Promoting sustainable livelihoods: evidence from the tribal regions of Marayoor, Kerala

N. D. Yogendra*

CSIR-Central Institute of Medicinal and Aromatic Plants, Research Centre, Bengaluru 560 065, India; and
Academy of Scientific and Innovative Research, Ghaziabad 201 002, India

The success of tribal farmers and rural youths in adopting advanced cultivation and processing techniques for lemongrass in Marayoor, Idukki district, Kerala, as part of the United Nations Development Programme and Central Institute of Medicinal and Aromatic Plants collaboration is discussed in the present study. The project, implemented across four tribal clusters from 2020 to 2022, focused on re-evaluating and enhancing lemongrass essential oil production technology. Results showed a three to four-fold increase in tribal farmer's income and year-round job opportunities for rural youths in the aromatic industry. Improved cultivation and processing methods led to self-sufficiency among tribal farmers and rural youths, reducing reliance on forest resources.

Keywords: Income, lemongrass, livelihood and sustainability, tribal cluster.

THE Southern Western Ghats region, which includes Anchunad and its surrounding landscape in Idukki district, Kerala, stands out for its remarkable ecological and cultural diversity. This area is characterized by a unique socio-economic fabric and a rich evolutionary history. The region's diverse ecosystems host a wide array of endemic species, while its cultural heritage reflects the traditions and practices of various indigenous communities. The intricate relationship between natural environment and human societies in this region highlights its significance in ecological and anthropological studies. It is also notable for its significant population of tribal communities within Kerala. Indigenous groups such as the Muthuvans and Hill Pulayas reside in the biodiversity-rich regions of Marayoor and Kanthallor. Many tribal members collect minor forest produce and work as casual labourers for the forest department. Additionally, agriculture and lemongrass cultivation are key activities supporting their livelihoods. The increasing pressures of development on ecosystems have led to the fragmentation of habitats, degradation of natural resources and heightened susceptibility to climate change. Within this context of communities relying on natural resources for their livelihoods and grappling with resource management challenges, it is crucial to integrate biodiversity conservation into mainstream policies by identifying gaps in current frameworks and institutional set-ups. In this preview, lemongrass cultivation is a major source of income for tribal communities, complementing their other means of livelihood[1]. Actively promoting lemongrass cultivation in fragile ecosystems and on rocky slopes could significantly enhance the economic status of the tribals in Marayoor. This practice not only offers a stable and sustainable income but also contributes to ecological security by stabilizing soil and promoting biodiversity in these sensitive areas. Encouraging this agricultural activity can lead to improved financial stability for the tribal population while simultaneously fostering environmental conservation.

The collaboration between the Ministry of Environment, Forest, and Climate Change and the United Nations Development Programme (UNDP), with funding from the Global Environment Facility (GEF), aims to launch the initiative 'Enhancing sustainable livelihoods and biodiversity conservation in the Anchunad and surrounding landscape'. This project targets the preservation of biodiversity within the high range mountain landscape of the Southern Western Ghats in peninsular India. It seeks to combat existing and emerging threats by establishing a robust collaborative governance framework for the multi-use management of the area. Additionally, the project aims to enhance the capacity of local communities and landscape stakeholders to observe, appreciate, and plan for resilience in the face of climate change, as well as for disaster risk reduction and management.

Lemongrass (*Cymbopogon flexuosus*, family: Poaceae) is a tall, perennial grass belonging to a group of approximately 45 species found in tropical and sub-tropical regions across Asia, Australia and Africa. Its cultivation spans from sea level to altitudes as high as 4200 m. Lemongrass is commonly grown in impoverished and marginal wastelands, and it is also utilized as live mulch along embankments. The essential oil extracted from lemongrass exhibits a pale yellow hue and emits a distinct lemon-like fragrance due to the presence of citral in its composition.

India leads globally in lemongrass production, with cultivation extending along the Western Ghats mountain range and adjacent to the foothills of Arunachal Pradesh and Sikkim in the Himalayas. It is commonly seen growing wild in the high-range forest areas of Marayoor and Kanthallor in the Idukki district of Kerala. Lemongrass oil is

*e-mail: yogendra.nd@cimap.res.in

extracted from the whole plant by steam distillation. Promoting lemongrass cultivation on fragile ecosystems and rocky slopes can enhance the economic well-being of tribal communities in Wayanad while also offering ecological benefits[1].

Lemongrass oil comprises primarily myrcene, citronellal, geranyl acetate, nerol, geraniol and neral, with traces of limonene and citral. Widely employed in perfumery, soap-making, cosmetics, and as a natural insect repellent and disinfectant, lemongrass oil serves multifaceted purposes[2]. Cultivation of lemongrass serves as a significant source of livelihood for indigenous communities such as the Muthuvans and Hill Pulayas inhabiting the arid terrains of the high range mountain landscape, particularly in Marayoor and Kanthallor. The tribal community members depend on the forest for fuelwood to distill lemongrass oil. It is estimated that lemongrass is cultivated over 500 ha in the forest region, and over 1000 tribal families are engaged in it. In the past, certain interventions in improving the distillation process were tried out, but they did not yield much results. A few of the challenges faced by the tribal communities are:

- Use of low-yielding varieties existing from long 25 years old (probably OD-19)
- Lack of diversification into other medical and aromatic plants, which have market potential
- Scope for value-added products not explored.

Tribes of Idukki district

Idukki district in Kerala is home to a diverse array of 14 scheduled tribe communities. Among these, the Mala Arayan, Mannan, Muthuvan and Urali communities stand out as the most prominent, collectively constituting 83.82% of the scheduled tribe population in the district. Additionally, other significant communities include Ulladan, Hill Pulaya and Paliyan, making up 14.97% of the remaining tribal population. Idukki district ranks second in Kerala in terms of its scheduled tribe population. According to the socio-economic report of 2013, there are a total of 14,315 scheduled tribe families, comprising a population of 52,913 individuals in Idukki (Table 1).

Status before interventions of the project

The Marayoor and Kanthalloor tribal farmers have cultivated lemongrass since their age-old days. The present cultivating variety is the old one (probably OD-19) since the farmers are not aware of where and when the lemongrass cultivation started. The existing lemongrass variety has very low oil content, making the crop economically unattractive to the growers. These tribal areas could be a potential source of organic lemongrass oil since they do not use chemical fertilizers or pesticides. In addition, this area with moderate temperature and relative humidity conditions is also highly suitable for cultivating many other aromatic and medicinal crops and that too in an organic way.

The Indira colony of Marayoor, where the Hill Pulayas tribal community resides, is frequently threatened by wild animals. To resolve the human–animal conflict issues, the forest department of Marayoor suggested the cultivation of lemongrass and other economically important aromatic crops, since the cultivation of major aromatic crops not only resolves human–animal conflict but also imparts livelihood security and sustainability to the tribal farmers. The majority of the tribal population residing in the Indira colony are cultivating an age-old variety, which has very low oil recovery (<0.40%) and poor citral content. Moreover, the distillation method is primitive and highly unscientific. The farmers hardly achieve a yield of 40–50 kg oil/ha giving them considerably lower returns.

Even though lemongrass has been cultivated for a long time, farmers are propagating the crop through seeds to expand the area. This unscientific method results in reduced growth and herb yield, resulting in low oil yield.

Methodology

A flow chart of activities carried out for the implementation of the project is presented in Figure 1.

Location of the study area

Activities of the project were carried out in four tribal settlements of Marayoor panchayat, Idukki, Kerala. Namely, Indira colony (10.221422°N, 77.1050797°E), Nellipettykudy (10.27861°N, 77.14170°E), Puthukudy (10.32987°N, 77.17392°E) and Vellakalkudy (10.33914°N, 77.16393°E) are the tribal settlements selected for the implementation of the project (Figures 2 and 3). These tribal settlement families live in this forest area with wild animals threat,

Table 1. Family and population details of tribes of Idukki

Community	Family	%	Population	%
Adiyan	–	–	–	2
Hill Pulaya	960	6.70	3415	6.45
Irular	1	–	–	5
Kanikaran	2	0.01	10	0.01
Kattunayakan	1	–	–	4
Mala Arayan	4,408	30.77	16,158	30.54
Malai Pandaram	13	0.09	49	–
Malavedan	57	0.39	214	0.40
Malayan	2	0.01	7	0.01
Mannan	2,426	16.95	9,064	17.13
Muthuvan	3,309	23.01	12,305	23.26
Malai Pandaram	423	2.95	1,484	2.80
Ulladan	819	5.72	3,025	5.72
Urali	1,894	13.23	6,823	12.89
Others			348	0.66

Source: Socioeconomic Survey Report 2013.

mainly tigers, elephants, Nilgiri tahr, gaur and Sambar deer, a threat to the conventional food crops as well as their domestic animals.

Selection of the study area

The selection of tribal settlements was based on the data collected from the socio-economic survey conducted using the one-to-one questionnaire method. These data were collected from different tribal settlements of Marayoor panchayat. Data was gathered on family income, total agricultural land, lemongrass cultivation, cropping pattern, land-use system and livestock population. The compiled data showed that four tribal settlements, namely Indira colony, Nellipettykudy, Puthukudy and Vellakalkudy (Figure 2), are the most dominant lemongrass growing areas with more than 50% of their cultivated area covered with lemongrass alone. Nellipettykudy settlement has 350 acres of total agricultural land, of which lemongrass alone covers more than 200 acres, and it has 50 primitive distillation units (DUs). Puthukudy settlement covers around 240 acres of agricultural land, of which lemongrass alone covers more than 150 acres, and it holds 32 primitive DUs. Among 380 acres of available agricultural land lemongrass alone covers more than 225 acres in Vellakalkudy, which has 38 primitive DUs (Figure 4).

Approaches

Introduction of high-yielding lemongrass variety Krishna

Lemongrass cultivation is the major source of income for the tribe people of Marayoor. However, the cultivated variety is too old, and the oil recovery is very poor, leading to lower oil yield. Tribal farmers have extracted lemongrass oil from the same rootstock for over twenty years. This problem resulted in reduced oil content over the years and a parallel decrease in oil yield. Currently, oil content in the present cultivating old variety ranges from 0.3% to 0.4% in summer and may go up to 0.45% to 0.50%. The lemongrass plants are short and grow to a height of a maximum 75–90 cm with narrow leaf width and dull green colour. This short stature will reflect a lower total grass weight per acre. One solution to address these issues is introducing a new variety suitable for the location.

The lemongrass variety Krishna was developed by CSIR-Central Institute of Medicinal and Aromatic Plants (CIMAP), Research Centre, Bengaluru, in 1997 and was found suitable for Indian plains and hilly areas. Krishna variety is known for its high citral content (>82%) and is suitable for south Indian conditions[3]. The oil content of variety Krishna ranges from 0.85% to 1.25%; in summer, it may reach up to 1.40%. The Krishna variety grows to a height of 160–170 cm, having a broader leaf and lush green colour.

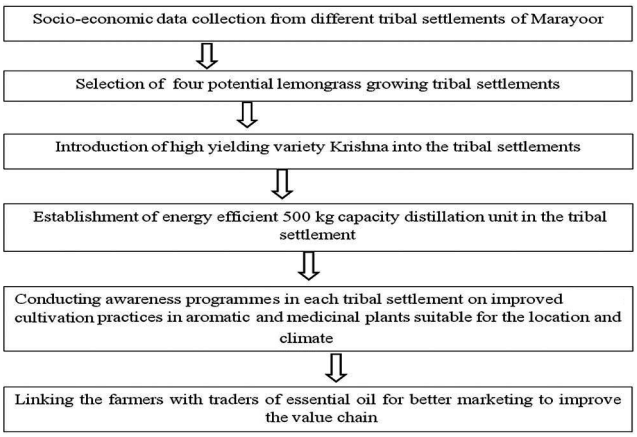

Figure 1. Flow chart of activities carried out in the project.

Comparison of Krishna variety with existing old variety in the tribal settlements

Phenotypic characters

Phenotypic characteristics of the plant give an idea about crop growth. Krishna variety of lemongrass was found superior over the old existing variety in settlements in terms of all the phenotypic characteristics such as plant height, number of tillers per plant, and appearance of the plant (colour). Krishna variety is grown luxuriantly compared to the old variety. An average plant height of 160–170 cm and tiller number of 30–35 per plant was observed compared with 75–80 cm plant height and 35–40 tillers per plant in the existing variety. Krishna variety is easily differentiated from the other varieties by their lush green colour, whereas the local variety appeared pale green[4].

Yield characteristics

Higher growth of the Krishna over the existing variety resulted in higher herbage yield. The test conducted in the tribal settlements for the oil recovery of Krishna with the existing variety revealed that the Krishna variety was found to be superior in oil yield over the existing variety. Krishna recorded 700 ml of oil per distillation from the 90 kg of herbage in Puthukudy and around 850–900 ml in Nellipettykudy over the existing variety recorded an average of 350–400 ml lemongrass oil per distillation. These results clearly showed that the Krishna variety is outstanding in oil and herbage yield.

Observations from the field visit

- Proper plant spacing was not maintained; slips were planted at closer spacing.

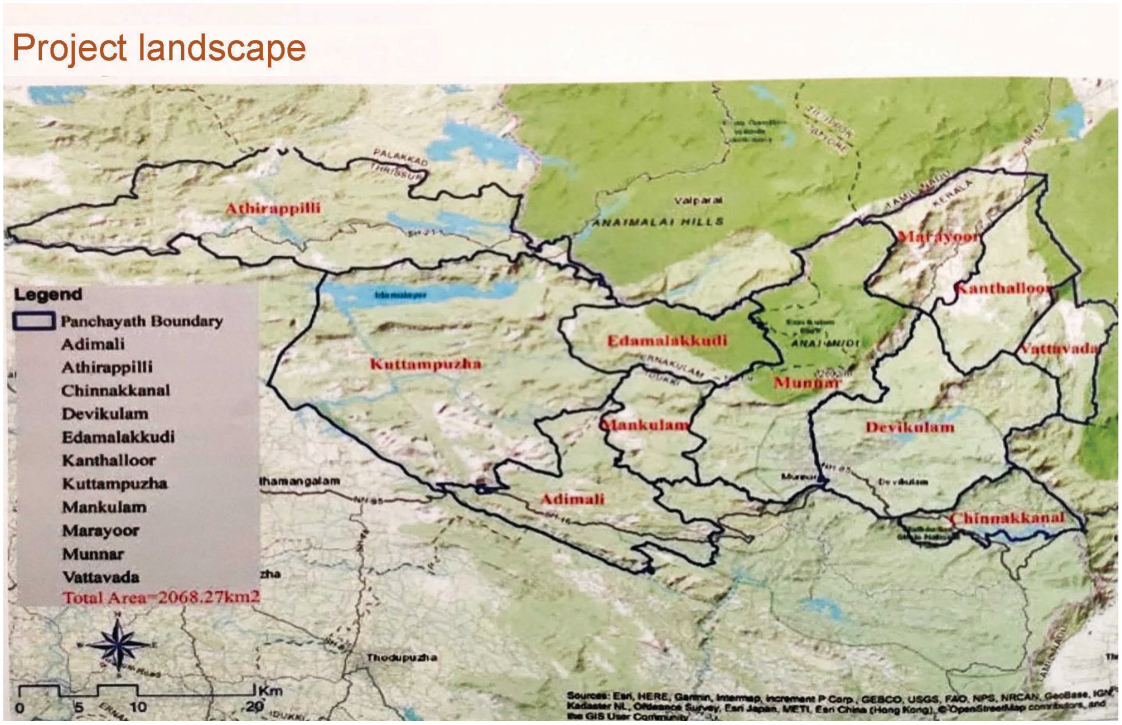

Figure 2. Project landscape area.

Figure 3. Landscape view of the tribal cluster.

- Using seed as propagation material in lemongrass.
- Distillation of lemongrass immersed in water without mesh in the distillation tank results in charring of grass and yields low-quality colour to the oil.
- A huge quantity of lemongrass is left after distillation as waste. Which could be used as fuel or for other value-added process.
- Tribal farmers are aware of some medicinal plant cultivation; hence, there is huge scope for introducing other high-value medicinal crops.
- Marayoor and Kanthallor landscape and climate are best suited for cultivating medicinal and aromatic crops (geranium and patchouli). There is tremendous scope for the cultivation of these crops.

Installation of the energy-efficient distillation unit

In the tribal settlements, farmers harvest the lemongrass and distil it through traditional (90 kg capacity) DUs. This unit is primitive and requires higher energy in terms of firewood and water. The oil recovery is too low from this unit. Also, it develops a charred colour in oil due to low-quality construction material, and boiling the grass with water without proper separating sieve/mesh leads to a reddish-brown colour. Due to the primitive nature of DU, farmers need a longer time to complete the distillation of grass from the unit area. In tribal settlements, farmers usually require one and a half days to complete 500–600 kg lemongrass distillation. This process is highly time-consuming

and requires higher energy to complete; hence, there is a need for a higher energy-efficient DU of 500 kg capacity.

DUs in the tribal settlements require 250–300 kg of firewood and 350–400 litres of water to complete the 90 kg lemongrass distillation (Figure 4). This process involves loading lemongrass onto the unit, 3 h of distillation and unloading the lemongrass from the unit. This whole process requires 4 h to complete. As these units are made of iron drums, rusting of the iron and dipping the lemongrass in water lead to the development of a reddish-brown colour to the oil. Oil recovery from the unit is also very low; usually farmers get 300–400 ml of oil from one distillation. Hence, these problems faced by the farmers could be eliminated by introduction of the energy-efficient DUs of 500 kg capacity.

The new DU is made of stainless steel (SS), which can distil 500 kg of grass at a time. It is fitted with an SS distillation tank, condenser, SS oil separators, mild steel (MS) chimney, material unloading system (chain pulley), water tank with MS support structure and accessories. The furnace is constructed of red/fly ash bricks and plastered. The new DU is energy efficient, requiring less firewood and water than traditional units. It is also more efficient in terms of oil recovery (Table 2).

Capacity building through awareness programmes

The project was strategically structured to integrate a community-based approach with capacity building and market linkage development strategies. This design was rooted in the belief that sustainable utilization, effective management, and successful marketing of medicinal and aromatic plants (MAPs) hinge upon early community involvement. It was recognized that empowering communities from the outset, enhancing their awareness of pertinent issues, equipping them with requisite knowledge and skills, and facilitating direct connections with national markets were essential for long-term success.

To foster community engagement and ownership, participatory methodologies were employed to conduct general awareness-raising sessions. Additionally, village development committees were pivotal in the project's implementation. They were actively involved in selecting participants for various training programmes and overseeing the execution of all project activities, ensuring a bottom-up approach that catered to the specific needs and aspirations of the communities involved (Table 3).

Figure 4. Primitive or old type of distillation unit used by the tribal farmers for the distillation process.

Selection of candidates for the training programmes

All participants transitioned into formal basic training sessions following a one-day awareness-raising session. Originally aiming to accommodate 75 participants, the project expanded its scope due to high demand from the community. Each participant underwent a two-day comprehensive training programme covering aspects such as cultivation techniques, harvesting practices, processing methods, value addition techniques, and marketing strategies specific to lemongrass essential oil.

Candidates, both men and women aged between 25 and 40, were carefully chosen for their passion and proficiency in lemongrass cultivation, distillation, and the value-addition process. The selection process involved assessing individuals' interests and expertise in these areas. Assistance in forming the group was provided by key figures within the community, including the village or tribal cluster head, known as Kheni, and tribal educators. These leaders played a vital role in identifying suitable candidates and forming a cohesive and skilled team.

Improving the market chain linkage

Most stakeholders would greatly benefit from regular access to comprehensive information on production trends, prices of specific product lines, product availability, market channel opportunities and other data with competitive value. Reliable and timely information in these areas is crucial for making informed decisions and strategizing effectively.

The present discussion on the state of information availability and reliability underscores the critical need for a management information system tailored for the MAPs sector at local, state and national levels in India. Such a system would address existing gaps and enhance the flow of information, enabling stakeholders to respond proactively to market demands and trends.

Table 2. Comparison of distillation units (DUs)

Characteristics	Traditional unit (90 kg capacity)	Field distillation unit (500 kg stainless steel)
Material used for construction of drum in DU	Iron drum	Stainless steel drum
Capacity of the unit	90 kg	500 kg
Firewood is required for single distillation	Approx. 150–200 kg	Approx. 350–500 kg
Water required for single distillation	200–250 litre	1500–2000 litre
Duration of single distillation	3 h	3 h
Total duration of process (from loading to unloading)	4 h	3.30–3.45 h
Oil yield per distillation	300–400 ml	2500–2750 ml
Colour of the oil	Reddish brown	Lemon to golden yellow
Ease of collection of oil after the process	Difficult	Easy
Ease of loading and unloading the lemongrass	Difficult	Easy
Is water recycled?	No	Yes

Table 3. Details of awareness and training programmes conducted at different tribal clusters of Marayoor, Idukki, Kerala

Name of the tribal settlement	Topic/subject covered	Awareness programme conducted	Number of participants		
			Male	Female	Total
Puthukudy	Improved production technologies of medicinal and aromatic plants	One-day awareness programme	89	64	153
Nellipettykudy		One-day awareness programme	75	40	115
Vellakalkudy		One-day awareness programme	67	54	121
Puthukudy	Promotion of aromatic crops value chain for conservation-based and sustainable livelihood practices	Two days skill development training	85	78	163
Vellakalkudy		Two days skill development training	110	92	202

Need for energy-efficient distillation unit

During the initial phase of the project initiation, preliminary data regarding lemongrass cultivation was gathered through a socio-economic baseline data survey conducted in the Marayoor and Kanthalloor grama panchayaths. Subsequently, four distinct tribal settlements – Indira colony, Puthukudy, Nellipettykudy and Vellakalkudy were identified from the collected data, where lemongrass cultivation is prevalent. Under the project, a provision of 75,000 slips per settlement was made, totaling 2.25 lakh slips of the high-yielding variety Krishna. This initiative resulted in the benefitting of 88 families from Nellipettykudy, 55 families from Puthukudy, and 53 families from Vellakalkudy.

In the tribal settlements, farmers harvest lemongrass and distil it using traditional distillation units with a capacity of 90 kg. These units are rudimentary, demanding significant amounts of firewood and water for operation. Moreover, the oil recovery from these units is inadequate, exacerbated by using low-quality construction materials and boiling the grass with water that lacks proper separating mesh or sieve. Consequently, this results in the development of a reddish-brown colour in the lemongrass essential oil due to the formation of charred residue. Because of its antiquated design, farmers spend significantly more time completing the distillation of lemongrass from the unit area. Typically, farmers in tribal settlements require one and a half days to distil 500–600 kg of lemongrass. This prolonged process consumes a substantial amount of time and energy. Consequently, there is a pressing need for a more energy-efficient distillation unit with a capacity of 500 kg.

In the distillation units found in tribal settlements, 125–150 kg of firewood and 250–300 litres of water are needed to complete the distillation of 90 kg of lemongrass. This process involves loading the lemongrass into the unit, distilling it for three hours, and then unloading it. The entire process typically takes four hours to complete. However, since these units are constructed from iron drums, rusting occurs, and immersing the lemongrass in water within the unit leads to a reddish-brown colour in the oil. Furthermore, oil recovery from the unit is minimal, with farmers usually obtaining only 300–400 ml of oil per distillation. These challenges faced by the farmers could be addressed by introducing energy-efficient distillation units with a capacity of 500 kg.

Benefits occurring to tribal

The successful intervention was made by introducing the high-yielding Krishna variety and setting up distillation units in the tribal settlements, which resulted in the enhanced production of lemongrass oil by a minimum of two to threefold. This internship increased the farmer's income by a minimum of three to fourfold, considerably improving tribal farmers' livelihoods. The success of Krishna variety cultivation and slip method propagation in the mission area motivated farmers from other settlements to take up Krishna

variety cultivation and slip method of multiplication/ propagation method. Farmers from the mission area happily shared their opinion of witnessing higher oil yield from Krishna variety cultivation.

Interventions/progress made under the UNDP project

Skill development programmes are crucial for the tribal community as they offer valuable opportunities to expand their knowledge and enhance their capabilities, making them more proficient in daily tasks. With the continuous advancements in technology and evolving workplace strategies, it becomes imperative for professionals to adapt and align their skills accordingly. Training serves as an effective avenue for bolstering knowledge and competencies. By offering consistent and pertinent training sessions, individuals can enhance their performance and productivity in the workplace.

Two training programmes were conducted at two different clusters at Marayoor tribal settlement, Idukki. More than 150 tribal farmers and youths participated in the programme. First day, emphasis was given on the value addition of essential oils particularly lemongrass, and their retail marketing. During the second day, improved agrotechnological practices, intercropping and the importance and market demand for the organically cultivated/produced forest products were explained to the tribal farmers. The panchayat members, Kudy youths and tribal teachers attended the programme. The merits of the slips method of multiplication were also explained. This becomes essential as the propagation through seeds will also deteriorate the quality of this high-yielding variety. To maintain the purity of the introduced high-yielding variety, the use of slips as propagating material was suggested for further expansion of the area rather than seeds as propagating material. The energy-efficient distillation unit of 500 kg capacity is being set up in Puthukudy. One training programme was also organized at the tribal farmer's field. This will enhance their skills in cultivating this crop, leading to better oil recovery and yield.

The present study has outlined the value chain of lemongrass cultivation and identified the organized and unorganized paths of the value chain. The study focused on re-evaluating and enhancing lemongrass essential oil production technology. Income enhancement of tribal farmers was achieved three to four-fold and year-round job opportunities for rural youths in the aromatic industry were created through the value chain. Improved cultivation and processing methods led to self-sufficiency among tribal farmers and rural youths, reducing reliance on forest resources. To successfully harness the potential of the lemongrass cultivation sector for sustainable resource management and economic prosperity, unorganized supply chains must be transformed into organized ones through effective policy measures and strategic actions. The study highlights the necessity of developing a pro-farmer value chain within the lemongrass cultivation industry. This requires more interdisciplinary research to create practical strategies for sustainable development in lemongrass cultivation.

The following are the project-related activity links: https://timesofindia.indiatimes.com/city/kochi/lemongrass-project-launched-in-marayoor/articleshow/79116787.cms (*The Times of India*, 9 November 2020); https://www.youtube.com/watch?v=ENXXBlNOwfk

1. Thekkan, S. and Paulsamy, Lemongrass oil a major source of income for the tribals of Wayanad district of Kerala. *Kongunadu Res. J.*, 2016, **3**(2), 67–69.
2. Alfassam, H. A., Aleanizy, F. S., Alqahtani, F. Y., Altalal, A. M. and Fitaihi, R. A., Household essential oils as antimicrobial agents for health and skincare. *Oriental J. Chem.*, 2017, **33**(4), 2123–2126.
3. Kulkarni, R. N., Bhaskaran, K., Ramesh, S. and Rajeswara Rao, B. R., Improved clonal variety Krishna of lemongrass. *CIMAP*, *News Letter*, 1997, **24**(1&2), 2–3.
4. Yogendra, N. D., Keerthi, P. E., Nazeer, M., Jnanesha, A. C., Verma, R. S. and Sundaresan, V., Livelihood enhancement and resource use efficiency under lemongrass intercropping with food crops. *Acta Ecol. Sinica*, 2023, 1–10.

ACKNOWLEDGEMENTS. I extend by gratitude to the Kerala Forest Department, UNDP India and UNDPIHRML Project and the Marayoor and Kanthaloor Grama Panchayat for their valuable contributions and cooperation during the project (GAP-443).

Received 12 June 2024; accepted 24 June 2024

doi: 10.18520/cs/v127/i2/153-159