



# Biodiversity conservation and improving the livelihood of tribal communities in Biligiri Rangaswamy Temple Tiger Reserve (BRTTR) through cost effective agro-biotechnological interventions

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## Introduction

India has rich biodiversity, unique physical and ethnic diversity, much indigenous knowledge or tribal ethnobotanical knowledge in its culture. Biodiversity has been threatened by over-exploitation of natural resources, unsustainable land use management and other factors. This has degraded the ecosystem, caused insecurity to the local people and threatened biodiversity. Therefore, in this context, a study in Biligiri Rangaswamy Temple Tiger Reserve (BRTTR) was proposed. This study aimed to understand the complexities involved in human and ecosystem interactions; it also aimed to find solutions for the socio-economic development of the local tribal population and the conservation of biodiversity. So far, only limited studies have been carried out on the Biligiri Rangaswamy Temple Tiger Reserve (BRTTR). Hence, the present work aims at exploring appropriate livelihood options for the Soliga tribal population residing in BRTTR, the medicinal plants of the study region and their importance for the local economy.

Medicinal plants are not only a major resource for the traditional medicine and herbal industry but also provide livelihood and health security to a large segment of the Indian population. Predominantly, the traditional ecological knowledge (TEK) is concealed among the local healers as the extent of the research to document with an aim to improve and transfer to the future generations is minimal (Konno, 2004). Studies reported that the habitat destruction and deforestation due to variety of factors have resulted in annual loss of thousands of hectares of forests that has impacted the survival of medicinal plants in natural landscapes. Various *in-situ* and *ex-situ* conservation measures have been put forth with an aim to protect the ecologically important medicinal plants from further destruction (Cunningham 1996; Sharma and Kala 2017). In conjunction to these measures, the indigenous knowledge on traditional medicine should be documented through surveys, which can act as a knowledge library for the future generations.

Limited information is available on the uses, vulnerabilities and conservation of traditional medicinal plants in the study area. Therefore, the present study has been initiated with an objective to

add a document concerning indigenous knowledge on the use and conservation of medicinal plants by the Soliga community of BRTTR.

Traditional cropping techniques along with rural agro-biotechnological techniques can contribute substantially to human well-being by increasing incomes and by creating a sustainable environment for the developed as well as the developing countries of the world (Khan et al 2009). Promoting the cultivation of medicinal plants has been gaining importance in most of the developing countries as it has the potential to improve the livelihoods of communities dependent on forests, which in turn lead to biodiversity conservation and socio-ecological sustainability.

## Objectives

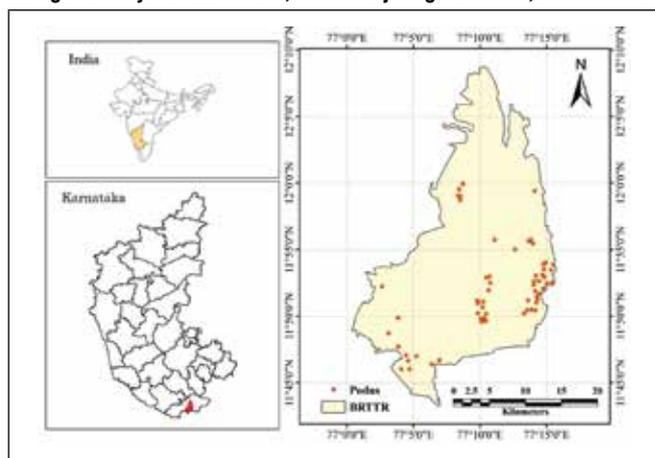
1. To undertake an in-depth survey to identify the status of a variety of medicinal and aromatic plants growing naturally in BRTTR using various ecological methods.
2. To document indigenous knowledge related to the composition of medicinal plants in traditional health care systems and the methods of prescribing them by local healers to cure a variety of ailments.
3. Cost-benefit analysis of medicinal plant cultivation and the importance of medicinal plants in local economy.
4. Development and demonstration of rural agro-biotechnology for the cultivation of a few species of medicinal plants for the socio-ecological development of the region.

## Description of the study area

The study area located in Biligiri Rangaswamy Temple Tiger Reserve (BRTTR) of Chamrajnagar district, Karnataka state. Geographically, this area is located between 11° 49' 36.31" N to 11° 54' 23.21" N and 77° 06' 48.51" E to 77° 10' 10.24" E, a chain of hills which is the meeting point of the Western Ghats and the Eastern Ghats, two of the most floristically rich areas in India. This confluence of the Western and Eastern Ghats is home to ecosystems that are unique to both the mountain ranges and makes the whole BRTTR range a very critical habitat. Thus, this sanctuary serves as an important bio-geographical

link for the biota of the entire Deccan Plateau. A wildlife sanctuary of 322.4 sq km was created on 27 June 1974, and enlarged to 539.52 sq km on 14 Jan 1987 (Fig 1). The BRT Sanctuary was declared a Tiger Reserve in December 2010. BRTTR is a protected reserve under the Wildlife Protection Act, 1973. BRTTR has the altitudinal range of 674-1651m above sea level. BRTTR is a home for a variety of medicinal and aromatic plant species. BRTTR links the Eastern and Western Ghats, allowing the movement of fauna between the two and facilitating gene flow between the populations of species in these areas. The temperature ranges from 10°C to 25°C and the annual rainfall is around 600 mm at the base and 3000 mm at the hilltop. This wide range of climatic conditions along with the altitude variations has made the study area into a highly heterogeneous forest with different vegetation types, namely scrubs, deciduous, evergreen and grasslands.

**Fig 1: Study area – BRTTR, Chamarajanagar district, Karnataka**



**Table 1: Socio-economic status of Soliga tribe**

Total number of Podus (settlements)	61
Total number of households	2854
Total population	15954
Main Occupation	Collection of NTFPs
Subsidiary occupation	Agriculture, Daily wages
Major crops cultivated	Coffee, pepper, finger millet, maize

(Source: Field survey, 2013)

## Methodology

### 1. Household survey

#### a. Demographic data

A household survey was conducted to collect data on the socio-economic status of the tribal population of BRTTR. The questionnaire was prepared and tested at the field level, with the indicators being family size, age, education, occupation, livestock details, land use, cropping pattern, medicinal plant collection and their use, annual income etc.

#### b. Traditional Ecological Knowledge Documentation:

A study was conducted among the Soligas of BRTTR to document their traditional ecological knowledge. The questions were related to traditional treatment methods and their preferences, dependency on forest resources for various purposes and medicinal plants in the forests. Local healers were interviewed in detail on the preparation methods and the dosages of the traditional medicine for curing various ailments.

### 2. Phytosociological study:

An extensive phytosociological study was conducted in the study area. Random sampling method and the standard scientific methods in phytosociological studies were followed and the data analysis has been carried out by using the variables such as frequency, density, abundance, relative dominance, relative frequency, basal area and diversity indices.

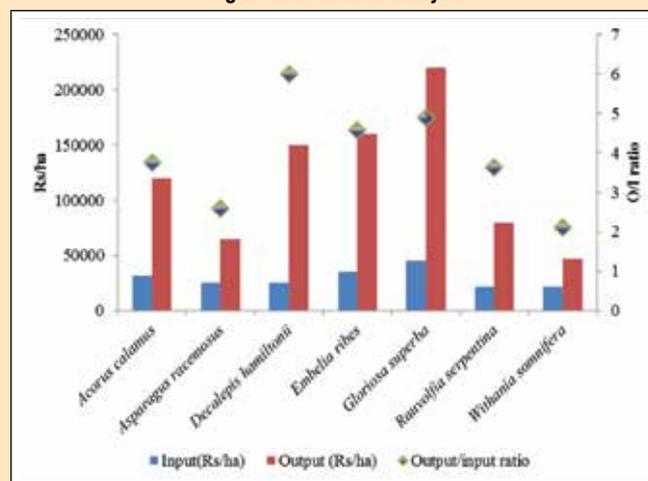
### 3. Demonstration model:

After the first empirical field visit, progressive and innovative farmers were identified. Based on the discussions and interactions with the farmers in the tribal population, a demonstration model was established in a village located in Yelundur range of BRTTR. Ten species of medicinal plants were prioritized for cultivation (Table 2). A low cost bamboo-made polyhouse was constructed for the cultivation of selected medicinal plants using agro biotechnological methods. The plant sources, i.e., roots, stems, seeds and other propagative materials were collected from forest area. Seeds were treated in various cost effective methods to increase the rate of germination. The seed germination tests were conducted in the laboratory to check the germination rate after treatment with plant growth regulators such as auxins and gibberellins. Active ingredients of the cultivated medicinal plant species were extracted and analyzed using biotechnology methods such as HPLC.

**Table 2: Medicinal plants prioritized for cultivation in polyhouse**

Botanical name	Family	Habit	Ecological status
<i>Acorus calamus</i>	Araceae	Perennial herb	Data deficient
<i>Aegle marmelos</i>	Rutaceae	Tree	Vulnerable
<i>Asparagus racemosus</i>	Liliaceae	Herb	Globally distributed
<i>Decalepis hamiltonii</i>	Asclepiadaceae	Woody climber	Endangered and endemic
<i>Gloriosa superba</i>	Liliaceae	Climber	Vulnerable
<i>Nothopodytes nimmoniana</i>	Icacinaceae	Small tree	Endangered
<i>Oroxylum indicum</i>	Bignoniaceae	Tree	Vulnerable
<i>Rauvolfia serpentina</i>	Apocyanaceae	Undershrub	Endangered
<i>Terminalia arjuna</i>	Combretaceae	Tree	Lower risk-near threatened
<i>Withania somnifera</i>	Solanaceae	Shrub	Globally distributed

**Fig 2: Cost-benefit analysis**



## Key Findings

- The Soligas are residing in 61 podus of BRTR. Total households of Soliga tribal communities are 2854 with the population of 15954 (Table 1).
- Phytosociological studies were conducted and quantitative information was collected and documented.
- Density, frequency, IVI (Important Value Index) and diversity indices have been prepared based on extensive field studies carried out across six forest ecosystems.
- Cost benefit analysis of medicinal plants shows that medicinal plants are low volume-high value crops with high output/input ratio (Fig 2).
- Indigenous Knowledge (IK) related to the use of 108 plant species in the traditional health care system among the Soliga tribal people was documented. These plants species represent 51 families, of which 43 belong to Dicotyledoneae and 8 to Monocotyledoneae classes of the division Angiosperm. The most dominant families were Asclepiadaceae (7 species), Euphorbiaceae (6 species), Fabaceae and Zingiberaceae (5 species) followed by Lamiaceae, Liliaceae, Rutaceae and Solanaceae (4 species each). Among the 108 recorded plant species, the majority are being used for the treatment of common illnesses. However, there are a few species which are used to cure major diseases (Table 3). Among these 108 plant species, few species were found to be ecologically important as they fall under various categories of IUCN (Table 4).
- A demonstration model was developed in the study region with the cultivation of ten ecological and economically important medicinal and aromatic plant species through scientific and technological interventions.
- A total of 80 Soliga tribal farmers residing in Podus (villages) in the study region have received training regarding the cultivation of various MAPs and the use of simple agro-biotechnology in cultivation.
- Laboratory trials on seed germination using various plant growth regulators such as gibberellic acid (GA<sub>3</sub>) showed that the germination rate increased on treatment, and not with direct sowing.
- Phytochemical screening had been carried out for the cultivated medicinal plant extract samples in order to determine the metabolites present in them. It was found that the presence of saponins, tannins, fixed oils and fats was abundant when compared to other metabolites. Also, the extraction of phytochemicals was more efficient with methanol solvent compared to petroleum ether.

**Table 3: No of plant species used to cure various illness by the Soliga tribe**

Common diseases	No of plant species	Major diseases	No of plant species
Bone fractures, calcium deficiency	3	Anaemia	1
Diarrhea	12	Arthritis	8
Gastrointestinal problems	4	Asthma	10
Headache	6	Blood pressure	1
Back and body pains	4	Chest pain	5

Cold, cough	11	Conjunctivitis	1
Eye infections, earache	2	Diabetes	9
Fever	10	Elephantiasis	1
Hair fall, dandruff	6	Jaundice/liver problem	2
Hemorrhage	1	Kidney stones	1
Inflammation, injuries, wounds	13	Mumps	1
Memory power	2	Snake bite, scorpion bite	6
Mouth ulcer	7	Tuberculosis	1
Purification of blood	2	Tumors	2
Reducing body weight	1	Urinary tract infections	2
Rejuvenator/Strength	8	<b>Note:</b> A few plants are used to cure more than one illness. Hence the total no of plant species exceeds the number 108 i.e., the list of plant species documented.	
Skin diseases/pigmentation	19		
Toothache	2		
Weakness	2		

**Table 4: Ecological status of plant species documented from IK**

Ecological status	No of plant species
Vulnerable	9
Endangered	7
Endemic	3
Low risk-least concerned	2
Data deficient	1
Globally distributed	86

## Policy Recommendations

1. The cultivation of Medicinal plant is profitable for farming communities. Several studies have reported that the profitability of medicinal plants cultivation is even above the cash crops. Therefore, adequate efforts should be made by the stakeholders for large scale cultivation of medicinal plants.
2. Due to variety of factors the ecological and indigenous knowledge of the region would face danger of vanishing. Therefore, initiatives of protecting TEK from patent issues should be given high priority and non-codified information to be codified for the future use.
3. Providing subsidies and loans for agro-techniques, particularly for medicinal plant cultivators could enhance the area under medicinal plant cultivation besides engaging many farmers in this activity.
4. Organizing field level demonstrations with respect to cultivation, production and marketing of medicinal plants can be an ideal approach for the conservation and development of medicinal plant sector
5. Technical aspects, like training the farmers, improving the infrastructure, and implementing new ideas and innovations, need to be prioritized for sustainable socio-ecological development.
6. Farmer-to-farmer training programmes needs to be organized at frequent intervals on cultivation of medicinal plant species. Farmers involved in cultivation of medicinal plants using cost effective technologies have to be encouraged to demonstrate their experience and skills to other farmers.
7. BRTR is rich in biodiversity. The area is inaccessible to the researchers due to the declaration of the area as Tiger Reserve.

However, there is a need to prepare a detailed data base on existing biodiversity of the region. The biodiversity inventORIZATION, monitoring and mapping can be done by the forest department in coordination with the research organizations involved in biodiversity conservation and ecosystem sustainability.

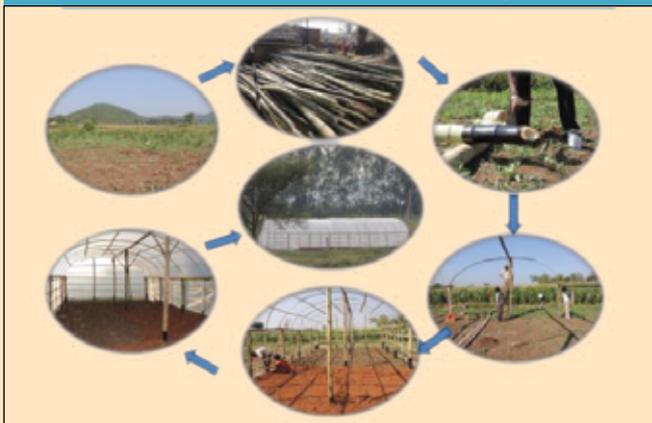
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#### Capacity Building and training at demonstration model



#### Construction of Low cost bamboo made Polyhouse

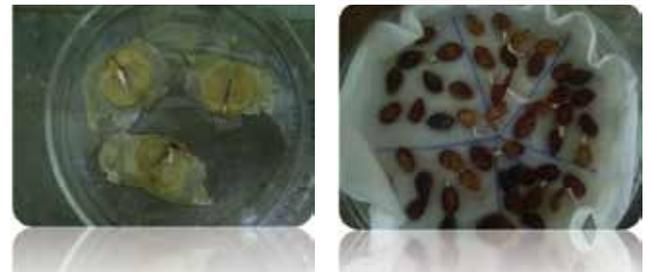


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Farmer-to-Farmer training programme on cultivation of medicinal plants



Seed germination trials using growth hormones



Phytochemical analysis of medicinal plant extracts



Low cost bamboo made polyhouse



Filling of bags



Propagative material

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