespread in Kerala, Tamilnadu, Karnataka, Andhra Pradesh, Maharashtra, Orissa, Madhya Pradesh, Bihar and West Bengal (Fig. 1). Isolated patches are also seen in Assam, Gujarat and Uttar Pradesh (Anonymous 1948).

The palmyra palm is a solitary dioecious palm reaching a height of 25–30 m and with an average stem diameter of 50–60 cm. The young trunk covered with clasping leaf bases transforms to a smooth bole with narrow leaf scars in age and is black in color. The large fan leaves clustered at the tip of the trunk make a loose crown, and the leaf bases clasp the stem firmly. Inflorescences are interfoliar; the male inflorescence has stout terete branches, while the female inflorescence is more sparingly branched. Fruits are semiglobose to globose and deep brown to black when ripe.

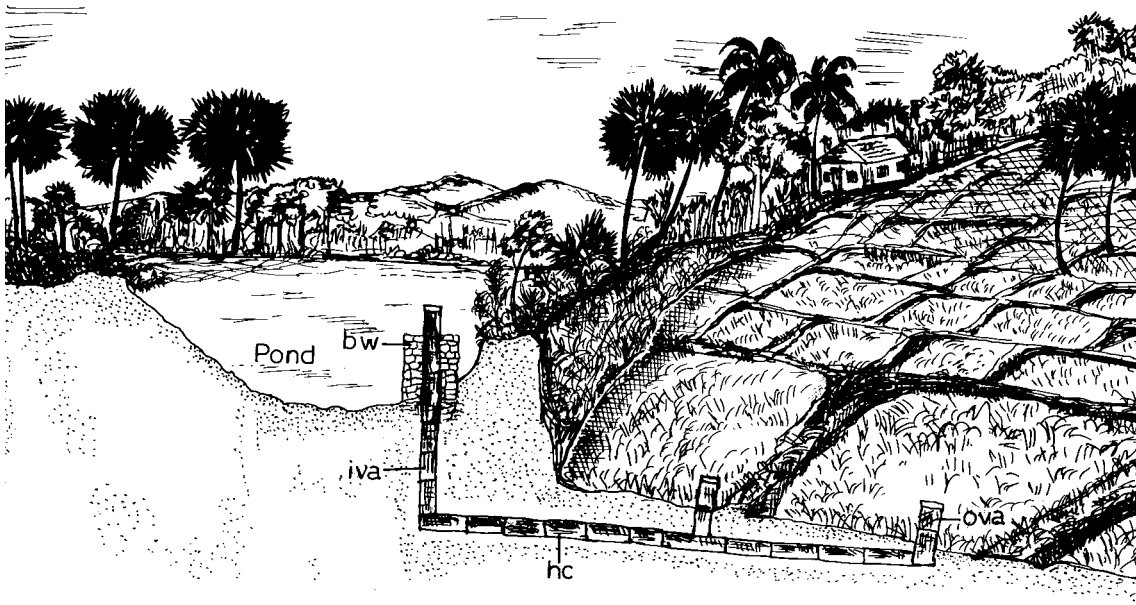
Palmyra palm and human life

The palmyra palm has been an inseparable part of human culture and tradition from very ancient times; each part of the tree is economically important. The palm yields timber, thatching material, fiber of various kinds, drinks, starch, sugar, famine food, firewood and many folk medicines.

The hard outer wood of the trunk is used for constructing the framework of roofs, house-hold posts and pillars, furniture and other utensils such as gutters and spouts (Morton 1988), rulers, walking sticks, etc.; the wood is also popularly used for furniture, windows grills and staircases.

The leaves yield excellent thatching material and are used for making mats, baskets, hand-held fans and other handicrafts; un-opened leaves are used as 'costumes' for decoration in festivals and formed the writing material for manuscripts in the pre-paper era. The petiole is a source of fiber and is

2. The village pond in which the traditional irrigation system is built.



3. Diagram of the traditional irrigation system using the palmyra palm. Key: bw- brick work; hc- horizontal conduit; iva- inner vertical arm; ova- outer vertical arm.

used as rope; fiber obtained from the clasping leaf bases is made into brushes and brooms.

Tapping the inflorescence yields *neera* – a valuable drink. Consumed in limited quantities *neera* is medicinal. Fermented *neera* yields toddy and on distillation yields arrack; on boiling *neera* crystallizes into palm sugar – the jaggery, candy or palm sugar toffee (Kamble 2003). On granulation it yields sugar resembling cane sugar. Jaggery is a coolant and the candy relieves coughs. The tender growing point of the tree (the palm heart or palm cabbage) is deliciously sweet and edible (Davis & Johnson 1987), and the sweet, gelatinous endosperm filling the tender fruit is a delicious healthy drink. The soft orange-yellow mesocarp pulp of the ripe fruit is sugary, dense and edible, and the enlarged embryo emerging from the germinating seed is highly nutritious and a famine food (pers. obs.). Germinating young shoots (unopened and solid) are boiled, salted and eaten. All parts of the palm are found used in folk medicine.

Parts of the tree such as immature wood, leaves, petiole, inflorescence and the soft central part of the stem are a good source of fuel, when dry; the immature wood is especially used as fuel in brick kilns.

The mature trunk of the palmyra palm is very durable and valuable. In addition to the conventional uses of the palm trunk mentioned above, Fischer (1931) mentioned that the stem is used as water pipes and troughs, though no documented report of its utility in irrigation or other water transport systems is available. Very recently we have come across a hitherto undocumented use of the palm in a traditional water engineering system, in a village called Vilayannur in the Palakkad District of Kerala, India, and we document it here, lest it should be lost.

The palmyra palm and the traditional irrigation system

In Kerala, among the many different crops cultivated, rice (paddy) is the most important, in respect of both area cultivated and the amount of associated employment. Palakkad district and Kuttanad of Alapuzha district are "the rice bowls of Kerala;" for a very long time rice has been the traditional crop cultivated in these areas, and together, the two districts contributed a lion's share of Kerala's annual rice production. Even in the current scenario of drastic reduction in the extent of rice cultivation in the State, in Palakkad rice cultivation is still a major source of livelihood and income for the rural population.

Rice is a water intensive crop that requires water for 90–100 days, depending upon the variety cultivated. Before the advent of modern irrigation

4. Pipelets made out of the trunk of the palmyra palm.

5. Two pipelets showing joinery.

systems and dams catering to the water requirements of the agriculture sector, farmers were solely dependant on monsoon showers, small diversions from river systems or small water bodies such as ponds or tanks. From ponds and lakes, water was lifted either manually or using cattle driven devices. Tapping the water bodies by breaking the bund a little on one side was the usual practice, but this method always had inherent problems, as the outlet frequently went out of control. Also, it is quite inconvenient to break the bund every time for tapping the water in installments and to close the same again, in order to allow the pond to fill up during the rainy season. The irrigation system using the palmyra palm emerged as an alternative that overcame the above difficulties.

The water engineering system consists of a pond (a miniature reservoir that collects water during the rainy season [Fig. 2]), the agricultural fields adjoining the pond and the pipe system carrying water from the pond to the fields (Fig. 3), as and when required. The pond has an area about 0.5 ha. The depth of the pond varies at the edges and the

center; it is shallow on one side (1.5 m), deeper on other sides (2.5–3 m) and deepest at the center (ca. 4 m). A 3–4 m deep well occupies the center of the pond. Two settlements and a farmhouse compound constitute the watershed of the pond. The monsoon fills the pond to the brim, and the water collected during the southwest monsoon (October–November, the second half of the rainy season) is used for irrigating the second crop of rice, the coconuts in homesteads, banana plantations and vegetable gardens between January and June, and for initial land preparation and sowing activities for rice cultivation until the arrival of the southwest monsoon. By the time the southwest monsoon arrives the water level in the pond will be very low. However, due to the vagaries of the monsoon and the consequent low rainfall, during the past 5–8 years, the pond has been filled with water from dams.

It is said that in the past when other farmers were cultivating only a single crop of rice each year, this farmhouse with its traditional irrigation system using palmyra trees, could harvest two or three crops a year using water from the pond. The topography of the area is such that the farmhouse gradually slopes towards the pond and subsequently to the rice fields. This relief feature is cardinal to the irrigation system and the bund of the pond at the sloping edge is kept 2 or 3 m thick, so as to withstand the pressure of the water.

The pipe system (Fig. 3) is an articulation of several pipelets (hollow cylinders 50–60 cm long [Figs. 4 & 5]), made from the stem of palmyra palm and consists of three units. 1. A horizontal conduit, 20–30 m in length and laid underground, one end of which is placed beneath the pond bottom and the other end outside the pond. 2. An inner vertical arm, connected to the blind end of the horizontal conduit below the level of the pond bottom and opening in to the pond. 3. An outer vertical arm, connected to the horizontal conduit at its extremity and opening into the rice fields. Sometimes an additional outer vertical arm may also be attached somewhere in the middle of the horizontal conduit.

The inner vertical arm opening into the pond is taller than the outer vertical arm(s) and consists of a few pipelets placed one above the other, of which four are removable. The inner vertical arm is situated in a pit in the pond, three sides of which are fortified with kiln bricks; this prevents sliding of the mud wall, while the fourth side remains open so that water intake to the pit is not hindered. Water drains from the pond to the inner vertical arm, passes through the horizontal conduit and comes out through the outlet(s), the outer vertical arm(s), situated in the rice field. The outer vertical arm(s) (Fig. 3) is made of two or three pipelets fixed one over the other with

6. View showing the outer vertical arm and its lid; note water coming through the outlet.

cementing material. Both the inner and outer vertical arms are closed with a lid (Fig. 6), usually made of granite, placed over them. The lid of the inner vertical arm acts as a valve whereas that of the outer vertical arm(s) prevents siltation into the pipe system while not in use. The horizontal conduit consists of many pipelets joined in a straight line using some crude cementing material made of lime, sand and gravel. In the Malayalam vernacular, the pipelets are known '*panayural*' (*pana* = palmyra palm, *ural* = mortar) and the lid, '*moodikallu*' (*moodi* = lid, *kallu* = stone).

Preparation of pipelets

A palm about 80–100 years old can yield a 25–30 m tall trunk. The basal 3–4 m portion of the trunk is the most mature and the strongest. Traditional carpenters believe that the amount of mature wood and its strength vary with the environment in which the palm grows, rather than its age. They infer the maturity of the palm from the resonance produced on striking the trunk of the standing tree near its crown with a wooden hammer. Unlike other trees, felling a palm tree requires special skills; the trunk has to be cut in to 3–4 m long billets and the billets brought down with the help of ropes, lest they split and become spoiled.

The outer and inner cores of the trunk differ in properties. The outer core of the stem being composed of closely packed interlacing vascular bundles is very hard. On the other hand, the inner core of the wood is a soft pith having only scattered vascular bundles and is hence susceptible to quick disintegration, especially when in contact with water. This structural difference is utilized in converting the billets to hollow pipelets. The billets are cut into pieces of required length and immersed in a marsh or swamp for three to four months so that hollowing the trunk is made easy. With a small crowbar or iron rod, the inner core is removed, and the pipelets are made. A crude finish is give to the inner surface of the pipelet by using a chisel; grooves are also provided at the ends for joining. The finished pipelet is 50–60 cm long and the inner diameter ranges between 15–20 cm with a wall thickness of 4–6 cm. Examination of old pipelets shows that their strength seems not to be compromised by age or attack by insects and other pests.

How the system works

When the system is not in use, the vertical arms (both inner and outer) are closed with the lids and any gaps with the lid(s) sealed with the help of hay or grass. The pipelets of the inner vertical arm are movable so that water can be drained from the pond in a controlled manner, stage by stage, as with a tap. When the lid over the inner vertical arm is removed, the amount of water available in the pond above the mouth of this pipelet can be drained for irrigation. When the water level of the pond reaches the level of the uppermost pipelet in the inner vertical arm, the intake of water through the system stops. If more water is required, the uppermost pipelet is removed so that water for a level further is released from the pond. In this way the pond can be emptied completely, to its bottom, stage by stage. Such a system suffices to cater to the requirements of a rice field of about 5–6 ha. for two crops a year.

Conclusion

With changing lifestyles, a major share of the vast lore of indigenous and traditional knowledge that paved the way for the development of modern science and technology has disappeared. Synthetic and health hazardous materials have found their place in our every day life in wanted and unwanted situations. There is great scope for the judicious use of much traditional and ethnic knowledge in place of unwanted synthetic materials in a variety of situations. However, traditional knowledge also vanishes at an irrecoverable pace, with the assimilation of many ethnic groups into modern society. A conscious effort needs to be made to document, assemble and explore the potentials of traditional ethnic knowledge.

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Photo Feature
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This image of *Maurtitia flexuosa* was taken by photographer Michele Falzone at Lake Sandoval, in the Tambopata National Reserve, Peru. More of Mr. Falzone's travel and nature photography can be seen on his website, www.michelefalzone.net.