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Mutualism between Humans and Palms: The Curious Case of the Palmyra Palm (*Borassus flabellifer* L.), and its Tapper

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Abstract:

Borassus flabellifer L., is a semi-domesticated palm of cultural and economic importance to local communities from the Persian Gulf to the Cambodian- Vietnamese border. Drawing from a qualitative study conducted in Southern India, we bring out its biocultural significance to the local people, and the mutualistic relationship between the palm and its tappers. Various parts of the palm are used as medicine and food by the local communities; it is celebrated in folklores, and even equated with gods. The tappers who add value to the palm by ensuring its produce is available to the local inhabitants, also take care of the semi-domesticated palm in its habitat. Energy is transferred from one partner (palmyra palm) to another (toddy tapper), and in return, the palm receives protection, seed dispersal and suitable habitat conditions to flourish. The claims of the tappers indicate that the relationship between the tappers and the palm is mutually beneficial.

Keywords: Biocultural Diversity; Toddy Palm; Human Ecology; Cultural Keystone Species; Conservation

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INTRODUCTION

Borassus flabellifer L., commonly known as toddy palm, palmyra palm or sugar palm, is a sub-tropical palm growing in the sandy and alluvial coastline from the Persian Gulf to the Cambodian- Vietnamese border, in close association with human beings (Bayton, 2007; Morton, 1988). Although it is primarily a crop cultivated for its timber, fruits and sap from the inflorescence stalk, it is also a plant of immense medicinal and cultural values (Davis & Johnson, 1987). Local communities throughout the home range of the palm make use of almost every part of the palm (Johnson, 1992; Lim, 2012), and its high utility value is one of the main reasons for the high cultural value accorded to it. Owing to its immense cultural importance, the palm has been conferred the status of the national tree of Cambodia, as well as the state tree of Tamil Nadu, India. There has been ample studies portraying the economic importance of the palm to the local communities. However, very little information is available on the relationship between palmyra and the tappers. Hence, we conceived this study with the twin objectives of documenting the cultural importance of the species, as well as the traditional knowledge (TK) of its ecology and usage. While recording the TK related to its ecology, we discovered that our participants see the relationship between the palm and the tappers as a mutualistic one. Hence, the focus was shifted towards understanding the mutualistic relationship claimed by the participants of the study.

We begin this article by discussing the cultural importance of palmyra palm for the people of southern Tamil Nadu, by adapting the Cultural Keystone Species (CKS) framework of Garibaldi and Turner (2004). Following that, we examine the mutualistic relationship between the palmyra palm and its tappers. Inferences have also been drawn to understand the

anthropogenic factors responsible for the decline of palm populations and the associated livelihoods.

Cultural Keystone Species (CKS)

We adapt the Cultural Keystone Species (CKS) framework of Garibaldi and Turner (2004) to assess the cultural importance of palmyra for the people of Southern Tamil Nadu. The framework proposes six criteria to assess the cultural importance of a species. They are: 1) Intensity, type and multiplicity of use, 2) Naming and terminologies in local language, 3) Role in narrative, ceremonies and symbolism, 4) Persistence and memory of use, in relation to cultural change, 5) Level of unique position in culture, and 6) Extent to which it provides opportunities for resource acquisition from beyond the territory. Our study uses criteria 1-5, while excluding criterion 6 as it would require extensive quantitative economic analyses.

Mutualism

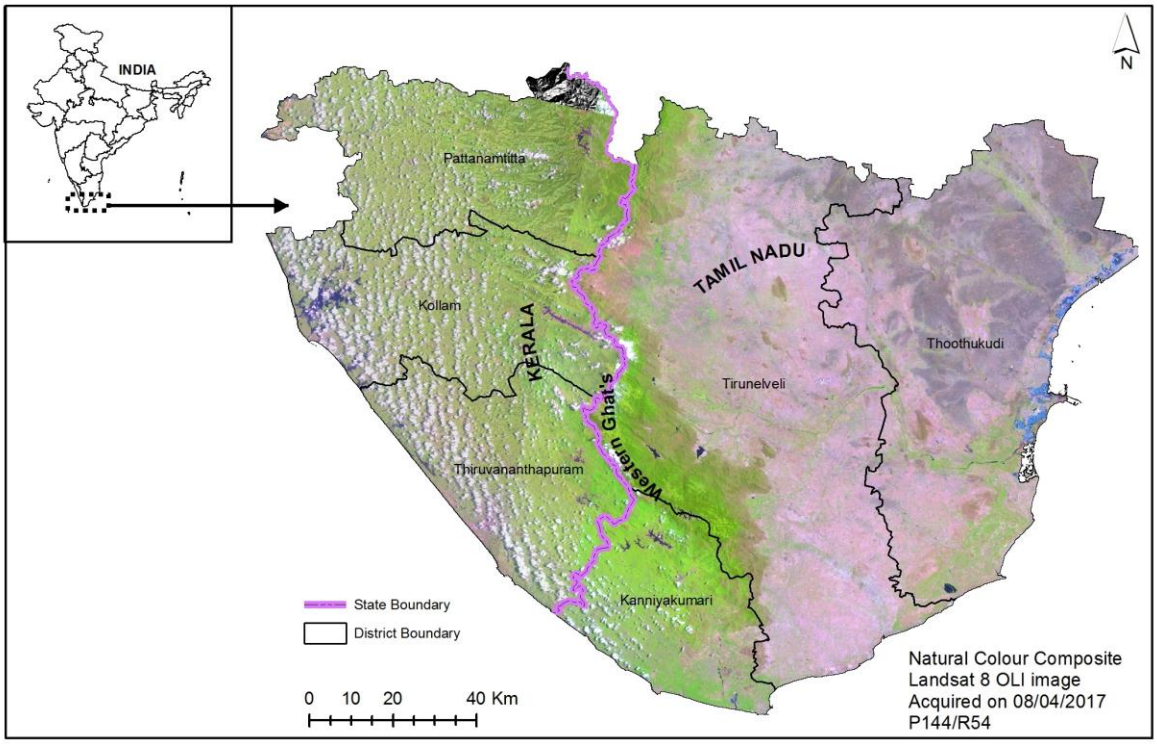
Mutualism is defined as 'an interaction between species that is beneficial to both' (Boucher et al. 1982), and the interacting species are termed as 'mutualists' (Janzen, 1985). In mutualism, benefits such as nutrition, energy, protection and transport are exchanged between interacting species. These benefits are either by-products, invested, or purloined, and their exchange enhances the overall fitness of the involving partners (Connor 1995). Hence, mutualism is considered as an important step in evolution (Leigh 2010). Janzen (1985) classifies terrestrial mutualism into five: harvest mutualisms, pollination mutualisms, seed dispersal mutualisms, protective mutualisms and human agriculture/animal husbandry. Of these, plant-animal interactions chiefly concerned with pollination and seed dispersal are the widely investigated ones (Bronstein 1994). Unlike these classic biological mutualisms, plant and animal domestication are distinguishable by the 'human intent' factor (Vigne 2011). However, humans also participate in mutualistic relationships such as humans-gut bacteria that do not involve human intent. The mutualistic relationship between the semi-domesticated palmyra palm and its tappers is a result of human intention, and is marked by a deep emotional bond between the partners. In addition, unlike agriculture where the changes are effected on the crop, behavioural/phenotypical changes are also required from the toddy tappers in order to participate in the interaction.

Material and Methods

The fieldwork was conducted in the Kanyakumari, Tirunelveli and Thoothukudi Districts of Tamil Nadu (Figure 1), India in June-September 2017 and June 2018. The study is qualitative in nature. We identified 14 palmyra tappers (male), two handicraft artisans (female), four roadside palm fruit vendors (males-2, females-2) and two traditional medicine practitioners (males). However, for the section on mutualism, we use data from interviews with the fourteen palmyra tappers alone, as we find the knowledge on mutualism exclusive to them. This is because the tappers are the ones who participate in the mutualistic partnership. Other community members and their interaction with the tappers and palmyra palm are limited to the use of its produces. Participants were chosen on the basis of their reputation as veteran palmyra tappers, through snowball sampling. All of them had at least ten years of experience as palmyra tappers, the first participant was a toddy tapper contacted through a non-profit association. Interviews were open-ended and followed a conversation style averaging about four hours. Interviews with the tappers were held on the field with little interruption to their daily activities, and was followed by field trips to their palms. In addition, group interviews were also conducted with office bearers of two cooperative federations from Kanyakumari and Thoothukudi districts. The study conforms to the code of ethics of the International Society of Ethnobiology (ISE) (2006). Prior to the interviews, the purpose of the study, nature of data collection, and the usage of the data were explained to the participants, following which oral prior Informed Consent was obtained. The second author is a community representative who has been documenting the socio-cultural importance of Palmyra since 1998.

Figure 1.

Map of Southern Tamil Nadu showing Kanyakumari, Tirunelveli and Thoothukudi districts.



Source: https://earthexplorer.usgs.gov/

Results and Discussion

The results of the study are broadly divided into two as i) *B. flabbellifer* as a cultural keystone species, and ii) Social networking, and the mutualistic relationship between toddy tappers and the palmyra palm.

B. flabellifer as a Cultural Keystone Species (CKS)

Intensity, type and multiplicity of use

All parts of the palmyra palm are used by the local communities in the study area comprising of Kanyakumari, Tirunelveli and Thoothukudi Districts of Tamil Nadu (Figure 1). The long and straight trunk is used to make pillars, beams, rafters, bed frames, bullock carts, etc. Fronds are used to make thatches, hen coops, umbrellas, baskets, fans, mats, wraps, decorative items and handicrafts. Both dry as well as fresh leaves are used as firewood, especially as starter fuel during important festivals such as *pongal* and other temple events.

Food wrapped in palm leaves, or hot rice gruel served in folded palm leaves imparts a characteristic flavour highly preferred by the local communities. Petioles are used as handles, fencing, stalks, stirrers and the cordage peeled off from the petiole is used to weave meshes over cots and chairs, ritual baskets and for handicrafts. Petiole cordage increases the durability of the handicraft products, and hence is preferred than the palm leaves. The sharply serrated edges of the stalk are carefully altered and used as cordage to make jaggery baskets, capable of withstanding loads of up to 20kg. Cordage from the leaf bases are considered of superior quality and were once used to make local sandals. Female palm yields highly sought after fruits from which tender endosperms in the jelly state are eaten raw, or made into drinks.

The fibrous pulps of fruits are roasted over fire, steamed, or cooked with jaggery and relished. At times, a delicious orange coloured squash rich in fibre is also made from the pulp. Seeds are allowed to sprout and the sprouts are cooked and eaten. Flour from such sprouts are also used to make unique traditional dishes. The inflorescence stalks are tapped to obtain a sweet nectar which is collected on lime coated mud vessels and consumed as such, fermented into toddy, or boiled to make palm jaggery and palm sugar. Numerous technological interventions have been made to convert the sweet nectar to value added products including palm candies, palm sugar and bottled drinks. The fermented toddy was once popular in the country side for consumption as a leisure drink. It is also used as a starter in making local breakfast dishes such as the *kall appam*. On special occasions, a rice porridge called akkani *kanji* used to be prepared. Roots are used to make baskets and the cylindrical base left after a palm is cut is used as water tanks or cattle feeding bowl.

The demand for palm products across the range is huge, with no backlog of stock reported. Enquiries with a cooperative federation based in Manapad of Thoothukudi district show that the profit made from selling palm leaf handicrafts have soared fivefold from INR 1,35,162 in 1990-91 to INR in 6,01,940 in 2015-2016. Palm leaf manuscripts are important sources of Tamil literature, religious texts, property documents, correspondence, as well as sources of history. All texts of Siddha, the Tamil system of medicine, were written on palm manuscripts. The form of Siddha practiced in Kanyakumari district is a codified system, written down on palm leaf manuscripts which are still in the possession of reputed Siddha families of the district. The Palmyra palm is hailed as a palm of multiple uses where it is grown; Basu and Chakraverty (1994) reports 801 total uses for the palmyra palm by quoting "Thalavilasam" an anthology written by Kudanththai Arunachalam. Lim (2012) also provides an extensive account of the uses of the species in South and Southeast Asia. In its natural ecosystem, palmyra palm is the dominant and most apparent (visible) palm. This is evident

even today in the anthropogenically unmodified coastal landscapes of Tirunelveli and Thoothukudi districts (Figure 2), indicating that ecological apparency (Guerra et al., 2015), could have been the underlying reason for the multiple use value associated with the palm. However, the apparency argument should also take into consideration the role of local culture and traditional knowledge in maximising the utility value of the palmyra palm (Eagleton, 2016).

Figure 2.

Typical palmyra dominated coastal landscape of Tirunelveli and Thoothukudi districts.

Naming and terminologies in local language

The palmyra palm, its different stages of growth, parts and produce are identified by unique names in the local dialect of Tamil. The first tender leaf to emerge during germination is called *peeli*- a term also used to refer to the feather of peacock which is interestingly abundant in the palmyra dominated landscape; the young palm is called *vadali*- a term that is also used as a metaphor in the local dialect to refer to adolescents; the fruit and sap yielding female palm is known as *paruvapanai* while the sap oozing from the male palm is known as *alavupanai*. Fronds are known as *panaiolai*, and *panaioilai* is classified into three on the basis of its maturity viz., kurutholai (tender shoot), *saraiolai* (green leaves) and *kaavolai* (dry leaves); the petiole is called *karukkumattai*, with *karukku* referring to the sharply erose teeth

and *mattai* to the stalk. The cordage peeled from the adaxial surface of the petiole is known as *agani* and that from the abaxial surface is known as *purani*. Young fruits are known as *kurumbai* and *nungu* while tender- the term *nungu* also alludes to the tender endosperm; the outer cover of the *nungu* after consumption is called as *koontha/koonthai*; mature unripe fruits are known as *panankai*; ripe fruits are known as *panampazham*. The spathe is known as *kothumpu*, *aluvaachi* or *paalai*; the fibrous, net-like sheath which hangs loose at the leaf base after the leaves spread out is known as *pannadai* or *chillaattai*. Both the words *pannadai* and *chillaattai* are also used as derogatory terms for men and women respectively. The net was traditionally used to strain the sweet toddy to retain the insects and dirt on it while letting the sweet nectar flow through. Thus, these terms *pannadai* and *chillatai* allude to men and women who retain undesirable traits, while letting go the desirable ones. The sweet toddy tapped from the inflorescence is known as *akkani* in the northwest part of Kanyakumari district and as *payani* or *pathaneer/pathani* in other places of Tamil Nadu; in the northwest pert of Kanyakumari district, the term *payani* refers to the intermediate plasma stage obtained when the sweet toddy is boiled into jaggery; sugar obtained from the sweet toddy is known as *panancheeni/ panamcheeeni*; the jaggery when solidified is known as *karuppatti* or *karupukatti* (Figure 3); a pale brown form of *karuppatti* made from a mixture of cane and palm sugar widely available in the Tirunelveli and Thoothukudi districts are known as *chillukaruppatti*; there are also many other varieties of *karupatti* such as *puli karupatti* (*puli*= tamarind), *sukku karuppatti* (*sukku* = dry ginger), *paanai karupatti*, *puttu karuppatty*, *olai karupetty* etc. In Kanyakumari district, *chillukaruppatti* is also known as *pandikarupatti*; rock sugar made from sweet toddy is known as *panankarkandu/ panamkarkandu*. Sprouts are known as *panankizhangu/ panamkizhangu* and the spongy endosperm obtained from the germinating seed is called as *thavan*. The seed is called as *panang kottai* or *panam andi*- the latter term is used only in Kanyakumari district.

Multiplicity of names and terms used to tag or describe a species is a common phenomenon observed in various communities, and are indicative of their immense cultural and economic importance to the respective community (Berlin, 1973; Drew, 2005; Seixas & Begossi, 2001. Lobel's study of 1978 with the people of Gilbert and Ellice Islands show that people use more than one name to refer to culturally important fishes such as tiger shark and milk fishes, while less important ones such as 'surf perches' are known by a single name. Beyond cultural importance, folk names also bear testimony to the ingenuity of the respective language (Franco et al., 2015). In the case of *palmyra palm*, we see both multiplicity of names (life stages) as well as multiplicity of terms used to describe the various parts and

products being applied, highlighting the immense cultural and economic importance accorded to the species.

Figure 3.

Karuppatti- solidified jaggery made from the sweet toddy.

Persistence and memory of use, in relation to cultural change

Kanyakumari district is the only district in Tamil Nadu lying on the windward side of the Western Ghats. As a result, the district receives copious rainfall that supports a wide range of tree crops (Figure 1). The climatic conditions thus suit the rubber crop that was introduced to the hilly districts by the government in the 1960s. By 1980, the crop had found its way into the plains, replacing diverse other crops such as tapioca, vegetables and even rice fields. The people of Kanyakumari district have also benefitted from the activities of Christian missionaries, local religious leaders such as Aiya Vaikundar, and the communist parties who have contributed to the upliftment of the socio-economic status of the Shanar/Nadar community - who were traditionally involved in palmyra tapping. As a result, palmyra tapping is no longer a lucrative activity in Kanyakumari. There are no young tappers, a factor that has contributed to decline in palm population. Although rubber cultivation is favoured

over palmyra for its high economic returns, land owners are willing to spare the palms for the sake of the nutritious sweet toddy and fruits. However, in the absence of tappers, the palms have become unproductive and their utility value is reduced to timber. Eventually, they are cut down as the economics of land value assumes supremacy over cultural values.

On the other hand, in the Tirunelveli and Thoothukudi districts of Tamil Nadu, the climate is relatively arid and the palmyra is still dominant on the plains. Although these districts have benefitted immensely from the Christian missionaries, the absence of a cash crop such as rubber has contributed to the survival of the palm and the tapping occupation. However, the construction of the Kodumudaiyar, Nambiyar, Vadakkupachaiar, and Adavinainar hydro reservoirs in the Thamirabarani river basin has led to an increase in the cultivation of banana and other water intensive crops in the two districts, which has begun weaning people away from tapping the palmyra. In addition, the younger generation is also hesitant to take up the work owing to low occupational pride. Although toddy tappers hold their occupation with high esteem and responsibility, the general public consider the occupation as an inferior one until recently. Cultural change, as understood from occupational shift, and abandoning of locale-specific cultural practices is relatively slow in these two districts, than the neighbouring Kanyakumari district. Palm products are highly sought after and used on a day today basis by all communities of these three districts. In Kanyakumari district, it is also common to come across villages named after palmyra palms or groves. Examples of such toponyms are: Kurumpanai, Panachamoodu, Karukkupanaivilai, Panamkuzhi, Vadalivilai, Panamkalai, Panavilai, Panavilagom, Olaivilai, and Osaravilai, Urapanavilai. There are also villages such as Koottapanai, Panakudi, Panakulam and Kalanthapanai in the Tirunelveli district named after the palmyra palm.

Alderman (2008) considers naming as an important process in the quest to maintain continuity by establishing connections between the past and present. Toponyms thus contribute to the development of ‘sense of place’ while also commemorating important aspects of history. The villages named after palmyra in Kanyakumari district have undergone changes in both the cultural as well as ecological landscapes with hardly any palms to be seen. Yet, their erstwhile association with palm still persists in the form of names that commemorate their role in shaping people’s sense of place.

Role in narrative, ceremonies and symbolism

The palmyra palm is widely revered by the associated families as an incarnation of the goddess *Kali*, and the sweet toddy alludes to her milk. Also, throughout the palm habitat, we see local deities such as *Maadan* worshipped beneath it (Figure 4). The high reverence for the palm makes it a taboo to speak badly about it even during casual discussions for those families closely associated. Elaborate rituals mark the commencement of the toddy season, with offerings made to the goddess. Even the families of tappers who had converted to Christianity practice these rituals, although in a different way. These families, do not refer to the palms as incarnation of *Kali*. However, they have utmost reverence for it, attributing their fortunes and wellbeing to it. It is also a common practice in the Tirunelveli and Thoothukudi districts to erect two five feet tall poles of palmyra palm as part of the makeshift marquee for wedding celebrations. Rituals are performed and offerings are made to these poles before the wedding. This indicates that the palm is also associated with fertility. The Goddess *Kali* who is black as the palm, and the allusion of the sweet toddy as her milk also corroborates this, as *Kali* worship has strong connections with fertility cult, especially in the rural areas of India (Maity, 1989). Such beliefs have also been reported elsewhere. Close et al. (2002) report that the mid-Columbia Plateau tribal culture places all beings on par with humans, and the community pays respect to the beings before and after harvest. In the case of palmyra palm, however, we see that the palm is elevated to the divine status, and considered superior to human beings.

Figure 4.

A palmyra palm worshipped as ‘sacred tree’ along with the folk deity.

Casualties and injuries due to fall from the palm while tapping occur once in a while. Yet, a widely held belief among the tapper families is that those associated with the palm will never experience misfortunes. For the public, whose relationship with the palm is limited to the consumption of its produce, it is common to compare the height of a tall man with the palm as “Haven’t you grown as tall as the palm tree?” The meaning alluded is that although the person has grown as tall as a palm, he is useless unlike the palm. Traditionally, rice gruel is served in palm leaflets folded to form a boat shaped disposable utensil in the ablution rituals held on the 16th or 41st day of a funeral. The Christian communities of the study area also use this folded palm leaf utensil to serve rice gruel during the lent season and Good Friday.

A popular folklore in the Kanyakumari district is the role of palmyra palms in the amphibious battle of Colachel (August 10, 1741) where the army of King Marthanda Varma

defeated the Dutch. It is said that the King who was well aware of the superior cannon skills of the Dutch Captain Eustachius De Lannoy, had ordered numerous palmyra palms to be chopped down and assembled on the sea shore in the guise of canons, creating an illusion of superior canon technology which was instrumental in forcing the Dutch to surrender. Bascom (1953) says that cultures depend upon folklores to maintain their continuity, and though they might be invented, their ready acceptance into the society will depend on their ability to fulfil certain cultural needs. The folklore on the role of palmyra in the battle of Colachel fulfils the need for a cultural symbol for the people, indicates the might of the palm, and reinforces its stature among the common folk. Folklores are subjected to multiple retelling in the course of history and in the process, they might be perpetuated, improvised or eliminated depending on the continuity of the cultural need. The persistence of folklore connected to the battle of Colachel reaffirms that the palmyra palm continues to be an important cultural symbol of the local people.

Unique position in the local culture

The toddy tappers pride in their ability to provide the purest form of nutrition to the people, while others hold the palm with utmost reverence. The palm is cited as one whose parts from the shoot to the root are useful, and thus a blessing from nature. It is held without doubt as an irreplaceable one in the local cultures, chiefly because its products are considered unique. Cane sugar is considered inferior to palm rock sugar; soft drinks, including the widely popular tea is considered as inferior to the sweet toddy; bottled alcoholic beverages are held as poor in quality against the fermented toddy; the tender fruits are considered as superior to any other fruit, and the flavour of food wrapped in palm leaves is unmatched by any other. It should also be noted that palmyra jaggery is not substituted with white sugar or sugar cane jaggery in traditional medicine, despite their popularity as common sweeteners.

This unique position is comparable to the position of species such as salmon (*Oncorhynchus* spp.), cockles (*Clinocardium nuttallii*) and abalone (*Haliotis kamtschatkana*) collected by the Gitga'at people of Canada. Garibaldi and Turner (2004) in their seminal work on cultural keystone species (CKS) describe how the Gitga’aat people identify themselves with the above mentioned species.

Medicinal values

In the folk medicine practiced in all three districts, the seed coat surrounding the tender endosperm is considered of high medicinal value, as it is believed to cure diseases related to stomach including common aches, gastritis and diarrhoea. Tender endosperm relieves eye sores, and also consumed for gastritis and used as a coolant. It is common to see roadside vendors selling the *nungu sharbath* which is a squash of the tender endosperm and a synthetic flavour. Seed sprouts are eaten to regulate blood pressure and blood sugar. A decoction of palm sugar/ jaggery is administered along with pepper, dry ginger and coriander seeds to cure cough. The same drink is also consumed as a regular drink by the name *chukku kaapi*, meaning dry ginger coffee. *Paniyaaram* - a mixture of rice and palmyra jaggery is a fried dish given to new mothers and those suffering from measles. Palm sugar is also used in food and drinks for babies as tonic. For digestive diseases such as bloating in cattle, a mixture of betel leaves and jaggery was once administered.

Siddha is the Dravidian system of medicine widely practiced in Tamil Nadu (Kumar & Navaratnam, 2013). Siddha also happens to be the most popular traditional system of medicine in the three districts, and it is widely regarded as unique to Kanyakumari district. The codified system of Siddha considers the fronds, petiole, flowers and fruits of palmyra as medicine. Petioles are used as astringent and aphrodisiac; petiole sap obtained by squashing the petioles can cure eye diseases; fruits (endosperms) are used as diuretic, demulcent and nutrient; consumption of endosperms could cure miliaria rubra while increasing the appetite; fermented toddy is used as tonic, aphrodisiac, diuretic, stimulant, antiphlogistic and coolant; flowers are used to cure peptic ulcer, dental diseases, oliguria and chronic fever; ash obtained by burning the flowers can heal wounds and is good for urination and laxation; palm sugar can cure conditions such as excessive thirst, rheumatoid arthritis fever, and dysuria; the jaggery is effective against delirium and tastelessness; jaggery is also used to cure diseases resulting from the simultaneous aggravation of the three humours of *vaatham, pitham* and *kapham*; jaggery can cure sluggishness and sexually transmitted diseases as well as dropsy/ anasarca; consumption of coleoptiles promote bone health and keep the body cool while also curing sexually transmitted diseases; coleoptiles are considered to be a tonic to boost overall health; roots are used to treat eye diseases; use of fans made of palmyra fronds would offset any derangement of *vaatham* (Mudaliyar, 1936).

The connection between palmyra palm and Siddha medicinal system does not end with the mere utilisation of the palmyra palm. *Varmakalai* or the art of healing by triggering

'vital spots' which is integral to the system of Siddha is a speciality of the physicians of the Nadar caste of the study area; it is widely believed that the form of healing developed in response to the casualties (especially of the bone and spinal cord) associated with toddy tapping (Sieler, 2015). This further highlights the strong connection between the palmyra palm and the traditional healing system of *varmakalai*.

Conservation status and threats at the local level

All palm products have a huge demand, owing to the popular belief that they are organic and natural and hence harmless. Although the demand for soft drinks from major brands has always been high throughout a warm and humid Tamil Nadu, there was a matching demand for the sweet toddy. The recent protests against the ban on *jallikattu*- the traditional bull taming sport of Tamil Nadu also led to widespread protests against major soft drink brands, accompanied by a huge spike in demand for local drinks including sweet toddy from the palmyra palm (Moorthy, 2017). However, the supply of palm products has been constrained by both the availability of raw materials as well as labour. Supply of tender fronds and sweet toddy have been dwindling steadily, along with the decline in palm population.

All our informants highlight the lack of toddy tappers as the main reason that has led to the chopping down of palms. . On the other hand, the lack of interest among the younger generation in toddy tapping can be attributed to formal education that weans people away from traditional occupation while also stigmatising it, and to the lack of support and encouragement from peers and the community. The support from the government too flows mainly into the downstream handicrafts sector, with various awards and schemes intending to encourage handicraft production, especially from Palmyra leaves. However, the toddy tappers receive no encouragement, not even an insurance scheme at present. According to our participants, the last available support to the palmyra tappers was in 1994.

In 2005-06, 12.3% (~20782 ha) of the total land area in Kanyakumari district was under rubber tree cultivation (Meti, 2016). The majority of this cultivation occurs at an elevation range of 0-100 m from the mean sea level which also happens to be the preferred altitudinal range of palmyra palm. Before the introduction of the rubber tree in 1960 (Agriculture Information, 2014), palmyra tapping was one of the chief occupations in the district. According to Sooryamoorthy (2000), of the 1.35 million people living in Kanyakumari in 1978, 0.125 million belonged to tappers' families. It used to be a common practice even until the 1980s to barter palm jaggery in the markets, as well as offer the first yield from the palms to the local church or temple. Today, one cannot spot palm jaggery

offerings in any places of worship, as their places have been taken over by rubber sheets, symbolically indicating the substitution of the role of bread winner for the masses. In the Tirunelveli and Thoothukudi districts, most of the palm yielding region are located towards the coast, which also happens to be used for illegal sand mining; huge tracts of land with standing palmyra crop have been purchased and cordoned off by a sand mining company. Hence, the palmyra palms in the land under the possession of the company are not available for toddy tapping. Besides, the locals also believe that indiscriminate sand mining has led to a fall in water table, leading to salinity incursion and decline in yield of toddy.

Social networking, and the mutualistic relationship between toddy tappers and the palmyra palm

Kanyakumari district, located on the windward side of the Western Ghats has a different monsoon regime from the Tirunelveli and Thoothukudi districts on the leeward side. The average rainfall for the period 2008-2009 for Kanyakumari district was 1456mm. The southern tip of the same Kanyakumari district is relatively arid with 826mm of average rainfall (Balchandran, 2008). The average rainfall for the Tirunelveli and Thoothukudi districts during the same period were 879mm and 740 mm respectively (Balchandran, a & b). Naturally, the flowering period of the Palmyra palm and the depending toddy season also differs considerably between these districts.

In the Kanyakumari District, the toddy season commences in the Tamil Month of *avani* (August), peaks in the month of karthigai (November), and ends in *pangkuni* (March), though it could also be extended up to *vaikaasi* (May) with reduced sap yield. Whereas, in the Tirunelveli and Thoothukudi Districts, the season begins in *maasi* (February) and ends in *aadi* (July). During years of deficit rainfall, the season would last a mere three months. As the season commences early, and ends early in the Kanyakumari district, the toddy tappers then migrate to Tirunelveli and Thoothukudi districts and sometimes to other parts of Tamil Nadu. The local migration begins with the arrival of contractors from Tirunelveli and Thoothukudi at least three months before February. These contractors, scout for talented toddy tappers and reserve them by paying a booking fee in advance. It is common for the tappers to go to the same region year after year and the network is largely a business relationship with rare cases of matrimonial alliances involved. This local migration enables the toddy tappers of Kanyakumari district to extend their tapping season to another three months, thereby reducing the lean season to just three months in a year.

The Palmyra palm grows in close association with humans and is widely considered as semi-domesticated, although there is little agreement if the species can also grow wildly in its native range or is entirely cultivated (Small, 2012). In the research site, the palms are planted along the hedges of agricultural fields, on roadside avenues, on the banks of ponds, lakes, canals and rivers as well as windbreakers on sand dunes. Natural dispersal then lead to formation of palm groves under conducive conditions. Palmyra palms are found both on common land owned by the local government, as well as private land.

If the land owner himself is not a toddy tapper, then an interesting tenure is established between the land owner and a toddy tapper. The toddy tapper offers to tap, in return for an equal share in its products. The sharing itself is an interesting system where the landowner and the tapper are entitled to the yield on alternate days. A tapper who climbs one hundred palms would plan the tenure in such a way that he would take home yield from fifty palms per day during the season, so that his spouse and family will have sap to convert to jaggery every day, without any loss of work. Families who are keen to make use of the tender endosperm will either reserve separate palms exclusively for fruits, or reserve certain inflorescence stalks within the same palms for fruiting. The toddy tapper and his family also establishes an intimate relationship with the palm, taking care to keep the crown clean free from debris such as dead fronds and leaf bases. Annual maintenance is carried out in the season when there is no yield, and the dried fronds which can be used as firewood or thatch are also equally shared. The toddy tappers also watch out for beetles, weevils and fungal infestations. Pest management is planned with the owner of the land, but executed by the toddy tapper. The contract between the landowner and the toddy tapper is mostly lifelong; incidences of tappers being replaced with another are extremely rare. This interesting tenure besides bringing economic benefits to two families, also promotes an interesting kinship between them. The occupation of toddy tapping is a male only domain, women only take care of the jaggery and handicraft production side.

The toddy tappers share a close relationship and emotional bond with their palmyra palms. The relationship between the toddy tapper and his palm is not one-sided, but a mutualistic one (Boucher, 1982), as it ensures livelihood security for the toddy tapper and his family. In return the tapper ensures that the palmyra palm is economically useful and relevant to the community, and ensures its survival in the anthropogenic landscape. The relationship is a symbiotic one as the tapper lives in emotional proximity with the palmyra palms. In this mutualistic relationship, energy is transferred from one partner (palmyra palm) to another

(toddy tapper), and in return, the palm receives protection, seed dispersal and suitable habitat conditions to flourish.

The relationship between the tapper and the palmyra palm while benefitting both the parties, also inflicts certain 'costs' on both partners. These costs are minor considering the larger benefits reaped by both parties, which is akin to other known mutualistic partnerships (Bronstein, 1998; Heil et al., 1998; Linsenmair, 2001). The palm has to forego a significant portion of its precious inflorescence sap, while the toddy tapper undergoes significant behavioural changes, besides foregoing other forms of employment opportunities. The climbers are also looked down upon because of their darker complexion acquired due to prolonged exposure to sun. Climbing the palm requires special skills and adaptation of the feet. The toddy tappers will not undertake any occupation other than climbing palmyra and coconut palms as it is believed to affect the capability for foot inversion which helps them in effectively applying the plantar surface to the surface of the palm trunk (Figure 5).

This claim is corroborated by the results of a study of the Twa people of Uganda whose calf muscles develop so as to allow dorsiflexion of their ankles to up to 450 which is similar to the dorsiflexion angle observed in chimpanzees (Venkataraman, 2012). Another study done by George et al. (2013) on the coconut palm climbers of South India also show that the feet of occupational coconut palm climbers exhibit significant levels of dorsiflexion, plantarflexion and foot inversion, indicating possibilities of skeletal adaptations of the foot. As the toddy tappers will not undertake any occupation other than climbing palmyra and coconut palms, during the lean season when there is no work, the toddy tapper is seen as 'lazing around' by his fellow villagers. On the other extreme, during the toddy season, the tapper has to leave his home as early as 3.00 am in the morning and returns home only late at night. The responsibility of raising the children now rests on the wives of the tappers who have to take care of the children all alone while engaging in jaggery production. The toddy tapper thus finds little time to spend with his children; his children are asleep when he leaves home in the morning as well as when he arrives late night - a scenario described as extremely painful by the tappers' families. At times, this situation forces the children to join their families in tapping and associated activities leading to loss of education opportunities.

Figure 5.

A tapper on his routine climb (Note the feet inversion).

Although mutualism is often perceived as a relationship between non-human living organisms, studies do describe mutualism involving human and non-human entities. For instance, Kuznar (1993) describes how the mutualistic relationship between the herders of South Central Andes, the herd animals and *Chenopodium* could have led to domestication of *Chenopodium* quinoa - an economically important crop. The palmyra palm has been found in semi-domesticated conditions for centuries together. Yet, research has been lacking on the evolutionary pressure exerted on it by human beings. Our interview results indicate that unlike plants such as figs which receive very little in return from partnership with humans (Wilson & Wilson, 2013), the palmyra palm is also a benefactor in the palmyra-tapper partnership. Mutualism is not always rosy, as it is common for a partner to involve in 'cheating' (Seagraves et al., 2005). Our interviews indicate that among the palmyra palms too, it is common for certain palms to turn into '*kallapanai*, or cheat palms' by drastically reducing the sap yields. Under such circumstances, the senior most tapper in the region will

be invited to ‘cajole’ the palm by removing the debris, dry fronds and leaf bases from the crown, following which the palm is reported to get back to the normal yield state. This process is known as ‘*vasapaduthuthal’* which could mean both ‘mesmerisation’ as well as ‘taking into custody’.

Although these palms are referred to as ‘cheat palms’, it is better argued that the human partner who refuses to perform his responsibilities in maintaining the palm is the real cheat, and the palm is resorting to a punitive action - a phenomenon widely reported in ecological mutualism (Bshary & Grutter, 2005). Such punitive actions in mutualistic relationships are known to enhance cooperation, which is also claimed in the partnership between of palmyra and toddy tapper. Although palmyra-tapper partnership inflicts costs on both sides, the relationship ensures that both parties receive relatively larger benefits, thus conforming to the definition of mutualism as “an interaction between species that is beneficial to both” (Heil et al., 1998).

Conclusion

The study shows that the palmyra palm is a culturally important palm for the people of southern Tamil Nadu, India. Almost every part of the palm is utilised by the communities; the palm is even considered as an abode of deities. Being the dominant palm in its habitat, it could be said that ecological apparency could be the reason behind its multiples uses. There is a rich corpus of terminologies in the local dialects of Tamil denoting the various growth stages of the palm, its male and female forms, parts, and products.

Despite economic change, the palm has managed to retain its cultural importance. Even in Kanyakumari district where cultural and landscape changes are more pronounced, the palm has persisted in collective memory and use. There various religious beliefs associated with the palm including as an abode of various folk deities contribute to its revered status. The palm and its products are widely used in the folk as well as codified systems of traditional medicine practiced in all three districts, with the palm and the associated tapping occupation having even contributed to the development of the *varma* system of healing practiced in Kanyakumari district. All these factors contribute to the cultural importance accorded to the palm by the local people. However, it is the palmyra tappers who help the communities to realise the full potential of the palm, and in the absence of their services, the economic importance of the palm has declined, leading to its felling.

The study shows that the relationship between the palmyra tappers and the palm could be a mutualistic one, with costs and benefits to both the partners. There are even claims that indicate the prevalence of a 'punitive' action by the palm to sustain the partnership. All crops undergo evolutionary changes during the process of domestication (Arellano & Casas, 2003; Mapes et al., 1995).

Although our understanding of the evolutionary changes in semi-cultivated crop plants such as the palmyra palm are limited, it is logical to argue from an Evolutionary Ethnobiology (Albuquerque & Junior, 2017) point of view that the long term interaction between the palmyra palm and the tappers would have driven evolutionary changes in the palm and behavioural/phenotypic changes in the dependant people which in turn has contributed to the sustenance of this partnership. The study is based on the traditional knowledge of the palmyra tappers recorded during the interviews. Although it reveals a hitherto undiscovered dimension in palmyra- tapper relationship, the claims of the tapper community about the partnership has to be further supported through empirical studies.

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