Final Report of the work done on the
Minor Research Project

Sanctioned by UGC

To

Dr. K. Danielkutty, Associate Professor,
Department of Botany, St.Thomas College
Kozhencherry, Pathanamthitta Dt., Kerala
(Retired)

Survey, identification, conservation and propagation of rare, endangered and endemic medicinal plants of Ethno-botanic importance in the Pampa River basin, Kerala and strategies for their in-situ and ex-situ conservation.

Statements of Expenditure, Utilization Certificates, Final Report of the work done, Undertaking etc.(Annexure III-VIII)

MRP(S)-980/10-11/KLMG022/UGC-SWRO
Dated 10/2/2011

Acknowledgement

The University Grants Commission has sanctioned me a Minor Research Project intitled

"*Survey, identification, conservation and propagation of rare, endangered and endemic medicinal plants of Ethno-botanic importance in the Pampa River basin, Kerala and strategies for their in-situ and ex-situ conservation"* wide the sanction order no. MRP(S)- 980/10-11/KLMG022/UGC-SWRO, Dated 10/2/2011.

I have undertaken the work in the Department of Botany, St.Thomas College, Kozhencherry, Pathanamthitta Dt., Kerala.

I am extremely thankful to UGC for sanctioning the project.

I am thankful the the Principal, Manager and staff members of the Botany Department for providing all the required facilities in the Botany Department for the fulfillment of the project.

Dr. K. Danielkutty

SURVEY, IDENTIFICATION, CONSERVATION AND PROPAGATION OF RARE, ENDANGERED AND ENDEMIC MEDICINAL PLANTS OF ETHNO-BOTANIC IMPORTANCE IN THE PAMPA RIVER BASIN, KERALA AND STRATEGIES FOR THEIR *IN SITU* AND *EX SITU* CONSERVATION.

Introduction

India is bestowed with unique diversity in culture and natural vegetation exhibiting rich plant diversity. It has all known types of agro-climatic, ecologic and seraphic conditions. It also has unique biogeographically positions having all known types of eco-systems. It harbors about 17500 flowering plants out of which 2000 plants are used in various classical systems of medicine like Ayurveda, Sidda and Unani. These Indian systems of medicine use predominantly plant materials for the preparation of their drugs. The tribals and other communities used about 8000 species of wild plants as traditional medicine (Pushpangadan, George and Sathish Kumar, 1994). To achieve the goal of *health for all* there is a need for global movement for conservation of medicinal plants and revitalization of the native health traditions of local communities (Somanadan *et al*, 1999). The variety of uses and vernacular names which these plants have are an indication of the awareness and knowledge which local communities possess about them. (Kerala Agricultural University, Medicinal plants for home remedies, 2006).

Medicinal plants are living and irreparable resources, which is exhaustible if over used and sustainable if used with care and wisdom. The importance of medicinal plants has been overlooked in the past. However, at present medicinal plants are looked upon not only as a source of affordable health care but also as a source of income. According to a WHO report,

over 80% of world population relies on traditional medicine, largely plant-based, for their primary healthcare needs.

The forest areas have been the traditional source of medicinal plants and herbs. The position can not be sustained much further because on the one hand the area under forests has been steadily shrinking and on the other the requirements of the medicinal plants and herbs has increased steeply. This has resulted in unscientific and over exploitation of medicinal plants in the forests. One indication of the scarcity of some medicinal plants is their steep prices. The ministry of Environment and Forests have already banned 29 endangered species of medicinal plants from their natural habitats.

Nearly 95% of the medicinal plants are harvested from the wild. The population, urbanization, shrinking forests, over harvesting and related factors has brought several medicinal plants to the very brink of extinction. Conservation of threatened medicinal plants is therefore considered to be the most important responsibility of all nations and institutions particularly the biodiversity rich nations.

Medicinal plants are renewable natural resources. Both conservation strategies, i.e., i*n situ* and *ex situ* can be adopted for conservation of medicinal plants. *In situ* conservation includes setting up of natural parks, sanctuaries, biosphere reserves. On the other hand *ex situ* conservation of medicinal plants can be accomplished by means outside natural habitats by cultivating and maintaining plants in botanic gardens, parks, other suitable sites, and through long term preservation of plant propagules in gene banks (seed bank, pollen bank, DNA libraries, etc.) and in plant tissue culture repositories and by cryopreservation.

Nearly 95% of the medicinal plants are harvested from the wild. The population, urbanization, shrinking forests, over harvesting and related factors has brought several medicinal plants to the very brink of extinction (Arora, 1997). Conservation of threatened medicinal plants is therefore considered to be the most important responsibility of all nations and institutions particularly the biodiversity rich nations (Winfred Thomas *et al,* 2003). The ministry of Environment and Forests have already banned the collection of 29 endangered species of medicinal plants from their natural habitats (Binu, 2010).

Pathanamthitta District came in to existence in 1992. It is carved out from the portions of three districts, viz. Kollom, Alappuzha and Iduki and occupies an area of 2697. 15 sq. km. It lies between 09^0 05'N latitude and $76^0$16'E longitude.The district is divided in to 5 taluks, viz. Ranni, Kozhencherry, Adoor, Tiruvalla and Mallappally.Topography is highly undulating with hills and valleys. Altitude ranges from 5-1200 m. The lowest is represenred by Tiruvalla and the highest by kakki hills (1000-1200m).Temperature varies from 24 to 30^0 in plains and 15 to 32^0 in the hills. March, April and May are the hottest months whereas December and January are the coldest. The southwest monsoon (June to September) and Northeast monsoon (October to November) provide an average of 714 and 450 mm rain respectively. The District experiences a tropical humid climate and relative humidity varies from 64 to 98%. Forest occupies 64% (1724 sq. km.) of the total area of the district.Tropical evergreen, tropical semievergreen, tropical moist deciduous, sholas and grasslands are the main vegetation types.

The Pampa River is the third largest river in Kerala (176 km) also has the fourth largest catchment area (2235 sq.km), starts from the Western Ghats of Pathanamthitta Dist, flows as a silver line along the heart of the central Travancore, becomes stagnant at the rice bowl of Kerala (Kuttanadu) and falls in the Arabian sea . Pampa River called the 'Dakshin Ganga', the Ganges of the South, drains through the foot hills of Sabarimala where the World famous pilgrim centre Sabarimala Sree Dharma Sastha Temple, the abode of Lord Ayyappa is located. The area surrounding the Sabarimala Temple is called Poomkavanam (Holy Garden) or Prasadam which consists of forests around18 hills. About 1550 km^2 of the catchment area of the river is with in Pathanamthitta District (lies between 9^0 15'- 9^0 30' N and longitude 76^0 20'- 77^0 15' E. Dozens of tributaries originating from Sabarimala -- surrounded by 18 hills -- join the River Pampa at various spots.

This river enriches the Pathanamthitta, Alappuzha districts of Kerala state. Kuttanad, an important rice cultivating area in Kerala gets the irrigation water from the Pamba river. The Pamba basin is bounded on the east by the Western Ghats. The river shares its northern boundary with the Manimala River basin, while it shares the southern boundary with the Achankovil River basin.Lord Ayyappan (Sri Dharmasastha) appeared to the Pandalam Raja as a

child on the banks of the Pamba River.The Pamba River has been venerated as Dakshina Ganga, and devotees of Lord Ayyappan believe that immersing oneself in the Pamba is equivalent to bathing in the Holy Ganges River. Bathing in the river, believed to absolve one's sins, is a requirement before commencing the trek through the forest to the Ayyappan Temple atop Sabarimala.The Pampa water purifies one from curse and evil. Neelimala, Appachimedu, Sabareepeedam, Saramkuthi are the other divine places enroute. Pampa basin area is known for its rich herbal wealth and flora it may be due to its **Purity and medicinal wealth** that augments the health of the devotees. Aaranmula Paarthasarathi Temple, Thakazhi Dharmasastra Temple are the other pilgrimage centers that dot the banks of Pampa. St. Thomas College, Kozhenchery is located on the bank of the river, only one KM away.

River Pampa basin is rich in biodiversity especially medicinal plants. These areas are unexplored and there are no major conservation projects. Anilkumar, Sivadasan and Ravi studied the Flora of Pathanamthitta District Western Ghats Kerala and it was published by Daya Publishing house, New Delhi, 2006.The flora presents a systematic account of a 1249 species belonging to 658 genera and 148 families of seed plants. The species index is registered as 460/1000 sq. km. which is comparatively very high and indicates the richness of the floristic diversity of the District. An analysis of the flora showed that 260 species are endemic which formed 22% of the total species. About 200 species are rare, and 175 are severely threatened, most of which are local endemics. They collected 90 wild relatives of cultivated crop plants (Anilkumar *et al*, 2006).

An environment committee of the Kerala assembly, which recently came out with a report on Sabarimala, said the hill shrine faces a grave environmental risk mainly because of the degradation of the Pampa river system. "The menace posed by pollutants and the stress caused on its fragile environs is a grave threat to the very sanctity of the forest temple at Sabarimala," the report warned. Another study conducted by the Thiruvananthapuram-based government-funded Centre for Earth Science Studies said the Pampa, the

third largest river in Kerala fed by nearly 270 mountain streams, has "reached horrifying levels of pollution and degradation".

The annual pilgrimage to Sabarimala by millions of devotees and Christian and Hindu religious conventions held every year on the banks of the Pampa are destroying the river and its environment, say government-instituted studies. As many as 30 million Hindu pilgrims from across the country travel to Lord Ayyappa's temple deep inside the hill forests of Sabarimala every year.

The report held a popular Christian convention organised every February by the Mar Thoma Church on the river's bank at Maramon, the annual Hindu festival held at Cherukolpuzha, and the annual Hindu pilgrimage to Sabarimala responsible for this.

Tribal communities depend mainly on plant resources for herbal medicines, food, forage, construction of dwellings, making household implements, sleeping mats, and for fire and shade. In 1916, Robins Harrington and Feiro Marreco promulgated the broad definition of ethnobotany and considered it as a study and evaluation of the knowledge of all phases of plant life amongst primitive societies, and of the effects of vegetal environment upon the life, customs, beliefs and history of the people of such societies. Later in middle of the 20th century anthropological and ecological aspects were also included with it. Ethnography is the systematic study of primitive people and their cultures. It is designed to explore cultural phenomena of the community through means of various anthropological research methods (Harsha *et al*, 1992).

The primitive tribals acquired the knowledge of economic and medicinal properties of of many plants by trial and error methods and they are the store house of such knowledge.This accumulated knowledge is passed on from one generation to the other by oral tradition without any written document.The life and culture of the tribals in the district is fast changing

due to the developmental activities initiated by Government and non-government agencies. Medicinal plants play a key role in the daily life of the tribals in the district.

The tribal tracts are the store house of information and knowledge on the multiple uses of plants. Tribal communities depend almost entirely on plant resources for all their needs. They depend on plants for medicines, food, forage, construction of dwellings, making household implements, sleeping mats, fire and shade, and for a score of other uses.

India has 8.24% tribal population; Kerala has only 1.14%. Tribals in Kerala are living on the hill ranges, mainly on the Western Ghat, bordering Karnataka and Tamil Nadu. As a natural border, the mountain has branches in Kerala as well as in Tamil Nadu and Karnataka. The tribals on the Kerala hills are only listed here.

Adiyan	Irular	Kattunaikkan	Kurichiyan	Malavedan	Mannan
Alar	Kadar	Kochuvelan	Kuruman	Malakkuravan	Muthuvan
Aranadan	Kammara	Koraga	Kurumban	Malasar	Mudugar
Cholanaikkan	Kanikkaran	Koda	Malapandaram	Malayan	Palaiyan
Iravallan	Kani	Kudiya	Malappulayan	Mala Arayan	Paniyan
Ulladar	Urali				

Tribals of Pathanamthitta

In Pathanamthitta District 6 tribal communities, Malappandaram, Urali, Mala-arayan, Ullladan, and Malakurava consisting only 0.6% of the total population of the District. In the past they lived on hunted food, tubers, roots, and wild fruitsand now they use rice as their stable food.

They collect Non Wood Forest Produce and barter them in local market for rice and other complimentary things.

Malapandaram

Population- 2122 Literacy 35.4%

Mala Pandarams are found in Achancoil, Pathanapuram, Naduvathumoozhy and Mannarappara forest ranges in the Pathanamthitta and Kollam districts of Kerala. They live by hunting and collection of forest products.

Malavedan

Alternate name: Malai Vedan

Population - 2435 Literacy 44.53%

Mala Vedans are found in the Pathanamthitta, Thiruvanathpuram and Idukki districts in Kerala. The main occupation is hunting and collection of forest produces.

Malakkuravan

Population - 584 Literacy 49.38%

The Malakkuravan's are found in Thiruvananthapuram, Pathanamthitta, and Kottayam districts. They are engaged in hunting, collection of honey and agriculture. Women are engaged in fire-wood collection, fortune-telling and palmistry.

Mala Arayan (Malayarayar)

Population – 24,949 Literacy 73.24%

Mala Arayans are found in Meenachil and Changanasseri Taluks of the Kottayam district and Pathanamthitta district. Due to the educational work of the CMS missionaries, they are well educated, socially and economically more developed than any other tribal communities in Kerala.

Urali (**Uraly)**

Population: 10335 Literacy 50.4 %

Urali tribe is found in Idukky, Kottayam and Kollam districts. Until the recent past, most of them used to live on small huts made on tree tops inside the forest. They are engaged in cultivation and collection of forest produces.

Ulladar

Population - 11687 Literacy 50%

Ulladar communities are seen in the forest as well as costal areas. Both these communities are included in the Scheduled Tribes list and are seen in Pathanamthitta, Thrisur, Idukki, Kottayam, and Kollam districts. Their main occupation of those on the hills used to be cutting trees, collection of fire woods while those who are in the costal area engage in making country boats and its maintenance. Some of them are also experts in catching turtle with special type of rode Binu, S. (2010).

Rare, Endangered and Threatened (RET) plants

The most serious aspect of the loss of biodiversity is the extinction of species. Once a species is eliminated, the unique information contained in its DNA and the special contribution of characters that it possessed are unlikely ever to be repeated again. Once a species goes extinct, their chances for further evolution are lost.A species is considered extinct when no member of the species remains alive anywhere in the world. A species that is found in only a single geographical area and nowhere else is said to be endemic to that area. Endangered species are that have a high likelihood of going extinct in the near future. Rare species are that have small total numbers of individuals often due to limited geographical ranges or low population densities. Species that may become endangered in the near future because populations of the species are decreasing in size throughout its range are vulnerable. Threatened species include those which are endangered, vulnerable and rare in IUCN categories. Conservation of rare, endangered and threatened (RET) plant species is an important issue. Hundreds of RET plants in India have already been recorded and their conservation suggested (Jain, 1983). The *Red Data Book (Nayar and Sasthri)* has enlisted 622 vascular plant species of Indian

flora till1990; this red figure rose to 1255 vascular plants till 2003, and it is on the increase day by day (Sanjappa et al 2012). In India, the RET species constitute7.7% of known Vascular plants. Globally, 13.8% of VPS are RET (Rao *et al*, 2003). According to the International Union for Conservation of Nature and Natural Resources, the current species extinction rate is between1000 and 10,000 times higher than it would naturally be. Once a species becomesextinct, the particular genetic resourceis lost forever.

***In situ* conservation strategy**

Plant tissue culture is an important tool under biotechnology .Plant tissue culture is the in vitro culturing of cells, tissues or organs in a nutrient media aseptically under controlled conditions. Tissue culture is providing to be rich and novel sources of variability with a great potential in crop improvement without resorting to mutation or hybridization.

In tissue culture large number of cells can be grown in a sterile controlled environment. The cells are obtained from stem, and leaf or other plant parts and are allowed to grow in culture medium containing organic and inorganic mineral nutrients, vitamins, carbon source, nitrogen source and growth regulators to encourage cell division and growth. In culture, highly organized and differentiated explants divides and re divides into an un organized proliferative masses of cells called calli .Each callus undergoes differentiation into shoots and roots and form plantlets.

Different types of media have been used by different workers for tissue culture. Formulations which served as basic medium for a wide spectrum of plant tissue culture were that of MS medium (Murashige and Skoog, 1962) , SH medium (Sehenk and Haberlandt,1972), Nitsch & Nitsch (1956), White (1963) ,and Gamborg's B5 (1968) media. Growth regulators particularly Auxin and Cytokinines are very important components of tissue culture media, but their selection and concentration depend upon the plant species and purpose of culture.

One of the most popular applications of plant tissue culture is micro propagation. It is the practice of rapidly multiplying stock plant material to produce large number of progeny plants, using modern plant tissue culture technique. Micro propagation is

an alternative to vegetative propagation. Different steps of micropropagation includes, initiation of culture from explants on a suitable nutrient medium , multiple shoot formation from the cultured explants, rooting of in vitro developed shoots, transplantation to the field following acclimatization. Propagation using nodal segment culture, through direct organogenesis, indirect organogenesis and somatic embryogenesis are in practice (Reinert and Yeoman, 1983)

In this project study the experimental plant selected is a medicinal plant *Tylophora indica (Burm.f) Merril.* The plant belongs to the family Asclepiadaceae. It is an Ayurvedic herb with the Sanskrit name of Anthrapachaka and in Malayalam Vallippala. The plant is a slender much branched laticiferous climber. Thick; long fleshy roots longitudinally fissured light brown corky bark. Leaves are oblong, acute and cordate at the base. Flowers are minute in axillary, umbellate cymes. Calyx divided nearly to the base, densely hairy outside. Corolla is greenish purple and fruits are follicles.

Tylophora indica (Burm.f) Merril. is traditionally used as a folk remedy for the treatment of bronchial asthma, bronchitis, inflammation, allergies, rheumatism, and dermatitis. Apart from this it is a good remedy in traditional medicine as anti-psoriasis and leucopenia. The leaves and roots have laxative, expectorant, diaphoretic and purgative properties.*Tylophora asthmatica* is recently adopted as the one of the important drugs from natural source for the treatment of respiratory diseases. Clinical studies have shown effectiveness of the drug in bronchial asthma and thus modern research withstands the ancient claims of our traditional healers. (Singh, 2005).

The chemical constituents in this plant are the alkaloids Tylophorine and Tylophorinine, which is responsible for the antibacterial, antifungal, anti inflammatory; anti allergic properties (Mulchandani , Iyer & Badheka, 1971). The medicinally useful plant parts are leaves and roots. The plant is effectively used in Ayurvedic treatments especially for treating respiratory diseases (Gopalakrishnan *et al*, 1980).

The herbal medicines from the medicinal plants are valuable source for treating various diseases. The over exploitation of medicinal plants destroys its diversity day by day. In order to

meet the increasing demand, plant regeneration by conventional methods is insufficient for large scale production of medicinal plants. Micro propagation has been successfully employed for the large scale production of medicinal plants. Recent reports reveals that medicinal value of plants are due to the presence secondary metabolites like alkaloids, phenolics, flavonoids etc. which are the important sources of modern drugs.

Due to its high alkaloid content and medicinal importance there have been conducted many tissue cultural and pharmacological investigations *onTylophora indica*

1. In vitro regeneration and plant establishment of Tylophora indica were obtained from petiole callus culture in MS medium supplemented with 2,4-D and TDZ (Thidiazuran) (Faizal *et al*; 2005)
2. Antioxidant activity of *Tylophora indica* was experimentally proved from the leaf extract. (Malathy , *et al* 2012)
3. In vitro culturing of nodal segments of *Tylophora asthmatica*, best results of shoot and root formation occurred in MS medium supplemented with KIN (2mg/l) and BA (0.5 mg/l). (Monika Yadav and Dwivedi,*et al* 2010)
4. In vitro culturing of multiple shoots from nodal segments for rapid clonal propagation in MS medium containing 2mg/l BAP. (Sulekha Rani and J.S. Rana,2010).
5. A method of mass propagation of *Tylophora indica* (Burm.f) Merill from leaf explants supplemented with 9 mg/l NAA and 4.65 mg/l KIN resulted in callus formation. (Harmanjith Kaur,Dinesh Goyal & Manju Anand, 2001)
6. Anti -tumor activity of *Tylophora asthmatica* against Ehrlich ascites (EA cells) Jancy Stephen & Vijayammal P.L, 2000)

Objectives of the minor project

1. Identification, Preservation, Conservation, Propagation of endangered Medicinal plants of Pampa River basin, Kerala.

2. *In situ* conservation of endangered medicinal plants in Botanical garden, strengthen the facilities for germ plasm preservation in College campus, micropropagation by tissue culture methods (*ex*

situ). Study the effect of different hormones in various explants of *Tylophora asthmatica*, axillary bud proliferation from nodal explants, Callus induction and indirect regeneration and formulate a schedule for the tissue culture proliferation

3. Re-introduction of endangered taxa (*in situ*) in wild natural ecosystem with the help of Forest department, promoting cultivation of medicinal plants and its sustainable management a people's movement. Propagate the fact that growing medicinal plants is much more remunerative as compared to growing traditional and horticultural crops.

4. Make scientific documentation of the identified endemic medicinal plants.

5. Assess the threat rate of endemic plants with the help of field Botanists, Foresters, Ecologists, taxonomists, Wildlife managers, User group representatives, Pharmaceuticals firms, Representatives of industries, Plant collectors, Herbal vendors, etc.

6. Arrange Educational and Public awareness programmmes for strengthening the idea of conservation and propagation of medicinal plants especially incorporating the Pathanamthitta District High school and Higher Secondary School Students.

7. Study the ethnic values of the endangered medicinal plants identified.

MATERIALS AND METHODS

The following institutes were consulted frequently for fulfilling the proper identification

a. Medicinal Plant Board, Govt. of Kerala, Thrissur

b. Nagarjuna Arya Vaidya Sala, Thodupuzha

c. Ousshadhi, Govt. of Kerala, Thrissur, Kerala

d. KFRI, Peechi, Thrissur, Kerala

e. Pankaja Kasthuri Medical College, Thiruvananthapuram &

f. BSI Coimbatore.

Spots of survey for the identification of plants on Pampa river basin

Gavi, Kochupampa, Kakki, Athikayam, Ayithala, Ranni, Aayikkal, Keekozhoor, Puthumon, Kiliyanikal, Vazhakkunnam, Cherukolpuzha, Melukara, Keezhukara, Kozhenchery, Aranmula.

Field surveys were conducted once in every two months from June 2011 to May 2013 in the above mentioned pampa basin about 1 km width from the river. Gavi to Aranmula extends about 100 km.Initial study trips were utilized to know more about the plants of ethnobotanic importance, rare and endangered plants, especially of medicinal importance.Tribal people were consulted to get information on the utility of plants, detailed methods of uses. Stay in tribal settlements helped to witness their pattern of plant utilizations.

Authentic identifications were done with the help of BSI Coimbatore, KFRI Trichur, Medicinal Plant Board, Govt. of Kerala, Nagarjuna Arya Vaidya Sala, Thodupuzha, Pankaja Kasthuri Medical College, Thiruvananthapuram and Ousshadhi, Govt. of Kerala, Thrissur, Kerala. These institutions were visited to compare the specimens with the Herbaria preserved there and also to obtain expert opinion for scientific documentation. Prepared Herbarium and reported the plants which are in the brink of extinction. Implemented *ex situ* conservation of endemic plants in the Botanical garden of St. Thomas College.

Developed tissue culture protocol for the micropropagation of *Tylophora indica (Burm.f) Merril.*The tissue culture work undertaken was to study the effect of different phytohormones such as IAA, IBA, NAA, 2, 4-D, BA and KIN. Nodal segments stem and leaves were used as the source of explants for the study.

Resullts

1.Rare, Endangered and Threatened (RET) plants Identified from Pampa basin

Nodal segment culture

Nodal segments when inoculated into the medium containing IAA (0.2 mg/l) and KIN (0.2 mg/l) induced low basal callusing (Plate 1.1). In higher concentrations of IAA (2 mg/l) and KIN (4mg/l) showed moderate callusing (Plate 1.2). When IAA (2mg/l) along with BA (2mg/l) was supplemented to MS medium, axillary bud initiation was observed (Plate 1.3).

Nodes cultured in MS medium containing IBA (3mg/l) and BA (3mg/l) showed callusing with direct shoot formation (Plate 1.4). Increasing concentrations of IBA (5mg/l) coupled with BA (3mg/l) induced callus with multiple shoot and root formation (Plate 1.5)

Combination of NAA (5mg/l) and KIN (3mg/l) resulted in the formation of low level of brown callusing. Indirect organogenesis with multiple shoot formation were observed when a combination of IAA (2mg/l) and IBA(2mg/l) were added to MS medium(Plate 1.6).While increasing the concentration of these two, frequency were also in higher level. Moderate rate of brown callusing was formed when 2, 4-D (0.7mg/l) and KIN (5mg/l) were used.

Callus induction and regeneration

For callus induction and regeneration, stem and leaves are used as explants. These explants were inoculated on MS medium containing different combinations and concentrations of growth hormones BA / KIN or along with IAA, IBA, 2, 4-D, NAA was used.

Stem culture

Stem segments cultured in MS medium containing IAA (1mg/l) and BA (3mg/l) results moderate callusing (Plate 2.1). When IAA (3mg/l) and BA (2mg/l) supplemented to the medium induced callusing on both ends. Both IAA and BA at 3mg/l induced profuse fragile callusing in

the medium (Plate 2.2). But IAA (2mg/l) along with IBA (2mg/l) showed fragile callusing with organogenesis (Plate 2.3).

In another treatment, stem segments cultured in MS medium with NAA (5 mg/l) and KIN (3mg/l) induced brown callusing. When IBA (2mg/l) along with BA (2 mg/l), light green fragile callus (Plate 2.4) as similar as when 2, 4-D(2mg/l) and KIN (2mg/l)were supplemented to the medium(Plate 2.5). When BA (6 mg/l) alone was provided to MS medium showed callusing on both ends with 5 axillary buds (Plate 2.6).

Leaf culture

When leaf explants were cultured in MS medium containing IAA (2 mg/l) and BA (4 mg/l) induced low rate of callus initiation (Plate 3.1). When a combination of IBA (1mg/l) and BA (3mg/l) was supplemented to the medium, showed initiation of light green callusing on all sides (Plate 3.2). At higher concentrations of IBA (2mg/l) and BA (4 mg/l) showed high rate of callusing (Plate 3.3).

Combinations of IAA (2mg/l) and KIN (4mg/l) showed no callus response. When MS medium with NAA (3mg/l) alone provided to the medium, showed direct regeneration of roots or rhizogenesis with callus formation (Plate 3.4), 2, 4-D (1mg/l) along with KIN (2mg/l) provided to the medium resulted low rate of callusing from one side (Plate 3.5). In another treatment, when these hormonal concentrations increased to, 2, 4-D (2mg/l) and KIN (4mg/l) provided moderate callusing in the medium (Plate 3.6).

TABLE 5

Response of nodal segments to various hormonal concentrations

Hormonal concentration (mg/l)						Rate of callusing	Response
IAA	IBA	NAA	2,4-D	KIN	BA		
0.2				0.2		+	Low basal callusing
2				4		++	Moderate basal callusing
2					2		Axillary bud initiation
	3				3		Callusing with direct shoot formation
	5				3		Callus with multiple shoot and root formation
		5		3		+	Low level of brown callusing
2	2						Indirect organogenesis with shoot and multiple root formation
			0.7	5		++	Moderate brown callusing

TABLE 6

Response of intermodal segments to various hormonal concentrations

Hormonal concentration (mg/l)						Rate of callusing	Response
IAA	IBA	NAA	2,4-D	KIN	BA		
1					3	++	Moderate callusing
3					2		Callusing on both ends
3					3	+++	Profuse fragile callusing
2	2					+++	Fragile callusing with organogenesis
		5		3			Brown callusing
	2				2	+++	Light green fragile callus
			2	2		++	Light green fragile callus
					6		Callusing with multiple shoot formation

Hormonal concentration (mg/l)						Rate of callusing	Response
IAA	IBA	NAA	2,4-D	KIN	BA		
2					4	+	Low callusing
	1				3	+	Initiation of light Low yellowish green callusing
	2				4	+++	Profuse green callusing
2				4			No response
		3				+	Low callusing with rhizogenesis
			1	2		+	Low creamy callusing
			2	4		++	Moderate green callusing

TABLE 7

Response of leaf explants to various hormonal concentrations

NODAL CULTURE

Plate 1 .1

plate1. 2

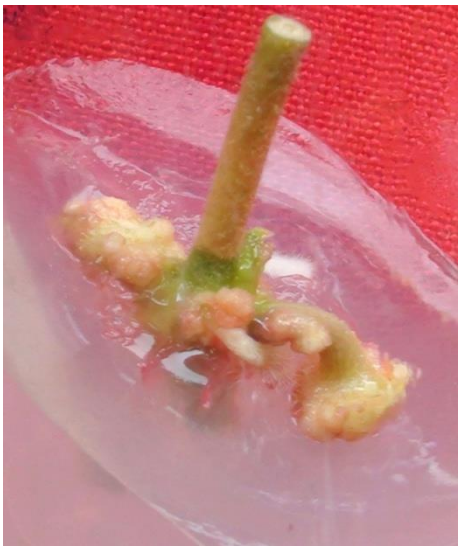

Plate 1.3

plate 1.4

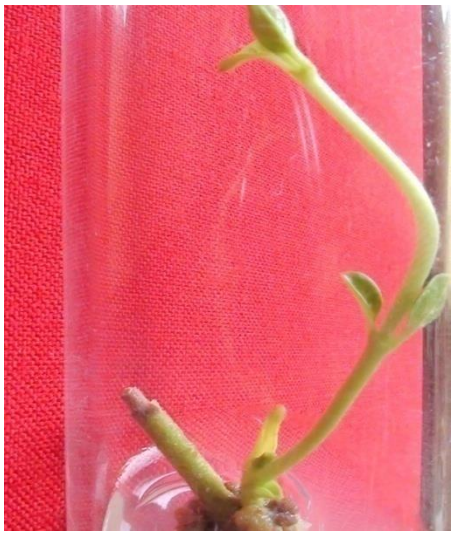

Plate 1.5

plate 1.6

STEM CULTURE

Plate 2.1

plate 2.2

Plate 2.3

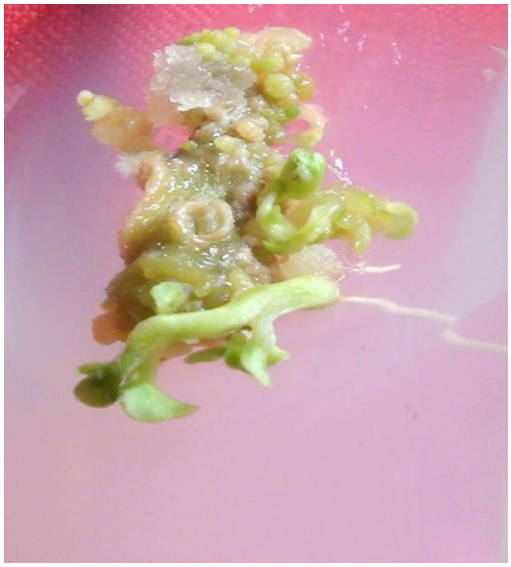

plate 2.4

Plate 2.5

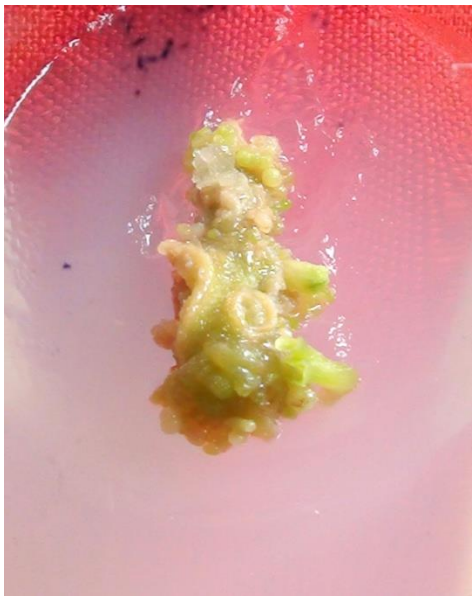

plate 2.6

LEAF CULTURE

Plate 3 .1

plate 3.2

Plate 3.3

plate 3.4

Plate 3.5

plate 3.6

Explanation of figures
PLATE 1
Discussion

The Pamba River is the third longest river in the South Indian state of Kerala after Periyar and Bharathappuzha and the longest river in the erstwhile princely state of Travancore. The pampa basin areas have been the traditional source of medicinal plants and herbs. The unscientific and over exploitation of medicinal plants from the river bank has faced a steep reduction in qualitative and quatitative amount. The ministry of Environment and Forests have already banned 29 endangered species of medicinal plants from their natural habitats. Nearly 95% of the medicinal plants are harvested from the wild. The population, urbanization, shrinking forests, over harvesting and related factors has brought several medicinal plants to the very brink of extinction. Conservation of threatened medicinal plants is therefore considered to be the most important responsibility of all nations and institutions particularly the biodiversity rich nations. Since river pampa basin is rich in biodiversity especially of medicinal plants, suitable conservation projects should be undertaken. Environmentalist, NGOs, local bodies, educational institutions should take the responsibility of conservation.

An environment committee of the Kerala assembly, which recently came out with a report on Sabarimala, said the hill shrine faces a grave environmental risk mainly because of the degradation of the Pampa river system. "The menace posed by pollutants and the stress caused on its fragile environs is a grave threat to the very sanctity of the forest temple at Sabarimala," the report warned. Another study conducted by the Thiruvananthapuram-based government-funded Centre for Earth Science Studies said the Pampa, the third largest river in Kerala fed by nearly 270 mountain streams, has "reached horrifying levels of pollution and degradation".

The Pampa Parirakshana Samithi (PPS), an eco group that has been campaigning for the cause of river Pampa since the past 25 years, has predicted the chances of a major deluge in Pathanamthitta and Alleppy districts, if the authorities concerned failed to rejuvenate the tributaries of river Pampa in a time-bound manner. Pathanamthittta district has been receiving an average annual rainfall of 4200 mm which is higher than the state average.The unprecedented flood situation following heavy rain in these districts in 2014 amply warned of the possibility of a catastrophic deluge in future. Indiscriminate sand-mining has lowered the Pampa river-bed resulting in salinity intrusion up to its Aranmula- Kozhenchery stretch in the recent past.Many sreams aand canals leading to Pampa had been illeagally converted and many others have become waste dumping areas over the past two decades.The streams and canals that have been the natural flood escape routes were very good water reservoirs that prevented flooding of villages to a certain extent in the past.The study was conducted by an expert team of PPS with financial support from the Pathanamthitta District Panchayath and Environment Department.

In India, the floristic diversity study and conservation strategies have been advanced much. Several *in situ* and *exsitu* conservation measures have been taken through biosphere reserves, national parks, botanical gardens, greenhouses, etc (Singh & Singh,2002). In spite of all those efforts, plant species are disappearing due to various causes and the red list becoming longer. (Muthu & Ganasan, 2012). Out of the 260 species of the RET plants identified by Anilkumar et al, 2006 in Pathanamthitta Dt., 73 are found in the Pampa basin, indicating a wide range of biodiversity.Through various tissue culture and micropropagation techniques vanishing plants can be regenerated. Also, a database regarding species which are recovering from RET to normal status, is essential to update the floristic status of the country. Declaration of river Pampa as abiodiversity heritage site and development of four to five metre wide ecotone on either river banks and environmental education and awareness campaign are certain urgent steps should be taken. Conservation projects with the help of neighbouring Colleges, Schools, and NGOs should be ensured. The ministry of Environment and Forests should take further

steps to bann collection of more endangered species of medicinal plants from their natural habitats (Binu, 2010).

By the survey 73 Rare, Endangered and Threatened (RET) plants and 11 endangered medicinal plants were identified from Pampa basin. Tribal people are consulted to get information in which ways they utilize these plants in their life style. Strategies for *in-situ* and *ex-situ* conservation were undertaken by planting them in the Botanical Garden of the St. Thomas College and developed a suitable protocol for tissue culture method. They showed different response in different hormonal concentrations and combinations. Nodal segments and leaves showed more response.

The following suggestions are made by the author for the river and biodiversity conservation.

1. Declare river pampa as a biodiversity heritage site
2. Declare four to five metre wide eco-tone on either river banks.
3. Raise the river bed by constructing a series of small check dams.
4. Rejuvevate the various tributaries
5. Implement the various methods of rain water harvesting to raise the ground water level.
6. Demarcate the boundaries Pampa and its tributaries
7. Promote eco-tourism and small hydro electric projects
8. Organise environmental education and awareness campaign

References

1. Anilkumar, N, Sivadasan, M and Ravi, N., 2006 . *Flora of Pathanamthitta District* (Western Ghats, Kerala), Daya Publishing house, New Delhi.

2. Arora, R.K., (1997). Ethnobotanical and its role in the Conservation and use of Plant Genetic Resources in India. *Ethnobotany* 9: 6-15.

3. Binu, S., 2010.Wild edible plants used by tribals in Pathanamthitta district, Kerala. *Indian Journal of Traditional Knowledge.*9 (2): 309-312.

4. Faisal, M, Ahmed Naseem and Mohammad Anis., 2007 An efficient micropropogation system for *Tylophora indica*: an endangered, medicinally important plant. Plant Biotechnology Reports 1(3):55-161.

5. Gopalakrishnan, C, Shankaranarayan, D, Nazimudeen, S. K and , L., 1980. Effect of tylophorine, a major alkaloid of *Tylophora indica*, on immune-pathological and inflammatory reactions. Indian Journal of Medical Research; 71: 940–948.

6. Harmanjith Kour, Manju Anand M and Dinesh Goyal., 2001. Extraction of tylophorine from in vitro raised plants of *Tylophora indica*. Journal of Medicinal Plants research, vol. 5(5) pp 729- 734.

7. Harsha, V.H., Herbar, S.S., Hedge, G.R. and Shirpathi, V., 1992. Ethnomedical knowledge of plants used by Kunabi tribes of Karnataka in India. *Fitorerapia.* 73: 281-287.

8. Ignacimuthu, S., Ayyanar, M., Sankarasivaraman, K. (2006).Ethnobotanical investigations among tribes in Madurai district of Tamil Nadu, India. *Journal of Ethnobiology and Ethnomedicine* 2:25.

9. Jain, S. K. and Rao, R. R. (eds), 1983. *An Assessment of Threatened Plants of India*, Botanical Survey of India, Howrah, pp. 1–334.

10. Jancy Stephen and Vijayammal, P.L., 2000. Anti-tumor activity of *Tylophora asthmatica.* Ancient science of life, July-Dec. (1-2):88-91

11. Jayanthi, M and Mandal, P .K., Plant regeneration through somatic embryogenesis and RAPD analysis of regenerated plantlets in *Tylophora indica* (Burm. f.) Merrill. In Vitro Cellular &Developmental Biology- Plant 2001; 37:576–580.

12. Kerala Agricultural University, 2006. *Medicinal plants for home remedies*. Educational CD.

13.Malathy, R, John, S. A, and Cholarajan, A., 2012. Anti oxidant activity of extract from the leaves of *Tylophora indica.* Journal of Microbiol. and Antimicrob.vol. 4 (4) pp 70-73, April

14. Manivannan, K., 2010. Strategies for conservation of RET medicinal plants of South India, *Proceedings of Internanational Forestry and Environment Symposium*, Published by the Dept.of Forestry and Envi.Sciences, University of Jayewardenepura, Srilanka.

15. Muthu, R. K. and Ganesan, R.,2012., *Rheedea*, Department of Botany, Calicut University, **22** (2), 03–106.

16. Mulchandani, N. B, Iyer, S.S, Badheka, L.P.,1971 Structure of tylophorinidine: a new potential anti-tumor alkaloid from *Tylophora indica*. Chem Ind 1971; 19:505–506.

17. Nayar, M. P. and Sasthri, A. R. K. (eds),1990.,*Red Data Book of Indian Plants*, Botanical Survey of India, Calcutta, 1987, vol.1, pp.1–371; 1988, vol.2, pp. 1–273;1990, vol. 3, p. 1–279.

18. Pushpangadan, P, George, V, and Sathish Kumar, C. 1994. Sustainable utilization of lesser known forest products of Kerala- *Final scientific and technical report*. TBGRI, Trivandrum

19. Reinert,J, Yeoman,M.M(ed.)1983: Plant cell and Tissue Culture. Biologia Plantarum Nov , Vol.25, issue 6,p 411

20. Rao, C. K., Geetha, B. L. and Suresh, G.,*Red List of Threatened Vascular Plant Species in India*, ENVIS, Botanical Survey of India, Howrah, 2003, pp. ix–144.

21. Sanjappa, M., Paul, T. K. and Lakshminarasimhan, P., 2012.In *Biological Diversity –Origin, Evolution and Conservation* (eds Sharma, A. K., Ray, D. and Ghosh, S.N.), West Bengal Biodiversity Board, Kolkata, Viva Books, New Delhi, 2012, pp. 243–251.

22. Singh Amrith pal., 2005. Phycological considerations of *Tylophora asthmatica.* Ethnobotanical leaflets vol 2005: Iss 1 Article 47

23. Singh, N. P. and Singh, K. P. (eds), 2002. *Floristic Diversity and Conservation Strategies in*

India, Botanical Survey of India, Kolkata, 2002, vol. 5, pp. 2341–3090.

24. Somanadan, B, Pushpangadan, P, George, V, Rajasakharan, S, Gudiksen, L, Smitt, UM and Nyman, U., 1999. An ethnopharmacological survey of potential angiotensin converting enzyme inhibitor from Indian medicinal plants. *J Ethnopharmacol.* 65, 103-111.

25. Sukumaran Nair, N., 2015. The Pampa Parirakshana Samithi (PPS), Study report 2015, The Hindu National *Daily*, Saturday, May 23.

26. Sulekha Rani, and Rana A S., 2010. In Vitro-propagation of *Tylophora asthmatica* – Influence of Explanting season, Growth regulators synergy, Culture passage and planting substrate. Journal of American Science, 6(12).

27. Yadav, M, Dwivedi, P,Singh, P and Singh, V.K.,2010. In vitro culture protocol of *Tylophora indica*, an anti-asthmatic medicinal herb. Indian Journal of Plant Physiology

28. Winfred Thomas D, Oliver King M. S., Soundrapandi, J and Narasimhan, D., (2003) "Evolution of Livelihood strategies among geographically isolated hill tribes of South India", Indian *Journal of Traditional Knowledge* Vol.4.

Annexure - III
UNIVERSITY GRANTS COMMISSION, BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

STATEMENT OF EXPENDITURE IN RESPECT OF MINOR RESEARCH PROJECT

1. Name of Principal Investigator :Dr. K. Danielkutty
2. Deptt. of PI _ :Botany
   Name of College :St. Thomas College, Kozhencherry
3. UGC approval Letter No. and Date_ :MRP(S)-980/10-11/KLMG022/UGC-SWRO
   Dated10/2/2011
4. Title of the Research Project _"*Survey, identification, conservation and propagation of rare, endangered and endemic medicinal plants of Ethno-botanic importance in the Pampa River basin, Kerala and strategies for their in situ and ex situ conservation".*

5. Effective date of starting the project : 16/3/2011

6. a. Period of Expenditure : From 1/6/2011 to 31/5/2013

b. Details of Expenditure

S.No.	Item	Amount Approved (Rs.)	Expenditure Incurred (Rs.)
1	Books & Journals	5000	5096
2	Equipment	40000	35550
3	Contingency including special needs	2500	2600
4	Chemicals	2500	5415
5	Field Work/Travel (Give details in the proforma	12500	14975
6	Any Other	10000	9834
Total		**72500**	**73470**

7. If as a result of check or audit objection some irregularly is noticed at later date, action will be taken to refund, adjust or regularize the objected amounts.

8. It is certified that the grant of Rs. 72500 (Rupees Seventy Two Thousand and five hundred only) received from the University Grants Commission under the scheme of support for Minor Research Project entitled "*Survey, identification, conservation and propagation of rare, endangered and endemic medicinal plants of Ethno-botanic importance the Pampa River basin, Kerala and strategies for their in situ and ex situ conservation".*

vide UGC letter No. F. MRP(S)-980/10-11/KLMG022/UGC-SWRO Dated 10/2/2011 has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.

SIGNATURE OF PRINCIPAL INVESTIGATOR

PRINCIPAL **(Seal)**

Annexure - IV
UNIVERSITY GRANTS COMMISSION,BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

STATEMENT OF EXPENDITURE INCURRED ON FIELD WORK

Name of the Principal Investigator: Dr. K. Danielkutty

Names of the Places visited

1. BSI, Coimbatore
2. Kerala Medicinal Plant Board, Govt. of Kerala Thrissur
3. Nagarjuna Arya Vaidya Sala, Thodupuzha,
4. Pankaja Kasthuri Medical College, Thiruvananthapuram
5. Ousshadhi, Govt. of Kerala, Thrissur, Kerala
6. KFRI, Peechi, Thrissur, Kerala

Gavi, Kochopampa, Kakki Athikayam, Ayithala, Ranni, Aayikkal, Keekozhoor, Puthumon, Kiliyanikal, Vazhakkunnam, Cherukolpuzha, Melukara, Keezhukara, Kozhenchery and Aranmula.

Duration of the Visit — The Collection spots were visited twice from 1/6/2011 to 31/5/2013

Journey Expenditure Incurred (Rs.) : Rs 14975

Certified that the above expenditure is in accordance with the UGC norms for Major Research Projects.

SIGNATURE OF PRINCIPAL INVESTIGATOR

PRINCIPAL **(Seal)**

12

Annexure - V

UNIVERSITY GRANTS COMMISSION , BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

Utilization certificate

Certified that the grant of Rs. 72500 (Rupees Seventy Two Thousand and five hundred only) received from the University Grants Commission under the scheme of support for Minor Research Project Entitled "*Survey ,identification ,conservation and propagation of rare, endangered and endemic medicinal plants of ethno-botanic importance the Pampa River basin, Kerala and strategies for their insitu and exsitu conservation".*

vide UGC letter No. F._: MRP(S)-980/10-11/KLMG022/UGC-SWRO Dated10/2/2011 has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.

SIGNATURE OF STATUTORY AUDITOR

PRINCIPAL INVESTIGATOR

Principal

(Seal)

Annexure -VI

UNIVERSITY GRANTS COMMISSION, BAHADUR SHAH ZAFAR MARG NEW DELHI – 110 002.

Final Report of the work done on the Minor Research Project.

1. Project report No. Final

2. UGC Reference No.F. ___:MRP(S)-980/10-11/KLMG022/UGC-SWRO

Dated10/2/2011

3. Period of report: from __1/6/2011___to _31/5/2013

4. Title of research project "*Survey ,identification ,conservation and propagation of rare, endangered and endemic medicinal plants of ethno-botanic importance the Pampa River basin, Kerala and strategies for their insitu and exsitu conservation".*

_____

5. (a) Name of the Principal Investigator___ Dr. K. Danielkutty

(b) Deptt. __Botany

(c) College where work has progressed ___ St. Thomas College, Kozhencherry

6. Effective date of starting of the project__1/6/2011

7. Grant approved and expenditure incurred during the period of the report:

a. Total amount approved : Rs 72500

b. Total expenditure :Rs 73470

c. Report of the work done: (Please attach a separate sheet)

i. Brief objective of the project

1. Identification, Preservation, Conservation, Propagation of endangered Medicinal plants of Pampa River basin, Kerala.
2. *In situ* conservation of endangered medicinal plants in Botanical garden, strengthen the facilities for germ plasm preservation in College campus, micropropagation by tissue culture methods (*ex situ*). Study the effect of different hormones in various explants of *Tylophora asthmatica*, axillary bud proliferation from nodal explants, Callus induction and indirect regeneration and formulate a schedule for the tissue culture proliferation
3. Reintroduction of endangered taxa (*in situ*) in wild natural ecosystem with the help of Forest department, promoting cultivation of medicinal plants and its sustainable management a

people's movement. Propagate the fact that growing medicinal plants is much more remunerative as compared to growing traditional and horticultural crops.

4. Make scientific documentation of the identified endemic medicinal plants.

5. Assess the threat rate of endemic plants with the help of field Botanists, Foresters, Ecologists, taxonomists, Wildlife managers, User group representatives, Pharmaceuticals firms, Representatives of industries, Plant collectors, Herbal vendors, etc.

6. Arrange Educational and Public awareness programmmes for strengthening the idea of conservation and propagation of medicinal plants especially incorporating the Pathanamthitta District High school and Higher Secondary School Students.

7. Study the ethnic values of the endangered medicinal plants identified.

ii. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication -

International Journal on Environmental sciences 6(2): July - December 2015

iii. Has the progress been according to original plan of work and towards achieving the objective

.Yes

iv. Please enclose a summary of the findings of the study. One bound copy of the final report of work done may also be sent to the concerned Regional Office of the UGC.

A bound copy of the final report including the introduction, objectives, materials and methods, results, discussion, conclusion and bibliograpgy is enclosed

v. Any other information

SIGNATURE OF THE PRINCIPAL INVESTIGATOR

PRINCIPAL **(Seal)**

Annexure – VII
UNIVERSITY GRANTS COMMISSION, BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

PROFORMA FOR SUBMISSION OF INFORMATION AT THE TIME OF SENDING THE FINAL REPORT OF THE WORK DONE ON THE PROJECT

1. Title of the Project…"*Survey, identification, conservation and propagation of rare, endangered and endemic medicinal plants of Ethno-botanic importance in the Pampa River basin, Kerala and strategies for their in situ and ex situ conservation".*

2. NAME AND ADDRESS OF THE PRINCIPAL INVESTIGATOR …Dr. K. Danielkutty

Penattum Mukalil Veedu, Cheppara P.O, Kottarakara,Kollam Dt,Kerala

3. NAME AND ADDRESS OF THE INSTITUTION :St. Thomas College, Kozhencherry

Pathanamthitta Dt.Kerala – 689 641

4. UGC APPROVAL LETTER NO. AND DATE …___:MRP(S)-980/10-11/KLMG022/UGC-SWRO , Dated10/2/2011

5. DATE OF IMPLEMENTATION ……1/6/2011……

6. TENURE OF THE PROJECT ……2 years……

7. TOTAL GRANT ALLOCATED ……Rs 1,00000/-

8. TOTAL GRANT RECEIVED :Rs. 72500 (Rupees Seventy Two Thousand and five hundred only)

9. FINAL EXPENDITURE Rs 73470

10. TITLE OF THE PROJECT ……"*Survey, identification, conservation and propagation of rare, endangered and endemic medicinal plants of Ethno-botanic importance in the Pampa River basin, Kerala and strategies for their in situ and ex situ conservation".*

11. OBJECTIVES OF THE PROJECT …

1. Identification, Preservation, Conservation, Propagation of endangered Medicinal plants of Pampa River basin, Kerala.
2. *In situ* conservation of endangered medicinal plants in Botanical garden, strengthen the facilities for germ plasm preservation in College campus, micropropagation by tissue culture methods (*ex situ*). Study the effect of different hormones in various explants of *Tylophora asthmatica*, axillary bud proliferation from nodal explants, Callus induction and indirect regeneration and formulate a schedule for the tissue culture proliferation

3. Reintroduction of endangered taxa (*in situ*) in wild natural ecosystem with the help of Forest department, promoting cultivation of medicinal plants and its sustainable management a people's movement. Propagate the fact that growing medicinal plants is much more remunerative as compared to growing traditional and horticultural crops.

4. Make scientific documentation of the identified endemic medicinal plants.

5. Assess the threat rate of endemic plants with the help of field Botanists, Foresters, Ecologists, taxonomists, Wildlife managers, User group representatives, Pharmaceuticals firms, Representatives of industries, Plant collectors, Herbal vendors, etc.

6. Arrange Educational and Public awareness programmmes for strengthening the idea of conservation and propagation of medicinal plants especially incorporating the Pathanamthitta District High school and Higher Secondary School Students.

7. Study the ethnic values of the endangered medicinal plants identified.

12. WHETHER OBJECTIVES WERE ACHIEVED ……yes

13. ACHIEVEMENTS FROM THE PROJECT ……

Anilkumar, Sivadasan and Ravi studied the Flora of Pathanamthitta District Western Ghats Kerala and it was published by Daya Publishing house, New Delhi, 2006.The flora presents a systematic account of a 1249 species belonging to 658 genera and 148 families of seed plants. The species index is registered as 460/1000 sq. km. which is comparatively very high and indicates the richness of the floristic diversity of the District. An analysis of the flora showed that 260 species are endemic which formed 22% of the total species. About 200 species are rare, and 175 are severely threatened, most of which are local endemics. By the survey on the Pampa river bank extending 100 Km from Aranmula to Kochupampa the auther is able to identify 73 Rare, Endangered and Threatened (RET) plants and 11 endangered medicinal plants. Strategies for *in-situ* and *ex-situ* conservation were undertaken by planting them in the Botanical Garden of the St. Thomas College and developed a suitable protocol for tissue culture method. Tribal people are consulted to get information in which ways they utilize these plants in their life style.

14. SUMMARY OF THE FINDINGS

By the survey on the Pampa river bank extending 100 Km from Aranmula to Kochupampa the auther is able to identify 73 Rare, Endangered and Threatened (RET) plants and 11 endangered medicinal plants. Strategies for *in-situ* and *ex-situ* conservation were

undertaken by planting them in the Botanical Garden of the St. Thomas College and developed a suitable protocol for tissue culture method. Tribal people are consulted to get information in which ways they utilize these plants in their life style.

Explants from Tylophora indica of different region exhibited different response in different hormonal concentrations and combinations. Nodal segments and leaves showed more response. Developed a suitable protocol for the micropropagation technique.

The list of the rare, endangered and threatened (RET) plants and the endemic medicinal plants of Ethno-botanic importance in the Pampa river basin identified are appended. The necessity to conserve the pampa basin as biodiversity heritage site is the most urgent action to be taken by the Ministry and Forest Department. It needs the association of local administrative bodies, local Colleges, Schools, NGOs, etc. The new botanical garden of the St. Thomas College, Botany Department is a site if exsitu conservation of selected endemic plants of Rivver Pampa basin. This Botanical Gaden is adopted by the Kerala Medicinal Plant Board's District's Reference Garden. It is visited by the Students from the nearby Higher Secondary Schools. The ptotocol developed for the micropropagation is applied in Schools and other degree colleges for the tissue culture experiments.

15. CONTRIBUTION TO THE SOCIETY … The necessity to conserve the pampa basin as biodiversity heritage site is the most urgent action to be taken by the Ministry and Forest Department. It needs the association of local administrative bodies, local Colleges, Schools, NGOs, etc. The new botanical garden of the St. Thomas College, Botany Department is a site if exsitu conservation of selected endemic plants of Rivver Pampa basin. This Botanical Gaden is adopted by the Kerala Medicinal Plant Board's District's Reference Garden. It is visited by the Students from the nearby Higher Secondary Schools. The ptotocol developed for the micropropagation is applied in Schools and other degree colleges for the tissue culture experiments.

16. WHETHER ANY PH.D. ENROLLED/PRODUCED OUT OF THE PROJECT……No……

17. NO. OF PUBLICATIONS OUT OF THE PROJECT : 1-International Journal on Environmental sciences 6(2): July - December 2015

(PRINCIPAL INVESTIGATOR)

(PRINCIPAL) **(Seal)**

Annexure – VIII

UNDERTAKING

This is to certify that, the assets (Books, Journals and Equipments) Purchased / acquired out of grants received from the UGC, under the Minor Research Project entitled "*Survey, identification, conservation and propagation of rare, endangered and endemic medicinal plants of Ethno-botanic importance in the Pampa River basin, Kerala and strategies for their in situ and ex situ conservation"* the faculty, Dr. K. Danielkutty of –Botany Department has deposited Book & Journals worth Rs. 509 and equipments worth of Rs 33500/ are deposited to the college on completion of project and will be used for all academic purpose. Also it is certify that, **"Funded UGC"** is mentioned on all concerned Books, Journals and Equipments.

Hence, certified.

Principal Investigator

Principal **Seal**

MRP(S)-980/10-11/KLMG022/UGC-SWRO

STATEMENT IN RESPECT OF MINOR RESEARCH PROJECT 2011

1. Name of Principal Investigator : Dr. K. Danielkutty
2. Deptt. of PI _ :Botany
   Name of College :St. Thomas College, Kozhencherry
3. UGC approval Letter No. and Date_ :MRP(S)-980/10-11/KLMG022/UGC-SWRO
   Dated10/2/2011
4. Title of the Research Project _"*Survey, identification, conservation and propagation of rare, endangered and endemic medicinal plants of Ethno-botanic importance in the Pampa River basin, Kerala and strategies for their in situ and ex situ conservation".*

5. Effective date of starting the project : 16/3/2011
6. Total amount sanctioned : Rs 72500/-

The Pamba River is the third longest river in the South Indian state of Kerala after Periyar and Bharathappuzha and the longest river in the erstwhile princely state of Travancore. Sabarimala temple dedicated to Lord Ayyappa is located on the banks of the river Pamba.The Pamba is considered as the Dakshina Ganga (Southern Ganges) due to its association with Kerala's Largest Pilgrim Centre - Sabarimala.The River Pamba enriches the lands of Pathanamthitta District and the Kuttanand area of Alappuzha District. Pampa originates at Pulachimalai hill in the Peerumedu plateau in the Western Ghats at an altitude of 1650 metres and flows through Ranni, Kozhenchery, Tiruvalla, Chengannur, Kuttanad, Karthikapally, and Ambalappuzha Taluks and finally empties into the Vembanad Lake... The Pamba basin is bounded on the east by the Western Ghats. The river shares its northern boundary with the Manimala River basin, while it shares the southern boundary with the Achankovil River basin. Pampa basin area is known for its rich herbal wealth and flora it may be due to its **Purity and medicinal wealth** that augments the health of the devotees.

The forest areas have been the traditional source of medicinal plants and herbs. The position can not be sustained much further because on the one hand the area under forests has been steadily shrinking and on the other the requirements of the medicinal plants and herbs has increased steeply. This has resulted in unscientific and over exploitation of medicinal plants in the forests. One indication of the scarcity of some medicinal plants is

their steep prices. The ministry of Environment and Forests have already banned 29 endangered species of medicinal plants from their natural habitats.

Nearly 95% of the medicinal plants are harvested from the wild. The population, urbanization, shrinking forests, over harvesting and related factors has brought several medicinal plants to the very brink of extinction. Conservation of threatened medicinal plants is therefore considered to be the most important responsibility of all nations and institutions particularly the biodiversity rich nations.

River Pampa basin is rich in biodiversity especially medicinal plants. These areas are unexplored and there are no major conservation projects. The Pathanamthitta district consists of three natural divisions, viz., the lowlands, midlands and highlands. The topography of the District is highly undulating with hills and valleys Kumar, Sivadasan and Ravi studied the Flora of Pathanamthitta District Western Ghats Kerala and it was published by Daya Publishing house, New Delhi, 2006.The flora presents a systematic account of a 1249 species belonging to 658 genera and 148 families of seed plants. The species index is registered as 460/1000 sq. km. which is comparatively very high and indicates the richness of the floristic diversity of the District. An analysis of the flora showed that 260 species are endemic which formed 22% of the total species. About 200 species are rare, and 175 are severely threatened, most of which are local endemics. They collected 90 wild relatives of cultivated crop plants

The tribal tracts are the store house of information and knowledge on the multiple uses of plants. Tribal communities depend almost entirely on plant resources for all their needs. They depend on plants for medicines, food, forage, construction of dwellings, making household implements, sleeping mats, fire and shade, and for a score of other uses.

India has 8.24% tribal population, Kerala has only 1.14% .In Pathanamthitta District 6 tribal communities, Malappandaram, Urali, Mala-arayan, Ullladan,and Malakurava consisting only 0.6% of the total population of the District. In the past they lived on hunted food, tubers, roots, and wild fruitsand now they use rice as their stable food. They collect Non Wood Forest Produce and barter them in local market for rice and other complimentary things.

(iii) Objectives

1. Identification, Preservation, Conservation, Propagation of endangered Medicinal plants of Pampa River basin, Kerala.

2. *In situ* conservation of endangered medicinal plants in Botanical garden, strengthen the facilities for germ plasm preservation in college Campus, micropropagation by tissue culture methods (*ex situ*).

3. Reintroduction of endangered taxa (*in situ*) in wild natural ecosystem with the help of Forest department, promoting cultivation of medicinal plants and its sustainable management a people's movement. Propagate the fact that growing medicinal plants is much more remunerative as compared to growing traditional and horticultural crops.

4. Make scientific documentation of the identified endemic medicinal plants.

5. Assess the threat rate of endemic plants with the help of field Botanists, Foresters, Ecologists, taxonomists, Wildlife managers, User group representatives, Pharmaceuticals firms, Representatives of industries, Plant collectors, Herbal vendors, etc.

6. Arrange Educational and Public awareness programmmes for strengthening the idea of conservation and propagation of medicinal plants especially incorporating the Pathanamthitta District High school and Higher Secondary School Students.

7. Study the ethnic values of the endangered medicinal plants identified.

Result

Due to the survey 73 Rare, Endangered and Threatened (RET) plants and 11 endangered medicinal plants were identified from Pampa basin. Strategies for *insitu* and *exsitu* Coservation were undertaken by planting them in the Botanical Garden of the St. Thomas College and developing a suitable protocol for tissue culture method. Tribal people were consulted to get information in which ways they utilize these plants in their life style.