

Probable Agricultural Biodiversity Heritage Sites in India. XVIII. The Cauvery Region

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Abstract

The region drained by the Cauvery (Kaveri) river, particularly the delta area, falling in the state of Tamil Nadu, is an agriculturally important region where agriculture has been practiced from ancient times involving the majority of the local tribes and communities. The delta area of the river has been described as one of the most fertile regions of the country, often referred as the 'Garden of South India'. Similarly, the river Cauvery is called the 'Ganges of the South'. The region is a unique example of the knowledge and skills practiced by the local communities in river and water management with the construction of a series of dams for flood control, and the establishment of a network of irrigation systems to facilitate round-the-year highly productive cultivation of rice and other crops. Also, the region has developed internationally recognized sustainable systems with a conservational approach towards livestock rearing in semi-arid areas and fishing in the coastal areas of the region. In the process of these developments, the local tribes and communities have evolved and conserved a wide range of genetic diversity in drought-tolerant crops like minor millets and water-loving crops like rice that has been used internationally. In recognition of these contributions, the region is being proposed as another National Agricultural Biodiversity Heritage Site based on indices used for the identification of such sites. The present paper discusses a representative set of contributions from the region in various fields of agriculture.

The region around the Cauvery (Kaveri) River (the Basin) is an agriculturally important and unique region. Cauvery, also spelled as Kaveri is the sacred river of southern India. It rises on the Brahmagiri Hill of the Western Ghats in southwestern Karnataka state, flows in a southeasterly direction for 765 km through Karnataka and Tamil Nadu, and descends into the Eastern Ghats in the form of a series of great falls. The river breaks into a large number of

distributaries before falling into the Bay of Bengal, south of Cuddalore, creating a wide delta called "the garden of southern India". Devout Hindus called the Cauvery river *Dakshina Ganga* (Ganges of the South). The region is unique because of the interaction of humans (communities) with the landscape of a river and its distributaries leading to the development of unique strategies for river management, particularly of flood waters, and its exploitation in field irrigation

by establishing a network of distribution channels, a system that has become a lifeline for the regional agriculture (food and nutritional security) and development. The local communities and rulers of the region have displayed excellent engineering skills in establishing an extensive network of irrigation, particularly in the deltaic area. The first dam, today called the Grand Anicut, was built in the 2nd century CE at the point where the river divides. A second dam (1836–38) was constructed across the Kollidam (Coleroon) River. Cauvery's northern and larger channel saved the old system from silting and extended irrigation to agriculture. These developments made settled agriculture the main occupation of more than 60 per cent of the population of the region living in rural areas of the river basin. The river passes through diverse topography, including arid to semi-arid tracts and ends in the coastal swamps. It has resulted in the evolution of diverse and unique practices for ecofriendly and sustainable management of livestock on the one hand, and conservational fishing techniques on the other, in addition to conservation field agriculture. In this process of agricultural development, the region has evolved and conserved genetic diversity among minor millets in the dry areas, while in the case of rice both for rainfed and irrigated systems in deltaic areas, which are supported by both good rainfall and a network of irrigation. For these contributions, the region deserves to be proposed as another National Agricultural Biodiversity Heritage Site based on the indices described by Singh and Varaprasad (2008). The present article discusses in brief some of the salient features of the region in this regard.

Location and extent

Physically, the extent of the region is spread along and around the flow of the Cauvery River. It is bounded on the north by the high Kollimalai, Pachaimalai, Shevaroy (Servaroyan), Kalrayan, Chitteri, Palamalai and Mettur hills separating it from the Krishna and Pennar basin, on the south and east by the low Sirumalai and Karanthamalai hills of the Eastern Ghats and Bay of Bengal respectively, and on the west by the Western Ghats. The river basin is estimated to be spread over 81,155 km² with many tributaries, including the Shimsha, the Hemavati, the Arkavathy, the Honnuhole, the Lakshmana Tirtha, the Kabini, the Bhavani, the Lokapavani, the Noyyal and the Amaravati rivers. About 44,000 km² of the basin lies in Tamil Nadu, from 10.00°N to 11.30°N latitude and 78.15°E to 79.45°E longitude, and the rest in Karnataka. The Cauvery River rises from southwestern Karnataka and flows down into the Bay of Bengal. After it leaves the Kodagu hills, it flows onto the Deccan plateau and forms two islands, Srirangapatna and Shivanasamudra. At Shivanasamudra it drops more than 100 m, forming a fall. It enters Tamil Nadu through the Dharmapuri district leading into the lower flat plains. It drops into the Hogenakkal Falls just before it arrives in the town of Hogenakkal and then meanders through the districts of Erode, Namakkal and Karur, where it is joined by other rivers, and reaches *Tiruchirappalli*. It then branches off and again joins to form the Srirangam Island, which is a part of the city of *Tiruchirappalli*. The Cauvery divides into numerous branches and covers the whole of the delta with a vast network

of irrigation channels in Nagapatnam and Tiruvarur districts, and gets merged into the wide expanse of paddy fields. The mighty Cauvery River here is reduced to an insignificant channel and enters the Bay of Bengal at the historical place of Poompuhar (Puhar), about 13 km north of Tharangampadi (Fig. 1). Physically, 55 per cent of the drainage area of the river falls in state of Tamil Nadu, including the most fertile delta area, and 42 per cent in the state of Karnataka. Administratively, the areas drained by the river cover the districts of Mandya, Mysore and Chamrajnagar of Karnataka, and Dharmapuri, Erode, Salem, Namakkal, Karur, Tiruchirappalli, Ariyalur, Perambalur, Thanjavur, Thiruvarur, Pudukottai, Cuddalore and Dindigal of Tamil Nadu (Fig. 1).

Landscape

As the region is basically a river basin of a river coming from the hills and going down into the sea, it can be divided into three sections; the upper areas with steep slopes, the middle area, and the lower area which is confined to the plains. Therefore, the landscape is full of hills, plateau, falls, plains and deltaic area. The regional slope runs in the eastward direction. The upper reaches of the basin are covered with hill ranges of the Western Ghats, while the sub-basin is broad, opening gently into an

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undulating area. In the northwest and south, there are a number of hill ranges which have steep slopes. More than 50 per cent of the land area in the basin is arable, which implies that it can be cultivated. About 22 per cent of the land is non-arable. The total forest cover in the basin is nearly 20 per cent and the rest of the area is inhabited. Some parts of the upper catchment area in the districts of Hassan and Coorg are at an elevation of 1,000 to 2,000 m above mean sea level (amsl), whereas going eastwards, the average elevation of the rest of the Mysore Plateau comes down to 600 m to 1,200 m amsl. The delta regions in east Tamil Nadu have an elevation of 300 to 600 m amsl. Further eastwards, the land slopes very gently into the sea with an average elevation <300 m amsl.

Agroclimate

The Cauvery region is a warm ecoregion. The climate is characterized by hot, dry summers from March to August, with intermittent rains from the southwest monsoon, and mild winters from September to February, with good rainfall from the northeast monsoon from October to

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Figure 1. Location and extent of the Cauvery region.

December. Precipitation varies considerably across the basin. The western side of the catchment mainly experiences the southwest monsoon from June to September, and the northeast monsoon from October to December falls on the eastern side. The rainfall during the rest of the period is insignificant. About 50 per cent rain is received during the southwest monsoon, about 33 per cent in the northeast monsoon, roughly 10 per cent in the pre-monsoons, and the rest in the winter months. The total number of rainy days are more than 100 per

year in the western part of the basin, and 40 to 50 elsewhere in the region (<www.indiawaterportal.org/book/export/html/24>). March is a dry month for the entire basin, while August is one of the wettest months in the year. The length of growing period extends from 90 to 150 days in a year. The Tamil Nadu part of the Cauvery basin receives an annual average rainfall of 956 mm. The rainfall in the deltaic region ranges from 1,000 to 1,140 mm, with the growing period varying from 120 to 200 days. There is severe drought during the growing period

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in the Kolli hills and the Pachamalai hill areas. The annual rains in these hills vary from 760 to 1,020 mm per annum. The rapid decrease in rainfall pattern from the coast to the Tamil Nadu hills is noteworthy as the coastal areas receive rains from cyclones. The drainage network in lowlands of the river is dense and the river forms a delta at Tiruchirappalli (Fig. 1).

The annual temperature ranges from 25°C to 40°C, though there is a considerable variation in the mean daily maximum and minimum temperatures across the catchment area. The mean daily maximum temperature ranges from 19.5°C to 33.7°C, whereas the mean daily minimum varies from 9.1°C to 25.2°C. The maximum temperature in the western areas, having a high relief, such as Mercara, is in the month of March (28.5°C). Wind in the area is linked with the monsoons, and mainly blows from the directions between the southwest and the northwest during the southwest monsoons. Clouds are also associated with the monsoon activity with the skies being generally overcast during the monsoons (<www.indiawaterportal.org/book/export/html/24>).

The principal soil types found in the basin are red soils, black soils, laterite soils, alluvial soils, forest soils and mixed soils. Soil types vary across the basin, but the red soils are the predominant category followed by black. The highland areas which fall in Karnataka have lateritic soils, reddish brown in color. These soils are shallow, acidic to neutral and are fertile, good for agricultural practices. The lowlands and plains of Karnataka have reddish brown soils, which are neutral to acidic in nature and are well drained. In some lowlands, the soils are neutral to weakly alkaline and have higher water-holding capacity. The soils in Tamil Nadu on the other hand are deep with increasing depth towards the coast. These soils have high clay content, low draining capacity, poor nitrate and phosphorus and high potassium and lime content. In the southeastern corner of the basin, some areas are swampy, which predominantly consist of alluvial clay with poor drainage.

The Cauvery delta and the riverine beds in the plains have loamy river alluvial soil. The eastern deltaic area is the most fertile area with the alluvial soil type. The major portion of the interior has either ferruginous sandy soil or ferruginous loam.

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Black cotton soil, which has characteristic properties of shrinkage and cracking is seen in parts of Tiruchirappalli and Dharmapuri districts. Red sterile soil is seen in pockets of Tiruchirappalli and Pudukkottai.

Floristic diversity

The basin is characterized by rich and unique flora and fauna. The vegetation comprises of tropical dry deciduous forests, tropical thorn forests and mangroves. The tropical dry deciduous forests are dry broadleaf forests of the Southern Deccan Plateau. These have three stories, with an upper canopy at 15–25 m, an understory at 10–15 m, and undergrowth at 3–5 m. The trees are draped in lianas in denser and mature forests. The major species are *Acacia catechu* Brandis, *A. chundra* Willd., *A. leucophloea* Willd., *Albizia amara* (Roxb.) Boivin, *Anogeissus latifolia* (Roxb.) Bedd., *Azadirachta indica* A. Juss., *Boswellia serrata* Roxb., *Cassia fistula* L., *Chloroxylon swietenia* DC., *Dalbergia latifolia* Roxb., *Dichrostachys cinerea* (L.) Wight & Arn., *Diospyros montana* Roxb., *Hardwickia binata* Roxb., *Plecosperrum spinarum*, *Pterocarpus marsupium* Roxb., *Shorea talura* Roxb., *Stereospermum*

personatum (Hassk.) Chatt., *Strychnos nux-vomica* L., *Terminalia bellirica* (Gaertn.) Roxb., *T. paniculata* Roth, *T. tomentosa* Wight & Arn., and *Wrightia tinctoria* (Roxb) R.Br. *Santalum album* L. (sandalwood) was an important species of these forests, now under threat.

The **tropical thorn scrub forests** are xeric scrubland. They consist of open, low vegetation that is characterized by thorny trees with short trunks and low, branching open crowns. The trees attain maximum heights of 6–9 m. Typical grasses of these forests include *Chrysopogon fulvus* (Spreng.) Chiov., *Heteropogon contortus* L., *Eremopogon foveolatus* (Delile) Stapf, *Aristida setacea* Retz., and *Dactyloctenium* L. species.

The second story of the thorn forests consists of spiny and xerophytic species, mostly shrubs, dominated by *Acacia* L. species, *Balanites roxburghii* Planch, *Cordia myxa* Roxb., *Capparis* L. spp., *Prosopis* L. spp., *Azadirachta indica*, *Cassia fistula*, *Diospyros chloroxylon* Roxb., *Carissa carandas* Lour., and *Phoenix sylvestris* (L.) Roxb. There are also several other habitat types found in these forests.

The parts of Tamil Nadu area receiving less rainfall have vegetation made up of thinly spread thorny forests of *Acacia planifrons* Wight & Arn., which is characterized by umbrella-shaped crowns, hence called ‘Carnatic umbrella thorn forest’ while the driest, rockiest areas are dominated by *Euphorbia* L. species, like *E. antiquorum* L., *E. tirucalli* L., *Capparis spinosa* Linn., and *Barleria spinosa* Hook. ex Nees, and

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are called 'Southern *Euphorbia* scrubs'. The soil in these areas is usually bare with some grassy growth during monsoon. The landscape is dotted with tall toddy palm or palmyra trees (*Borassus flabellifer* L.).

The tidal mangroves represented in Pichavaram include, *Aegiceras corniculatum* (L.) Blanco., *Avicennia marina* (Forsk.) Vierh., *A. officinalis* L., *Ceriops decandra* (Griffith) Ding Hou, *Rhizophora apiculata* Blume, *R. mucronata* Lam. Wherever there is an intrusion of the sea along the coast, the following common salt-tolerant species can be found: *Apluda mutica* Linn., *Atriplex repens* Roth., *Eremopogon foveolatus* (Del.) Stapf, *Sporobolus tremulus* (Willd.) Kunth, and *Suaeda* Forsk. ex J.F. Gmel. spp.

Agriculture and agrobiodiversity

More than 60 per cent of the total population in the river basin lives in the rural areas and their major occupation is agriculture. Forty-eight per cent of the lands are under cultivation in the basin. Around 24 per cent of the cultivable area has some or other means of irrigation. The basin is shared by Karnataka and Tamil Nadu. The Cauvery delta region is known as the 'Rice Bowl of South India' or the 'food basket of Tamil Nadu', providing 40 per cent of agricultural production of Tamil Nadu. The farmers follow rainfed farming

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in the dry areas and hilly outcrops of the Shevaroy, Kolli, and Pachamalai hills, and irrigated farming along the hinterland of the Cauvery basin and delta. The important crops cultivated in the semi-dry hills are millets, pulses, and oilseeds in the *khariif* (rainy) season, and sorghum and oilseeds in the *rabi* (postrainy) season. Groundnut is cultivated in northeastern Tamil Nadu both under irrigated and non-irrigated conditions. The crops grown in the region vary from area to area, however, the major crops are paddy (grown on 77.8 per cent of the area) followed by pulses occupying 9 per cent of the area (black gram, green gram, etc.). Other crops are *ragi* (finger millet), *jowar* (sorghum), sesame (gingelly), sugarcane, cotton, and horticultural crops like coffee, pepper, banana, betel vine, onion, etc.

Because of the canal water supply, and with plentiful rainfall during the northeast monsoon, there cannot be any other crop but rice from September to December. The Cauvery basin is a granary of paddy, particularly the area supported by the network of irrigation canals. The major paddy-producing areas are Mandya in Karnataka, and the eastern coastal or deltaic regions of Tamil Nadu, i.e., Thanjavur, Nagapattinam, Cuddalore and Pudukottai (Fig. 2). Rice is cultivated in the following irrigated and rainfed conditions: (a) *Upland* rice is banded rainfed and semi-dry or maybe subsequently irrigated; (b) *Rainfed* rice is raised with direct seeding either by broadcasting or sowing behind the country plow; (c) *Semi-dry* rice, where the dry seeds are sown either pre- or post-monsoon, and the crop is irrigated later; and (d) *Lowland* rice, which is banded and



Figure 2. Rice cultivation in the Cauvery Delta area (Thanjavur). (Source: Wikipedia).

irrigated, either by river water or tank water. Transplanting is the common practice.

The major *ragi*-growing region is the Mysore plateau with Chamarajanagar in Karnataka, and Dharmapuri, Salem, and Erode in Tamil Nadu. The major *jowar*-cultivating districts are Chamarajanagar and Mandya in Karnataka; Dharmapuri, Erode, Namakkal, Coimbatore, and Dindigul in Tamil Nadu. Cuddalore is the major sugarcane-growing district in the entire basin. In the black cotton soil belt, cotton and sunflower is cultivated on a large scale. Under the traditional cropping system, cotton was raised in the rice fallows, by sowing cotton seed after piercing the moist soil with a sharp stick after placing the seed. To avoid encrustation, farmers fill the hole with sand and pot watered the holes. (<www.indiawaterportal.org/book/export/html/24>).

Pulses, black gram, and green gram are next important crops, grown in the rice fallows throughout the delta region from January onwards under no tillage condition. Summer-irrigated black gram is grown with splash irrigation, the sowings commencing

in April. Sesame (gingelly) is also sown in April in fields prepared after the summer showers. In light clay loamy soils brought under garden land condition, crops like groundnut, maize, gingelly and irrigated pulses are rotated.

Among horticultural crops, vegetables like brinjal (eggplant), chili, and greens are grown during the summer months in limited area, in the well-drained fertile lands depending upon the underground water source. Banana, sugarcane, and ornamentals like *Jasminum* L., rose, *Chrysanthemum* L., *Crossandra* Salisb., and *Nerium* L. (*arali*) occupy the land for more than one year for the successive returns. Coconut gardens, bamboo and wood lots are scattered in the delta in different densities. Mango, jackfruit, citrus of various kinds, guava, pomegranate, custard apple, etc., are among the more prevalent fruit trees, in addition to cashew in specific pockets. Tapioca (cassava) is cultivated in Erode and Salem for the flourishing starch industry. Plantain and coconut are cultivated on a commercial scale wherever irrigation facilities are available.

Rice being the principal crop, most cropping systems are rice based. In the areas of

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northern and central Tamil Nadu where the rains are sporadic, cotton is grown. In the same region, where irrigation facilities are available through tubewells or irrigation canals, sugarcane is cultivated. The planting is done during December–January. Oilseed crops like sunflower (*Helianthus annuus* L.) is cultivated in the black cotton soil areas of Tamil Nadu, where tubewell irrigation is prevalent. The prevalent cropping patterns involving these crops are: rice–sunflower, sesame–finger millet, mung bean/urid bean–groundnut, rice–rice–groundnut, rice–rice–sesame–groundnut, rice–rice–sesame.

Additionally, the forests of Javadi and Dharmapuri are known for the commercially important species of sandalwood (*Santalum album*), which is cultivated for its commercial value. Livestock rearing is another important activity in the semi-arid areas of the region supported by traditional practices like ‘*korangadu*’, in addition to normal grazing (Fig. 3). Several breeds, particularly in cattle, like *Kangayam*, and sheep and goats, like *Mecheri* (*Maiylambadi*), *Karuvai* (*Kilakarsal*), etc., are reared.



Figure 3. *Korangadu*, a traditional, sustainable/conservation grazing grassland (Source: <agroecology.typepad.jp>).

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Fishing is a common agricultural activity both under the river system and marine system in the coastal region using traditional methods. The river provides a significant level of species and genetic diversity in fishes, including ornamental fishes. Jayaram *et al.* (1982) published a survey of the entire River Cauvery system with a major account on fish fauna.

Representative crop species in various crop groups

Cereals, pseudocereals, and millets. Barnyard millet [*Echinochloa crusgalli* (L.) P. Beauv.], *kelvaragu* or finger millet (*Eleusine coracana* Gaertn.), maize (*Zea mays* L.), *panivaragu* or proso millet (*Panicum miliaceum* L.), pearl millet [*Pennisetum glaucum* (L.) R. Br.], rice (*Oryza sativa* L.), *samai* or little millet (*Panicum sumatrense* Roth), *sanwa* or barnyard millet (*Echinochloa frumentacea* Link.; syn. *Panicum frumentaceum* Roxb.), sorghum [*Sorghum bicolor* (L.) Moench], *thenai* or foxtail millet/Italian millet [*Setaria italica* (L.) Beauv.], *thipa ragi* (*Eleusine indica* Steud.), *varagu* or kodo millet (*Paspalum scrobiculatum* L.), and *vedalu* or poor man’s millet [*Echinochloa colona* (L.) Link.].

Grain legumes and oilseeds. Black gram [*Vigna mungo* (L.) Hepper], castor (*Ricinus communis* L.), cowpea (*Vigna unguiculata*

L.), gingelly or sesame (*Sesamum indicum*), green gram [*Vigna radiata* (L.) R. Wilczek], groundnut (*Arachis hypogaea* L.), horse gram [*Macrotyloma uniflorum* (Lamk.) Verdc], physic nut (*Jatropha curcas* L., *J. gossypifolia* L., *J. villosa* Wt. var. *ramnadensis* Raman), pongam oil tree [*Pongamia pinnata* (L.) Pierre], sunflower (*Helianthus annuus*), and tur or pigeonpea [*Cajanus cajan* (L.) Millsp.].

Fodder and fiber crops. *Cenchrus ciliaris* L. [syn. *Pennisetum ciliare* (L.) Link], *cholapul* (*Chrysopogon montanus* Trin.), cotton (*Gossypium hirsutum* L.), *dadara* [*Borreria hispida* (Linn.) K. Schum.], *hariali* (*Cynodon dactylon* Pers.), Indian bowstring hemp (*Sansevieria roxburghiana* Schult. f.; syn. *S. zeylanica* Roxb.), *kurutupul* (*Chloris barbata* Sw.), *ottanpul* (*Seltaria verniculata*), *roselle* (*Hibiscus subdariffa* L.), *sunhemp* (*Crotalaria juncea* L.) and *vennampul* [*Trachys muricata* (L.) Pers.].

Vegetables. *Agasthi* [*Sesbania sesban* (L.) Merr.], *bird pepper* (*Capsicum frutescens* L.), *bitter gourd* (*Momordica charantia* L., *M. balsamina* L.), *brinjal* (*Solanum melongena* L.), *canavalia* [*Canavalia ensiformis* (L.) DC.], *chili* (*Capsicum annum* L.), *Coccinia indica* L., *cucumber* (*Cucumis sativus* L.), *C. melo* var. *agrestis* Naud. (an edible weedy form), *muringa*

(*Moringa oleifera* Lam.), *muskmelon* (*C. melo* L.), *okra* [*Abelmoschus esculentus* (L.) Moench], *pumpkin* (*Cucurbita pepo* L.), *purple bean* [*Macroptilium atropurpureum* (DC.) Urb.], *ridge gourd* [*Luffa acutangula* (L.) Roxb.], *snake gourd* (*Trichosanthes anguina* L.), *sponge gourd* (*Luffa cylindrica* Roxb.; syn. *L. aegyptiaca* Mill.), *summer squash* (*Cucurbita pepo*) and *winter squash* (*C. maxima* Lam.).

Leafy vegetables. *Amaranthus* (*Amaranthus spinosus* L., *A. tenuifolius* Willd., *A. viridis* L., *A. dubius* Mart. ex Thell.).

Bulbs and tubers. *Air potato* (*Dioscorea bulbifera* L.; syn. *D. sativa*), *cassava* or *tapioca* (*Manihot esculenta* Crantz), *elephant-foot yam* [*Amorphophallus paeonifolius* (Dennst.) Nicolson], *Indian kudzu* [*Pueraria tuberosa* (Roxb. ex Willd.) DC], *onion* (*Allium cepa* L.), *rasa valli kilangu* (*Dioscorea alata* L.) and *sweet potato* [*Ipomoea batatas* (L.) Lam.].

Fruits. *Aonla* (*Emblica officinalis* Gaertn.; syn. *Phyllanthus emblica*), *bael* [*Aegle marmelos* (L.) Correa ex Roxb.], *cashew* (*Anacardium occidentale* L.), *clove tree* [*Syzygium aromaticum* (L.) Merr. & L.M. Perry], *custard apple* (*Annona squamosa* L.), *grape* (*Vitis vinifera* L.), *guava* (*Psidium*

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guajava L. Links), jackfruit (*Artocarpus heterophyllus* Lam.), jamun [*Syzygium cuminii* (L.) Skeels], karonda (*Carissa carandas* Lour., *C. inermis*), lemon [*Citrus limon* (L.) Burm. f], lime [*C. aurantifolia* (Christm.) Sw.; syn. *C. medica* L.], mango (*Mangifera indica* L.), mangostan (*Garcinia mangostana* L.), plantain (*Musa acuminata* L. Colla, *M. sapientum* L.), pomegranate (*Punica granatum* L.), pomelo [*Citrus maxima* (Burm.) Merr. or *C. grandis* Osbeck], rose apple [*Syzygium jambos* (L.) Alston], tamarind (*Tamarindus indica* L.), toddy palm or palmyra (*Borassus flabellifer*), watermelon [*Citrullus lanatus* (Thunb.) Matsum. & Nakai], wild date palm (*Phoenix pusilla* Gaertn.), wood apple (*Limonia acidissima* L.) and *Ziziphus horrida* Roth.

Species. Chili (*Capsicum annuum*), coriander (*Coriandrum sativum* L.), curry leaf [*Murraya koenigii* (L.) Spreng.], pepper [*Piper nigrum* L. (Lam. ex Link)] and turmeric (*Curcuma longa* L.; syn. *C. domestica* Valet.).

Others. Betel vine (*Piper betle* L.), *Caesalpinia pulcherrima* (L.) Swartz, *C. sappan* L., cocoa (*Theobroma cacao* L.), coconut (*Cocos nucifera* L.), coffee (*Coffea arabica* L.), henna (*Lawsonia inermis* L.), *Hibiscus rosa-sinensis* L., indigo

(*Indigofera tinctoria* L.) and sugarcane (*Saccharum officinarum*).

Ornamentals. *Arali* (*Nerium oleander* L., *N. indicum* Mill.), *Bauhinia purpurea* L., bluebell barleria (*Barleria cristata* L.), *Chrysanthemum* spp., *Crossandra infundibuliformis* (L.) Nees, *Gomphrena globosa* L., *Jacaranda acutifolia* Humb. & Bonpl., *Jasminum* spp., *Rosa* L. spp., and vedchi or scarlet ixora (*Ixora coccinea* L.).

Medicinal species. The local tribes/communities have significant indigenous knowledge about the medicinal properties of plants from the region, including mangroves and halophytes found in the coastal areas (Ravindran *et al.*, 2005a). A survey in the districts of Tamil Nadu recorded 114 species distributed over 97 genera being used for toothache (29.82%), for toothbrushes (25.43%), for mouth wash (16.66%), for dental diseases (14.03%), for stomach ulcers (12.28%), and for gum bleeding (10.53%) (Ganesan, 2008). Another ethnobotanical survey in the Pachamalai hills identified 84 different uses of 119 plant species, covering not only disease and health management in humans, but also in animals and plants (Geetha Rani, 2010). Rajendran and Manian (2011) reported 16 species being used for the treatment of diabetes in the Kolli hills. The commonly cultivated/used medicinal plants are *varttilai kasturi* (*Abelmoschus*

Additionally, the forests of Javadi and Dharmapuri are known for the commercially important species of sandalwood (Santalum album), which is cultivated for its commercial value.

Fishing is a common agricultural activity both under the river system and marine system in the coastal region using traditional methods.

manihot (L.) Medik.), *Acalypha indica* Linn., *Adhatoda vasica* Nees, *Alangium salviifolium* (L.f.) Wangerin, *avarai* (*Cassia auriculata* L.), *bhringraj* [*Eclipta prostrata* L.; syn. *E. alba* (L.) Hassk.], *brahmi* (*Bacopa monnieri* L. Pennell), *Centella asiatica* L., *Gloriosa superba* Linn., *Hemidesmus indicus* L. R.Br., *Hedyotis* L. spp., *keela nelli* (*Phyllanthus niruri* L.), *Piper longum* L., *Rauwolfia serpentina* Benth, senna (*Senna alexandrina* Mill.; syn. *Cassia senna* Linn.), *Sida cordifolia* L., *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn., *T. bellerica*, *Tylophora indica* (Burm.f.) Merrill., *uttamani* or *seendhal kodi* [*Pergularia daemia* Forsk.] and *vasambu* (*Acorus calamus* L.).

Timber and wood. *Albizia amara*, *Dalbergia latifolia*, bamboo [*Bambusa arundinacea* (Ritz.) Roxb.; *Dendrocalamus strictus* (Roxb.) Nees.], sandalwood (*Santalum album*) and teak (*Tectona grandis* L.).

Multipurpose species. *Acacia nilotica* (L.) Delile, *katha* or *areca nut* (*Areca catechu* L.), *Morus alba* L. (host for silkworm), *Sesbania sesban*, *Terminalia bellerica*, *T. paniculata*, *T. tomentosa* (wood/medicine) and *toddy palm* or *palmyra palm* (*Borassus flaberrifer*) landscaping and local beverage.

Gum- and resin-yielding plants and forest products. Forests of the region are known for timber wealth (sandalwood), bamboo and plants of food and medicinal value. The tribal populations collect food in the form of minor fruits, tubers and greens, gum resin, firewood, and bark and leaves for use in local health system.

Wild relatives. Arora and Nayar (1984) reported wild relatives of the crops such as

Abelmoschus angulosus Mast, *Cajanus volubilis* (Blanco) Blanco [syn. *Atylosia volubilis* (Blanco) Gamble], *Chionache semiteres* (Benth.) Henr., *Luffa graveolens* (Roxb.), *L. umbellata* M. (Klein) Roem (Coromandal area) from the region, and *Panicum psilopodium* Trin. from the southern Deccan peninsular region. In the recent past, many more wild relatives of crops have been recorded from the region, like *Abelmoschus ficulneus* (L.) Wight & Arn., *Capparis* spp., *Crotalaria* L. spp., *Erianthus arundinaceus* (Retz.) Jesw., *Indigofera caerulea* Roxb. var. *caerulea*, *Momordica tuberosa* (Roxb.) Cogn. (syn. *M. cymbalaria* Hook. Fenzl ex Naud.), *Oryza meyeriana* Baill. var. *granulata*, *O. officianalis* Wall ex Watt. ssp. *malampuzhaensis* (Krish) Tateoka, *Panicum trypheron* Schult., *Phoenix pusilla*, *P. sylvestris*, *Saccharum spontaneum* L. (significant variability), *Solanum nigrum* L., *S. surattense*, *Sorghum halepense* (L.) Pers., *S. stapfii* (Hook.f.) C.E.C. Fischer., *Syzygium alternifolium* (Wight) Walp, *S. zeylanicum* L., *Trichosanthes cucumeriana* L., *Vitis adnata* (Roxb.) Wall. and *V. pallida* Wight & Arn.

Endemic species. Nayar *et al.* (2009) listed *Acrachne sundararajii* Umamaheswari, *Albizia lathamii* Hole, *Chloris bournei* Rang. & Tadul., *Crotalaria madurensis* R. Wight., *Dalbergia coromandeliana* Prain, *Dichrostachys santapau* Sebastine & Ramam., *Eragrostis rottleri* Stapf., *Hildegardia populifolia* (Roxb.) Schott. & Endl., *Jatropha maheshwarii* Subr. & Nayar, *J. villosa* var. *ramadensis* Raman, *Sorghum stapfii*, and *Vernonia shevaroyensis* Gamble as endemic to the region. *Erythrina variegata* forma *mysorensis* (Gamble)

Maheshwari has also been reported to be endemic to the region. A representative set of endemic species is presented in Table 1. Additionally, there are endemic mangrove species like *Scyphiphora hydrophyllacea* and rare mangrove associate species like *Tamarix troupii* Hole. As the river is very rich in fish biodiversity, there are number of fish species endemic to the river like *Hypselobarbus dubius*, but most are under threat (Balasundaram *et al.*, 1999).

Threatened species. The Red Data Book on Plants of India (Nayar and Sastry, 1987–88) listed *Capparis diversifolia* Sessé & Moc, *Ceropegia fimbriifera* Bedd., *C. omissa* H. Huber., *C. spiralis* L., *Crotalaria digitata* Hook., *C. globosa* Wight & Arn., *C. longipes*, *C. rigida* B. Heyne, *C. scabra* Gamble, *Hedyotis barberi* (Gamble) A.N. Henry & Subr., *Indigofera barberi* Gamble, *Polycarpaea*

diffusa Wight & Arn., *Rhynchosia velutina* Wight & Arn. (a perennial climbing or trailing herb), *Vanda wightii* Rchb.f., *Hedyotis* L. spp. (medicinal), and *Wendlandia angustifolia* Wight ex Hook.f., of agricultural significance, to be under threat. Several more species, *Acacia campbellii* Arn., *Albizia lathamii* Gamble, *A. thompsonii* Brandis, *Asparagus rottleri* Baker, *Ceropegia odorata* Nimmo ex Hook.f., *Hildegardia populifolia* (Roxb.) Schott. et Endl., *Indigofera constricta* (Thur.) Trimen and *Oryza officinalis* Wall. ex Watt subsp. *malampuzhaensis* (Krish) Tateoka, have also been reported to be under threat (Nayar *et al.*, 2009). A set of species under threat has been listed in Table 2. Some avian species of agricultural significance under threat are the red-headed vulture (*Sarcogyps calvus*) and the endemic Nilgiri wood-pigeon.

Table 1. Representative economically important plant species endemic to the Cauvery Region, India.

Species	Family	Habit	Distribution	Use
<i>Acrachne sundararajii</i>	Poaceae	Herb	Tamil Nadu	Forage grass
<i>Albizia lathamii</i>	Fabaceae	Tree	Karnataka, Madhya Pradesh, Tamil Nadu	Wood, genetic resource
<i>Chloris bournei</i>	Poaceae	Herb	Leeward Deccan	Forage grass
<i>Crotalaria madurensis</i>	Fabaceae	Woody herb	Srisailam, Southern Eastern Ghats	Genetic resource
<i>Crotalaria paniculata</i> var. <i>nagerjunekondensis</i>	Fabaceae	Woody herb	Southern Eastern Ghats	Genetic resource
<i>Dalbergia coromandeliana</i>	Fabaceae	Tree	Coromandel coast	Wood, genetic resource
<i>Erythrina variegata</i> forma <i>mysorensis</i>	Fabaceae	Tree	Karnataka region of Cauvery	Medicinal (bark/leaves)
<i>Jatropha villosa</i> var. <i>ramadensis</i>	Euphorbiaceae	Shrub	Carnatic coast	Genetic resource, biofuel

Table 2. Representative economically important plant species under threat in the Cauvery region, India¹.

Species	Family	Habit	Threat status ²	Use
<i>Acacia campbellii</i> ³	Fabaceae	Tree	VU	Wood
<i>Albizia thompsonii</i> ³	Fabaceae	Tree	R	Genetic resources
<i>Asparagus rottleri</i> ³	Liliaceae	Undershrub	DD	Medicinal
<i>Capparis diversifolia</i> ³	Capparaceae	Small tree	VU	Genetic resource, fruit
<i>Ceropegia fimbriifera</i> ³	Asclepiadaceae	Twiner	VU & R	Leafy vegetable, medicinal (ceropegine)
<i>Crotalaria digitata</i> ³	Fabaceae	Undershrub	EN & R	Genetic resource
<i>Crotalaria longipes</i>	Fabaceae	Shrub	EN	Genetic resource
<i>Erythrina variegata</i> <i>forma mysorensis</i>	Fabaceae	Tree	DD	Medicinal (bark/leaves)
<i>Hedyotis barberi</i> ³	Rubiaceae	Annual herb	VU & R	Medicinal
<i>Indigofera barberi</i> ³	Fabaceae	Undershrub	R	Medicinal
<i>Indigofera constricta</i> ³	Fabaceae	Shrub	R	Medicinal
<i>Oryza officinalis</i> subsp. <i>malampuzhaensis</i>	Poaceae	Tall herb	DD	Wild relative of rice
<i>Rhynchosia velutina</i> ³	Fabaceae	Climbing herb	VU	Genetic resource, wild relative of pigeonpea
<i>Vanda wightii</i> ³	Orchidaceae	Epiphyte	EX	Ornamental orchid

1. Source: Nayar and Sastry, 1987–88; Nayar *et al.*, 2009.

2. EX = Possibly extinct; EN = Endangered; DD = Data deficient; R = Rare; VU = Vulnerable.

3. Listed by the Ministry of Environment and Forests, Government of India.

Associated culture and tribes

The anthologies of early Tamil poems collectively known as *Sangam* literature (c. 300 BCE to 300 CE) provide a vivid account of the transition, from an earlier tribal-pastoral stage to a state society in the ancient Tamil country (Tamilakam), with agriculturally dominant era of the region. They indicate the simultaneous existence of different ecological regions and suggest how different but interrelated ways of life, ranging from food gathering, marginal agriculture, fishing, and cattle-tending to

intensive agriculture, coexisted. During the early days, the power/survival struggle was dominated by cattle-raids, war and booty, but slowly people began to settle down as peasants, and gradually a stratified society emerged. The peasantry looking for protection and immunity from raids and plunder tended to be absorbed into a system in which a rudimentary statehood came into existence. In the fertile river valleys (*Marutam* regions) of the Cauvery, Periyar and Yaigai, agriculture flourished and surpluses were produced particularly during the three ancient dynasties, the *Chola*

(c. 900–1270 CE), the *Chera* (3rd century BCE to 12th century CE), and the *Pandya* (560–1550 CE).

The hilly areas of the Shevroy hills, Pachamalai hills, Kolli hills occurring in the districts of Dharmapuri, Salem, Cuddalore, and Tiruchirappalli have the major tribal communities called “*malayali*”. The tribal men and women of the Pachamalai hills (Malayali tribes) are known to possess knowledge on various treatments using local plants for curing ailments in humans as well as livestock (Geetha Rani, 2010). The other major tribes of the region are *Irular*, *Kadar*, *Kond Kapus*, *Konda Reddis*, *Malai Padaram*, etc. The cropping patterns followed by the tribals of this region ensured the sustainability of the land through the adoption of a mixed cropping system. The traditional methods of irrigation and storage of produce in traditional granaries were social/village friendly practices/efforts, ensuring the participation of all village communities and sharing of benefits.

Technology and products

Being the basin of a great river, the region is known for the strategies and technologies

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that evolved and the skills used by the local people in river management and its exploitation for irrigation of crops. From the early times, the local communities have evolved practices for efficient control and management of river waters, and its effective use, facilitating water supply for drinking and irrigation purposes using appropriate channels. In its course through Karnataka, the Cauvery river is interrupted by twelve dams (‘anicut’) and the water is diverted through artificial channels for the purpose of irrigation and for supply of drinking water to the town of Mandya. Near Srirangapatna, there is an aqueduct (channel or pipe for water transport), the ‘*Bangara Doddi Nala*’, which was constructed in the 17th century by the then Maharaja of Mysore, Ranadheera Kanteerava Narasimharaja Wodeyar. It is said to be the only aqueduct where the water from a river, dammed upstream, is carried by the aqueduct over the very same river a few miles downstream.

During the reign of Srimara Srivallabha (811–857 CE), a number of irrigation projects were undertaken, which included renewing of existing tanks, canals and sluices, in which brick and granite blocks were used as building materials. The same procedure continued in subsequent times, as in the stone embankment named *Kallanai*, the *Parakrama-Pandian Kallanai*, the *Vira Pandyan-Kal* channel, and water reservoirs like the *Vallabha Pereri* (big lake). There was regular provision for the upkeep of these irrigation facilities. Consequently many such structures are in use even today. The Chola king Karikalan has been immortalized in the embankments of the Cauvery that he built all the way from Puhar

(Cauverypoompattinam) to Srirangam (island) around 1,600 years ago. On either sides of the river, the walls are found spread across a distance of 330 meters. The *Kallanai* dam built by the king on the border between Tiruchirappalli and Thanjavur is an excellent display of engineering skills. The dam was constructed using earth and stone, which bore the destructive force of nature for centuries and protected the regional life and livelihood (Raman, 2008). There was tremendous agrarian expansion during the rule of the Chola (c. 900–1270 CE) all over Tamil Nadu, but particularly in the Cauvery Basin. Most of the distributing canals of the Cauvery River criss-crossed the deltaic region. Many tanks came up during the Chola period, e.g., Rajendra Chola I's huge tank, called Solagangam in Gangaikonda Solapuram.

Cauvery River flows from the northwest to the southeast, and drains vast areas of the southern Indian peninsula. It was dammed in the 2nd century CE at the Grand Anicut, which reflects the genius of the local people and the interest, encouragement and support from the rulers for efficient management and use of water resources to support agriculture, ensuring food and nutritional security and prosperity to the region. It is one of the first dams to be constructed in the world. The Grand Anicut is believed to have been built in the mid to late Chola times, and was later rebuilt by the British. It was a vast construction for its time, spanning more than 300 m across the Cauvery, with a width of more than 18 m. The Chola monarchs needed the dam to tackle the flooding problem and for using the flood waters of the Cauvery

for irrigation to facilitate creation of more consistent food production and wealth. The Cholas controlled this system by granting water rights, just as they would grant land rights to kinsmen, military chiefs, royal retainers, village officers and especially religious institutions (Raman, 2008). The Cholas defined the agrarian structure in this area of the region called the 'rice bowl of Tamil Nadu', and where the fan of water channels of the Cauvery Delta was used to irrigate the fields, thereby providing almost constant water supply to the lowlands. The drainage network of the river is dense and the river forms a delta at Trichinopoly (Tiruchirappalli, Karur, Ariyalur, and Perambalur). More than 60,000 ha of the cultivable lands are irrigated by these channels in each of Mandya, Mysore, and Thanjavur districts. Further, groundwater was extracted for irrigation through wells, borewells, canals, tanks, and lifts.

In most crops grown in the region, the local tribes and communities have evolved significant genetic diversity suited to various ecologies and with desired traits of both agronomic and economic value. Most indigenous landraces and farmers' varieties grown in the region are resistant to pests, less vulnerable to diseases, and hardier. Rice, which is the main crop of the region is traditionally grown under both rainfed and irrigated agroecosystems, and presents maximum genetic variability, reflected by one estimate that between 1921 and 2006, around 150 rice varieties were bred from Tamil Nadu predominantly using only local germplasm (<www.advanceagriculturalpractice.in/w/index.../Rice_in_Tamil_Nadu>). The traditional

The tribal men and women of the Pachamalai hills (Malayali tribes) are known to possess knowledge on various treatments using local plants for curing ailments in humans as well as livestock.

upland variety *Puzhuthi Kar Nel*, the dryland rice is grown in the Western Ghats bounded Erode district under rainfed and garden land conditions through direct sowing. It is susceptible to lodging and has red and bold grains. On the other hand, the traditional lowland variety *Kalurundai* grown in Nagapattinam district is resistant to drought, pests, diseases, and salinity with bold yellow grains. In the state of Tamil Nadu, the most prized cultivar is the short-grained *ponni* variety (a released variety), which primarily evolved and is grown in the delta regions of the Cauvery River. The Cauvery is also referred to as *Ponni* in the South; therefore, the name reflects the geographic association of this variety with the Cauvery River. On the basis of processing, there are two types of *ponni* marketed and used: *ponni* boiled rice, where the paddy is boiled before making rice, and *ponni* raw rice, where the paddy is directly hulled into rice without boiling. *Ponni* raw rice has its own fragrance and texture. *Ponni* raw rice is preferred by South Indians. Another variety grown in Tanjavur is called *Thanjavur* rice, again a short-grain rice variety known for its good texture and long shelf life. In addition, there are a large number of varieties/landraces known from the region, which offer variability for most traits of rice of economic significance. For example, long-duration varieties like *Vallai samba*, *Karthigai samba*, *Kallurandai kar*,

Kattikar, *Jeeranga samba*, *Tadu kkan*, *Thillainayagam*, *Shen molagai*, *Erapalli samba*, *Godavari samba*, *Anaikomban*, *Poongar*, *Rasacadam*, *Kudavali* (with better seed viability and germination percentage), *Kambachamba* (with high tillering), and *Khuruvai* (early maturity). In a recent reassessment of the traditional varieties against changing climate in the Cauvery Basin, 72 genotypes, including these varieties, were screened against high temperature and its effect on pollen fertility and spikelet sterility. These efforts resulted in the identification of *Vallai samba*, *Karthigai samba* with higher tolerance to temperatures up to 43°C, suggesting that these two landraces are a source of heat tolerance and could be used in future breeding programs on heat tolerance, as a response to changing climate of global warming. Further, *Kudavali* recorded higher plant stand, and *Kambachamba* higher tiller and yield-related traits (Geethalakshmi *et al.*, 2011; Babu *et al.*, 2012). In addition, every district of the region is known for traditional varieties, for example, Mandya for *Mandya Vani*, *Mandya Vijaya*, *Mangala*, *Madhu*, *Pushpa*, Erode for *Puzhuthi Kar Nel*, and Nagapattinam for *Kichidi Samba*, *Via Kunda*, *Suran Kuruvai*, *Pichavari*, *Seeraga Samba*, *Vellai Kuruvi*

During the reign of Srimara Srivallabha (811–857 CE), a number of irrigation projects were undertaken, which included renewing of existing tanks, canals and sluices, in which brick and granite blocks were used as building materials.

Kar, Val Sivappu, Kuzhi Vedichan, Chinna Samba/Sada Samba, Kalurundai, etc. The traditional varieties *Thungara* and *Pulithikar* collected from the Kolli hills have tolerance to diseases, while *Adimodan* from Coimbatore has resistance to diseases. During the tsunami of 2004 the landraces like *Kunthali, Kallurundai, Vellakudavalai, Katchakombalai, Kuzhivedichan* and *Surakuruvai* were found to withstand the intruding sea water. They were collected from Nagapattinam and have been found to be tolerant to salt (MSSRF, 2004–05). The MS Swaminathan Research Foundation has identified additional varieties like *Arcot kitchilli, Bangalore kar, Kattu nellu, Kurvai nellu, Kullan kar, Madumulungi, Paguna palai, Pulithikar, Samba mosanam, Samba nellu*, and *Vella puzhithi* resistant to pests and diseases; *Karum puzhithi* tolerant to flood, and *Aadimodan, Kappakar, Karum puzhithi, Kotta nellu*, and *Thungara*, tolerant to drought (MSSRF, 2002–03; Nayar *et al.*, 2009). Some of the scented varieties from the region are *Aarcadu kitchedi samba, Jeeranga samba*.

In small millets, less variability is reported at national level. However, the MS Swaminathan Research Foundation has recognized the Kolli hills as an important center of genetic diversity for

The Chola king Karikalan has been immortalized in the embankments of the Cauvery that he built all the way from Puhar (Cauverypoompattinam) to Srirangam (island) around 1,600 years ago.

millets. In a recent study, 21 different landraces from five millet crop species were found in the Kolli hills. These included *Sundangikelvaragu, Perungelvaragu, Karunguliyankelvaagu, Arisikelvaragu, Sattaikelvaragu, Karakelvaragu* in finger millet or *kelvaragu*; *Vellaperumsamai, Kattavettisamai, Karumsamai, Malliasamai, Thirigulasamai, Sadansamai* in little millet or *samai*; *Perunthinai, Koranthinai, Senthinai, Mookanthinai, Palanthinai* in Italian millet or *thenai*; *Panivaragu* in common millet or *panivaragu* and *Thirivaragu* in kodo millet or *varagu* (Bioversity International, 2011). Earlier selections by local people have generated variability for economic characteristics. For example, in proso millet, variety Co 3 was developed from Coimbatore local with tolerance to shoot fly and early maturity (Seetharama *et al.*, 2006). In finger millet, the accession GE476 has been identified with large leaf area, high dry matter, and moderate to high photosynthetic efficiency. In pearl millet, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) collected 46 accessions from the region. The landraces are tall type with larger and broader leaves. These accessions showed significant variation with respect to photosensitivity (Rao *et al.*, 1986). In sorghum, appreciable genetic variability was collected from the region and was used in early period for developing varieties cultivated under Co-series.

Significant genetic diversity has been recorded in the case of sesame, and varieties have been developed from local landraces through selection, such as TMV-5 from a landrace of

Srivaikundam, and KRR1 and KRR2 from Karur local (Duhoon *et al.*, 2004).

The region offers significant genetic diversity for several species of vegetables, particularly cucurbits, which has been used in the development of a number of cultivars. For example, in *Lagenaria siceraria*, Arka Bahar has been developed from Karnataka local and Co 1 from Tamil Nadu local; in *Luffa acutangula*, Co 2 and Co 1 and in *L. cylindrica*, Co 1, have been developed from Coimbatore type and local germplasm; in *Cucurbita moschata*, Co 1 and Co 2 have been developed through selection from local germplasm; in *Momordica charantia*, Co 1; in *Trichosanthes anguina* Co 1 and Co 2; and in *Benincasa hispida*, Co 1 and Co 2 through selection from the local germplasm (Sirohi *et al.*, 2005). In onion, Co 2, Co 3, and Co 4 have been developed through mass selection in Tamil Nadu local, while MDU1 was developed by mass selection in Somlathi local (Pandey *et al.*, 2005). In okra, the region offers genetic resource in the form of wild relatives, *Abelmoschus angulosus* and *A. ficulneus*, conserved by local communities for centuries.

Among seed spices, in coriander, several products have been developed using local/adapted germplasm: Co 1 is a selection from Koilpatti local, Co 2 is a reselection from collection P2 from Gujarat, CS287 is another reselection from Guntur collection, and Co 3, a reselection from Acc 695 of Indian Agricultural Research Institute (IARI), in turmeric, Co 1, BSR1, and BSR2 are clonal selections from induced mutants of Erode local (Ravindran *et al.*, 2005b). Also, in case of chilis used as spices, the

varieties like Co 1, Co 2, and Co 3 have been selected from the local germplasm.

The tropical fruits cultivated in the region offer significant genetic diversity. For example, in mango, it is represented by traditional varieties like *Banganpalli* (large fruit), *Bangalora*, *Neelum* (dwarf, regular bearing), *Rumani*, *Mulgoa*, and in banana by *Pachable*, *Karpurvalli*, *Monthan*, *Morris*, *Mysore Poovan*, *Nendran*, *Pachanadan*, *Rasthali*, *Robusta*, etc. In acid lime (*Citrus aurantifolia*), PKM1 is a seedless line; in lemon (*C. limon*), *Galgol* and *Euroka* are traditional cultivars; in pomegranate (*Punica granatum*), the variety Ganesh has been derived from local *Alandi*, and G173 from Ganesh (Karihaloo *et al.*, 2005). Additionally, the region offers rich genetic diversity in *Tamarindus indica*.

The region also offers genetic variability in common tuber crops of the family Araceae, like taro (*Colocasia esculenta*), elephant-foot yam (*Amorphophallus paeoniifolius*), tennia (*Xanthosoma sagittifolium*), and giant taro (*Alocasia macrorrhiza*). The national collections of elephant-foot yam include two distinct types, namely 'Karuna' from Tamil Nadu with a small discoid mother rhizome bearing oblong tuberous cormels, and 'Chena' from Kerala with very large discoid rhizomes. *Karuna kizhangu* found in Tamil Nadu also produces corms (Edison *et al.*, 2005).

The region has large tracts of arid and semi-arid lands, where pastoral agriculture is the main activity among resource-poor farmers. They have developed some unique practices to support survival and keeping

of livestock, conserving natural resources. For example, *Korangadu* is a traditional grazing land in the semi-arid tracts in the districts of Erode, Karur, and Dindigul (Fig. 3). It consists of paddocks (small enclosed fields) having a typical combination of grasses, legumes, and trees, fenced with live thorny shrubs of *mullukiluvai* [*Commiphora berryi* (Arn.) Engl.], a thorny drought-resistant shrub. Basically, it is used as a breeding tract called *Kangayam* of cattle, which supply good quality plow and draft bullocks, local buffaloes and native breeds of sheep (*Mayilambadi* breed) and goats. This unique system, displaying indigenous knowledge regarding the management and conservation of unique animal breeds, their upkeep, rearing, along with conservation of grasslands, is a valuable heritage system that needs to be preserved and promoted. It has been considered by FAO (Food and Agriculture Organization of the United Nations) as a Globally Important Agriculture Heritage System under other potential systems and sites (FAO, 2008a, 2008c). However, it is being threatened by several factors, mainly the lack of awareness regarding the benefits of this system for the region.

Additionally, the recent study regarding the local communities in the different areas of the region has discovered the evolution and conservation of several breeds. For example, in case of cattle, breeds like *Kangayam* derived from the *Kangayam* division of Coimbatore and several other breeds in different parts of the region, such as *Mee Konga*, *Mazha Konga*, *Palamalai*, *Alambadi*, *Mottai* cattle (Tanjore polled cattle

or *Umbalachery*), *Jallikattu* (*Pulikulam* or *Jellicut*), *Tondainadu* (*Tiruvannamalai*), *Tirunelveli* – a hill breed, *Thambiran madu* (bred by Kannadas), *Irucchali* (nearly extinct, from Shivaganga district), *Konadan* (*Manapparai*), *Perambalur mottai* cattle (*Mottai madu*), *Semmarai* (*Malayan* or *Bargur*; bred by the Lingayats) are bred and conserved by different communities (<tamilnaducattle.blogspot.com/2011/01/tamilnadu-cattle-breeds.html>). Similarly, in case of sheep breeds like *mecheri* (*Maiylambadi* – from Salem, Erode), *mandya* (*Bannur* and *Bandur* – from Mandya, Mysore), *Karuvai* (*kilakarsal*), *Kurumbai* (from Coimbatore), *Tiruchy Karungurumbai* (tiruchy black – from Tiruchy, Perambalur, Tiruvannamalai, Salem and Dharampuri) have been bred and conserved in the region (Bhatia and Arora, 2005).

The river system is very rich in fish biodiversity (Jayaram *et al.*, 1982; Balasundaram *et al.*, 1999; <fish.mongabay.com/data/ecosystems/Cavally%20River.htm>). The fish diversity of Periyar, originating as a natural spring in the Kolli hills, recorded a total of 19 species of fish belonging to 15 genera and 9 families. Of the 19 species, most are under threat. *Ompok bimaculatus* and *Pseudeutropius atherinoides* are endangered and *Barilius bendelisis*, *Puntius sophore*, *Labeo calbasu*, and *Mystus cavasius* come under the low risk nearly threatened (LRNT) category, and *Cirrhinus reba*, *Puntius conchonius*, *Mystus vittatus*, *Mystus bleekeri*, *Awaous guamensis*, *Clarius batrachus* and *Mastacembelus armatus* are vulnerable species (Balasundaram *et al.*, 2001).

In the coastal areas of the region, fishing is a major agricultural activity. The coastal fishing communities in Sirkali Taluk have used the *Catamaran* for the last 2000 years. It is a sustainable ecofriendly traditional fishing system crucial for preserving and promoting sustainable fishing in coastal areas. The *Catamaran* is a type of multihulled boat or ship consisting of two hulls or *vakas*, joined by some structure, the most basic being a frame, formed of *akas*. It has evolved into a light watercraft called *Kattumaram* in the Tamil language. The word *kattu* means ‘tie’, and *maram* is the ‘wood tree’, thus, *Kattumaram* simply means ‘tying two trees together’ (Fig. 4). It was invented by the *Paravas*, an aristocratic fishing community of southern Tamil Nadu. Recently, this system has also been considered by the FAO as one of the Globally Important Agriculture Heritage Systems under other potential systems and sites (FAO, 2008a, 2008b) needing protection, promotion and use in other parts of the world with similar conditions for sustainable/conservation fishing.



Figure 4. A traditional *Kattumaram* boat for fishing. (Source: Wikipedia)

Future perspective

The biodiversity of the region is being threatened by a number of factors, including expanding agriculture, and needs attention with suitable strategies for protection and conservation. Though the Cauvery river basin, with its network of canals and aqueducts, is the granary of Tamil Nadu, it has seen decreasing rainfall in the last few decades. Appropriate rain harvesting and augmentation of irrigation facilities can help overcome the shortage of water and bring more marginal lands under intense cultivation. High-value, quality vegetable, flower and fruit production under normal and technologically managed greenhouse conditions can provide value additions to the products and greater income to the farmers.

Korangadu pasture land needs to be protected and promoted, as it can provide financial security to resource-poor farmers and help conservation of local livestock breeds and plant diversity of forage value. Awareness needs to be generated at the local, regional, national and international levels for possible initiation or replication of such systems. But before that, the traditional knowledge of grassland management practices, livestock management and ethno-veterinary practices needs to be experimentally analyzed to justify the gains, for preservation,

The recent study regarding the local communities in the different areas of the region has discovered the evolution and conservation of several breeds.

In the coastal areas of the region, fishing is a major agricultural activity. The coastal fishing communities in Sirkali Taluk have used the Catamaran for the last 2000 years.

promotion, and documentation. Same may apply to the *Kattumaram* boat for promotion of conservation fishing without damaging the fish biodiversity, and many other practices followed in the region for river and water management.

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