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Medicinal and Aromatic Plants for Diversifying Semi-Arid Tropical (SAT) Systems: A Case of Public Private Partnership (PPP)



INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

ICRISAT *Science with a human face*

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Abstract

In the community watersheds in Asia, with improved water availability farmers diversify their cropping systems with high-value crops for increasing the incomes through efficient use of water and other natural resources. International Crops Research Institute for Semi-Arid Tropics (ICRISAT) is developing sustainable and economically productive livelihood opportunities in rural areas through crop diversification. To help small scale farmers, promising strategies for crop diversification are taken up by linking up with reliable partners who could provide support with production technology and market high-value medicinal and aromatic plants (MAPs) through public-private partnership (PPP) mode. The lead crops selected by farmers that are the focus of this case study include lemongrass (*Cymbopogon flexuosus*), coleus (*Coleus forskolii*), and Aswagandha (*Withania somnifera*). The farmers in the project area were resource poor, facing constraints such as, poor infrastructure, unscrupulous middlemen, and absence of production technology and reliable market for their crops to increase their farm income. By introduction of MAPs through technical backstopping, capacity building, and marketing support from private industries, the partnership was developed to benefit farmers. As a result of this innovative partnership with private sector, farmers increased their farm income as compared to their conventional crops. In addition, rural employment was generated due to the need of post-harvest handling and processing of their crops, more profitable crops were grown, adding product value through village level processing. This holistic participatory process-oriented approach includes new science tools, linking on-station research to on-farm watersheds, thematic and technical backstopping tested successfully on pilot scale in SAT districts of Andhra Pradesh, India, under APRLP-ICRISAT Project.

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Semi-Arid Tropical (SAT) Systems: A Case of
Public Private Partnership (PPP)**

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Contents

Background	1
Introduction.....	1
Objectives	2
The Approach	3
The Process	4
A. On-station Activity	4
B. On-farm Activity	9
Research and Development.....	12
Constraints/Problems.....	13
Conclusions.....	15
References.....	17
Annexure I	18
Annexure II.....	20

Background

In order to accomplish crop diversification with farmers' participatory research and development activities, an innovative methodology has been adopted. It involves in taking up challenges of adapting, specifying and generating technologies appropriate to socio-economic situation in the region. With application of this methodology, identification and implementation of a new agro-industrial project - "growing aromatic crops and extraction of essential oils" and couple of herbs have emerged. This as well generates a technical and scientific base, which is unique in these watershed villages in addition to continuing with their traditional agricultural activity. The area which deserve more attention and which, at present, has a higher level of development, is the area of "natural products" (essential oils and extracts). ICRISAT has developed the "islanding" approach (nucleus) watershed and scaling-out the benefits through capacity building of the lead farmers in the nucleus watersheds as trainers (Wani et al., 2003; Mula et al., 2008). The experience gained in two nucleus watersheds selected for introduction of new crops (medicinal and aromatic plants) and rural agro-industries development for value addition in Karivemula village of Kurnool district and Padamatipalli in Nalgonda district of Andhra Pradesh (AP) are presented in this document.

Introduction

Water is the lifeline of the people living in the Semi-Arid Tropics (SAT) regions and unless it is managed, its continuing depletion will endanger the survival of the people living in this region. The main source of water in SAT is the monsoon rain, which generally occurs as downpours, resulting into excess water during rainy days. The farmers in SAT regions adopt such a cropping system that provides good yields with available soil moisture and withstands challenging climatic and soil conditions. Keeping both the situations on the board, the appropriate way to manage these constraints is through the adoption of watershed management. Watersheds are not only the units for managing the rainwater but also converging points of various rural activities of the people living there.

Traditionally, watersheds have been viewed as hydrological units to conserve soil and water, and a compartmental approach has been adopted. However, through the integrated watershed management approach all natural resources in the watershed are managed efficiently and effectively so that the rural livelihoods can be improved substantially through convergence of various activities.

For improving the rural livelihoods, crop diversification through Medicinal and Aromatic Plants (MAPs) and watersheds form a logical entry point for efficient management of natural resources. Over the years watershed approach not only evolved in terms of objectives, approach, institutions but also investments and technologies (Wani et al., 2003, 2006, 2008). New avenues of building public-private partnerships in the area of natural resources management through watersheds are emerging (Wani et al., 2007, 2008a, 2008b; GoI, 2008). New holistic and participatory approach to manage community watersheds with technical backstopping through consortium has benefited farmers with increased productivity, family incomes and protecting environment (Wani et al., 2003, 2008; Sreedevi et al., 2004; Shiferaw et al., 2006).

The risk-prone farmers in the dryland areas of the SAT generally grow low-value cereal crops and face number of socio-economic, biophysical and infrastructure constraints for improving their livelihoods. Community watersheds are identified as growth engines for development of drylands (Wani et al., 2003, 2008). Community watersheds are used as entry points for improving rural livelihoods by adopting a consortium approach for technical backstopping (Wani et al., 2003). Farmers in developed watersheds diversified their cropping

systems with high-value crops with increased water availability (Shiferaw et al., 2006). For efficient use of limited water resources in the watersheds in the Andhra Pradesh Rural Livelihoods Program (APRLP), MAPs cultivation and value addition were evaluated using public-private partnership (PPP).

The overall objective of crop diversification through introduction of medicinal and aromatic crops was to help increase the income of small holders through new crops and market options for sustainable production and improve livelihoods.

A number of medicinal plants possess the ability to grow in poor soils and under low rainfall and moisture conditions, thereby assisting in the natural regeneration of these crops. Many species are shade tolerant while others are climbers, trees, shrubs and herbs that can be grown in different landuse and cropping systems. The entry of these MAPs into the world food and drug market as environment-friendly (including organic and certified) botanical products is providing an important a new opportunity for farmers.

In general, the public and private sector partnership in agricultural research organizations are predominantly engaged in research. An innovative partnership has been developed by ICRISAT for diversification of SAT systems by using medicinal and aromatic plants and value addition at village level. An memorandum of understanding (MoU) was entered by ICRISAT, Patancheru, with M/S MAK Royale Herbal Biosys Pvt. Ltd. company that has a component of sharing of benefits and expenditure to develop a model MAPs on-station-training center at ICRISAT and marketing of MAPs products of farmers in project area.

Marketing of diversified crop products is a major constraint for resource-poor farmers because of prevalence of uncertain and unorganized marketing system for medicinal crops, handling of large volumes of harvest and a small opportunity window for processing. As a result, in case of MAPs it's a buyers market which puts the producers/farmers at disadvantageous position. To harness the technical capabilities of private sector and to overcome the risks involved in marketing MAPs products by small-scale farmers, ICRISAT has signed an MoU with private sector to pool resources to harness advantage of complimentary skills, improve access to scientific and technical resources, infrastructure, and provide opportunities for cost sharing. The area of natural products deserves more attention due to technological, financial and marketing aspects. Hence, this crop diversification activity is based on the introduction of MAPs with production and processing technology and marketing buyback system by involving private sector partnership.

Objectives

The overall objective was to improve rural livelihoods in drought-prone five districts of Andhra Pradesh, India. The community watersheds were used as an entry point for improving livelihoods through convergence and efficient management of conserved natural resources such as soil and water. The specific objectives were:

- to diversify systems with high value MAPs through integrated use of water resources in the SAT and enhance income through value chain micro enterprises;
- to develop a value chain model for MAPs at village level by linking farmers to markets;
- fostering private partnership for technical backstopping and marketing linkages for new crop products;
- capacity building of stakeholders in adopting new crops (medicinal and aromatic crops) and production technologies.

The Approach

For improving livelihoods through crop diversification, sustainable production, and income-generating activity, one watershed village in each of Kurnool and Nalgonda districts were selected based on the pro-active and willingness of farmers to the basic objectives of crop diversification. These two watershed villages were selected after visiting number of villages in the respective districts and conducting *grama sabhas* (village meetings) with farmers and consultation with NGO, project implementing agency (PIA), and District Watershed Management Agency (DWMA) staff members. Two to three follow-up meetings were conducted in villages where farmers showed willingness to participate in the crop diversification activity with MAPs. The selection of watersheds was based on the positive response of the stakeholders and pro-active nature of the PIAs to take-up the activity.

The selected farmers from each village were taken to exposure visit to other farmers' fields and on-station training was provided at ICRISAT center. The selection of crops was left to participant farmers' choice. Initially, one aromatic crop viz., lemongrass and two medicinal herbs viz., coleus and *ashwagandha* were selected by farmers. These plants have good demand in national and international markets. Farmers having water sources, and good water holding capacity soils selected lemongrass and coleus and some farmers selected *ashwagandha* to grow under rain-fed conditions under low input regimes. ICRISAT facilitated buyback agreement between farmer groups and industry for sale of essential oils extracted from lemongrass and raw products of herbs at village level through private partnership.

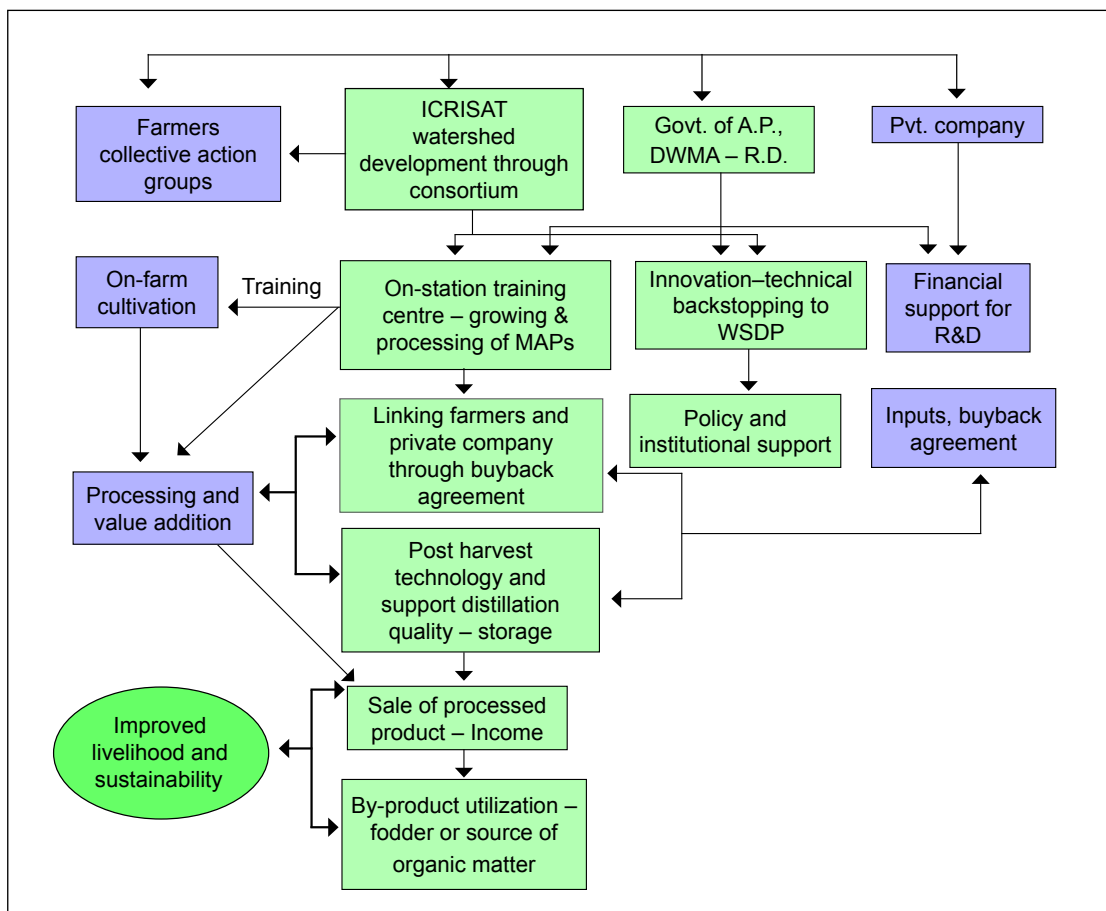


Figure 1. Public-private partnership (PPP) for MAPs flow diagram.

The Process

A. On-station Activity

The main objective of on-station activity was to develop a model MAP centre at ICRISAT with technical support from partner institutions. Five medicinal herbs (Table 1) and five aromatic plants (Table 2) suitable to the area were identified and selected. These were initially grown on 20 ha of land. A multi-crop steam distillation plant was erected on the site to extract aromatic oils for value addition to MAP products. This facility was developed for demonstration and training of the farmers, NGOs, PIAs, village para-workers, WDTs, and other project related personnel on cultivation, harvesting, handling and operation of distillation plant and extraction of oils from aromatic crops, including oil storage and precautions in handling oils and production economics of various oil-yielding crops. The private-sector company assisted in supply of genuine seed materials and production technology.

1. Capacity building

In order to build the capacity of the farmers to undertake cultivation and processing of MAP, on-station-training programs were conducted at ICRISAT. Through these trainings farmers understood the potential of diversification of SAT systems through cultivation of medicinal and aromatic plants and value-addition products to increase their incomes with available water resources.

Participants comprising of NGOs, WDTs, village para-workers and farmers from Nalgonda, Mahbubnagar, and Kurnool districts participated in these training programs. The training programs had two

sessions, in which the forenoon sessions were dedicated to presentation of the major topics, and interaction with participants including general discussions about crops cultivation aspects, and marketing problems. The afternoon session covered field demonstrations, showing cultivation practices, harvesting, processing and extracting oil using steam distillation plant from aromatic crops like lemongrass and palmarosa. The participants were also taught to operate the distillation unit and extract oil from aromatic crops. The practical opportunities and hands-on training gave them the confidence to operate distillation unit and collect oil.

2. Crops

Initially, five medicinal herbs (Table 1) and five aromatic crops (Table 2) were selected based on the market demand and agroecological suitability of crops. These crops were grown at ICRISAT center, Patancheru, AP. The seed material of crops were selected and supplied by the partner organization.

Participants observed the MAPs growing at ICRISAT centre and made a note of their growth characteristics, and appearance. However, most of the farmers/participants observed the MAPs for first time in field.



Figure 2. Farmers group discussing procces and crops of medicinal plants.



Figure 3. On-station training of farmer groups; left: In the class room; right: In the field-distillation plant.

Table 1. Medicinal herbs grown at ICRISAT center.

S.No	Common name	Scientific name	Family
1	Senna/swarna pathri	<i>Cassia angustifolia</i>	Caesalpiaceae
2	Ashwagandha	<i>Withania somnifera</i>	Solonaceae
3	Kalmegh	<i>Andrographis paniculata</i>	Acanthaceae
4	Bhuamlaki/nelavusiri	<i>Phyllanthus amarus</i>	Euphorbiaceae
5	Coleus	<i>Coleus forskolii</i>	Lamiaceae

Table 2. Aromatic plants grown at ICRISAT center.

S.No	Common name	Scientific name	Family
1	Lemongrass	<i>Cymbopogon flexuosus</i>	Gramineae
2	Vetiver	<i>Vetiveria zizanioides</i>	Gramineae
3	Palmarosa	<i>Cymbopogon martini</i>	Gramineae
4	Eucalyptus	<i>Eucalyptus citriodora</i>	Myrtaceae
5	Citronella	<i>Cymbopogon winterianus</i>	Gramineae

3. Cultivation practices

The overall requirements of a successful crop production were taught to the farmers, the important areas of crop production and management. The training program also included classroom sessions on suitable climatic conditions, soils, varieties, crops grown under rain-fed and irrigated conditions, sowing methods, nursery preparation, plant protection aspects, etc. The classroom sessions were followed by field visits where they practically observed cultivation practices learnt in the classroom and had the opportunity to get clarified any doubts with the experts.

4. Intercropping

The main objective of intercropping, planting method and crops used for intercropping and economics were shown practically to the farmers on the field. Selection of crops and time of planting two different crops were demonstrated on the field. Intercropping of coleus and *Eucalyptus citriodora*; lemongrass and *Eucalyptus citriodora*, their planting methods and cultivation aspects and economics of production were dealt in detail for the benefit of the farmers.



Figure 4. Lemongrass crop in Karivemula.



Figure 5. Coleus crop in Karivemula.



Figure 6. Coleus plant.



Figure 7. Plamarosa crop.



Figure 8. Ashwagandha plant with green berries.



Figure 9. Farmers showing coleus crop matured root ready for harvest.

5. Harvesting

Similar to field crops, MAPs also have bio-indicators of maturity, indicating right stage for harvest, such as flowering in coleus, change in fruit color from green to pink in *ashwagandha*, etc. The farmers were trained in identifying these indicators in respective crops. The economic plant part used in medicinal preparations varies from crop to crop and the harvesting method also differs. They were shown how to harvest and process the crops in the field by involving the participating farmers in the harvesting process.

6. Value addition process

Value addition to MAPs products is one of the objectives of crop diversification. Processing of aromatic plants by extraction of oil is value addition to lemongrass, palmarosa, vetiver, and *Eucalyptus citriodora*.

The participating farmers were taught the skills of processing aromatic plants, by using steam distillation plant. They were given opportunities to conduct distillation of lemongrass. The important operations like management of temperature of boiler and condensing unit and their effect on quantity and quality of oil were demonstrated. Effects of season, cultivation practices, time of harvest, and duration of crop growth and distillation process on oil output were discussed in detail and shown to them. Demonstration of oil separator, which condenses the oil along with water collected in oil separating can and subsequently how oil is collected by decanting top water layer and stored were also undertaken.



Figure 10. Processing (cutting into small pieces and shade drying) of coleus and ashwagandha roots after harvest.



Figure 11. Distillation of lemongrass in Padmatipally village, Nalgonda district.

The economic plant parts of coleus and *ashwagandha* are roots. These were demonstrated by pulling out the crop from the field. The harvesting procedure, time of harvest and processing of roots (cutting into small pieces to remove moisture under shade) for market were demonstrated.

7. Storage

The methods of storage of MAP products were demonstrated. Aromatic oils are to be stored in clean and airtight containers, kept in cool, dry and dark place whereas colours of dried *ashwagandha* can be put in gunnybags.

8. Marketing

Marketing of MAPs products has been a tricky business and a major constraint in successful implementation of crop diversification activity. Small and resource-poor farmers have no access to market and marketing trends. Hence, identification of potential markets proved to be a difficult task for small-scale farmers.

Most of the industries engaged in procuring MAPs involve in inefficient, secretive, and somewhat opportunistic process of sourcing. As a result, the trade in MAPs has been largely unorganized and carried out through a plethora of small-scale traders. The resource-poor farmers are the victims of middlemen. To address these marketing constraints of project farmers, ICRISAT entered into an MOU with a private sector company (Mak Royale) for marketing of MAP products and facilitated buyback arrangement (Annexure 1) with minimum support price between farmer and buyer (partner) at village level.

The second supply chain for other crops, coleus and *ashwagandha* were identified. A meeting with medicinal plants growers group (MPGG) members and the company was arranged in the village to discuss about quality standards that farmers must meet and to arrive at a quantity that would be supplied. The company was interested in purchasing MAPs from the MPGGs and enter into a formal buyback agreement. However, the group members and the company had informal agreement Annexure II regarding the quantity and quality to supply. Finally, at the end of season the verbal agreement was successfully executed and continued there after every year.

9. Training material

A detailed technical brochure in local language on MAP cultivation practices, economics of production, and medicinal values of plant parts were distributed to participants for information. Posters on each crop were prepared and displayed at village *panchyats* for ready information to village farmers. These extension materials enhanced farmers' learning.

10. Cost of cultivation

Based on the information collected on practical experience on cultivation from different farmers in the project area, site specific aspects of cultivation expenses and economics of cultivation were detailed in Annexure I.

B. On-farm Activity

1. Formation of groups

The farmers showed great enthusiasm in diversification activity after getting awareness on the crops and developed confidence after meeting farmers cultivating MAPs during exposure visits and on-station training at ICRISAT. Those farmers who shared common interest on growing MAPs grouped together in watershed villages, formed into medicinal plants growers group (MPGG) in the two districts. The farmer groups took up cultivation of aromatic plants and medicinal herbs. The farmers selected the crop which they felt were more suitable and confident of growing on their land in small areas in *khari* 2004. Many medicinal and aromatic plants suitable for cultivation on marginal lands in project area, which are market driven were introduced to the farmers and these crops had potential in creating many new rural employment opportunities for local people

The key idea in setting up these producer groups at the village level was to see that they grow further to block and district levels and further get into the framework that could produce a substantial quantity of MAPs on a sustainable basis, thus making it economically viable for the company to continuing sourcing the material from the same groups of farmers. In addition, a substantial farmer base that could be mobilized to produce specific crops would be highly beneficial in negotiating future contracts and in securing good financial returns for its members. It was assumed from the outset that even small and marginal farmers could participate in cultivation of MAPs if they are able to follow the group approach.

2. Assessing the potential for growing MAP in the watershed villages

In order to successfully produce MAPs in the watershed villages, it was necessary to identify those crops that are suitable to the local agro-climatic conditions, and soils and rainfall pattern/ irrigation facility. The crops that were selected were in accordance to the above criteria and were having good

market demand and well suited to small-scale farmers in the villages. The plant species selected by farmers in different villages is given in table 4 and 5 and in their view point, the cultivation of medicinal and aromatic plants was due to following reasons:

- lemongrass and coleus can be grown on paddy fields with 1/3 water requirement from that of paddy crop;
- Coleus and *ashwagandha* can be grown on less fertile and marginal red and sandy loam soils;
- the damage due to animals, wild bore (is a problem in the area) is negligible as these animals avoid these crop due to non-palatability and bitter taste;
- it's less labor intensive;
- crop needs minimum supervision, little risk, less labour intensive when compared to other commercial crops;
- simple harvesting procedures;
- products are stable and can be stored for longer periods and occupy less storage space
- export potential as well as local use
- generation of local employment
- non-cumbersome post-harvest processing for value addition

Table 4. Cultivation of *ashwagandha* at Karivemula village in Kurnool district, AP.

Farmer Name	Sy.No.	Area Planted (ha)
B.Kautlaya	56	0.6
M.Vishnuvardhan Reddy	302/1	0.4
M.Vanoorappa	47	0.4
k.Masthan	41	0.6
M.Vijaya Mohan Reddy	25	1.2

Table 5. Cultivation of coleus at Karivemula at in Kurnool district, AP.

Farmer Name	Sy.No.	Area Planted (ha)
M. Vishnuvardhan Reddy	366	0.8
B.Kaulutya	366	0.6
K.Pullama	345	0.4
C.Ramulu	406	0.4
Ramakrishna Reddy	347	0.6
Venkat Reddy	124	0.8
Mohan Reddy	231	0.4
Md.Husain	295	0.4

Table 6. Cultivation of lemongrass at Padamatipalli village in Nalgonda district, AP.

Farmer Name	Sy.No.	Area Planted (ha)
C. Madava Reddy	421	1.0
Narashima Reddy	423	1.5
Kishtaya	286	1.0
N. Maisaya	432/1	2.0
R. Vankanna	286/2	1.0
Ramulu	324	1.0
M. Venkat Reddy	432	1.5
Padma Reddy	432	2.0
C. Ratnaya.m	456	2.0
K. Ramakka	465	1.5

3. Exposure visits

The interaction among farmers were found to be the most effective knowledge-sharing method and effective communication system, which gave opportunities to the other farmers to meet and share the experiences and discuss difficulties and income realities in growing MAPs. Moreover, farmers got on the spot firsthand information from experienced farmers. This method enabled the farmers to ask some crucial questions to make decision by assessing their resources and capabilities to take up MAPs cultivation. Selected farmers from different watershed villages were exposed to farmers' fields that have MAP cultivation in and around Mahbubnagar, Nalgonda and Kurnool districts. These exposure visits had a very positive impact on the attitudes of farmers' groups on the potential of MAPs. The visits increased their confidence and eliminated any doubts they had regarding the financial viability of these crops.

4. Training group members

Group members were trained on different aspects of production and post-harvest technologies needed for each crop, the anticipated market conditions for those crops, and the expected economic returns. The possible risks associated with the growing of MAPs were shared and discussed. Initially, these training programs were conducted by experts from partner institution, and consortium partners, but soon the training programs were organized on-station and carried out by MAPs specialist. In addition, farmers who were successful in producing different MAPs also served as trainers for new farmer groups producing MAPs for the first time.

5. Inputs

The details of quality seed material suitable for local agro-climatic conditions that were selected and supplied to grow on the ICRISAT training center by private partner company is given in Table 1 and 2. The seed material was propagated on the center has following purposes:

- 1) to produce large quantity and quality plating/seed material;
 - 2) to develop package of practices for each crop;
 - 3) these production nurseries serve as demonstration-cum-training centers;
 - 4) enable to workout cost of cultivation and economics of production of crop and value added products.
- Finally, inputs like seeds/ planting materials were made available to farmer groups through the partner organization on cost sharing basis.

ICRISAT has facilitated financial linkages between farmer groups and state medicinal plant board. The board has a program to support cultivation of MAPs through subsidy up to 25 per cent on the cost of cultivation. Farmers availing subsidy from medicinal plant board have been able to reduce the burden to some extent on their investment. By adoption of this model efforts were made to sustain the partnerships by selling the planting/seed material to the farmer groups.

6. Buyback arrangement

To facilitate farmers in selling their produce at reasonably good price without being cheated by unscrupulous marketing agents and uncertain market demands of medicinal crops, ICRISAT developed a marketing buyback agreement (Annexure II) with minimum support price and procurement of produce at village levels. NGO, VO and SHGs and farmers witnessed the signing of agreement in the village between MPGG and buyer (partner) in presence of DWMA (funding agency) and WDT members. Farmers felt confident of risk-free selling of their produce for reasonably good price through buyback marketing arrangements, thus removing the major constraint of marketing.



Figure 12. Buyback agreement between farmers and partner in Karivemula village, Kurnool district.

7. Farmers' response and learnings

The feedback from farmers gave lot of insights to the facilitating partners to look into their needs for effective implementation of project activities. These include:

- information on other economically important medicinal plants suitable for a particular agroecological area is required;
- list of MAPs having market demand along with buyers and procurement price;
- price and address list of suppliers of seed and planting materials of MAP;
- crop-wise brochure covering all aspects from seed to market will be very helpful;
- need more practical training courses on production and processing of different MAPs;
- one-day training is too short and hectic, two-days training course is ideal to learn better
- training programs need to be conducted in every village on MAP and exposure visits to other farmers' field will build confidence;
- another concern the farmers had was that as ICRISAT takes responsibility of implementing "buyback arrangement" for the produce at village level, what happens when the buyer fails to procure the produce?

Research and Development Activity

The ICRISAT and partner company agreed to conduct research on by-products of distillation of aromatic crops. During the processing of aromatic crops like lemongrass and palmarosa through steam distillation, there were two byproducts, (Figure. 13) de-oiled grass and waste water from the oil separator (after separating the oil from the condensed oil-water mixture). The waste water was analyzed for major nutrients like nitrogen, phosphorus and potassium (N:P:K). The details are given in the Table 9, and its utilization as foliar spray on crops is under study. Experiments with the de-oiled grass for preparation of vermicompost, as fodder for livestock, fuel for boiler and soil mulch (Figure 14) in orchards and plantation crops are also under study.



Figure 13. De-oiled lemon grass fed to cattle.

Constraints / Problems

Major impediments in optimal exploitation of commercial value of medicinal plants through their cultivation and use in Andhra Pradesh were studied and summarized below:

- unstrained availability of quality raw material and medical products based on medicinal plants;
- lack of location specific technologies for cultivation of medicinal plants;
- poor extension services to popularize the cultivation of medicinal plants cultivation and use;
- poor marketing network and awareness of marketing strategies;
- non-availability of improved seed materials for sowing and lack of information on scientific cultivation practices;
- lack of information on seasonal variations on the quality of plant products;
- poor knowledge on harvesting practices, time of harvest and product storage and handling;
- very low export market share;
- low volumes of production does not permit small farmers entering the far away markets on a sustainable basis;
- MAPs market generally demand large volumes of production on a regular basis;
- lack of quality analysis facilities and non-availability to small farmers and high costs involved;
- individual farmers can't grow high-value medicinal crops because they play no role in pricing their products and approach to far away markets for sale.



Figure 14. Soil mulch with de-oiled lemongrass in citroders plantation.

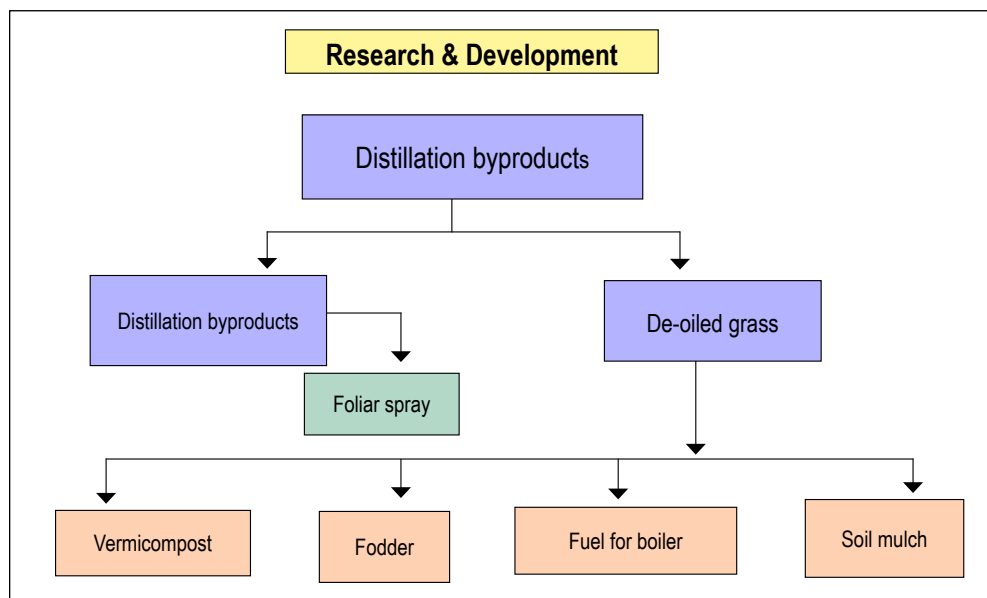


Figure 15. Flow chart showing byproducts of distillation of aromatic crops.

Conclusions

A successful innovation partnership system between ICRISAT and MAK Royale company has established a model on-station MAPs training center and replicated the same on pilot scale in Karivemula village of Kurnool district and Padamatipally in Nalgonda district with the support from DWMA, Government of Andhra Pradesh. This innovative partnership has developed productive relationships between research and non-research commercial organizations, and farmers and public/private organizations. These linkages are important as they facilitate the knowledge flows that underpin creativity. This analysis helps to focus attention on the barriers to interaction and thus aids in the development measures that foster better integration of the system as a whole.

Integrated development of promising strategies for crop diversification by the introduction of medicinal and aromatic crops has increased the income of small holders by 60 to 160 percent through new crops when compared to conventional crops like groundnut, sorghum and sunflower (Tables 7 & 8).

An innovative partnership between private industry (buyer) and farmers (producer) has overcome the risks involved in marketing of MAP products, has increase trade value of crop products and adding value through processing at village level.

The holistic approach includes new science tools, linking on-station research to on-farm watersheds, technical backstopping through partnership and consortium of institutions which has successfully implemented the model developed for crop diversification activity in two villages. Research and development activity includes intercropping by medicinal herbs like *ashwagandha*, *kalmeg*, *nelavesiri*, *nelavemu*, *coleus*, and *nelathsangedu*. Aromatic crops like lemongrass and citronella crops with *Eucalyptus citriodora* are under study. Utilization of by-products are showing some promising results in using de-oiled grass for fodder and vermicomposting and as soil mulch in reducing the number of irrigations in *Eucalyptus citriodora* plantations.

Table 7. Yield and economics of MAP cultivating farmers in watershed villages.

Crops*	Cost of production(in Rs.ha ⁻¹) ^a	Yield inkg ha ⁻¹ *	Gross income in Rs. ha ⁻¹ *	Net income in Rs. ha ⁻¹ *
Aromatic Plant				
1. Lemongrass	18750	187**	65450	46700
Medicinal Herbs				
1. Coleus	10750	1125	57625	46607
2. <i>Ashwagandha</i>	3312	614	19648	16336

* Average of all farmers
a= family labour input was not included in total cost
** oil
Selling price of oil Rs. 350 kg⁻¹
Selling price of coleus dried roots Rs. 51 kg⁻¹
Selling price of *ashwagandha* dried roots Rs. 32 kg⁻¹

Table 8. Yield and economics of conventional crops grown in the project area.

Crops*	Cost of production (in Rs.ha⁻¹)* a	Yield in kg ha⁻¹*	Gross income in Rs. ha⁻¹*	Net income in Rs. ha⁻¹*
Groundnut**	13500	2200	35200	21700
Sunflower	9500	2000	38000	28500
Sorghum**	1800	8100	8100	6300

* Average of 10 farmers
a= family labour input was not included in total cost
** Average fodder value was Rs.1500 ha⁻¹
Selling price of groundnut pod Rs. 16 kg⁻¹
Selling price of sunflower grain Rs.19kg⁻¹

Table 9. Analysis of de-oiled wastewater released from distillation of lemongrass.

Contents	MIN-N (Mg L⁻¹)	Soluble -P (Mg L⁻¹)	Soluble-K (Mg L⁻¹)
	3.7	0.2	1.6.

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Annexure I

1. Cost of cultivation of lemongrass (*Cymbopogon flexuosus*) per hectare.

A. Expenditure per ha

S.No	Components	1 Year	II Year	III Year	IV Year	V Year
1	Land Preparation	1500				
2	Fertilizer	3500	2500	2500	2500	2500
3	Manures	2500	2500	2500	2500	2500
4	Planting	1000				
5	Irrigation	1500	1500	1500	1500	1500
6	Weeding/ hoeing	2000				
7	Harvesting	1500	2000	2000	2000	2000
8	Distillation cost	3500	3500	3500	3500	3500
9	Planting material	18750				
	Total expenditure	36000	12500	12500	12500	12500

B. Returns

Duration	Quantity of oil X Price per KG	Gross income
1 Year	270 X 220	59400
II Year	360 X 220	79200
III Year	360 X 220	79200
IV Year	360 X 220	79200
V Year	360 X 220	79200

Note: General market value of lemongrass oil ranged from Rs 300 to 420

C. Net profit

Components	IYear	II Year	III Year	IV Year	V Year
Returns	59400	79200	79200	79200	79200
Expenditure	36000	12500	12500	12500	12500
Net profit	23400	66700	66700	66700	66700

2. Cost of cultivation of Ashwagandha (*Withania somnifera*) per ha

S.No	Cost of Inputs (In Rs)*	Amount (in Rs)	Total expenditure
1	Seed -7.5kg	100	750
2	Fertilizer	3750	3750
3	Labour charges (sowing and intercultural)	1000	1000
4	Harvesting charges	2500	2500
	Total expenditure		8000
		Returns	
1	Dried roots(500kg)	40/-kg	20000
2	Seed 250kg	50/-kg	12500
	Total income		32500

*Labour input by family was not taken into account for arriving at net income
 Net returns = 32500 - 8000 = Rs.24500 ha⁻¹

3. Cost of cultivation of coleus (*Coleus forskohli*) per ha

S.no	Cost of Inputs (In Rs)*	Amount (in Rs)	Total expenditure
1	Seed (84000 stem cuttings)	2500	2500
2	Fertilizer	7500	7500
3	Labour charges (sowing and intercultural)	6000	6000
4	Pest management	1250	1250
5	Harvesting charges	6500	6500
	Total expenditure		23750
		Returns	
	Dried roots(800kg)	35/-kg	70000
	Total income		70000

* Labour input by family was not taken into account for arriving at net income
 Net returns = 70000 -23750 = Rs.46250 ha⁻¹

Annexure II

BIPARTITE AGREEMENT

This bipartite agreement entered into between M/s. Mak Royale Herbel Biosys (P) Ltd. A company incorporated under the Companies Act, 1956, having its registered office at 12-13-5, Mak Royale Chambers, Taranaka 'X' roads, Secunderabad – 500 017, A.P. and its farms at (i) a. Jalpally Village B. Mamidipally Village, R.R. District. (ii) Koniapally village Mahbubnagar district duly represented by its managing director Sri Mohd. Mujeeb Ali Khan.

AND

Medicinal Plants Growers Association

Sri/ Smt./ _____

S/o.,D/o.,W/o. _____

Resident of _____ P.O. _____

Mandal _____ District _____ State _____

Hereinafter called the farmers association which expression shall, unless repugnant to the context or meaning, be deemed to include his/her legal representatives, successors in interest, administrators and heirs, assigns of the second part.

Preamble

Where as the company is engaged in research, development, production, cultivation, extension and awareness of medicinal and aromatic plants and offers: consultancy, technical know-how, package of practices, agrotechnologies and marketing end products of medicinal and aromatic plants.

And where as the farmer is desirous of cultivating lemongrass/citronella/ palmarosa/ *Eucalyptus citriodora* plants for processing and selling oil of the same.

And where as for the purpose of cultivating the above mentioned aromatic plants, the farmer does not possess requisite technical know-how and expertise.

And where as the company possesses requisite knowledge and expertise in cultivation of medicinal and aromatic plants by modern and innovative methods and sophisticated technology as well as necessary inputs for a better healthy and economic crop production.

And where as the farmer has approached the company with a request to sell oil extracted from palmarosa / lemongrass / citronella / *Eucalyptus citriodora* grown in his fields and the company renders the farmers the requisite expertise for raising the crops on his/her land and; as quid pro quo therefore, the farmer has offered to sell the entire produce i.e. oil produced on the land, exclusively to the company on the terms and conditions hereinafter provided.

And where as the company with a view to getting consistent supplies of the oils on sustained basis as assured by the farmer for meeting its supply commitment undertaken by the company with its clientele on the very basis of this purchase arrangement with the farmer. The company has agreed to sell to the farmer good quality planting material of palmarosa/lemongrass/ citronella / *Eucalyptus citriodora* at reasonable price.

And whereas the parties hereto have mutually agreed to reduce into writing the aforesaid arrangement and the terms and conditions thereof.

This agreement witnessed as follows

ARTICLE – I

Farmers Obligation

1. Planting of lemongrass / *Eucalyptus citriodora* / citronella / palmarosa

The farmer shall at his /her cost plough the land and prepare the land according to the instructions of company personnel and plant the saplings / plantlets/slips given to him / her by the company.

2. Payment for planting material:

The farmers shall purchase his entire requirement of planting material from the company. The company shall deliver the required planting material to the farmers at their villages from the nurseries raised at company-owned farms or any other nursery. The cost of planting material and transportation charges have to be paid by the farmer after receiving the planting material.

3. Protection of plantation and aid to growth:

The farmer agrees fully to protect plants raised on his / her land from damage, remove weeds growth at suitable intervals, plough the land as maybe required from time to time, provide need based irrigation, apply requisite doses of fertilizers at appropriate time and take all such steps as warranted and necessary to aid a robust and healthy growth of the crop in accordance with the package of practices recommended by the company.

4. Farmer to sell palmarosa / lemongrass / *Eucalyptus citriodora* / citronella oils exclusively to the company:

In consideration of the company selling the planting material to the farmer at reasonable price and providing free technical services for planting and raising the crops, the farmer hereby irrevocably agrees, undertakes and declares that he / she shall sell the entire quantity of oils of the afore said crops exclusively to the company at the rates as agreed upon.

5. The farmer hereby covenants with and assures the company that as per the guidance, and appropriate training given to the farmers by the company technical experts, that the end product i.e. oil is susceptible to oxidation, impurities and evaporation, he/she shall follow the steam distillation process, packaging and handling meticulously for the purpose of ensuring optimum yield and also to minimize losses by way of oxidation, evaporation and loss in transit etc., on account of faulty packaging.

6. Intimation of schedule of harvesting and processing:

The farmer shall intimate the progress of the cultivation and the commencement of distillation and status of production well in advance.

7. Inspection of the farm by the company:

The farmer agrees to permit the company representatives, visitors and nominees free access to the land, during the currency of the agreement for assessment of the growth of the crop by observation or by any means or for study or for giving advice to the farmer in relation to the growth and maintenance of the crop.

ARTICLE – II

Company's Obligation

Supply of planting material of palmarosa/ lemongrass / citronella / *Eucalyptus citriodora*.

1. The company agrees to sell the farmer the required quantity of planting material.
2. The company agrees to provide:
 - (i) Free technical advices for planting and monitoring of the crop during the currency of this agreement.
 - (ii) Recommend package of practices to be adopted by the farmer.
 - (iii) The company promises to supply high quality planting material and timely supply of planting material, i.e. after receiving the first monsoon rain in the month of June – July 2004, to enable the farmers to plant at right time for good crop establishment
 - (iv) The company agrees to sell the planting material at a reasonable price to the farmers as given below, excluding transport charges.
 1. Lemongrass -----/slip
 2. Palmarosa -----/kg seed
 3. *E. citriodora* -----/plant
 4. Citronella -----/slip

3. Procurement price:

The company shall procure the oil from the farmers by paying the minimum support price (MSP) given below. In case the prevailing price of the oil in the market is above the MSP, the company and the farmers will negotiate the procurement price of the oil and such negotiated oil price will have 5 Per cent marketing surcharge payable to company.

- | | |
|-----------------------------|------------|
| (i) Lemongrass Oil | Rs.300/kg. |
| (ii) Citronella Oil | Rs.300/Kg. |
| (iii) Eucalyptus Citriodora | Rs.290/Kg. |
| (iv) Palmarosa | Rs.400/kg |

4. The oil produced by the farmers shall be accepted by the company subject to inspection of the consignment at the village site or village *panchayat* office. The company will have its own packing system and containers for transportation of oil from the village site. The company will issue specific acceptance note/receipt on the spot after procuring oil from the farmers. This receipt/note shall alone constitute acceptance of the delivered material and conclusive sale in all respects.

5. The company hereby convenants with and assures the farmer of minimum support price (MSP) (as stated in clause No.3) or the negotiated prices of the oil on existing higher market price of the oil at that time.

6. Payments: 25% of the total oil sale price will be paid on the spot and the balance 75Per cent sale price payment shall be made by the company to the farmer within 15 (fifteen) days of receipt of the oil from the farmer at the village *panchayat* office.

7. Harvesting and processing: The company technical staff will be monitoring the crop development, impart technical advise from time to time and advise farmers about the correct stage of harvest and train them in distillation processing and oil extraction methods without any charges.

ARTICLE-III

1. Period of Agreement:

This agreement shall be valid and effective in the first instance for a period of one year commencing from 1st September, 2004 to August 30th 2005. After signing of by both the parties, hereafter the very same commitment may be renewed, failing which the company shall purchase the oil from the farmer as per the prevailing market prices by charging 5% towards services charges.

2. Jurisdiction:

It is hereby mutually agreed that all or, any disputes arising out of these presents shall be subject to jurisdiction of the courts established at Secunderabad, alone.

In witness where of signed, sealed and delivered by the named parties on this _____ day of _____ at _____ in the presence of following.

SRI. MOHD. MUJEEB ALI KHAN M.D.

Mak Royale Herbal Bio Sys. (P) Ltd.

Farmer representative

WITNESS:

- 1.
- 2.

About ICRISAT



Science with a human face

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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