

Research Study No. 2007/5

**CULTIVATION OF MEDICINAL AND AROMATIC CROPS AS A MEANS OF
DIVERSIFICATION OF AGRICULTURE IN UTTARANCHAL**

R.P.S.MALIK

**AGRICULTURAL ECONOMICS RESEARCH CENTRE
UNIVERSITY OF DELHI
DELHI**

AUGUST, 2007

PREFACE

As a result of continuing increase in the demand for herbal medicines around the world and with little control over their collection or trade regulation, the only way to protect wild populations of medicinal plants and minimize threats to sustainability is to increase the supply of equally effective cultivated specimens. Shift from collection to cultivation of medicinal and aromatic plants is also likely to ensure purity, authenticity and sustainable supply of raw materials required for herbal drugs. Despite some efforts made at promoting cultivation of these plants, their adoption for cultivation by farmers have, for a variety of reasons, so far not been very encouraging. Encouraging farmers to cultivate medicinal and aromatic plants through a diversification of their cropping pattern in favor of these crops, requires information on a number of underlying economic and non-economic variables. Given that efforts at promoting cultivation of medicinal and aromatic plants are still in their early stages in different parts of the country and some of the basic reliable information on some of the underlying economic variables associated with their cultivation is not easily available, the Ministry of Agriculture assigned Six Agro Economic Research Centres (AERCs), located in different parts of the country to undertake a study on "Cultivation of Medicinal and Aromatic Crops as a Means of Diversification in Agriculture". The AERC Unit located at ADRT, Institute of Social and Economic Change, Bangalore has coordinated the study who have also provided the basic analytical framework. The present report relates to the state of Uttaranchal.

We would like to thank Professor R.S.Deshpande (ISEC) for coordinating the study and Mr Nipender Chouhan (CAP, Selaqui) for help in conduct of the field work. We are grateful to Mr Mool Chand, Mr P.K.Bhattacharya, Mr K.K.Shingari and Mr Balbir Singh for shouldering the responsibility of conducting the field work. Mrs Santosh Mann, Mrs Parveen Taneja and Mrs Prem Bhasin helped with the computer work for which we are thankful to them.

We hope the results of the study would be useful in supporting the efforts aimed at promoting cultivation of medicinal and aromatic plants.

New Delhi
August 2, 2007

R.P.S.Malik

CONTENTS

SECTION 1	INTRODUCTION	1
1.1	What are Aromatic and Medicinal Plants?	
1.2	The Study: Scope and Objectives	
1.3	Medicinal and Aromatic Plants in the Himalayan Region	
1.4	The Study : Methodology	
1.5	Cultivation Practices and Uses of Jumbo Faran	
1.6	Cultivation Practices and Uses of Lemon Grass	
1.7	Outline of the Report	
SECTION II	IMPORTANCE OF MEDICINAL AND AROMATIC	12
	<i>PLANTS IN UTTRANCHAL</i>	
2.1	The State and its Economy	
2.2	Medicinal and Aromatic Plants in Uttaranchal	
2.3	System of Collection and Marketing of Herbs in Uttaranchal	
2.4	Cultivation of Medicinal and Aromatic Plants	
2.5	Infrastructure for R & D in Medicinal and Aromatic Plants in Uttaranchal	
2.6	Infrastructure for Processing Facilities in the State	
2.7	Action Plan for Development of Medicinal and Aromatic Plants	
SECTION III	ECONOMICS OF CULTIVATION OF AROMATIC AND MEDICINAL PLANTS	25
3.1	Relative Crop Economics of Medicinal Plants (Jumbo Faran) with Competing Crop(s)	
3.2	Operation wise Labor Requirement for Cultivation of Medicinal Plants	
3.3	Operation wise Labor Use for Cultivation of Rajma and Wheat (Competing crops to Medicinal Plants)	

- 3.4 Cost of Cultivation of Medicinal Plants
- 3.5 Relative Crop Economics of Aromatic Plants (Lemon Grass) with Competing Crop(s)
- 3.6 Operation wise Labor Requirement for Cultivation of Aromatic Plants
- 3.7 Operation wise Labor Use for Cultivation of Paddy and Wheat (Competing crops to Aromatic Plants)
- 3.8 Cost of Cultivation of Aromatic Plants

SECTION IV MOTIVATIONAL FACTORS AND PROCESS OF DECISION MAKING 47

- 4.1 Experiences with Cultivation of Medicinal Plants
- 4.2 Experiences with Cultivation of Aromatic Plants
- 4.3 Motivational Factors : What prompted Cultivation of Medicinal Plants?
- 4.4 Motivational Factors : What prompted Cultivation of Aromatic Plants?
- 4.5 Increasing Area Under Cultivation of Medicinal Plants
- 4.6 Increasing Area Under Cultivation of Aromatic Plants
- 4.7 Factors That Could Divert Area Away from Medicinal Plants
- 4.8 Factors That Could Divert Area Away from Aromatic Plants

SECTION V MARKETING OF MEDICINAL AND AROMATIC PLANTS 63

- 5.1 Marketing Channel for Disposal of Produce : Medicinal Plants
- 5.2 Marketing Channel for Disposal of Produce : Aromatic Plants
- 5.3 Problems Encountered in Marketing – Medicinal Plants
- 5.4 Problems Encountered in Marketing – Aromatic Plants
- 5.5 Estimation of Domestic and International Demand for Medicinal and Aromatic Plants

SECTION VI SUMMARY OF MAIN FINDINGS AND CONCLUSIONS 69

- 6.1 Comparative Economics of Identified Medicinal and Aromatic Plants with Alternative Crops
- 6.2 Experiences of Sampled Cultivators of Medicinal and Aromatic Plants Changes in Area under the Identified Crops

- 6.3 Motivating Factors
- 6.4 Factors that Could Help Bring Larger Area Under the Identified Crops
- 6.5 Factors that Could Influence Diversion of Area From Under Identified Crops
- 6.6 Marketing of Medicinal and Aromatic Plants
- 6.7 Issues Related to Cultivation and Extension
- 6.8 Need for Strengthening Database & Market Intelligence
- 6.9 Inadequate Processing Facilities
- 6. 10 Marketing

LIST OF TABLES

Table Number		Page
1.1	Sample Crops and Sample Size	8
2.1	Land use pattern in UTTARANCHAL – 1999-2000	13
2.2	Cereals: Area, Production & Productivity	14
2.3	Pulses: Area, Production & Productivity	14
2.4	Oilseeds: Area, Production & Productivity	15
2.5	Area and Production of Important Aromatic Plants in Uttaranchal	19
2.6	District wise Number of Ayurvedic Pharmacies in Uttaranchal	
2.7	Number of Distillation Units for Distillation of Aromatic Plants – Uttaranchal	21
3.1	Crops/ Crop Combinations Selected for Comparing the Relative Crop Economics	27
3.2	Some Characteristics of the Sampled Farmers of Medicinal Plants	28
3.3	Details of Land Holding of Sampled Growers of Medicinal Plants	29
3.4	Details of Operation wise Labor Use in Cultivation of Medicinal Plants (Average Per Ha Per Year)	30
3.5	Operation wise Labor Use in Rajma, Wheat and Rajma+Wheat	31
3.6	Economics of Cultivation of Medicinal Plants (Per Hectare Per Year Averaged Over Five Years)	33
3.7	Economics of Cultivation of Rajma (Competing Crop for Medicinal Plants)	34
3.8	Economics of Cultivation of Wheat (Competing Crop for Medicinal Plants)	35

3.9	General Features of the Sampled Cultivators of Aromatic Plants	36
3.10	Details of Land Holding of Sampled Growers of Aromatic Plants	37
3.11	Details of Operation wise Labor Use in Cultivation of Aromatic Plants (Average Per Ha Per Year)	38
3.12	Operation wise Per Hectare Labor Use in Paddy, Wheat and Paddy+Wheat	39
3.13	Economics of Cultivation of Aromatic Plants (Per Hectare Per Year Averaged Over Five Years)	41
3.14	Economics of Cultivation of Paddy (Competing Crop for Aromatic Plants)	43
3.15	Economics of Cultivation of Wheat (Competing Crop for Aromatic Plants)	44
3.16	Comparative Economics of Jumbo Faran and Lemon Grass With Their Competing Crops – Summary Results (Rs Per Hectare)	46
4.1	Experiences with cultivation of Medicinal plants and Changes in Area Under Cultivation	49
4.2	Experiences with cultivation of Aromatic plants and Changes in Area Under Cultivation	50
4.3	Motivating Factors for Cultivation of Medicinal Plants	51
4.4	Motivating Factors for Cultivation of Aromatic Plants	53
4.5	Factors that would encourage larger area under Medicinal plants	55
4.6	Factors Constraining Increasing Area under Medicinal plants	56
4.7	Factors that would encourage larger area under the Aromatic plants	58
4.8	Factors Constraining Increasing Area under Aromatic plants	59
4.9	Circumstances under which farmers would move area out of Medicinal plants	60
4.10	Circumstances under which farmers would move area out of Aromatic plants	62

5.1	Reasons for Choice of a Particular Marketing Channel –Medicinal Plant	64
5.2	Reasons for Choice of a Particular Marketing Channel –Aromatic Plants	66
5.3	Problems Encountered in Marketing of Medicinal Plants	66
5.4	Problems Encountered in Marketing of Aromatic Plants	67
6.1	Comparative Economics of Jumbo Faran and Lemon Grass With Their Competing Crops – Summary Results (Rs Per Hectare)	70

EXECUTIVE SUMMARY

CULTIVATION OF MEDICINAL AND AROMATIC CROPS AS A MEANS OF DIVERSIFICATION OF AGRICULTURE IN UTTARANCHAL¹

1. The Study: Rationale, Scope and Objectives

Most of the medicinal plants grow wild and are collected from forests. Hundreds, and possibly thousands, of plant species are being harvested by millions of poor rural population and used by millions around the world for treating a variety of illnesses. As a result, documenting their population levels or ascertaining the impact of their uncontrolled extraction for use and trade on sustainability has proven to be difficult. However, in the absence of any significant efforts having been made so far at their conservation, serious concerns have often been raised about the increasing threat of depletion and the potential endanger to the survival of plant species in the wild as a result of their uncontrolled extraction.

Due to continuing increase in the demand for herbal medicines around the world and with little control over their collection or trade regulation, the only way to protect wild populations of medicinal plants and minimize threats to sustainability is to increase the supply of equally effective cultivated specimens. Shift from collection to cultivation of medicinal and aromatic plants will also ensure purity, authenticity and sustainable supply of raw materials required for herbal drugs, including polyherbals. Despite some efforts made at promoting cultivation of these plants, their adoption for cultivation by farmers have, for a variety of reasons, so far been slow to come by. Encouraging farmers to cultivate medicinal and aromatic plants through a diversification of their cropping pattern in favor of these crops, requires information on a number of underlying economic and non-economic variables. Some of the information needs include : the relative economics of cultivation of these crops vis-à-vis alternative crops the farmers are currently cultivating, the demand for these crops, the availability of markets for disposal of these crops etc. Given that efforts at promoting cultivation of medicinal and aromatic plants are still in their early stages in different parts of the country and some of the basic reliable information on some of

¹ This study has been undertaken by R.P.S.Malik.

the underlying economic variables associated with their cultivation is not easily available, the Ministry of Agriculture assigned Six² Agro Economic Research Centres (AERCs), located in those parts of the country where cultivation of medicinal and aromatic plants has already commenced or is in its early phases of introduction, to undertake a study on “Cultivation of Medicinal and Aromatic Crops as a Means of Diversification in Agriculture”. The AERC Unit located at ADRT, Institute of Social and Economic Change, Bangalore has coordinated the study who have also provided the basic analytical framework³. Based on individual study reports, the ADRT will bring out a consolidated all-India status report. The present study conducted by AERC, Delhi pertains to the State of Uttaranchal. The specific objectives of the study are:

1. To understand the economics of cultivation of the selected medicinal and aromatic crops and find their economic and market potential as preferred by the farmers.
2. To assess the area being cultivated under selected medicinal and aromatic plants
3. To study the relative economic impact of cultivation of medicinal and aromatic plants by the farmers
4. To identify bottlenecks in the marketing of medicinal and aromatic plants and suggest possible remedies.
5. Attempt an estimation of domestic and international demand for the selected medicinal and aromatic crops in the light of the effect of new IPR regime on pharmaceuticals

2. Methodology

The present study is based mainly on primary data collected from the farmers who have been cultivating some of the medicinal and aromatic crops. The study design stipulated selection of one medicinal crop and one aromatic crop for detailed enquiry. However adoption of any strictly scientific criterion for selection of a specific medicinal and aromatic plant, from amongst those being cultivated by farmers, for

² The Six states where this study has been conducted include – Karnatka, Kerala, Madhya Pradesh, Maharashtra, Uttaranchal, and West Bengal

³ We would like to thank Professor R.S.Deshpande of ISEC for doing the basic groundwork and for coordinating the study.

detailed study was constrained due to the lack of a systematic secondary data base which should normally form the basis for such a selection. This lack of a data base in turn was due to the fact that cultivation of medicinal and aromatic crops is a relatively new phenomenon in Uttaranchal and the State wide data base on the area and production of these crops is yet to be compiled. In view of these and other related considerations the choice of crops for detailed enquiry was made as follows.

Neither all plants collected from the wild are amenable to cultivation nor cultivation practices for all such crops found in the wild need to be developed. The groups of medicinal and aromatic crops, which are amenable for cultivation, comprise a large number of crops of which the cultivation practices and suitable plant material have so far been developed for only a few. Of these few however only a still smaller number of crops are actually being cultivated by the farmers. For example, while suitable cultivation practices have been developed for about 30 medicinal and aromatic crops, however cultivation on any significant scale (either in terms of area under these crops, the level of their production or in terms of number of cultivators cultivating these crops) is being done in respect of one or two crops only due mainly to relatively better market demand for these crops as compared to the others and availability of sufficient quantities of required planting material which often is not easily available for all the crops developed in experimental stations for cultivation. Moreover given the fact that the cultivation of these crops is a relatively new phenomenon the limited resources available with official agencies for propagation of cultivation of new crops have rightly not been spread thinly over introduction of a larger number of crops in one go but efforts have been more focused.

Given these considerations, the selection of crops and region for sample selection for the present study has been done based on whatever fragmented secondary information was available from formal and informal sources and on the basis of discussion with local official agencies in the State⁴. For similar reasons, coupled with the fact that most of the farmers cultivating these identified crops were thinly stretched over a relatively large geographical area with hilly terrain, adherence to strict sampling procedures using generally followed stratification procedures for

⁴ We would in particular like to thank Mr Nipender Chouhan of CAP, Selaqui for his assistance in making secondary data available and in planning of the field work of the study.

regional and farm size grouping stratification for sample selection could not be followed in the present case. However all efforts have still been made to ensure that the sample households selection was random and that this sample fairly represent the prevailing situation on ground.

Keeping in view the above constraints and limitations the medicinal crop selected for the present study is Jumbo Faran while the aromatic crop selected for the study is Lemon Grass. The sample for the medicinal crop has been selected from District Chamouli while for aromatic plants the sample has been drawn from District Dehradun. While the sample for the identified medicinal crop comprised of 21 cultivating households that of identified aromatic plant comprised of 42 households (Table 1).

Table 1 Sample Crops and Sample Size

Type of Crop	Crop Name	District	Sample Size
Medicinal	Jumbo Faran (<i>Allium stracheyi</i> Baker)	Chamouli	21
Aromatic	Lemon Grass (<i>Cymbopogon flexuosus</i> Nees)	Dehradun	42
Total			63

The identification of competing crops for comparing the economics of the identified medicinal plants and aromatic plant has been done on the basis of the number of sampled farmers cultivating those crops as also the area under such crops. Accordingly for each of the two focused crops viz jumbo faran and lemon grass we have identified the following crop/crop combinations as competing crops for comparing the relative economics (Table 2).

Table 2: Crops/ Crop Combinations Selected for Comparing the Relative Crop Economics

Crop Type	Crop Name	Competing Crops	
		Kharif	Rabi
Medicinal	Jumbo Faran	Rajma	Wheat
Aromatic	Lemon Grass	Paddy	Wheat

3. Medicinal and Aromatic Plants in Uttarakhand

Uttarakhand is situated in the western Himalayan zone, traditionally known as a gold mine of medicinal and aromatic plants in the country. The state has a very rich diversity of medicinal and aromatic plants. The State is mostly hilly and has broadly been divided into two regions, Kumaon and Garhwal, which can be divided into three main climatic zones:

- The Alpine zone.
- The Temperate zone and,
- The Sub-Tropical zone.

All three zones with altitudinal variations accommodate a variety of medicinal plants. The State is blessed with thousand of species; however, about 320 species have been identified having medicinal value. The forest department has reported about 175 species being commercially extracted and traded. It is estimated that the State is well positioned to generate revenue of more than Rs. 1, 000 crores per annum through medicinal plants trade.

Traditionally, the tribal and poor population of Uttarakhand has had close socio-economic developmental links with medicinal plants. These resources have provided them not only primary herbal medicines for their survival but also substantial part of their income. Even today, majority of the population living in and around the forests derive their income from collection of medicinal plants. The State Government in 2003 declared Uttarakhand as a "Herbal State"⁵.

Although Uttarakhand is a storehouse of a rich variety of species of herbs, medicinal and aromatic plants however this massive potential has remained largely unexploited in the absence of a well planned and coordinated strategy for commercial cultivation and integrated arrangements for processing and marketing. Most of the herbs and medicinal plants are being collected as wild from forests essentially as a non timber forest product.

Some of the available estimates on the extent of cultivation achieved so far however reveal that commercial cultivation is still in its infancy stage and less than 300 hectares. have so far been brought under cultivation under different schemes throughout the state. Even some of this cannot be said to be commercial in the real

⁵ This is also in line with the State's philosophy of going organic.

sense because these are in the form of herbarium, demo centres or nurseries. Only a few species have started to be commercially cultivated. The supplies from the cultivation sources do not exceed 5 to 7 % of the total volume traded and about 95% of the supplies continue to be sourced from wild sources and sites. The National Medicinal Plant Board has identified about 32 species for cultivation out of which Government of Uttaranchal has laid emphasis on about 10 which have been chosen for cultivation in Uttaranchal

While we could not obtain the data on actual extent of cultivation of medicinal plants in the State, the data in respect of cultivated area and production of aromatic plants was available with Centre for Aromatic Plants (CAP), Selaqui. As per these estimates, 10 species of aromatic plants are being cultivated commercially in the State and these species currently occupy about 170 acres (about 67 hectares) land. Of these, a single species lemongrass alone accounts for more than 44 percent of the area while some others such as Stevia, Tagetus and Rose are being cultivated on less than 5 acres of land.

4. Main Results

4.1 Comparative Economics of Identified Medicinal and Aromatic Plants with Alternative Crops

Cultivation of medicinal and aromatic plants is a relatively new phenomenon and the (selected) crops once planted can be harvested over almost five year period. Most of the selected cultivators have not had gone through the entire crop cycle period. Before we present the comparable results of relative crop economics it is important to mention that although the data on per hectare input use, crop output and crop profitability in the case of Jumbo Faran and Lemon Grass were derived on the basis of five year data the comparable information in the case of competing crops viz Rajma and Wheat (for Jumbo Faran) and Paddy and Wheat (for Lemon Grass) was derived on the basis of single year data. The relative economics is thus based on the assumption that the farmers would continue to grow the same crop/ crop combination (Rajma and Wheat in the case of Jumbo Faran, and Paddy and Wheat in the case of Lemon Grass) during the comparable period of five years during which these focused crops are cultivated, using current levels of input and thereby incurring current level of cultivation expenses and obtaining current levels of crop yields.

We present in Table 3 summary results of per hectare per year estimates of cost, gross value of output and net returns for Jumbo faran and its competing crops – Rajma and Wheat, and Lemon Grass and its competing crops – Paddy and Wheat. In the case of medicinal plants, while the cost of cultivation and gross returns for Jumbo Faran are substantially higher than the combined cost and value of output of rajma and wheat, the net returns of both are almost at the same level. In the case of aromatic plants while the cost of cultivation and gross value of output of lemon grass are less than the combined corresponding values for paddy and wheat, the net returns of lemon grass are higher than that of paddy and wheat by almost 34 percent.

4.2 Experiences of Sampled Cultivators of Medicinal and Aromatic Plants Changes in Area under the Identified Crops

- Overall 67 percent of the sampled cultivators of medicinal plants reported either increase or no change in cultivated area under the crop since they first started its cultivation. About 33 percent reported some decline in area allocated to this crop.
- Of the 42 sampled cultivators of aromatic plants, 29 percent reported some increase in area since they began its cultivation while the remaining 71 percent reported no change. An important observation is that none of the cultivators who started its cultivation reported any decline in its area since the start of the cultivation.

Table 3: Comparative Economics of Jumbo Faran and Lemon Grass With Their Competing Crops – Summary Results (Rs Per Hectare)

Crop	Row	Cost (C2 Basis)	Gross Value of Output	Net Returns
Medicinal Plants (Jumbo Faran)	1	33606	109485	75879
Rajma	2	13637	83211	69574
Wheat	3	6337	12109	5742
Rajma+Wheat	4	20004	95320	75316
Medicinal – (Rajma+Wheat)	1-4	13602	14165	563
Aromatic Plants (Lemon Grass)	5	9361	31838	22477
Paddy	6	9215	16044	6529
Wheat	7	10625	19768	9143
Paddy+Wheat	8	19840	35812	15972
Aromatic – (Paddy+Wheat)	5-8	(-) 10479	(-) 3974	6505

Motivating Factors

- Of the various factors that have influenced the cultivation of medicinal plants, the most important ones have been: easy to cultivate, higher relative profitability, demonstration effect of its cultivation by fellow farmers, good demand of this crop and easy availability of inputs, low level of input requirement and low cost of production. Its easy cultivation practices and higher relative profitability have in fact been the two most important factors which have encouraged almost all the sampled cultivators to go in for cultivation of medicinal plants.
- Of the various factors that have influenced the cultivation of aromatic plants, the single most important factor that has influenced almost the entire sample households has been its ease in cultivation. The other important factors that have influenced the cultivation decision of the sampled farmers have however varied. Low input requirements and low input costs, higher relative profitability, easy availability of inputs, demonstration effect of the other farmers cultivating this crop and good demand for this crop have also to varying extent influenced the cultivation of aromatic plants by sampled farmers.

Factors that Could Help Bring Larger Area Under the Identified Crops

- While 15 of the 21 sampled cultivators (71 percent) of medicinal plants responded that they are willing to bring larger area under cultivation of medicinal plants, the remaining 6 (29 percent) are not willing to bring any more area under the crop. The 15 sampled farmers willing to bring larger area under cultivation of medicinal plants, were asked to rank the factors, from those listed, they would consider relatively more important in influencing this decision. As expected all the 15 farmers listed increased profitability as the most important factor that would encourage them to bring still larger area under the crop. The second most important factor included improved marketing facilities for the crop (by 7 of the 15 farmers), more technical assistance and know-how including making available seedlings from the government agencies (by 4 of the 15 sampled farmers) and improved

demand for these crops (by 4 of the 15 cultivators). Thus apart from increased profitability, improvement in marketing facilities and improved demand for these factors could influence farmer's decision in bringing larger area under the crop.

- In the case of aromatic plants, of the 42 sampled cultivators 28 cultivators (67 percent) are willing to bring still larger area under the cultivation of aromatic plants while the remaining 14 (33 percent of the total) are not willing to increase any further the area under cultivation of this crop. Unlike in the case of sampled cultivators of medicinal plants, all of whom accorded increased profitability from the crop as the most important factor that would encourage them to bring larger area under the medicinal plants, in the case of aromatic plant cultivators the most important facilitating factor that could encourage such a shift varied. While 16 of the 28 cultivators who are willing to bring larger area under its cultivation attributed increased crop profitability as the most important motivating factor, 4 attributed increased and stable output prices as the most important factor. In the case of the remaining farmers the other most important factors that could influence their this decision is improved marketing facilities. Of the 14 sampled cultivators who are not willing to increase area under this crop, 11 (79 percent of the total) attributed it to small size of their land holding while the remaining 3 attributed it to lack of irrigation facilities. The second and third important factors in influencing such a decision have been – lack of irrigation facilities, lack of processing facilities, difficulties in marketing etc.

Factors that Could Influence Diversion of Area From Under Identified Crops

- Of the 21 sampled cultivators of medicinal plants, 20 are inclined to shift the current area under medicinal plants to an alternate crop should the relative profitability of other competing crop becomes higher than that of medicinal plants . Other important factors cited for such a likely shift in area from under the medicinal crop to other crops include – non improvement in marketing facilities and lack of demand for these crops.
- As in the case of medicinal plants, a majority (57 percent) of the sampled cultivators of aromatic plants would also shift the area from under aromatic

plants to alternate crops should the profitability of aromatic plants goes down in relation to that of the competing crops. Another 21 percent of the sampled cultivators however feel that the most important factor that would influence their decision in shifting away from aromatic plants to alternative crops is the non- improvement in marketing facilities for the aromatic plants. Another important factor that could influence the decision of the farmer in moving away from the cultivation of aromatic plants is the lack of increased demand for these crops.

Marketing of Medicinal and Aromatic Plants

- The markets for disposal of cultivated medicinal plants have not so far very well developed and organized even though its cultivation, albeit on a small scale, started a few years ago. This is on account of several factors- the most important being the small size of production, that too scattered over four to five harvests in a year, and spread over a large hilly area with not so easily accessible tracts. As a result almost all the cultivators normally have no option but to sell their produce to a local middleman. In the present case also all the sampled cultivators of medicinal plants reported that they sold their entire marketable surplus to the local middleman. Further the entire crop by all the sampled cultivators was sold in the raw form rather than after processing it.
- Unlike medicinal plant, cultivation of the aromatic plants has been a relatively new phenomenon. Most of the efforts in this case so far have been directed towards encouraging farmers adopt its cultivation and extending the cultivation to newer areas. To promote its cultivation and allay any fears of the cultivators with regard to its marketing the cultivators were assured of guaranteed procurement of the entire crop at a fixed price by the CAP. Even those cultivators who would like to extract the oil from lemon grass, rather than selling the grass in its raw form to the CAP, were provided assured facilities for oil extraction at a nominal price. Apart from above, no significant formal market or processing facility in the vicinity of the production area has so far developed. Due to the absence of such a formal market, almost all the sampled cultivators sold their produce either to CAP or to the private

entrepreneur who has set up the above plant. Further as in the case of medicinal plant cultivators, the entire crop by all the sampled cultivators was sold in the raw form rather than after extracting the oil, even though facilities for this existed.

- Almost all the sampled cultivators of medicinal plants reported no problems with their crop disposal. This implies that even though the crop was being sold to a middleman, the farmers faced no problem in their dealings with him.
- Of the 42 sampled cultivators of aromatic plants, 19 (about 45 percent) reported no marketing related problems, while 11 (about 26 percent) reported large distance of their farm from the market center. Another 8 cultivators (about 19 percent) cited problems relating to delays in receipt of payment.

5. PROMOTING CULTIVATION OF MEDICINAL AND AROMATIC CROPS – WHAT NEEDS TO BE DONE

Despite the multifarious advantages associated with cultivation of medicinal and aromatic crops, their adoption for cultivation by farmers has not however so far been very encouraging. This is in large part due to the fact that medicinal and aromatic plants sector in India operates in a near policy vacuum. Encouraging cultivation of these crops require concurrent policies and effective actions aimed at regulating collection of medicinal plants from wild; research, development and extension efforts aimed at developing newer plant varieties suitable for cultivation and their propagation and adoption by farmers; organizing effective post harvesting marketing and trade operations including their processing and exports and developing an efficient marketing infrastructure, and building an efficient information base, including marketing intelligence, and its proper and timely dissemination.

5.1 Issues Related to Cultivation and Extension

- Given that thousands of species of medicinal and aromatic plants are available and collected from the wild, it is neither possible nor desirable to direct cultivation efforts at all these species. Promoting widespread cultivation of medicinal and aromatic plants through domestication of species grown in the wild, therefore require appropriate prioritization of research efforts. As a first step this would require identification of those species which are under more

serious threat of extinction and which are in relatively greater demand than the others both in the domestic market and for international trade. Knowledgeable person associated with the trade of these plants suggest that there are around 10 – 12 medicinal plants which are required in bulk (1000 to 10000 tons) and are currently mainly obtained through natural sources (wild stocks) and which are depleting fast. Therefore, research priority in the first instance should focus efforts in developing suitable planting material and associated package of practices for cultivation of such species. In addition there are about 15 medicinal plants which are currently imported to meet the internal demand and therefore for the purpose of import substitution, developing suitable cultivation techniques for their cultivation is necessary.

- Systematic cultivation of medicinal and aromatic plants need specie-specific and location specific cultural practices, depending on prevailing soil, water and climatic conditions at a given location. Hence research and development work and cultivation techniques have to be tailored keeping these in view, though efforts need to be made towards standardization of cultivation practices and harvesting times to get the desired quality of medicinal and aromatic plants.
- While developing cultivated varieties, efforts need to be made towards genetic enhancement of at least some of these species, as compared to that of species found in the wild, by different methods of breeding including through traditional genetic transformation and use of biotechnology. The efforts of different agencies involved in the development of these plants need to be better coordinated and closely integrated.
- Non availability of suitable and adequate planting material at the right time severely constrains the adoption by farmers of these crops. More nurseries in different parts of the State need to be developed to make planting material easily available to farmers.
- Widespread field demonstrations of species developed for cultivation will motivate the farmers to adopt cultivation of medicinal and aromatic plants. Some of the improved production technologies developed at research stations have not been transferred to the field to the required extent due to lack of

sufficient extension personnel and infrastructure. More efforts need to be invested in this direction.

- Farmers would switch over to cultivation of these plants, besides other factors, if returns from these crops are substantially better than the alternative crops being cultivated by the farmers. While relative crop profitability depends upon several factors an important consideration in developing suitable crop varieties and package of practices for such crops should be to ensure minimization of the cost of cultivation and maximization of the crop yields. Currently, the cost of planting material is the major cost in cultivation of these crops. Efforts need to be made to cut down on the cost of planting material so that relative crop economics can be improved.
- Given the growing demand for organic products, more so for medicinal and aromatic plants, efforts should be directed towards development of such species which are suitable for cultivation under organic farming conditions.
- One of the factors weighing buyer's preference for wild species over cultivated ones is the perceived superiority of medicinal constituents of a wild plant as compared to that of a cultivated plant. This in large part is due to the fact that this information on these aspects is not readily available to the buyers. Lack of adequate number of analytical laboratories capable of handling detailed analysis are not easily available. There is a need for setting up a network of regional analytical labs to facilitate the analysis of the constituents of the medicinal plants so that quality certification could be done. This will help build buyer's confidence and encourage farmers to go in for cultivation of medicinal and aromatic plants. Some of the labs could be authorized to issue certification as a means of building buyer confidence as also for product standardization.
- If appropriate cultivation practices are developed and the crop economics is favorable, efforts can also be made to popularize cultivation of medicinal & aromatic plants in green houses as well as inter-crops.
- Even simple interventions, such as, better method of harvesting, storage, grading and local level value addition can substantially improve returns to local people. Lack of knowledge on these issues has been an important

constraining factor in realizing these benefits. There is a need for capacity building of farmers and extension workers so that returns from cultivation can be improved.

- The State has a good network of State and Central institutions and research centres undertaking research on various aspects of cultivation of medicinal and aromatic plants. However there does not appear to be much coordination amongst different institutions as a result of which there are some overlaps and duplication of efforts on the part of these agencies. Apart from better coordination amongst these agencies there is a need for an added interaction and coordination between these research institutions and marketing and processing agencies so that a proper market feed back could be obtained and research efforts could be prioritized accordingly.

5.2 Need for Strengthening Database & Market Intelligence

- Any systematic and realistic planning for cultivation and marketing of medicinal and aromatic plants and promoting their sustainable development requires sincere efforts aimed at developing an authentic statistical data base not only in respect of cultivated species of these crops but also of those being currently collected from the wild. Unfortunately an authentic data base in respect of medicinal and aromatic plants is not available in Uttaranchal. The current agricultural statistics collection in the State is confined only to the major field crops and few horticulture crops. Similar database pertaining to area and production of medicinal and aromatic plants need to be developed. In addition, there is also a need for creating a data base on such variables as species wise demand, supply, end uses etc.
- As of now there appears to be little or no direct contacts between collectors / cultivators and processors/ final consumers. This is in large part attributed to lack of knowledge and awareness about markets with no institutional arrangement available to bridge this information gap. Generally traders or their representatives, visiting local areas are the only source of market information available to these people. Lack of availability and access of market information is thus an important factor constraining improvement of returns to producers of medicinal and aromatic plants. Apart from thus creating the data base on extent of cultivation of these

plants, there is a need to set up a market intelligence unit to regularly collect, analyze and widely disseminate latest and reliable information relating to markets, marketing channels, prices, trade including imports and exports and make this information available to all concerned in a timely fashion.

5.3 Inadequate Processing Facilities

- The processing of medicinal and aromatic plants is generally done in either one or two stages. The first stage is semi-processing while the second stage is conversion in to formulations. While conversion in to formulations requires appropriate infrastructure facilities and technical know how and may be beyond the reach of an ordinary farmer, however semi-processing involving such functions as cleaning and grading and undertaking such activities as drying, powdering, making concentrates, boiling and distilling, etc. can be done at the local level. Some farmers are already doing some semi-processing of the medicinal plants for their self consumption. Marketing of semi-processed product rather than raw crop can lead to value addition and improve the profitability of the cultivator. Efforts thus need to be made to encourage semi processing of these crops by encouraging setting up of diversified small scale enterprises/ cottage industries in remote and far-flung areas either through formation of cooperatives or through encouragement of small private entrepreneurs. This will also help in reducing the transportation and packing costs of raw materials and also provide additional employment to local people
- Uttaranchal has about 15 reputed pharmacies preparing formulations, however these are not sufficient. Efforts need to be made to encourage entrepreneurs set up more processing facilities for preparation of formulations.

5.4 Marketing

- Marketing of medicinal herbs in general and those of cultivated species in particular is erratic in Uttaranchal. Institutional efforts are confined up to cultivation and propagation but are almost totally absent for development of marketing. The trade is currently non transparent, inefficient, imperfect, informal and opportunistic and often carried out in a hush-hush manner. As a result the farmers are able to realize only a very small fraction of the price paid by the ultimate consumer of final product resulting in lower crop profitability and not providing enough incentive to

the farmers to go in for its cultivation. Policy intervention aimed at promoting cultivation of medicinal and aromatic plants has thus to consider marketing as a major component.

- The important constraints for marketing of medicinal and aromatic plants in Uttaranchal arise as a consequence of several factors : the hilly terrain with sparse habitation thinly spread, inadequate infrastructure development (principally road and transport) in relation to these characteristics, generally small size of farm holding of which farmers have currently devoted only a small portion for cultivation of these plants, and low levels of production that too realized over three to four cuttings in a year. In the absence of any institutional support for marketing (CAP does provide some limited support for aromatic plants but that too in its catchments area only and this support is not likely to continue for ever), coupled with lack of any market intelligence and the fact that production of individual farmer in each cutting is very small, the farmer has no option but to fall in the trap of agents of dealers and sell his crop at whatever price is being offered to him. The only price mechanism he has at his disposal to guide him is the previous years sales price. These un-organized market channels have lead to monopoly of few individuals and industries controlling and dictating the market and depriving the farmers of a more remunerative price for his produce. To promote large scale cultivation of these crops the state would have to intervene either through formation of farmers marketing cooperatives or promoting contract farming under a legally binding enforceable contracts and monitored by a regulatory authority.
- In addition, to meet the domestic as well as international quality standards, post harvest marketing operations e.g., harvesting, grading and standardization, system of certification, packing and transportation need to be improved. For international regulations it may also be necessary to have ISO systems of certification.

SECTION 1

INTRODUCTION

1.1 What are Aromatic and Medicinal Plants?

Medicinal Plants: The plants used for medicinal purposes throughout the world are clubbed under the category of Medicinal Plants. According to World Health Organization (WHO), “a medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi-synthesis.” The WHO estimates that 80 percent of the developing countries population depends on traditional medicine for their health needs. In addition, modern pharmacopoeia also still contains at least 25% drugs derived from plants and many other, which are synthetic analogues built on prototype compounds, are isolated from plants. Transition from synthetic drugs and microbially produced antibiotics to plant based drugs is rapidly gaining acceptance. In many developed countries, traditional herbal remedies are making a comeback as alternatives to conventional medicine. In the United States, the number of people using herbal medicines has increased from 2.5 percent in 1990 to 37 percent in 2000. With the sharp rise in popularity of traditional medicines, the economic importance of these plants has increased enormously. With increasing population and increased awareness the demand for traditional medicines and thereby that of medicinal plants is likely to continue to grow in the future at a much faster rate.

Aromatic Plants are essential oil yielding plants. They have volatile, odoriferous oils in special cells, glands or ducts located in different parts of a plant, such as, the leaves, barks, roots, flowers and fruits and sometimes in just one or two parts. The oils are usually present in very small amounts and comprise only a tiny fraction of the entire plant material. The oils are produced during some metabolic processes of the plant and are secreted or excreted as odoriferous by-products. The fragrant oils may not necessarily be present as such in the living plants but may occur as odorless compounds termed as glycosides. When the plant tissues are macerated, an

enzyme reaction occurs which causes the glycosides to undergo a chemical change. This action in turn liberates the distinctive essential oil.

Currently most of the medicinal plants grow wild and are collected from forests. Hundreds, and possibly thousands, of plant species are being harvested by millions of poor rural population⁶ and used by millions around the world for treating a variety of illnesses. As a result, documenting their population levels or ascertaining the impact of their uncontrolled extraction for use and trade on sustainability has proven to be difficult. However, in the absence of any significant efforts having been made so far at their conservation, serious concerns have often been raised about the increasing threat of depletion and the potential endanger to the survival of plant species in the wild as a result of their uncontrolled extraction⁷.

With their large populations and ancient heritage of traditional herbal-based medicines, China and India are two great producers of medicinal plants having more than 40% of global biodiversity. Some of the other major producers of herbal medicine include the United States, Germany, Bulgaria, Poland, Japan, Madagascar, and Sudan. The United States is also a major market for herbal medicines, importing hundreds of thousands of tons of herbs each year to support its \$3 billion market. Other major consumers include Germany, France, Italy, Spain, and the United Kingdom. Europe as a whole imports one-quarter of the world's trade in herbal medicines, around 440,000 metric tons.

An estimate of EXIM Bank puts the international market trade of medicinal plants related trade at over US\$60 billion per year, which is growing at the rate of 7%. In the prevailing scenario of continuing increase in the demand for herbal medicines around the world and with little control over their collection or trade regulation⁸, the

⁶ Being an important source of income for the poor communities around the world, collecting medicinal plants for sale continues to thrive irrespective of the consequence of such an action on the possible threat to the existence of these plants.

⁷ TRAFFIC has studied the use of medicinal plants in Europe, the United States, Africa, and Ecuador, concluding in each case that a number of plant species are threatened as a result of uncontrolled collection.

⁸ There is very little regulation or monitoring of legal trade in countless medicinal plants, as such illegal trade is not generally a significant problem. In cases where medicinal plant species are protected from trade, smuggling occurs if the plants are rare and valuable enough to risk the consequences. For example, wild Asian ginseng, which grows only in two provinces of far-eastern

only way to protect wild populations of medicinal plants and minimize threats to sustainability is to increase the supply of equally effective cultivated specimens. Despite some efforts made at promoting cultivation of these plants, their adoption for cultivation by farmers have, for a variety of reasons, so far been slow to come by. Herbal plant cultivation is underway in Europe, but it is still in the experimental phase in the United States, and has barely been attempted in Africa and Latin America.

India has been considered as a treasure house of valuable medicinal and aromatic plant species. The Ministry of Environment and Forests, Government. of India have identified and documented over 9,500 plant species considering their importance in the pharmaceutical industry. In India also, threatened by over exploitation of wild populations, some attempts have just begun to encourage farmers to cultivate medicinal plants. In the present context of 'back to nature' in health care, it is relevant that these valuable plant species are not only conserved but also promoted for commercial cultivation in order to meet the increasing demand within the domestic and export markets. It is expected that increasing the amount of cultivated herbs available will decrease the pressure on wild plant populations and help in their conservation.

Shift from collection to cultivation of medicinal and aromatic plants will also ensure purity, authenticity and sustainable supply of raw materials required for herbal drugs, including polyherbals. Agro-techniques have been developed for a large number of medicinal and aromatic plants by the ICAR Institute and several State Agricultural Universities under the All India Co-ordinated Research Project on Medicinal and Aromatic Plants. However, due to unorganized marketing arrangements this sector has not exploited its full potential. A Medicinal Plants Board has also been constituted in the Department of Indian Systems of Medicines & Homeopathy to address all the issues.

Russia and one province of China, is protected from trade in these two countries. But the finest specimens of wild Asian ginseng sell for tens of thousands of dollars per kilogram. These high prices create a tremendous incentive for poachers, and as many as 600 kilograms of wild ginseng are smuggled out of Russia every year. In the United States, trade in wild American ginseng has been regulated for decades, but poaching inside national parks still occurs.

1.2 The Study: Scope and Objectives

Encouraging farmers to cultivate medicinal and aromatic plants through a diversification of their cropping pattern in favor of these crops, requires information on a number of underlying economic and non-economic variables. Some of the information needs include : the relative economics of cultivation of these crops vis-à-vis alternative crops the farmers are currently cultivating, the demand for these crops, marketing arrangements and the availability of markets for disposal of these crops etc. Given that efforts at promoting cultivation of medicinal and aromatic plants are still in their early stages in different parts of the country and some of the basic reliable information on some of the underlying economic variables associated with their cultivation is not easily available, the Ministry of Agriculture assigned Six⁹ Agro Economic Research Centres (AERCs), located in those parts of the country where cultivation of medicinal and aromatic plants has already commenced or is in its early phases of introduction, to undertake a study on “Cultivation of Medicinal and Aromatic Crops as a Means of Diversification in Agriculture”. The AERC Unit located at ADRT, Institute of Social and Economic Change , Bangalore has coordinated the study who have also provided the basic analytical framework. Based on individual study reports, the ADRT will bring out a consolidated all-India status report. The present study conducted by AERC, Delhi pertains to the State of Uttaranchal. The specific objectives of the study are:

6. To understand the economics of cultivation of the selected medicinal and aromatic crops and find their economic and market potential as preferred by the farmers.
7. To assess the area being cultivated under selected medicinal and aromatic plants
8. To study the relative economic impact of cultivation of medicinal and aromatic plants by the farmers
9. To identify bottlenecks in the marketing of medicinal and aromatic plants and suggest possible remedies.

⁹ The Six states where this study has been conducted include – Karnatka, Kerala, Madhya Pradesh, Maharashtra, Uttaranchal, and West Bengal

10. Attempt an estimation of domestic and international demand for the selected medicinal and aromatic crops in the light of the effect of new IPR regime on pharmaceuticals

1.3 Medicinal and Aromatic Plants in the Himalayan Region

The role of medicinal plants is particularly important in the Himalayan region. These areas are naturally and richly endowed with a large variety of plant species, many of which have medicinal properties. A large proportion of the rural population in these areas depends on locally available medicinal plants to meet their health care requirements. Furthermore, the collection and marketing of these plants provide an important source of income for communities living in the mountain areas. Unfortunately, the increase in demand has also increased the threat of depletion, as many of these plants are largely collected from the wild. At present, 90% collection of medicinal plants is from the wild. Over 70% of the plant collections involve destructive harvesting because of the use of parts like roots, bark, wood, stem and the whole plant in case of herbs. Currently medicinal plants are collected without paying attention to the stage of maturity. As the price paid to the gatherers tends to be very low, they often "mine" the plants, as their main objective is to generate income. A critical factor in wild harvesting is the availability of cheap labor to undertake the very labor intensive work of herbal gathering. Women are the main gatherers and also the users. While over 800 species are used in production by industry, less than 20 species of plants are under commercial cultivation. This poses a definite threat to the genetic stocks and to the diversity of medicinal plants if biodiversity is not sustainably used. With the rampant deforestation, women have to cover greater distances for the collection of herbs that once grew almost outside their habitation. As forest habitat disappear and over harvesting for commercial use reduces the stocks of wild medicinal plant material, there is a corresponding drop in the availability of the plants normally used as the first and last resort for all health care by rural population. Unrestricted exploitation of crude drugs from natural sources without proper measures of conservation have brought the natural medicinal plant wealth both of the region in particular and the country in

general to a situation where several species have become either endangered or are on the verge of extinction¹⁰.

In the context of conserving biodiversity and promoting and maintaining the health of local communities, besides generating productive employment for the poor, with the objective of poverty alleviation in tribal and rural areas, the prevailing situation calls for immediate attention to issues relating to conservation and sustainable use of medicinal plants. Measures such as in-situ and ex-situ conservation¹¹ of such species, which have been over-harvested resulting in low density of these species in nature, coupled with cultivation for sustained development of growing herbal drug industry are called for. Policy intervention and support is, therefore, urgently needed for conservation and to encourage and facilitate investments into commercial cultivation of medicinal and aromatic plants.

1.4 The Study : Methodology

The present study is based mainly on primary data collected from the farmers who have been cultivating some of the medicinal and aromatic crops. The study design stipulated selection of one medicinal crop and one aromatic crop for detailed enquiry. However adoption of any strictly scientific criterion for selection of a specific medicinal and aromatic plant, from amongst those being cultivated by farmers, for detailed study was constrained due to the lack of a systematic secondary data base which should normally form the basis for such a selection. This lack of a data base in turn was due to the fact that cultivation of medicinal and aromatic crops is a relatively

¹⁰ Although there are restrictions on extractions and procurement from wild, yet the trade is going on secretly and resulting in over exploitation of resource areas thus leading to unsustainable practices.

¹¹ ***In-situ*** conservation is defined as conservation of ecological, species and genetic diversity in their natural habitat so as to let the dynamic of eco-system takes its natural course. This natural process can go unhindered indefinitely. A number of protected areas, such as National Parks etc, are specifically delineated to conserve the biota along with natural ecological and eco-evolutionary processes.

Ex-situ conservation means efforts made by research wing of forest department and other Institutions to conserve artificial shelters e.g. aquaria, arboreta, botanical gardens, fen houses, zoological parks etc.

new phenomenon in Uttaranchal and the State wide data base on the area and production of these crops is yet to be compiled. In view of these and other related considerations the choice of crops for detailed enquiry was made as follows.

Neither all plants collected from the wild are amenable to cultivation nor cultivation practices for all such crops found in the wild need to be developed. The groups of medicinal and aromatic crops, which are amenable for cultivation, comprise a large number of crops of which the cultivation practices and suitable plant material have so far been developed for only a few. Of these few however only a still smaller number of crops are actually being cultivated by the farmers. For example, while suitable cultivation practices have been developed for about 30 medicinal and aromatic crops, however cultivation on any significant scale (either in terms of area under these crops, the level of their production or in terms of number of cultivators cultivating these crops) is being done in respect of one or two crops only due mainly to relatively better market demand for these crops as compared to the others and availability of sufficient quantities of required planting material which often is not easily available for all the crops developed in experimental stations for cultivation. Moreover given the fact that the cultivation of these crops is a relatively new phenomenon the limited resources available with official agencies for propagation of cultivation of new crops have rightly not been spread thinly over introduction of a larger number of crops in one go but efforts have been more focused.

Given these considerations, the selection of crops and region for sample selection for the present study has been done based on whatever fragmented secondary information was available from formal and informal sources and on the basis of discussion with local official agencies in the State¹². For similar reasons, coupled with the fact that most of the farmers cultivating these identified crops were thinly stretched over a relatively large geographical area with hilly terrain, adherence to strict sampling procedures using generally followed stratification procedures for regional and farm size grouping stratification for sample selection could not be followed in the present case. However all efforts have still been made to ensure that

¹² We would in particular like to thank Mr Nipender Chouhan of CAP, Selaqui for his assistance in making secondary data available and in planning of the field work of the study.

the sample households selection was random and that this sample fairly represent the prevailing situation on ground.

Keeping in view the above constraints and limitations the medicinal crop selected for the present study is Jumbo Faran while the aromatic crop selected for the study is Lemon Grass. The sample for the medicinal crop has been selected from District Chamouli while for aromatic plants the sample has been drawn from District Dehradun. While the sample for the identified medicinal crop comprised of 21 cultivating households that of identified aromatic plants comprised of 42 households (Table 1.1).

Table 1.1 Sample Crops and Sample Size

Type of Crop	Crop Name	District	Sample Size
Medicinal	Jumbo Faran (<i>Allium stracheyi</i> Baker)	Chamouli	21
Aromatic	Lemon Grass (<i>Cymbopogon flexuosus</i> Nees)	Dehradun	42
Total			63

1.5 Cultivation Practices and Uses of Jumbo Faran

Cultivation of Jumbo Faran requires soil with high carbon content and is best cultivated under climatic conditions varying from dry and cold temperate to alpine zone. The crop grows well at an altitude of 2200 to 3500 meters above MSL. The best time for sowing of the crop is March-April and is best transplanted during July. The number of plants required per hectare is about 1.5 lakhs. The crop duration is about five years with three to four cuttings per year. The first cutting is generally done during October, the second during April while the third cutting is done during July. Jumbo Faran is essentially used as an ingredient in drugs used for treatment of digestive system ailments.

1.6 Cultivation Practices and Uses of Lemon Grass

Of the various aromatic plants introduced so far for cultivation by the farmers in the state, cultivation of lemon grass is ahead of the others. The farmers were first given seedlings of lemon grass for cultivation by Centre for Aromatic Plants (CAP), Selaqui, Dehradun, in September 2004. The crop was initially introduced for cultivation on waste and relatively poor quality land. The farmers were given training by the CAP in the cultivation of lemon grass and each of the farmers who took the training were given free seedlings for cultivation on about two bighas of land. It is however not known if all the farmers who underwent training and got the planting material actually planted the crop in their fields.

Lemon grass (also known as China grass, Cochin grass, Malabar grass etc) is a multi year grass of Poaceae family from whose leaves lemongrass oil is extracted. The three main varieties of lemon grass found in India are : east India lemongrass (*Cymbopogon flexuosus*), west India lemongrass (*C.Citratus*) and Jammu lemongrass (*C. pendulus*). Of these three varieties, the oil of east India lemongrass is considered the best. The main component of lemongrass is Citral constituting about 75 to 80 percent by volume due to which this grass smells like lemon and derives its name. Besides Uttaranchal, in India the lemongrass is being commercially cultivated in Kerala, Tamilnadu, Karnatka, Assam, Madhya Pradesh, West Bengal and Maharashtra. It is estimated that at all-India level the current production of lemongrass oil is around 500 tonnes per year while the demand is around 800 million tonnes per year. The lemongrass oil also has great potential for exports.

The lemongrass leaves are used for making tea. The lemongrass oil has various uses. The main component of oil – Citral – is used to manufacture several value added products such as Jiranile Nitrile, Alpha ionon, Beta ionon which are respectively used in manufacture of soaps and detergent fragrance, high quality perfumes, and Vitamin A. Vitamin A is used in manufacturing of several types of medicines. Lemongrass oil is also known to keep away parasites and fungal infections. It also has anti-inflammatory and anti- bacterial properties and the aroma is energizing.

Lemongrass can be cultivated on various soil types, however soils with pH between 7.0 and 8.5 are considered more appropriate. The crop grows well in tropical and subtropical climatic conditions. The ideal temperature range is 9 to 35 degrees Celsius with relative humidity of 60-80 percent.

Lemongrass once planted can be harvested for four to five years, hence good land preparation is required before planting of the crop. There are several varieties of lemongrass under cultivation. The crop is planted with 'slips'. For making slips, either one year old plants or clumps are taken and individual slips taken out of them. The best time for planting the slips is February – March and July-October. Approximately 36,000 slips are required for one hectare of land. One irrigation is recommended immediately after planting of the slips. Although the crop does not require much irrigation after the roots have set in, however for better production and better quantity and quality of oil, irrigation at a gap of 15-20 days during summers and between 25-30 days during winter is recommended.

The first cutting of the crop is done after 90-100 days of planting. The subsequent cuttings are taken at a gap of 75-80 days. In all about four to five cuttings per year can generally be taken for crops grown in good quality land with irrigation facilities while in poor quality and otherwise uncultivable land two to three cuttings per year can be taken. The economic life of crop once planted is about four to five years.

The oil from the harvested crop can be extracted after drying for 4-5 hours in the field. The oil is extracted using the steam distillation or hydro-steam distillation process. Although the ratio of oil extraction to mass of leaves depend on several factors such as soil conditions, availability of irrigation, timing of harvest etc. the oil content generally varies between 0.4 to 0.6 percent. Commercially cultivated crop generally yields around 160 kg oil per hectare in first year, 225 kg in second and third years, 200 kg in fourth year and 175 kg in the fifth year.

1.7 Outline of the Report

In the following Section we briefly describe the general agriculture economy of the State of Uttaranchal and the importance of medicinal plants in the State. In Section

III we work out the relative economics of the identified medicinal and aromatic crops and compare the relative economics of these crops with the alternative crops the farmers are currently cultivating. In Section IV we dwell on the motivational factors and decision making criteria of the farmers with respect to the cultivation of medicinal and aromatic plants. Section V deals with the aspects relating to problems in marketing of these crops while in the last section we give main findings of the study and the broad conclusions emerging from the study.

SECTION II

IMPORTANCE OF MEDICINAL AND AROMATIC PLANTS IN UTTARANCHAL

2.1 The State and its Economy

The State of Uttaranchal is the youngest Indian state which came into existence in November, 2000 having been carved out of the State of Uttar Pradesh. The economy of Uttaranchal is predominantly agricultural. Agriculture and allied activities contribute around two-thirds of the net domestic output from the commodity producing sectors. The key GDP drivers identified for Uttaranchal are Tourism, Agriculture and Horticulture, the Medicinal plants/Herbal wealth, the generation of Hydro Energy, Information Technology and Biotech. The challenge is to exploit these optimally so that the common man can benefit out of it and have a stake in the system.

The total reported area of the State is 55.66 lakh hectares (Table 2.1). Being mostly of hilly terrain, the net sown area of the state is only about 14% of the total reporting area. Among the cultivated land about 50% of the landholdings are sub marginal and further 21% of the land is between 0.5- 1 ha. Thus about 71 percent of land holdings are less than 1 ha. in size and cover about 27 percent of the area under cultivation. The cropping intensity is about 160%, and the ratio of gross irrigated area to gross sown area is only 24.6%.

Table 2.1 Land use pattern in UTTARANCHAL – 1999-2000

Sr. no	Category	Area in Hectares	% Area Report
1	Total reported area	5565804	100
2	Forest	3466152	62.28
3	Barren & Uncultivable land	294936	5.30
4	Land put under non-agricultural uses	166768	3.00
5	Culturable Waste	322510	5.79
6	Permanent pastures and other grazing land	222958	4.01
7	Land under misc. tree crops and groves etc.	216260	3.89
8	Current Fallows	13743	0.25
9	Other fallows	69236	1.24
10	Net area sown	793241	14.25

In the hills the major crops grown include *Madua*, *Ramdana* and Potato whereas in the plains the major crops are cereals, pulses and sugarcane. Over 85 percent of gross cultivated area is used for growing food grains, mostly for self-consumption by households, except in Haridwar, Udham Singh Nagar and Dehradun districts, which do produce large surplus of food grains. Rice, *Mandua* and *Sawan* in Kharif and Wheat & Barley in Rabi are the main cereal crops whereas Urd, *Gahat*, Rajma, Lentil and Pea, are the main pulse crops of the State. Oilseeds occupy about 45 thousand hectares of cropped land. Soybean is the main crop of oilseeds. Mustard, a pure oilseed crop, has a significant coverage in Rabi season. Area production, productivity of various crops over the years is summarized in Tables 2.2, 2.3 and 2.4 below:-

Table 2.2 Cereals: Area, Production & Productivity

Name of Crop		2001-02 Prov.	2002-03 Prov.	2003-04 Prov.	2004-05 Anticipated	2005-06 Target
Rice	Area	283	282	288	299	300
	Production	571	483	549	628	630
	Productivity	20.15	17.07	19.03	21.00	21
Maize	Area	33	35	46	50	50
	Production	49	38	68	75	78
	Productivity	14.59	10.86	14.70	15	15.60
Mandua	Area	131	156	136	134	137
	Production	160	154	174	189	195
	Productivity	12.23	9.86	12.82	14.10	13.20
Wheat	Area	386	411	397	401	401
	Production	734	762	745	820	820
	Productivity	19.01	18.54	18.77	20.45	20.44
Barley	Area	24	29	32	28	28
	Production	28	36	35	36	37
	Productivity	11.05	12.29	10.94	12.86	13.21

Area ['000 Hectares] Production ['000 MT] Yield [Quintal / hectare]

Table 2.3 Pulses: Area, Production & Productivity

Name of Crop		2001-02 Prov.	2002-03 Prov.	2003-04 Prov.	2004-05 Anticipated	2005-06 Target
Total Pulses	Area	50	50	42	53	55
	Production	36	34	28	48	50
	Productivity	7.2	6.80	6.67	9.06	9.09

Area ['000 Hectares] Production ['000 MT] Yield [Quintal / hectare]

Table 2.4 Oilseeds: Area, Production & Productivity

Name of Crop		2001-02	2002-03	2003-04	2004-05	2005-06
		Prov.	Prov.	Prov.	Anticipated	Target
Total Oilseed	Area	26	29	37	44	45
	Production	18	20	35	43	45
	Productivity	6.92	6.89	9.46	9.77	10.00

Area ['000 Hectares] Production ['000 MT] Yield [Quintal / hectare]

2.2 Medicinal and Aromatic Plants in Uttaranchal

Uttaranchal is situated in the western Himalayan zone, traditionally known as a gold mine of medicinal and aromatic plants in the country. The state has a very rich diversity of medicinal and aromatic plants. The State is mostly hilly and has broadly been divided in to two regions, Kumaon and Garhwal, which can be divided into three main climatic zones:

- The Alpine zone.
- The Temperate zone and,
- The Sub-Tropical zone.

All three zones with altitudinal variations accommodate a variety of medicinal plants. The State is blessed with thousand of species; however, about 320 species have been identified having medicinal value. The forest department has reported about 175 species being commercially extracted and traded. It is estimated that the State is well positioned to generate revenue of more than Rs. 1, 000 crores per annum through medicinal plants trade.

Traditionally, the tribal and poor population of Uttaranchal has had close socio-economic developmental links with medicinal plants. These resources have provided them not only primary herbal medicines for their survival but also substantial part of their income. Even today, majority of the population living in and around the forests derive their income from collection of medicinal plants. The State Government in 2003 declared Uttaranchal as a "Herbal State"¹³.

¹³ This is also in line with the State's philosophy of going organic.

Although Uttaranchal is a storehouse of a rich variety of species of herbs, medicinal and aromatic plants however this massive potential has remained largely unexploited in the absence of a well planned and coordinated strategy for commercial cultivation and integrated arrangements for processing and marketing. Most of the herbs and medicinal plants are being collected as wild from forests essentially as a non timber forest product.

2.3 System of Collection and Marketing of Herbs in Uttaranchal

Bhesaj Sangh, comprising of village level cooperative societies in Uttaranchal, was for a long time the only agency in the state which was entrusted with the job of regulation of collection and sale of medicinal plants collected from wild in the forests. The *Sangh* was basically created by middlemen and traders to save the collectors from exploitation. However in 1986, the then Uttar Pradesh government also authorized Kumaon Mandal Vikas Nigam (KMVN), Nainital to undertake collection and sale of medicinal plants, thus bringing to an end the monopoly of *Bhesaj Sangh* in the Kumaon region. Subsequently, Garhwal Vikas Mandal Nigam (GVMN) was also given these rights, but nothing concrete could come on implementation front. *Bhesaj Sangh* however continued to remain more popular than their counterpart i.e. KMVN and GVMN because of their focused attention to herbal and medicinal plants only. *Bhesaj Sangh* with their district level cooperatives had appointed area wise agents who facilitated collection of these plants. These agents were given permit/license for harvesting. Legally, these agents were trained in to herbal and medicinal plants (H & MP) harvesting methods and its identification. These agents collect the H & MP and deliver them to the godowns of *Bhesaj Sangh*. They were being paid as per prices fixed by *Bhesaj Sangh* along with other Government authorities.

However in 2003 the Uttaranchal Government took a decisive policy decision to transfer the harvesting and marketing rights of these plants to the Forest Corporation (FC).

2.4 Cultivation of Medicinal and Aromatic Plants

Policy makers and conservationists in Uttaranchal have long been pleading for promotion of cultivation of herbal and medicinal plants as a means of increasing

incomes of farmers, for strengthening conservation measures, as an alternative source of supply for these plants and also as a means of crop diversification. However until recently, no serious efforts had been made in Uttaranchal to promote the cultivation of important medicinal herbs and aromatic plants. Recently, the Government of India has taken some progressive step by establishing Medicinal Plant Board at National and State level so that medicinal plants of high demand and trade can be grown on government and private lands. The main objective in setting up these Boards has been to promote cultivation of these plants so as to meet the demand of these plants by industries and other user groups without disturbing the natural habitat of the medicinal herbs.

Consequent to this, to promote conservation and harness the potential of medicinal and aromatic plants as a major income generating activity of farmers in the state, a Medicinal and Aromatic Plants Board under the chairmanship of Chief Minister has been set up in Uttaranchal. *Jadi Buti, Shodh & Vikas Sansthan* (Herbal Research and Development Institute) at Gopeshwar, Chamoli is the apex implementing agency which has been assigned the job of preparation of an integrated action plan for conservation, propagation/cultivation, processing and marketing of herbs, medicinal and aromatic plants. The Board is expected to develop close linkages with the tourism sector. The forest policy as well as the horticulture policy are also being developed in tandem to ensure that there is a scientific exploitation of this natural wealth and bio-diversely lest the very wealth be endangered or squandered away. The cooperative sector is also being activated, under the overall supervision of the Medicinal and Aromatic plants Board.

In addition, several other steps have been taken by the state government to develop this sector. Under conservation scheme, the Government has established several herbal gardens such as at Mandal, Selaqui and Muni Ki Reti (Rishikesh). Several farmers have been trained in cultivation of medicinal plants and beginning of cultivation has been made in more than 150 ha. spread throughout the State. The Government has also announced establishment of "Uttaranchal Medicinal Plant Export Zone" which would be monitored by a committee and explored for international markets. Development of websites & portals for information dissemination have also been proposed

Some of the available estimates on the extent of cultivation achieved so far however reveal that commercial cultivation is still in its infancy stage and less than 300 hectares. have so far been brought under cultivation under different schemes throughout the state. Even some of this cannot be said to be commercial in the real sense because some of these are in the form of herbarium, demo centres or nurseries. Only a few species have started to be commercially cultivated. The supplies from the cultivation sources do not exceed 5 to 7 % of the total volume traded and about 95% of the supplies continue to be sourced from wild sources and sites. Some critiques also point out that even this 5-7 percent share of cultivated plants may be an exaggeration since sometimes collections from wild sources are also being sold as cultivated ones. These critiques point out that the extent of cultivation of H & MP is not finding much of fortune due to several reasons. Few of the prime reasons behind reluctance for cultivation are:

- Undefined market channels with uncertainty
- Need for registration and licenses for cultivation
- Harassments in obtaining permits and in transit of materials
- End-users' denial for acceptance of commodities on ground of poor quality
- Phytochemical composition in terms of medicinal value.
- Lower price realization again on ground of phyto-chemical compositions
- Lack of certification on quality
- Non-availability of certified seeds and planting materials
- Instant comparison of cultivated H & MP with wild species grown under natural conditions

The National Medicinal Plant Board has identified about 32 species for cultivation out of which Government of Uttaranchal has laid emphasis on about 10 which have been chosen for cultivation in Uttaranchal

While we could not obtain the data on actual extent of cultivation of medicinal plants in the State, the data in respect of cultivated area and production of aromatic plants was available with Centre for Aromatic Plants (CAP), Selaqui. As per these estimates, 10 species of aromatic plants are being cultivated commercially in the

State and these species currently occupy about 170 acres (about 67 hectares) land (Table 2.5). Of these, a single species lemongrass alone accounts for more than 44 percent of the area while some others such as Stevia, Tagetus and Rose are being cultivated on less than 5 acres of land.

The important districts identified for cultivation of the above plants are: Dehradun (Blocks – Kalshi, Vikasnagar, and Chakrata), Chamoli (Joshimath), Pithorgarh (Didihat), and U.S.Nagar (Khatima and Sitarganj).

Table 2.5 : Area and Production of Important Aromatic Plants in Uttaraanchal

Sr.No.	Species	Area (in acres)	No of Farmers
1.	Lemongrass	74.89	176
2.	Citronella	6.64	25
3.	Basil	18.60	28
4.	Geranium	18.02	18
5.	Palma Rosa	21.30	10
6.	Jamarosa	13.50	07
7.	Tagetus	3.50	02
8.	Chamomile	8.20	38
9.	Stevia	2.00	17
10.	Rose	3.75	01
	Total	170.40	322

Source : Herbal Research and Development Institute, Govt of Uttaraanchal, Dehradun

2.5 Infrastructure for R & D in Medicinal and Aromatic Plants in Uttaraanchal

The state has a good network of state and central government institutions which can provide good research and development inputs into the sector. (ICFRE, WII, FRI, BSI, GBPIHED, CIMAP, CDRI, HAPPRC, Universities). There are also a number of NGOs like COMFORPTS, SHER, VCPCR, FES etc who continue to play an important role in the development of the sector.

2.6 Infrastructure for Processing Facilities in the State

Since the collection of herbs from wild is in vogue in Uttarakhand for a long time, some of the infrastructure for processing and marketing of these herbs has developed over time. In a survey carried out by HRDI, information was collected on the number of ayurvedic pharmacies in different districts, their input use and the products manufactured by them. The survey results suggest that there are 101 ayurvedic pharmacies located in Uttarakhand, of which 80 percent are located in two adjoining districts of Dehradun and Haridwar (Table 2.6).

Table 2.6 : District wise Number of Ayurvedic Pharmacies in Uttarakhand

District	Number of Pharmacies
Dehradun	23
Haridwar	57
Nainital	4
Udham Singh Nagar	4
Almora	3
Pauri Garhwal	7
Tehri Garhwal	3
Total	101

Source: HRDI "Herbal Uttarakhand: Present market Scenario. HRDI Farmers Bulletin 01/2003

Similarly the CAP, Selaqui has compiled information on the number of distillation units for aromatic plants both in the institutional and also private sectors. Of the 41 distillation units in the state, 27 (66 percent) are in the institutional domain while the remaining 14 (34 percent) have been set up by private entrepreneurs (Table 2.7)

Table 2.7 : Number of Distillation Units for Distillation of Aromatic Plants – Uttarakhand

Sr. No	Department	No of Distillation Units
Institutional		
1.	Centre for Aromatic Plants(CAP), Selaqui, Dehradun	04
2.	HRDI, Gopeshwar	02
3.	CIMAP, Nagla and Purda	07
4.	TIFAC-CIMAP	13
5.	Forest Corporation	01
Private Entrepreneurs		
1.	Pauri	04
2.	Munsiyari	01
3.	U.S.Nagar	08
4.	Simlatgadlu (near Rani Pokhari)	01

Source : CAP, Selaqui

2.7 Action Plan for Development of Medicinal and Aromatic Plants

Concerned by the slow progress in promoting cultivation of medicinal and aromatic plants in the state, the government has drawn an action plan for development of Medicinal and Aromatic Plants which is being implemented by the Herbal Research and Development Institute with the help of various collaborating Departments in order to develop Uttarakhand as “Herbal State”. Under this plan the following targets have been laid down for the next five years:

- In-situ conservation of Medicinal and Aromatic Plants in 1500 ha.
- Establishment of herbal gardens in 100 ha.
- Training of 1000 farmers in cultivation of Medicinal and Aromatic Plants.
- Establishment of 800 nurseries for production of quality planting material.
- Cultivation of Medicinal and Aromatic Plants in 1000 ha.
- Establishment of 13 collection and storage centres.
- Establishment of 3 terminal markets and 3 industrial states.

As per action plan, the following activities were proposed to be carried out during the year 2005-06 with a total proposed outlay of Rs 200 lakhs for herbal development.

(a) Survey and Conservation

The medicinal and aromatic plant diversity is being depleted due to over exploitation and habitat destruction. The Institute in collaboration with forest department is implementing a conservation, development and harvesting (CDH) plan in the State, under which the following activities will be taken up during 2005-06:

(i) Rapid mapping exercise (RME)

RME will be undertaken in 100 ranges for identification of medicinal and aromatic plant, of rare and endangered plants as well as for establishment of conservation, development and harvesting compartments.

(ii) Establishment of MPCAs

The rare and threatened species will be conserved as *in-situ* as a forest gene banks. A total of 91,435 ha area has already been identified for undertaking RME and it is proposed to establish MPCAs (medicinal plants conservation areas) in 300 ha in three climatic zones during 2005-06.

(iii) Establishment of herbal gardens

In order to conserve rare and endangered plants as ex-situ, 8 herbal gardens are to be set up in different climatic zones of Uttaranchal. Two herbal gardens (10 ha) one in Kumaon and another in Garwhal will be established during 2005-06.

(iv) Seed Resource Centres

Availability of quality seed is necessary for production of cost effective and quality raw herbs, especially for high altitude medicinal plants. It is proposed to develop seed resource centers for species like Aconitum, Picrorhiza, Valeriana, Rauwolfia and Gloriosa in 10 ha. selected areas.

(b) Nursery Development

It is proposed to raise 10 Lakh seedlings of various medicinal and aromatic species for cultivation in farmer's fields with help of forest and cooperative departments.

(c) Training and capacity building

Training and capacity building of farmers, growers, traders, vaidyas is required for nursery development, cultivation and processing of medicinal and aromatic plants. A total of 1500 farmers, 500 vaidyas, and 100 staff are proposed to be trained during 2005-06.

(d) Documentation of tradition knowledge

As per Action Plan, traditional knowledge of Uttaranchal is being documented for identification of vaidyas and traditional medicines for revitalization of traditional and folk medicinal systems. One block in each district has been identified for this purpose during 2005-06.

(e) Processing Units

Processing units are necessary for processing and value addition of medicinal and aromatic plants. 20 processing Units have already been established and 7 more units are proposed for 2005-06.

(f) Marketing Centers

Three marketing Centres are proposed to be set up in Haridwar, Ramnagar, and Tanakpur during 2005-06 for marketing of medicinal and aromatic plants. This will help farmers to sell their products for better prices without any interference of middlemen and commission agents.

(g) Infrastructure development

Although the Institute has been established during 1993, yet there is hardly any infrastructure available for efficient running of the institute. Therefore, it is proposed to construct administrative building, guest house, laboratories and training centers and staff quarters in head quarter as well as its regional centers at Dehradun and Almora.

(h) Research and Development

The main R&D activities during the year will include: agro technology development, tissue culture, inventorization, productivity trials, quality control, herbal product development, clinical trails, etc. It is proposed to transfer technology of cultivation of 14 species of medicinal and aromatic plants to farmers and also to introduce new crops like stivia, seabackthorn and jatropa for commercial cultivation in Uttaranchal.

SECTION III

ECONOMICS OF CULTIVATION OF AROMATIC AND MEDICINAL PLANTS

While successful introduction of a new crop and its adoption by cultivators in a given region is dependent on several factors, the most important consideration that drives its cultivation is its relative economics vis-à-vis the crops being currently cultivated by the farmers. The chances of adoption of a new crop by the farmers greatly improve if the financial returns from cultivation of this crop are higher in comparison to the crops he is currently cultivating. This is however not to undermine the importance of other complementary conditions required for the successful introduction and cultivation of any crop such as availability of required inputs for the cultivation of the crop, the required research, development and extension support, the availability of markets for crop disposal, a fair price for the crop etc. In this Section we examine the relative economics of cultivation of identified medicinal and aromatic plants in selected areas of Uttranchal with some of the alternative crops the farmers are currently cultivating in these areas.

As already discussed, while there are a very large number of plant species of medicinal and aromatic plants which are presently collected from the wild, not all of them are currently amenable to cultivation. It is estimated that Indian public sector research institutions have so far developed standardized practices for the propagation and agronomy of a total of around 40 species. Further it is neither possible to cultivate different plant species at all locations nor the performance of each of these species will be the same at different locations. Their performance can vary substantially depending upon the location, its altitude above sea level and the prevailing agro-climatic conditions etc. It may thus be pertinent to emphasize here that the economics of identified species of medicinal and aromatic plants estimated in this study and presented in the following paras is specie and location specific and these results may provide little or no indication of the economics of cultivation of medicinal and aromatic plants in general as a group or even the economics of cultivation of the analyzed plant species cultivated at a different location within the state or in a different state. What is clear however is that although estimates of

returns could vary widely, cultivation of medicinal and aromatic plants can be quite valuable.

Since cultivation of medicinal and aromatic plants is a relatively recent phenomenon, very few studies have been undertaken to evaluate the relative crop economics of cultivating these crops. A few studies on the economics of cultivation of some of the medicinal plants indicate that the potential returns to the farmer from cultivation of medicinal plants can be quite high. A 1995 study suggested that the cultivation of certain high altitude Himalayan herbs could yield products priced anywhere between Rs. 7,150 to 55,000 per hectare although it is not clear at which point in the marketing chain these prices are paid (Nautiyal 1995). Rao and Saxena (1994) reported average annual (per hectare) income of Rs. 120,000 through mixed cropping of high altitude medicinal herbs. Although high altitude medicinal plants tend to command higher prices but even those of lower altitudes are also significant.

In the context of comparing the relative economics of cultivation of the identified medicinal and aromatic plants with the alternative crops for the present study, it may be important to briefly comment on the identification of alternative crops.

Identification of alternative crop/ crop combination for comparing the relative economics is a difficult issue. For a given medicinal/aromatic plant being cultivated by a farmer, the alternative crops that are being currently cultivated or can be cultivated by a farmer can vary and would depend on a host of factors – the location of the village, the availability of irrigation, the size of the land holding of the farmer, soil conditions, availability of seedlings, availability of marketing facilities, etc. etc.

The nature of competing crop for a given aromatic/ medicinal plant can vary not only across villages but even within a village between different farmers growing the same aromatic/ medicinal plant. As already explained in Section II, the selection of sample households for the present study for both the selected crops viz Jumbo Faran and Lemon Grass had to be spread over a group of villages. As a result, the nature of crops/ crop combinations which could be labeled as alternative/ competing crop for the identified aromatic/ medicinal plant sometimes varied across different sampled households. While on the one hand, such a prevailing scenario of field conditions offer an opportunity of comparing the economics of the focused crops with more than one alternative crop/ crop combination, the very small sample size/ very small area

under each of such crop/ crop combination may somewhat compromise the robustness of the results. Under the prevailing conditions, for the present study, we have identified alternative crop/crop combinations on the basis of the number of sampled farmers cultivating those crops as also the area under such crops. Accordingly for each of the two focused crops viz jumbo faran and lemon grass we have identified the following crop/crop combinations as competing crops for comparing the relative economics (Table 3.1).

Table 3.1: Crops/ Crop Combinations Selected for Comparing the Relative Crop Economics

Crop Type	Crop Name	Competing Crops	
		Kharif	Rabi
Medicinal	Jumbo Faran	Rajma	Wheat
Aromatic	Lemon Grass	Paddy	Wheat

Before we proceed to present the results on relative crop economics, it may be pertinent to mention that being relatively new crops, both the selected aromatic and medicinal plants in a majority of the cases were being cultivated by the sampled farmers on only a very small plot of land while the competing crops were being cultivated on a relatively much larger part of the land, depending on the land available with the farmer for cultivation. For the purpose of comparison of the relative crop economics the figures for the focused crops and competing crops have been brought to a common unit viz one hectare. Blowing up the figures to per hectare basis, specially for the focused crops which were being cultivated by the sampled farmers on relatively smaller pieces of land, may also lead to multiplication by the same factor of possible reporting errors in input use and crop output. However while this can not be avoided, but this must be kept in view when generalizing the results.

In the following pages we first focus on comparing the relative crop economics of the medicinal plant – jumbo faran – with its competing crop (s) and then compare the relative economics of the aromatic plant – lemon grass – with the identified competing crop (s)

3.1 Relative Crop Economics of Medicinal Plants (Jumbo Faran) with Competing Crop(s)

As already discussed, the sample for medicinal plants for the present study was drawn from District Chamoli of Uttranchal State. The sample size consisted of 21 farmers.

Some of the basic characteristics of the sampled farmers are presented in Table 3.2. The average age of the sampled cultivator of medicinal plant was about 48 years and the average family size was 6 which was roughly divided equally between male and female. Of the 21 cultivators, almost half had studied up to between primary and secondary school level, while one third of the total sampled respondents were illiterate. One cultivator had however obtained an undergraduate degree as well.

Table 3.2 : Some Characteristics of the Sampled Farmers of Medicinal Plants

Item	Unit	Value
Average Age of Respondent	Years	47.6
Average Family Size	Number	6.14
-Male		2.90
-Female		3.24
Education Level of Respondents	Number	21 (100)
-Illiterate		7 (33.33)
-Up to Primary		3 (14.29)
-Primary to High School		10 (47.62)
-High School to Secondary School/ Intermediate		0
-Degree and above		1 (4.76)
Total Sample Size	Number	21

Figures in parentheses denote percentages

The average size of operational holding in the case of sampled cultivators of medicinal plants was 1.75 hectares, most of which was owned (1.71 hectares) and only a very small portion of the operated area (0.04 hectares) was leased-in. The entire area, both owned and leased-in, was however unirrigated (Table 3.3).

**Table 3.3 : Details of Land Holding of Sampled Growers of Medicinal Plants
(Sample Size 21)**

Type	Unit	Total	Irrigated	Un irrigated
Owned	Ha	1.71	0	1.71
Leased –in	Ha	0.04	0	0.04
Leased-out	Ha	0	0	0
Operated	Ha	1.75	0	1.75

As already discussed, the medicinal plants once cultivated can be harvested three to four times per year over a period of almost five years. Some of the major costs in cultivation of the crop – land preparation and planting -are thus incurred during the first year only while in subsequent years relatively minor costs, such as composting, weeding, harvesting etc only need to be incurred. For similar reasons the labor requirement per year for the crop differ from year to year depending upon the operations carried out in different years. The yield of the crop over the five years is also not uniform. Therefore, for working out the average per year requirement of labor and other inputs, cost of cultivation and for estimating the average per year crop yield and value of output, we have considered the entire five year crop cycle. The average per year labor use, cost of production and value of output has then been estimated as the simple average of the five year values of these parameters. All the costs and value of output have been derived at current prices and as such no discounting of the costs and benefits has been done.

3.2 Operation wise Labor Requirement for Cultivation of Medicinal Plants

The details of average per hectare per year operation wise labor input in cultivation of medicinal plants is presented in Table 3.4. The total human labor input per year by sampled farmers is estimated at 3261 labor hours per year. Weeding followed by harvesting are the most labor intensive operations. These two operations account for almost 95 percent of the total labor use in cultivation of medicinal plants. None of the sampled farmers used tractor for land preparation or for any other operation. The average bullock hour use per hectare per year work out to 36 hours.

Table 3.4 : Details of Operation wise Labor Use in Cultivation of Medicinal Plants (Average Per Ha Per Year)

Unit - Number of Hours

Operation	Human Labor	Bullock Labor	Tractor Labor
Land Preparation	36 (1.1)	36	-
FYM/ Compost	36 (1.1)	-	-
Planting/ Sowing	84 (2.6)	-	-
Chemical Fertiliser	-	-	-
Weeding	1660 (50.9)	-	-
Irrigation		-	-
Harvesting and Transportation	1445 (44.3)	-	-
Total (Average per year)	3261 (100.0)	36	

3.3 Operation wise Labor Use for Cultivation of Rajma and Wheat (Competing crops to Medicinal Plants)

The operation wise labor use in crops, viz Rajma in *Kharif* and Wheat in *Rabi* season, competing with medicinal plants is given in Table 3.5. The total labor use for cultivation of Rajma work out to 2132 hours per hectare. Of the total labour use, 40 percent is accounted for by harvesting and 32 percent by weeding. Similarly of the total labor use of 1548 hours per hectare in the case of wheat, 31 percent is accounted for by harvesting operation and about 33 percent for weeding operation. The combined labour use per hectare for both Rajma and Wheat work out to 3680 hours per hectare per year.

Table 3.5 : Operation wise Labor Use in Rajma, Wheat and Rajma+Wheat

Operation	Rajma			Wheat			Rajma+Wheat		
	Human Labor	Bullock Labor	Tractor Labor	Human Labor	Bullock Labor	Tractor Labor	Human Labor	Bullock Labor	Tractor Labor
Land Preparation	173 (8.1)	173	-	162 (10.5)	162	-	335 (9.1)	335	-
FYM/Compost	200 (9.4)			181 (11.7)			381 (10.4)		
Planting/Sowing	173 (8.1)			153 (9.9)			326 (8.9)		
Chemical Fertiliser	-			-			-		
Weeding	684 (32.1)			505 (32.6)			1189 (32.3)		
Irrigation	-			-			-		
Harvesting	852 (40.0)			487 (31.4)			1339 (36.3)		
Transportation	50 (2.3)	10		60 (3.9)	20		110 (3.0)	30	
Total	2132 (100.0)	183	-	1548 (100.0)	182		3680 (100.0)	365	

Contrasting the labor use per hectare per year in the cultivation of medicinal plants and its competing crops Rajma and wheat, it will be seen that the combined labor use in competing crops Rajma and wheat is almost 13 percent higher than that of medicinal plants.

3.4 Cost of Cultivation of Medicinal Plants

The major cost in cultivation of medicinal plants is the cost of the planting material. Due to a large number of saplings required to be planted per hectare of area, the total cost on planting material works out to be substantial (Table 3.6). At about Rs 1 per sapling and average number of saplings per hectare at about 1.52 lakhs the total planting material cost during the year in which it is planted works out to about Rs 1.52 lakhs, though this cost averaged over the five year growth period of the crop becomes about Rs 30,400 per year. The cultivation of medicinal plants requires good land preparation. The sampled cultivators were not using any chemical fertilizers. The cultivators were however using substantial quantities of FYM. Since the farm

size is small and there is enough family labor available, almost the entire cultivation work is usually done by family labor. The per hectare cost (Cost A2 basis) per year, averaged over five years, work out to Rs 33606 per hectare. The average crop yield per hectare per year (averaged over the five year period) of sampled farmers works out to 12.2 quintals per year. With the average current output price of Rs 9000 per quintal, the gross value of output per hectare per year is estimated at Rs 1,09,485. The net returns over cost have been estimated at Rs 75879 per hectare per year. Converted in to per quintal basis of output, the average cost per quintal of output work out to Rs 2761 while the average value of output per quintal is Rs 9000 giving net returns of Rs 6235 per quintal of output.

As already discussed since the medicinal plants occupy the land throughout the year, for working out the comparative economics of cultivation of medicinal plants with alternative crop (s) one should take in to consideration the alternative crops sown in both *kharif* and *rabi* seasons.

Rajma, the competing crop, is cultivated during the kharif season. Being a crop with low input requirements, an uncomplicated cultivation process and fairly high returns is quite popular with the cultivators of the region (Table 3.7). The seed of Rajma at about Rs 50 per kilogram is quite expensive and with seed requirement of about 200 kilograms per hectare, account for bulk of the cultivation cost. Farmers do not use chemical fertilizers on Rajma though substantial quantities of FYM are used. The average per hectare yield of Rajma on sampled cultivators is estimated at 19.32 quintals and at an average output price of Rs 4307 per quintal, the gross value of output per hectare works out to Rs 83211. The returns over costs are estimated at Rs 69514. Converted in to per unit of output basis, the cost per quintal of output works out to Rs 706 while the net returns per quintal are 3601.

Table 3.6: Economics of Cultivation of Medicinal Plants (Per Hectare Per Year Averaged Over Five Years)

Cost Components	Unit	Quantity	Value (Rs)
Bullock Labor *	Hours	36	675
Tractor Labor *	Hours	-	-
Planting Material*	Number of Saplings	30413	30413
FYM	Quintals	109	2518
Fertiliser			
-N	Kg	0	0
-P	Kg	0	0
-K	Kg	0	0
Irrigation	Number	0	0
Transport	Rs		0
Total Cost	Rs		33606
Output and Returns			
Yield of Main Product	Quintals	12.17	
Price	Rs Per Quintal		9000
Yield of Bye Product	Quintals	-	
Price	Rs Per Quintal	-	
Gross Returns	Rs		109485
Returns over Cost	Rs		75879
Unit Values			
Cost	Rs Per Quintal		2761
Gross Returns	Rs Per Quintal		9000
Net Returns	Rs Per Quintal		6235

* Although these costs are incurred in the first year only, for comparative purposes these have been shown here as average per year averaged over five years.

Table 3.7: Economics of Cultivation of Rajma (Competing Crop for Medicinal Plants)

Cost Component	Unit	Quantity	Value (Rs)
Bullock Labor	Hours	173	3201
Tractor Labor	Hours	-	-
Seeds	Kilograms	188	8874
FYM	Quintals	62	1374
Fertiliser			
-N	Kg	-	-
-P	Kg	-	-
-K	Kg	-	-
Irrigation	Number	-	-
Transportation	Rs		188
Total Cost	Rs		13637
Output and Returns			
Yield of Main Product	Quintals	19.32	
Price	Rs Per Quintal		4307
Yield of Bye Product	Quintals	-	
Price	Rs Per Quintal	-	
Gross Returns	Rs		83211
Returns over Cost	Rs		69574
Unit Values			
Cost	Rs Per Quintal		706
Gross Returns	Rs Per Quintal		4307
Net Returns	Rs Per Quintal		3601

In the area where the selected medicinal plants are being cultivated, wheat is the most important *rabi* season crop. Almost all the sampled cultivators have been cultivating wheat in the *rabi* season. In the absence of any irrigation facilities the farmers cultivate wheat as a rainfed crop and do not use any chemical fertilizers, though they have been using substantial doses of FYM (Table 3.8). For the sampled farmers the cost per hectare of wheat works out to Rs 6367. The average wheat yield on sampled farms is 17.25 quintals per hectare. With an average output price of Rs 650 per quintal and the estimated value of by product, the total gross returns per hectare work out to Rs 12109. The returns over estimated cost work out to Rs 5398 per hectare.

Converted in to per quintal of output basis, the average cost per quintal of main product works out to Rs 369 while net returns per quintal are Rs 333.

Table 3.8: Economics of Cultivation of Wheat (Competing Crop for Medicinal Plants)

	Unit	Quantity	Value (Rs)
Cost Component			
Bullock Labor	Hours	162	3030
Tractor Labor	Hours	-	-
Seeds	Kilograms	109	1016
FYM	Quintals	89	1946
Fertiliser			
-N	Kg	-	-
-P	Kg	-	-
-K	Kg	-	-
Irrigation	Number	-	-
Transportation	Rs		375
Total Cost	Rs		6367
Output and Returns			
Yield of Main Product	Quintals	17.25	
Price	Rs Per Quintal		650
Yield of Bye Product	Quintals	14	
Price	Rs Per Quintal		64
Gross Returns	Rs		12109
Returns over Cost	Rs		5742
Unit Values			
Cost	Rs Per Quintal		369
Gross Returns	Rs Per Quintal		650
Net Returns	Rs Per Quintal		333

3.5 Relative Crop Economics of Aromatic Plants (Lemon Grass) with Competing Crop(s)

As already discussed, the sample for medicinal plants for the present study was drawn from District Dehradun of Uttarakhand State. The sample size consisted of 42 farmers.

Some of the basic characteristics of the sampled farmers are presented in Table 3.9. The average age of sampled cultivator at 43 years was lower than that of cultivators of medicinal plants. The average family size was also lower – 5.5 members per household, divided equally between male and female members. As in the case of cultivators of medicinal plants, almost half the sampled cultivators had studied up to between primary and secondary level. One fourth of the sampled cultivators had studied up to between high school and intermediate level while about 14 percent of the cultivators were graduate and above. Just one of the 42 sampled cultivators was illiterate. The education profile of sampled cultivators of aromatic plants was thus much better than those of sampled cultivators of medicinal plants.

Table 3.9: General Features of the Sampled Cultivators of Aromatic Plants

Item	Unit	Value
Average Age of Respondent	Years	42.9
Average Family Size	Number	5.48
-Male		2.74
-Female		2.74
Education Level of Respondents	Number	42 (100)
-Illiterate		1 (2.38)
-Up to Primary		3 (7.14)
-Primary to High School		21 (50.00)
-High School to Secondary School/ Intermediate		11 (26.19)
-Degree and above		6 (14.29)

Figures in parentheses denote percentages

The average size of land holding of sampled cultivators of aromatic plants was also roughly the same as that of sampled cultivators of medicinal plants. However unlike in the case of medicinal plant cultivators, some instances of leasing-in and leasing-out of land were present in the case of sampled cultivators of aromatic plants (Table 3.10). Of the average holding of 1.70 hectares, 1.52 hectares (89 percent) was owned , 0.23 hectares (14 percent) was leased-in while a small portion 0.05 hectares was leased out. Unlike in the case of sampled cultivators of medicinal plants who did not have any irrigation facilities, some irrigation facilities were available to a majority of sampled cultivators cultivating lemon grass. Of the 1.70 hectares of operational land holding 1.31 hectares (77 percent) was irrigated while the remaining 0.39 hectares (23 percent) was unirrigated.

**Table 3.10 : Details of Land Holding of Sampled Growers of Aromatic Plants
(Sample Size 42)**

Type	Unit	Total	Irrigated	Un irrigated
Owned	Ha	1.52	1.09	0.43
Leased – in	Ha	0.23	0.22	0.01
Leased- out	Ha	0.05	0	0.05
Operated	Ha	1.70	1.31	0.39

The major competing crops being cultivated by the sampled farmers are paddy in kharif and wheat in Rabi. In what follows we first compare the labor use and then work out the relative economics of lemon grass with paddy-wheat. It may be important to mention here that like medicinal plants, lemon grass once cultivated gives output over 4 to 5 years. Some of the major cultivation expenses, such as on land preparation, seeding etc thus are incurred only during the first year while in subsequent years the cultivation expenses are far less than those in the first year. Similarly, the productivity of the lemon grass also varies depending upon its age. Since the magnitude of labor use, cost and expenses vary from year to year and are borne over four to five years period of crop length and the output, which also varies from year to year, is also realized over this period, it is important to take in to

consideration the entire growth period over which cost are incurred and the benefits are realized. Accordingly we have considered the entire crop growth period.

3.6 Operation wise Labor Requirement for Cultivation of Aromatic Plants

The details of average per hectare per year operation wise labor input in cultivation of aromatic plants is presented in Table 3.11. The total human labor input per year by sampled farmers is estimated at 708 labor hours per hectare. Harvesting followed by weeding are the most labor intensive operations. These two operations account for almost 74 percent of the total labor use in cultivation of aromatic plants. The average bullock and tractor hour use per hectare per year worked out to 50 and 1.4 hours respectively.

Table 3.11: Details of Operation wise Labor Use in Cultivation of Aromatic Plants (Average Per Ha Per Year)

Unit - Number of Hours

	Human Labor	Bullock Labor	Tractor Labor
Land Preparation	31 (4.4)	20	1.4
FYM/ Compost	21 (3.0)	-	-
Planting/ Sowing	51 (7.2)	-	-
Chemical Fertiliser	4 (0.6)	-	-
Weeding	146 (20.6)	-	-
Irrigation	80 (11.2)	-	-
Harvesting and Transportation	375 (53.0)	30	-
Total (Average per year)	708 (100.0)	50	1.4

3.7 Operation wise Labor Use for Cultivation of Paddy and Wheat (Competing crops to Aromatic Plants)

The operation wise labor use in crops, viz Paddy in Kharif and Wheat in Rabi season, competing with aromatic plants, is given in Table 3.12. The total labor use

for cultivation of Paddy work out to 1117 hours per hectare. Of the total labor use 29 percent is accounted for by sowing and 28 percent by harvesting. Similarly of the total labor use of 461 hours per hectare in the case of wheat, 46 percent is accounted for by harvesting operation. The combined labor use per hectare for both Paddy and Wheat work out to 1578 hours per hectare per year.

Table 3.12 : Operation wise Per Hectare Labor Use in Paddy, Wheat and Paddy+Wheat

Operation	Paddy			Wheat			Paddy+Wheat		
	Human Labor	Bullock Labor	Tractor Labor	Human Labor	Bullock Labor	Tractor Labor	Human Labor	Bullock Labor	Tractor Labor
Land Preparation	46 (4.1)	22	19.3	48 (10.4)	39	20.5	94 (6.0)	61	39.8
FYM/Compost	21 (1.9)			24 (5.2)			45 (2.9)		
Planting/Sowing	322 (28.8)			16 (3.5)	9	6	338 (21.4)	9	6
Chemical Fertiliser	10 (0.9)			10 (2.2)			20 (1.3)		
Weeding	219 (19.6)			40 (8.7)			259 (16.4)		
Irrigation	147 (13.2)			62 (13.4)			209 (13.2)		
Harvesting	312 (27.9)			211 (45.8)			523 (33.1)		
Transportation	40 (3.6)	10		50 (10.8)	20		90 (5.7)	30	
Total	1117 (100.0)	32	17	461 (100.0)	68	25	1578 (100.0)	91	36

Contrasting the labor use per hectare per year in the cultivation of aromatic plants and its competing crops Paddy and wheat, it will be seen that the combined labor use in competing crops Paddy and wheat is almost 12.3 percent higher than that of aromatic plants.

3.8 Cost of Cultivation of Aromatic Plants

Before we attempt to give the information on cost of cultivation of lemon grass, it may be important to mention here that since the cultivation of lemon grass is of relatively recent origin in the study area, different sampled farmers were at different stages of cultivation of lemon grass. Thus while some sampled farmers had completed one year of the crop growth period, some others had completed two and some were in the third year of cultivation. Thus we could not get data on inputs and outputs for complete crop cycle from the sampled farmers. For the remaining period of the crop growth cycle the input cost data and output data has been extrapolated based on the basis of discussion with the sampled farmers as also based on the recommended cost of cultivation practices. It may incidentally be mentioned that lemon grass being a new crop is being generally cultivated under the supervision of the relatively more experienced farmers of the region and that of staff of CAP, Selaqui, the farmers to a large extent are following standardized and almost uniform recommended practices for its cultivation.

The major cost in cultivation of aromatic plants is the cost of the planting material. Due to a large number of saplings required to be planted per hectare of area, the total cost on planting material works out to be substantial. At about Rs 1 per sapling and average number of saplings per hectare at about 37,5000 the total planting material cost during the year in which it is planted works out to about Rs 37,000, though this cost averaged over the five year growth period of the crops gets reduced to about Rs 7200 per year (Table 3.13). The cultivation of aromatic plants require good land preparation. The sampled cultivators were using both – the chemical fertilizers as well as substantial quantities of FYM. Since the farm size is small and there is enough family labor available, almost the entire cultivation work is usually done by family labor. The per hectare cost (Cost A2 basis) per year, averaged over five years, work out to Rs 10283. The average crop yield per hectare per year (averaged over the five year period) of sampled farmers work out to 276 quintals. With the average output price of Rs 115 per quintal the gross value of output per hectare per year is estimated at Rs 31838. The returns over cost have been estimated at Rs 21555 per hectare per year. Converted in to per quintal basis of output, the average cost per quintal of output work out to Rs 38 while the average value of output per quintal is Rs 115 giving net returns of Rs 77 per quintal of output.

Table 3.13 : Economics of Cultivation of Aromatic Plants (Per Hectare Per Year Averaged Over Five Years)

Cost Components	Unit	Quantity	Value (Rs)
Bullock Labor *	Hours	20	616
Tractor Labor *	Hours	1.4	355
Planting Material*	Number of Saplings	7508	7227
FYM	Quintals	21	460
Fertiliser			
-N	Kg	32	165
-P	Kg	12	114
-K	Kg		
Irrigation	Number		381
Transportation	Rs		922
Total Cost	Rs		10240
Output and Returns			
Yield of Main Product	Quintals	276	
Price	Rs Per Quintal	115.4	
Yield of Bye Product	Quintals	-	
Price	Rs Per Quintal	-	
Gross Returns	Rs		31850
Returns over Cost	Rs		21610
Unit Values			
Cost	Rs Per Quintal		37
Gross Returns	Rs Per Quintal		115
Net Returns	Rs Per Quintal		78

* Although these costs are incurred in the first year only, for comparative purposes these have been shown here as average per year averaged over five years.

As already discussed, since the aromatic plants occupy the land throughout the year, for working out the comparative economics of cultivation of aromatic plants with alternative crop (s) one should take in to consideration the alternative crops sown in both kharif and rabi seasons.

The important kharif crop of the sampled cultivators cultivating aromatic plants is Paddy. The economics of paddy cultivation in the study area is presented in Table 3.14. The planting material cost works out to Rs 663 per hectare. The farmers have been using chemical fertilizers along with FYM. The total per hectare cost is

estimated at Rs 9215 per hectare. The estimated average crop yield is 28 quintals per hectare. With an output price of Rs 573 per quintal, the gross value of output per hectare works out to Rs 16044 giving Rs 6829 as returns over costs.

In terms of per quintal of output, the cost per quintal work out to Rs 329. With estimated gross value of per quintal of output at Rs 573, the net returns per quintal work out to Rs 244.

The important rabi crop of the sampled cultivators cultivating aromatic plants is wheat. The economics of wheat cultivation in the study area is presented in Table 3.15 . With an average seed rate of 122 kilograms per hectare the total seed cost works out to Rs 1304 per hectare. The farmers have been using chemical fertilizers along with FYM. The total per hectare cost is estimated at Rs 10625 per hectare. The estimated average crop yield is 28 quintals per hectare. With an output price of Rs 642 per quintal and the value of by product derived, the gross value of output per hectare works out to Rs 19768 giving Rs 9143 as returns over operating costs.

In terms of per quintal of output basis, the cost per quintal, the value of output per quintal and net returns per quintal work out to Rs 379, Rs 706 and Rs 327 respectively.

Table 3.14: Economics of Cultivation of Paddy (Competing Crop for Aromatic Plants)

	Unit	Quantity	Value (Rs)
Bullock Labor	Hours	22	677
Tractor Labor	Hours	19.3	4883
Planting Material		52	663
FYM	Quintals	59	1470
Fertiliser			
-N	Kg	82	264
-P	Kg	52	500
-K	Kg	4	13
Irrigation	Rs		437
Transportation	Rs		308
Total Cost	Rs		8901
Output and Returns			
Yield of Main Product	Quintals	28	
Price	Rs Per Quintal		573
Yield of Bye Product	Quintals		
Price	Rs Per Quintal		
Gross Returns	Rs		16044
Returns over Cost	Rs		6829
Unit Values			
Cost	Rs Per Quintal		329
Gross Returns	Rs Per Quintal		573
Net Returns	Rs Per Quintal		244

Table 3.15: Economics of Cultivation of Wheat (Competing Crop for Aromatic Plants)

Cost Component	Unit	Quantity	Value (Rs)
Bullock Labor	Hours	39	1200
Tractor Labor	Hours	20.5	5187
Planting Material	Seed	122	1304
FYM	Quintals	49	1128
Fertiliser			
-N	Kg	72	334
-P	Kg	65	637
-K	Kg	0	0
Irrigation	Number		220
Transportation	Rs		615
Total Cost	Rs		10625
Output and Returns			
Yield of Main Product	Quintals	28	
Price	Rs Per Quintal	642	
Yield of Bye Product	Quintals	28	
Price	Rs Per Quintal	64	
Gross Returns	Rs		19768
Returns over Cost	Rs		9143
Unit Values			
Cost	Rs Per Quintal		379
Gross Returns	Rs Per Quintal		706
Net Returns	Rs Per Quintal		327

3.9 Summing Up : Comparative Economics

Before we present the comparable results of relative crop economics it is important to mention once again that although the data on per hectare input use, crop output and crop profitability in the case of Jumbo Faran and Lemon Grass were derived on the basis of five year data the comparable information in the case of competing crops viz Rajma and Wheat (for Jumbo Faran) and Paddy and Wheat (for Lemon Grass) was derived on the basis of single year data. The relative economics is thus based on the assumption that the farmers would continue to grow the same crop/ crop combination (Rajma and Wheat in the case of Jumbo Faran, and Paddy and Wheat in the case of Lemon Grass) during the comparable period of five years during which these focused crops are cultivated, using current levels of input and thereby incurring current level of cultivation expenses and obtaining current levels of crop yields.

We present in Table 3.16 summary results of per hectare per year estimates of cost, gross value of output and net returns for Jumbo faran and its competing crops – Rajma and wheat, and Lemon Grass and its competing crops – Paddy and Wheat. In the case of medicinal plants, while the cost of cultivation and gross returns for Jumbo Faran are substantially higher than the combined cost and value of output of rajma and wheat, the net returns of both are almost at the same level. In the case of aromatic plants while the cost of cultivation and gross value of output of lemon grass are less than the combined corresponding values for paddy and wheat, the net returns of lemon grass are higher than that of paddy and wheat by almost 34 percent.

Table 3.16 : Comparative Economics of Jumbo Faran and Lemon Grass With Their Competing Crops – Summary Results (Rs Per Hectare)

Crop	Row	Cost	Gross Value of Output	Net Returns
Medicinal Plants (Jumbo Faran)	1	33606	109485	75879
Rajma	2	13637	83211	69574
Wheat	3	6337	12109	5742
Rajma+Wheat	4	20004	95320	75316
Medicinal – (Rajma+Wheat)	1-4	13602	14165	563
Aromatic Plants (Lemon Grass)	5	9361	31838	22477
Paddy	6	9215	16044	6529
Wheat	7	10625	19768	9143
Paddy+Wheat	8	19840	35812	15972
Aromatic – (Paddy+Wheat)	5-8	(-) 10479	(-) 3974	6505

SECTION IV

MOTIVATIONAL FACTORS AND PROCESS OF DECISION MAKING

As already mentioned, the cultivation of medicinal and aromatic plants is a relatively new phenomenon in Uttaranchal. Although the Government has been trying to propagate the cultivation of these crops amongst the farming community in the State to inter-alia encourage conservation of such plants collected from the wild, help crop diversification and provide increased income from farming, the success so far has been somewhat slow to come by. It is however expected that once the initial small set of cultivators successfully cultivate and market these crops, and as the necessary research and extension efforts intensify and the supportive marketing and processing infrastructure facilities develop, the demonstration effect of these experiences, if successful, will encourage more farmers to engage in cultivation of these and other similar crops and the area under these crops and the range and varieties of different medicinal and aromatic plant species under cultivation would increase substantially in the near future. Given the predominantly small size of cultivated land holding in the State and given the uncertain cultivation and marketing conditions under which these new crops have been introduced, the farmers who have chosen to cultivate these crops, as expected, have been somewhat cautious and have devoted only a very small portion of their cultivated land to cultivation of these crops.

In this section we briefly elaborate on the factors that motivated the sampled cultivators towards cultivation of medicinal and aromatic plants and ascertain their experiences with the cultivation of these crops. Based on their initial experience we attempt to ascertain how enthusiastic they are in either continuing with the cultivation of these crops or in bringing larger area under these and other similar crops. What other facilitating factors, in their view, could motivate them and other fellow farmers to continue cultivating these crops and bring still larger area under them? We do realize that since enough period has not elapsed since cultivation of these plants, specially that of aromatic plants, was started by the farmers in the study region the responses of the farmers may not be that realistic. We do however believe that their experiences, howsoever short these may have been, will provide

enough indicative information to enable planners formulate appropriate policies and/or make appropriate corrections in the existing policies so that ways and means could be identified which could give a further fillip and encourage cultivation of these plants on a much larger area by a much larger number of farmers.

4.1 Experiences with Cultivation of Medicinal Plants

The cultivation of medicinal plants started about 4-5 years ago and thus some of the sampled cultivators have had fair amount of experience - with respect to its cultivation practices, economics of cultivation as well as aspects of its marketing. One would generally expect that if their overall initial experience with the cultivation of medicinal plants has been positive, they would, over these years, have either increased the area under the crop or at least have continued to cultivate it at the original level, though there could be other reasons for such a phenomenon. If their initial experience with the cultivation has not been very positive they might have reduced the area under the crop, though in this case also there could be some other factors responsible for such a decline in area.

Of the 21 sampled cultivators of medicinal plants, 18 (almost 86 percent) have been cultivating it for more than 4 years while the remaining three started its cultivation relatively recently. Of the 18 cultivators who have been cultivating it for more than 4 years as many as 12 (about 67 percent) reported increase in area under its cultivation ever since they first started its cultivation. Five cultivators reported some decline in its cultivated area while the remaining one farmer did not make any change in the cultivated area under the crop. Of the three cultivators who have had less than 4 years exposure to this crop, 2 reported decline and one no change in area. Overall 67 percent of the sampled cultivators reported either increase or no change in cultivated area under the crop since they first started its cultivation. About 33 percent reported some decline in area allocated to this crop.

Table 4.1 : Experiences with cultivation of Medicinal plants and Changes in Area Under Cultivation

Cultivation Experience	Number of Cultivators	Number of Cultivators Reporting Change in Crop Area Over the Years		
		Increased Constant	Decreased	
More than 4 years	18 (100) (86)	12 (67)	5 (28)	1 (5)
Less than 4 years	3 (100) (14)	0 (0)	2 (67)	1 (33)
Total	21 (100) (100)	12 (57)	7 (33)	2 (10)

Note : Figures in parentheses denote percentages

4.2 Experiences with Cultivation of Aromatic Plants

Unlike medicinal plants the cultivation of aromatic plants is relatively new and farmers as yet do not have enough exposure to the cultivation and marketing of this crop. Of the 42 sampled cultivators, 26 (about 62 percent) started its cultivation in 2004 while the remaining 16 (38 percent) started its cultivation in 2005 only. Since the cultivation started only recently one would not expect many changes in the area under cultivation during this short period. Of the 26 cultivators who started cultivation in 2004, 9 (about 35 percent) reported some increase in area allocation towards this crop while the remaining 17 (about 65 percent) reported no change in area. Of the 16 who started its cultivation in 2005, only 3 made some increase in area to this crop subsequent to the start of its initial cultivation. Thus of the 42 cultivators 29 percent reported some increase in area while the remaining 71 percent reported no change. An important observation is that none of the cultivators who started its cultivation reported any decline in its area since the start of the cultivation.

Table 4.2 : Experiences with cultivation of Aromatic plants and Changes in Area Under Cultivation

Cultivation Experience	Number of Cultivators	Number of Cultivators Reporting Change in Crop Area Over the Years		
		Increased Constant	Decreased	
Since 2004	26 (100) (62)	9 (35)	0 (0)	17 (65)
Since 2005	16 (100) (38)	3 (19)	0 (0)	13 (81)
Total	42(100) (100)	12 (29)	0	30 (71)

Note : Figures in parentheses denote percentages

4.3 Motivational Factors : What prompted Cultivation of Medicinal Plants?

The decision of the sampled cultivators to go in for cultivation of medicinal plants has not been prompted by any single factor. A multiplicity of factors have influenced the decision of the cultivators to go in for cultivation of medicinal plants. In fact 16 of the 21 sampled cultivators advanced 5 or more possible reasons which have individually and jointly influenced their decision to go in for cultivation of medicinal plants. In the case of 4 of the sampled cultivators the decision to go in for cultivation of medicinal plants was influenced by 4 factors while in the case of only one sampled cultivator this decision was influenced by less than four factors.

Of the various factors that have influenced the cultivation of medicinal plants, the most important ones have been: easy to cultivate, higher relative profitability, demonstration effect of its cultivation by fellow farmers, good demand of this crop and easy availability of inputs, low level of input requirement and low cost of production. Its easy cultivation practices and higher relative profitability have in fact been the two most important factors which have encouraged almost all the sampled

cultivators to go in for cultivation of medicinal plants. Apart from these two common factors, the number and nature of other factors which have influenced cultivation of medicinal plants have differed between sampled farmers. These included low input requirement, easy availability of inputs, demonstration effect of other farmers and good demand of the final output.

Table 4.3 : Motivating Factors for Cultivation of Medicinal Plants

Reasons	Number	Percent to Total Sample Size
1 Easy to Cultivate	21	100
2 Easy Availability of Inputs	16	76
3 Nearness of Market for Output	6	29
4 More Profitable than Alternative Crop	20	95
5 Low Input Requirement and Low Cost of Cultivation	16	76
6 Because Other Farmers in the Neighborhood are cultivating it	18	86
7 Good Demand	17	81
8 High Medicinal Content Value	0	0
9 Subsidy Provided by the Government	1	5
10 Technical Know how Provided by Government/ NGO	0	0
11 Others	0	0
SUMMARY- MULTIPLICITY OF FACTORS		
Less than 4 Factors	1	5
4 Factors	4	19
5 or More Factors	16	76

4.4 Motivational Factors : What prompted Cultivation of Aromatic Plants?

As in the case of cultivation of medicinal plants, in the case of aromatic plants also no single factor alone has influenced the decision of the sampled cultivators for going in the cultivation of aromatic plants. In the case of 22 of the 42 sampled cultivators (constituting 53 percent of the sample) the decision to go in for cultivation of aromatic plants has been influenced by a combination of five or more factors. Seven sampled farmers attributed this to a combination of four factors while the remaining 13 attributed their cultivation to less than four factors.

Of the various factors that have influenced the cultivation of aromatic plants, the single most important factor that has influenced almost the entire sample households has been its ease in cultivation. The other important factors that have influenced the cultivation decision of the sampled farmers have however varied. Low input requirements and low input costs, higher relative profitability, easy availability of inputs, demonstration effect of the other farmers cultivating this crop and good demand for this crop have also to varying extent influenced the cultivation of aromatic plants by sampled farmers.

Table 4.4 : Motivating Factors for Cultivation of Aromatic Plants

Reasons	Number	Percent to Total Sample Size
1 Easy to Cultivate	41	98
2 Easy Availability of Inputs	20	48
3 Nearness of Market for Output	10	24
4 More Profitable than Alternative Crop	21	50
5 Low Input Requirement and Low Cost of Cultivation	24	57
6 Because Other Farmers in the Neighborhood are cultivating it	17	40
7 Good Demand	16	38
8 High Plant Content Value	3	7
9 Subsidy Provided by the Government	17	40
10 Technical Know how Provided by Government/ NGO	16	38
11 Others	9	21
SUMMARY- MULTIPLICITY OF FACTORS		
Less than 4 Factors	13	31
4 Factors	7	16
5 or More Factors	22	53

4.5 Increasing Area Under Cultivation of Medicinal Plants

The decision on area allocation by a cultivator for a given crop, more so for a new crop, is influenced by several factors about some of which the cultivator may have had little or no knowledge when he first started its cultivation. Having once decided to cultivate the new crop, the decision on expanding its cultivation to a larger area is influenced by the experience the cultivator has had with its cultivation as also more deterministic information about the other complementary factors. Most of the sampled cultivators of medicinal plants have had a relatively sufficient experience (of about four years) in cultivating this crop and were better equipped to take a more informed decision about expanding its cultivation.

On the basis of the experience the sampled cultivators have had with the cultivation of medicinal plants, we attempted to ascertain from the sampled cultivators, if they would like to bring still larger area under cultivation of this crop and what factors would encourage them to do so. While 15 of the 21 sampled cultivators (71 percent) responded that they are willing to bring larger area under cultivation of medicinal plants, the remaining 6 (29 percent) are not willing to bring any more area under the crop.

The 15 sampled farmers willing to bring larger area under cultivation of medicinal plants, were asked to rank the factors, from those listed, they would consider relatively more important in influencing this decision. As expected all the 15 farmers listed increased profitability as the most important factor that would encourage them to bring still larger area under the crop (Table 4.5). The second most important factor included improved marketing facilities for the crop (by 7 of the 15 farmers), more technical assistance and know-how including making available seedlings from the government agencies (by 4 of the 15 sampled farmers) and improved demand for these crops (by 4 of the 15 cultivators). Thus apart from increased profitability, improvement in marketing facilities and improved demand for these factors could influence farmer's decision in bringing larger area under the crop.

Table 4.5 : Factors that would encourage larger area under Medicinal plants

Factors	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Increased Profitability	15				
Increased and stable output prices					
Improved marketing facilities		7	6		1
More assistance from Govt. agencies tech.know how/ making available seed		4	0	1	
Subsidy by Govt.					
Improved cultivation practices					
Improved pest & disease resi.environment					
Improved Irri. Availability				2	2
Improved demand for these plants		4	9	2	
Improved Availability of credit					
Improved facilities for processing				1	
Any Other					
Total	15	15	15	6	3

Of the 6 sampled cultivators who were not willing to bring any additional area under the medicinal plants, 5 attributed their this decision to the small size of their holding and not to any problems associated with cultivation or disposal of these plants (Table 4.6). The next best important factors behind their this decision was lack of irrigation facilities and lack of adequate processing facilities.

Table 4.6 : Factors Constraining Increasing Area under Medicinal plants

Factors	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Small size of holding	5	1			
Difficulty in marketing/		1			
Lack of Irri. Facilities		2			
Large fluctuation in output prices					
Un-remuneration as compare to other crops					
No subsidy or other support from the Govt.agencies					
Non availability of certified seed					
Pest and disease problems					
Lack of tech. Know how					
Non availability of credit					
Long gestation period from planting to harvesting			1		
No facilities available for processing		2			
Output quality not compar-able with wild species					
Risky crop					
Any other	1				
Total	6	6	1		

4.6 Increasing Area Under Cultivation of Aromatic Plants

Unlike medicinal plants, the cultivators of aromatic plants have had very little experience with its cultivation. So one would expect that the decision about expanding cultivation of aromatic plants to larger areas, in the case of most of the cultivators, would still be based on somewhat incomplete information. With whatever little initial experience the farmers have had with its cultivation, of the 42 sampled cultivators 28 cultivators (67 percent) are willing to bring still larger area under the cultivation of aromatic plants while the remaining 14 (33 percent of the total) are not willing to increase any further the area under cultivation of this crop.

Unlike in the case of sampled cultivators of medicinal plants, all of whom who accorded increased profitability from the crop as the most important factor that would encourage them to bring larger area under the medicinal plants, in the case of aromatic plant cultivators the most important facilitating factor that could encourage such a shift varied. While 16 of the 28 cultivators who are willing to bring larger area under its cultivation attributed increased crop profitability as the most important motivating factor, 4 attributed increased and stable output prices as the most important factor. In the case of the remaining farmers the other most important factors that could influence their this decision are : improved marketing facilities (in the case of 3 cultivators), provision of some subsidy by the government (1 cultivator), improved irrigation facilities (1 cultivator) and other miscellaneous factors (3 cultivators). The frequencies of the various attributes characterized as second and third important factors that would influence the decision of the farmers however varied (for details see Table 4.7).

Table 4.7 : Factors that would encourage larger area under the Aromatic plants

Factors	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Increased Profitability	16	8	1		
Increased and stable output prices	4	4	4		
Improved marketing facilities	3	6	5		
More assistance from Govt. agencies tech.know how/ making available seed	0	3	5	3	
Subsidy by Govt.	1	2	5	3	1
Improved cultivation practices	0	0	1	1	
Improved pest & disease resi.environment	0	1	1	2	
Improved Irri. Availability	1	0	1	4	3
Improved demand for these plants		1	2	3	3
Improved Availability of credit			1		1
Improved facilities for processing		2	2	6	3
Any Other	3	1	0	0	1
Total	28	28	28	22	12

Of the 14 sampled cultivators who are not willing to increase area under this crop, 11 (79 percent of the total) attributed it to small size of their land holding while the remaining 3 attributed it to lack of irrigation facilities (Table 4.8). The second and third important factors in influencing such a decision have been – lack of irrigation facilities, lack of processing facilities, difficulties in marketing etc.

Table 4.8 : Factors Constraining Increasing Area under Aromatic plants

Factors	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Small size of holding	11	1			
Difficulty in marketing		2		3	
Lack of Irri. Facilities	3	4	1		1
Large fluctuation in output prices					
Un-remuneration as compare to other crops		1	1		
No subsidy or other support from the Govt.agencies		2	2	1	
Non availability of certified seed					
Pest and disease problems			1		
Lack of tech. Know how					
Non availability of credit				1	2
Long gestation period from planting to harvesting					
No facilities available for processing		3	2	1	1
Output quality not compar-able with wild species					
Risky crop					
Any other		1	1		
Total	14	14	8	6	4

4.7 Factors That Could Divert Area Away from Medicinal Plants

A majority of the sampled cultivators have currently allocated only a small portion of their cultivated land for the cultivation of medicinal plants. As discussed above, while a majority of the cultivators would like to bring still larger area under the crop however the cultivators are not averse to diversify away from the cultivation of these

medicinal plants in case the current underlying conditions were to change. Of the 21 sampled cultivators, 20 are inclined to shift the current area under medicinal plants to an alternate crop should the relative profitability of other competing crop becomes higher than that of medicinal plants (Table 4.9). Other important factors cited for such a likely shift in area from under the medicinal crop to other crops include – non improvement in marketing facilities and lack of demand for these crops.

Table 4.9 Circumstances under which farmers would move area out of Medicinal plants

Factors	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Profitability of other crops become higher	20	1			
Marketing facilities for aro./ Med plants do not improve	1	14		1	
Pest and disease environ. does not undergo any change			1		1
Wide price fluctuations do not end		1	2		1
Problems in availability of seeds do not diminish					
Irrig. facilities do not improve				2	
Demand for these crops do not pick up		2	12	3	
Support of Govt.agencies is not forthcoming		3			
Any other					
Total	21	21	15	6	2

4.8 Factors That Could Divert Area Away from Aromatic Plants

As in the case of medicinal plants, a majority (57 percent) of the sampled cultivators of aromatic plants would also shift the area from under aromatic plants to alternate crops should the profitability of aromatic plants goes down in relation to that of the competing crops (Table 4.10). Another 21 percent of the sampled cultivators however feel that the most important factor that would influence their decision in shifting away from aromatic plants to alternative crops is the non- improvement in marketing facilities for the aromatic plants. Another important factor that could influence the decision of the farmer in moving away from the cultivation of aromatic plants is the lack of increased demand for these crops.

Table 4.10 : Circumstances under which farmers would move area out of Aromatic plants

Factors	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Profitability of other crops become higher	24	9	5	2	1
Marketing facilities for aro./ Med plants do not improve	9	19	6		
Pest and disease environ. does not undergo any change	2	2	0	1	
Wide price fluctuations do not end			4	3	
Problems in availability of seeds do not diminish			1		
Irrig. facilities do not improve	2	5	4	7	3
Demand for these crops do not pick up	5	3	19	3	5
Support of Govt.agencies is not forthcoming		4	3	4	6
Any other					
Total	42	42	42	20	15

SECTION V

MARKETING OF MEDICINAL AND AROMATIC PLANTS

Availability of assured markets and a remunerative price for the produce are two important factors that play an important and decisive role in encouraging farmers, more so for a new crop, to first cultivate and then bring in a larger area under the said crop. Since the cultivation of medicinal and aromatic plants have started only recently and that too on a somewhat small scale in certain identified pockets only, one would not expect any large scale organized marketing infrastructure to have come up to cater to these crops. As often happens, government agencies, trying to encourage farmers cultivate new crops, have in addition to providing extension assistance in cultivation of these crops, have to ensure that farmers are provided with an assured outlet for the disposal of their crop at a remunerative price at least during the initial period of its cultivation where after some agency/ entrepreneur would likely come over to take over this role and minimize the role of the government agency in performing this role.

In this section we briefly examine the marketing arrangement in place and used by for sampled cultivators for disposal of medicinal and aromatic plants. We also ascertain the experiences of the farmers in using these marketing arrangements for disposal of their medicinal and aromatic plants.

5.1 Marketing Channel for Disposal of Produce : Medicinal Plants

The markets for disposal of cultivated medicinal plants have not so far very well developed and organized even though its cultivation, albeit on a small scale, started a few years ago. This is on account of several factors- the most important being the small size of production, that too scattered over four to five harvests in a year, and spread over a large hilly area with not so easily accessible tracts. As a result almost all the cultivators normally have no option but to sell their produce to a local

middleman. In the present case also all the sampled cultivators of medicinal plants reported that they sold their entire marketable surplus to the local middleman. Further the entire crop by all the sampled cultivators was sold in the raw form rather than after processing it.

As to the reasons for choosing to sell the produce to the middleman, convenience of doing so was cited as the most important reason by all the sampled cultivators. In addition, low or near zero cost of marketing and the faith and perception of a fair price for their produce offered by the agent also influenced this decision of selling their produce to the village middleman. Five of the sampled cultivators attributed their this decision to sell their produce to the village middleman, apart from convenience, to lack of any other alternative avenue for crop disposal.

Table 5.1 : Reasons for Choice of a Particular Marketing Channel –Medicinal Plant

Reasons	Number	Percent to Total Sample Size
Convenience	21	100
Better Price, Low Cost	13	62
Absence of Government Support	2	10
No Alternative	5	24
Others	1	5

Note : Total may not add up to total sample size due to a multiplicity of reasons given by some farmers

5.2 Marketing Channel for Disposal of Produce : Aromatic Plants

Unlike medicinal plant, cultivation of the aromatic plants has been a relatively new phenomenon. Most of the efforts in this case so far have been directed towards encouraging farmers adopt its cultivation and extending the cultivation to newer areas. To promote its cultivation and allay any fears of the cultivators with regard to

its marketing the cultivators were assured of guaranteed procurement of the entire crop at a fixed price by the CAP. Even those cultivators who would like to extract the oil from lemon grass, rather than selling the grass in its raw form to the CAP, were provided assured facilities for oil extraction at a nominal price.

The sampled cultivators of aromatic plants were selected from two areas- one within the vicinity of CAP and the other from villages which were somewhat far off from CAP. An entrepreneur in this area has set up a processing plant and is performing the function of procurement and oil extraction on lines similar to CAP and on terms similar to those offered by CAP. The sampled cultivators in this area were utilizing the services of this plant rather than traveling to CAP to dispose off their produce.

Apart from above, no significant formal market or processing facility in the vicinity of the production area has so far developed. Due to the absence of such a formal market, almost all the sampled cultivators sold their produce either to CAP or to the private entrepreneur who has set up the above plant. Further as in the case of medicinal plant cultivators, the entire crop by all the sampled cultivators was sold in the raw form rather than after extracting the oil, even though facilities for this existed.

On the reasons for choice of selling their produce to the government agency/ the entrepreneur rather than trying to sell through some other agency, about 60 percent of the sampled respondents cited convenience of crop disposal as the most important factor influencing their decision to sell the produce to the government agency. About 64 percent of the sampled cultivators cited no other alternative for crop disposal as an important factor for selling their produce to these agencies.

Table 5.2 : Reasons for Choice of a Particular Marketing Channel –Aromatic Plants

Reasons	Number	Percent to Total Sample Size
Convenience	25	60
Better Price, Low Cost	9	21
Absence of Government Support	7	17
No Alternative	27	64
Others	1	2

Note : Total may not add up to total sample size due to a multiplicity of reasons given by some farmers

5. 3 Problems Encountered in Marketing – Medicinal Plants

Given the limited or no other market options for crop disposal, we ascertained from the sampled cultivators of medicinal plants their experiences in marketing their produce through the channel they had opted for, in particular the problems encountered in the process. Almost all the sampled cultivators reported no problems with their crop disposal. This implies that even though the crop was being sold to a middleman, the farmers faced no problem in their dealings with him.

Table 5.3 : Problems Encountered in Marketing of Medicinal Plants

Problem	Rank 1	Rank 2
Higher commission charged by the middle-man		
Irrational deductions		
Delay in payments		
Markets very far off	1	
Lack of transport facilities	1	2
No problems	19	
Others (Please specify)		
Total	21	2

5.4 Problems Encountered in Marketing – Aromatic Plants

Unlike the medicinal plants where the cultivators sold their produce to the middleman within their own village, the cultivators of aromatic plant sold off their produce to CAP/ the entrepreneur. The farmers have to carry and deliver their produce at the plant. Since the produce has to be physically carried, farmers are likely to encounter some problems depending upon- the distance of CAP from their farms, availability of transport for carrying the produce, some delays in receipt of payments etc. Of the 42 sampled cultivators, 19 (about 45 percent) reported no marketing related problems, while 11 (about 26 percent) reported large distance of their farm from the market center. Another 8 cultivators (about 19 percent) cited problems relating to delays in receipt of payment.

Table 5.4 : Problems Encountered in Marketing of Aromatic Plants

Problem	Rank 1	Rank 2	Rank 3
Higher commission charged by the middle-man			
Irrational deductions			
Delay in payments	8	4	2
Markets very far off	11	7	1
Lack of transport facilities	4	10	5
No problems	19		
Others			
Total	42	21	8

5.5 Estimation of Domestic and International Demand for Medicinal and Aromatic Plants

Although an estimation of domestic and international demand for selected medicinal and aromatic plants was originally intended to be undertaken as part of the study,

however this objective could not be pursued very far in a scientific manner due to the lack of a rigorous methodological approach and the availability of the required data to carry out such an analysis. Instead informal views of some of the stakeholders - selected knowledgeable farmers and some traders were obtained to ascertain the likely magnitude of domestic and international demand for these crops.

Although most of the interviewees did not have much knowledge about the international scenario, however the opinion gathered during such discussions reveal that the domestic demand for medicinal and aromatic plants as also the prospects of their cultivation in Uttaranchal are substantial, provided some of the underlying conditions, most of which are discussed elsewhere in this report, are attended to. This would not only lead to increased production of these crops but will greatly improve the economy of the state and economic well being of the cultivators in particular and other sections of the society in general.

SECTION VI

SUMMARY OF MAIN FINDINGS AND CONCLUSIONS

Main Findings

6.1 Comparative Economics of Identified Medicinal and Aromatic Plants with Alternative Crops

Cultivation of medicinal and aromatic plants is a relatively new phenomenon and the (selected) crops once planted can be harvested over almost five year period. Most of the selected cultivators have not had gone through the entire crop cycle period. Before we present the comparable results of relative crop economics it is important to mention that although the data on per hectare input use, crop output and crop profitability in the case of Jumbo Faran and Lemon Grass were derived on the basis of five year data the comparable information in the case of competing crops viz Rajma and Wheat (for Jumbo Faran) and Paddy and Wheat (for Lemon Grass) was derived on the basis of single year data. The relative economics is thus based on the assumption that the farmers would continue to grow the same crop/ crop combination (Rajma and Wheat in the case of Jumbo Faran, and Paddy and Wheat in the case of Lemon Grass) during the comparable period of five years during which these focused crops are cultivated, using current levels of input and thereby incurring current level of cultivation expenses and obtaining current levels of crop yields.

We present in Table 6.1 summary results of per hectare per year estimates of cost, gross value of output and net returns for Jumbo faran and its competing crops – Rajma and Wheat, and Lemon Grass and its competing crops – Paddy and Wheat. In the case of medicinal plants, while the cost of cultivation and gross returns for Jumbo Faran are substantially higher than the combined cost and value of output of rajma and wheat, the net returns of both are almost at the same level. In the case of aromatic plants while the cost of cultivation and gross value of output of lemon grass are less than the combined corresponding values for paddy and wheat, the net returns of lemon grass are higher than that of paddy and wheat by almost 34 percent.

6.2 Experiences of Sampled Cultivators of Medicinal and Aromatic Plants

Changes in Area under the Identified Crops

- Overall 67 percent of the sampled cultivators of medicinal plants reported either increase or no change in cultivated area under the crop since they first started its cultivation. About 33 percent reported some decline in area allocated to this crop.
- Of the 42 sampled cultivators of aromatic plants, 29 percent reported some increase in area since they began its cultivation while the remaining 71 percent reported no change. An important observation is that none of the cultivators who started its cultivation reported any decline in its area since the start of the cultivation.

Table 6.1: Comparative Economics of Jumbo Faran and Lemon Grass With Their Competing Crops – Summary Results (Rs Per Hectare)

Crop	Row	Cost (C2 Basis)	Gross Value of Output	Net Returns
Medicinal Plants (Jumbo Faran)	1	33606	109485	75879
Rajma	2	13637	83211	69574
Wheat	3	6337	12109	5742
Rajma+Wheat	4	20004	95320	75316
Medicinal – (Rajma+Wheat)	1-4	13602	14165	563
Aromatic Plants (Lemon Grass)	5	9361	31838	22477
Paddy	6	9215	16044	6529
Wheat	7	10625	19768	9143
Paddy+Wheat	8	19840	35812	15972
Aromatic – (Paddy+Wheat)	5-8	(-) 10479	(-) 3974	6505

6.3 Motivating Factors

- Of the various factors that have influenced the cultivation of medicinal plants, the most important ones have been: easy to cultivate, higher relative profitability, demonstration effect of its cultivation by fellow farmers, good demand of this crop and easy availability of inputs, low level of input requirement and low cost of production. Its easy cultivation practices and higher relative profitability have in fact been the two most important factors which have encouraged almost all the sampled cultivators to go in for cultivation of medicinal plants.
- Of the various factors that have influenced the cultivation of aromatic plants, the single most important factor that has influenced almost the entire sample households has been its ease in cultivation. The other important factors that have influenced the cultivation decision of the sampled farmers have however varied. Low input requirements and low input costs, higher relative profitability, easy availability of inputs, demonstration effect of the other farmers cultivating this crop and good demand for this crop have also to varying extent influenced the cultivation of aromatic plants by sampled farmers.

6.4 Factors that Could Help Bring Larger Area Under the Identified Crops

- While 15 of the 21 sampled cultivators (71 percent) of medicinal plants responded that they are willing to bring larger area under cultivation of medicinal plants, the remaining 6 (29 percent) are not willing to bring any more area under the crop. The 15 sampled farmers willing to bring larger area under cultivation of medicinal plants, were asked to rank the factors, from those listed, they would consider relatively more important in influencing this decision. As expected all the 15 farmers listed increased profitability as the most important factor that would encourage them to bring still larger area under the crop. The second most important factor included improved marketing facilities for the crop (by 7 of the 15 farmers), more technical

assistance and know-how including making available seedlings from the government agencies (by 4 of the 15 sampled farmers) and improved demand for these crops (by 4 of the 15 cultivators). Thus apart from increased profitability, improvement in marketing facilities and improved demand for these factors could influence farmer's decision in bringing larger area under the crop.

- In the case of aromatic plants, of the 42 sampled cultivators 28 cultivators (67 percent) are willing to bring still larger area under the cultivation of aromatic plants while the remaining 14 (33 percent of the total) are not willing to increase any further the area under cultivation of this crop. Unlike in the case of sampled cultivators of medicinal plants, all of whom accorded increased profitability from the crop as the most important factor that would encourage them to bring larger area under the medicinal plants, in the case of aromatic plant cultivators the most important facilitating factor that could encourage such a shift varied. While 16 of the 28 cultivators who are willing to bring larger area under its cultivation attributed increased crop profitability as the most important motivating factor, 4 attributed increased and stable output prices as the most important factor. In the case of the remaining farmers the other most important factors that could influence their this decision is improved marketing facilities. Of the 14 sampled cultivators who are not willing to increase area under this crop, 11 (79 percent of the total) attributed it to small size of their land holding while the remaining 3 attributed it to lack of irrigation facilities. The second and third important factors in influencing such a decision have been – lack of irrigation facilities, lack of processing facilities, difficulties in marketing etc.

6.5 Factors that Could Influence Diversion of Area From Under Identified Crops

- Of the 21 sampled cultivators of medicinal plants, 20 are inclined to shift the current area under medicinal plants to an alternate crop should the relative profitability of other competing crop becomes higher than that of medicinal

plants . Other important factors cited for such a likely shift in area from under the medicinal crop to other crops include – non improvement in marketing facilities and lack of demand for these crops.

- As in the case of medicinal plants, a majority (57 percent) of the sampled cultivators of aromatic plants would also shift the area from under aromatic plants to alternate crops should the profitability of aromatic plants goes down in relation to that of the competing crops. Another 21 percent of the sampled cultivators however feel that the most important factor that would influence their decision in shifting away from aromatic plants to alternative crops is the non- improvement in marketing facilities for the aromatic plants. Another important factor that could influence the decision of the farmer in moving away from the cultivation of aromatic plants is the lack of increased demand for these crops.

6.6 Marketing of Medicinal and Aromatic Plants

- The markets for disposal of cultivated medicinal plants have not so far very well developed and organized even though its cultivation, albeit on a small scale, started a few years ago. This is on account of several factors- the most important being the small size of production, that too scattered over four to five harvests in a year, and spread over a large hilly area with not so easily accessible tracts. As a result almost all the cultivators normally have no option but to sell their produce to a local middleman. In the present case also all the sampled cultivators of medicinal plants reported that they sold their entire marketable surplus to the local middleman. Further the entire crop by all the sampled cultivators was sold in the raw form rather than after processing it.
- Unlike medicinal plant, cultivation of the aromatic plants has been a relatively new phenomenon. Most of the efforts in this case so far have been directed towards encouraging farmers adopt its cultivation and extending the cultivation to newer areas. To promote its cultivation and allay any fears of the

cultivators with regard to its marketing the cultivators were assured of guaranteed procurement of the entire crop at a fixed price by the CAP. Even those cultivators who would like to extract the oil from lemon grass, rather than selling the grass in its raw form to the CAP, were provided assured facilities for oil extraction at a nominal price. Apart from above, no significant formal market or processing facility in the vicinity of the production area has so far developed. Due to the absence of such a formal market, almost all the sampled cultivators sold their produce either to CAP or to the private entrepreneur who has set up the above plant. Further as in the case of medicinal plant cultivators, the entire crop by all the sampled cultivators was sold in the raw form rather than after extracting the oil, even though facilities for this existed.

- Almost all the sampled cultivators of medicinal plants reported no problems with their crop disposal. This implies that even though the crop was being sold to a middleman, the farmers faced no problem in their dealings with him.
- Of the 42 sampled cultivators of aromatic plants, 19 (about 45 percent) reported no marketing related problems, while 11 (about 26 percent) reported large distance of their farm from the market center. Another 8 cultivators (about 19 percent) cited problems relating to delays in receipt of payment.

Promoting Cultivation of Medicinal and Aromatic Plants – What Needs to be Done

As discussed above and in the previous Sections, cultivation of medicinal and aromatic crops need to be promoted not only to conserve the fast extincting species found in the wild but also to meet the ever growing demand for consumption of these plants both from within the country and also from abroad. Shift towards cultivation of medicinal and aromatic plants, in addition, is also expected to raise the profitability from crop cultivation leading to increased incomes of the farmers. Despite the multifarious advantages associated with cultivation of medicinal and aromatic crops, their adoption for cultivation by farmers has not however so far been very encouraging. This is in large part due to the fact that medicinal and aromatic plants sector in India operates in a near policy vacuum. Encouraging cultivation of these

crops require concurrent policies and effective actions aimed at regulating collection of medicinal plants from wild; research, development and extension efforts aimed at developing newer plant varieties suitable for cultivation and their propagation and adoption by farmers; organizing effective post harvesting marketing and trade operations including their processing and exports and developing an efficient marketing infrastructure, and building an efficient information base, including marketing intelligence, and its proper and timely dissemination.

6.7 Issues Related to Cultivation and Extension

- Given that thousands of species of medicinal and aromatic plants are available and collected from the wild, it is neither possible nor desirable to direct cultivation efforts at all these species. Promoting widespread cultivation of medicinal and aromatic plants through domestication of species grown in the wild, therefore require appropriate prioritization of research efforts. As a first step this would require identification of those species which are under more serious threat of extinction and which are in relatively greater demand than the others both in the domestic market and for international trade. Knowledgeable person associated with the trade of these plants suggest that there are around 10 – 12 medicinal plants which are required in bulk (1000 to 10000 tons) and are currently mainly obtained through natural sources (wild stocks) and which are depleting fast. Therefore, research priority in the first instance should focus efforts in developing suitable planting material and associated package of practices for cultivation of such species. In addition there are about 15 medicinal plants which are currently imported to meet the internal demand and therefore for the purpose of import substitution, developing suitable cultivation techniques for their cultivation is necessary.
- Systematic cultivation of medicinal and aromatic plants need specie-specific and location specific cultural practices, depending on prevailing soil, water and climatic conditions at a given location. Hence research and development work and cultivation techniques have to be tailored keeping these in view, though efforts need to be made towards standardization of cultivation practices and harvesting times to get the desired quality of medicinal and aromatic plants.

- While developing cultivated varieties, efforts need to be made towards genetic enhancement of at least some of these species, as compared to that of species found in the wild, by different methods of breeding including through traditional genetic transformation and use of biotechnology. The efforts of different agencies involved in the development of these plants need to be better coordinated and closely integrated.
- Non availability of suitable and adequate planting material at the right time severely constrains the adoption by farmers of these crops. More nurseries in different parts of the State need to be developed to make planting material easily available to farmers.
- Widespread field demonstrations of species developed for cultivation will motivate the farmers to adopt cultivation of medicinal and aromatic plants. Some of the improved production technologies developed at research stations have not been transferred to the field to the required extent due to lack of sufficient extension personnel and infrastructure. More efforts need to be invested in this direction.
- Farmers would switch over to cultivation of these plants, besides other factors, if returns from these crops are substantially better than the alternative crops being cultivated by the farmers. While relative crop profitability depends upon several factors an important consideration in developing suitable crop varieties and package of practices for such crops should be to ensure minimization of the cost of cultivation and maximization of the crop yields. Currently the cost of planting material is the major cost in cultivation of these crops. Efforts should be made to cut down on the cost of supply of planting material so that relative crop economics can be improved further.
- Given the growing demand for organic products, more so for medicinal and aromatic plants, efforts should be directed towards development of such species which are suitable for cultivation under organic farming conditions.
- One of the factors weighing buyer's preference for wild species over cultivated ones is the perceived superiority of medicinal constituents of a wild plant as compared to that of a cultivated plant. This in large part is due to the fact that

this information on these aspects is not readily available to the buyers. Lack of adequate number of analytical laboratories capable of handling detailed analysis are not easily available. There is a need for setting up a network of regional analytical labs to facilitate the analysis of the constituents of the medicinal plants so that quality certification could be done. This will help build buyer's confidence and encourage farmers to go in for cultivation of medicinal and aromatic plants. Some of the labs could be authorized to issue certification as a means of building buyer confidence as also for product standardization.

- If appropriate cultivation practices are developed and the crop economics is favorable, efforts can also be made to popularize cultivation of medicinal & aromatic plants in green houses as well as inter-crops.
- Even simple interventions, such as, better method of harvesting, storage, grading and local level value addition can substantially improve returns to local people. Lack of knowledge on these issues has been an important constraining factor in realizing these benefits. There is a need for capacity building of farmers and extension workers so that returns from cultivation can be improved.
- The State has a good network of State and Central institutions and research centres undertaking research on various aspects of cultivation of medicinal and aromatic plants. However there does not appear to be much coordination amongst different institutions as a result of which there are some overlaps and duplication of efforts on the part of these agencies. Apart from better coordination amongst these agencies there is a need for an added interaction and coordination between these research institutions and marketing and processing agencies so that a proper market feed back could be obtained and research efforts could be prioritized accordingly.

6.8 Need for Strengthening Database & Market Intelligence

- Any systematic and realistic planning for cultivation and marketing of medicinal and aromatic plants and promoting their sustainable development requires sincere

efforts aimed at developing an authentic statistical data base not only in respect of cultivated species of these crops but also of those being currently collected from the wild. Unfortunately an authentic data base in respect of medicinal and aromatic plants is not available in Uttaranchal. The current agricultural statistics collection in the State is confined only to the major field crops and few horticulture crops. Similar database pertaining to area and production of medicinal and aromatic plants need to be developed. In addition, there is also a need for creating a data base on such variables as species wise demand, supply, end uses etc.

- As of now there appears to be little or no direct contacts between collectors / cultivators and processors/ final consumers. This is in large part attributed to lack of knowledge and awareness about markets with no institutional arrangement available to bridge this information gap. Generally traders or their representatives, visiting local areas are the only source of market information available to these people. Lack of availability and access of market information is thus an important factor constraining improvement of returns to producers of medicinal and aromatic plants. Apart from thus creating the data base on extent of cultivation of these plants, there is a need to set up a market intelligence unit to regularly collect, analyze and widely disseminate latest and reliable information relating to markets, marketing channels, prices, trade including imports and exports and make this information available to all concerned in a timely fashion.

6.9 Inadequate Processing Facilities

- The processing of medicinal and aromatic plants is generally done in either one or two stages. The first stage is semi-processing while the second stage is conversion in to formulations. While conversion in to formulations requires appropriate infrastructure facilities and technical know how and may be beyond the reach of an ordinary farmer, however semi-processing involving such functions as cleaning and grading and undertaking such activities as drying, powdering, making concentrates, boiling and distilling, etc. can be done at the local level. Some farmers are already doing some semi-processing of the medicinal plants for their self consumption. Marketing of semi-processed product rather than raw crop can lead to value addition and improve the profitability of the cultivator. Efforts thus need to be made to encourage semi processing of these

crops by encouraging setting up of diversified small scale enterprises/ cottage industries in remote and far-flung areas either through formation of cooperatives or through encouragement of small private entrepreneurs. This will also help in reducing the transportation and packing costs of raw materials and also provide additional employment to local people

- Uttranchal has about 15 reputed pharmacies preparing formulations, however these are not sufficient. Efforts need to be made to encourage entrepreneurs set up more processing facilities for preparation of formulations.

6. 10 Marketing

- Marketing of medicinal herbs in general and those of cultivated species in particular is erratic in Uttaranchal. Institutional efforts are confined up to cultivation and propagation but are almost totally absent for development of marketing. The trade is currently non transparent, inefficient, imperfect, informal and opportunistic and often carried out in a hush-hush manner. As a result the farmers are able to realize only a very small fraction of the price paid by the ultimate consumer of final product resulting in lower crop profitability and not providing enough incentive to the farmers to go in for its cultivation. Policy intervention aimed at promoting cultivation of medicinal and aromatic plants has thus to consider marketing as a major component.
- The important constraints for marketing of medicinal and aromatic plants in Uttaranchal arise as a consequence of several factors : the hilly terrain with sparse habitation thinly spread, inadequate infrastructure development (principally road and transport) in relation to these characteristics, generally small size of farm holding of which farmers have currently devoted only a small portion for cultivation of these plants, and low levels of production that too realized over three to four cuttings in a year. In the absence of any institutional support for marketing (CAP does provide some limited support for aromatic plants but that too in its catchments area only and this support is not likely to continue for ever), coupled with lack of any market intelligence and the fact that production

of individual farmer in each cutting is very small, the farmer has no option but to fall in the trap of agents of dealers and sell his crop at whatever price is being offered to him. The only price mechanism he has at his disposal to guide him is the previous years sales price. These un-organized market channels have lead to monopoly of few individuals and industries controlling and dictating the market and depriving the farmers of a more remunerative price for his produce. To promote large scale cultivation of these crops the state would have to intervene either through formation of farmers marketing cooperatives or promoting contract farming under a legally binding enforceable contracts and monitored by a regulatory authority.

- In addition, to meet the domestic as well as international quality standards, post harvest marketing operations e.g., harvesting, grading and standardization, system of certification, packing and transportation need to be improved. For international regulations it may also be necessary to have ISO systems of certification.

Comments of the Coordinator (ISEC, Bangalore) on the Draft Report on “Cultivation of Medicinal and Aromatic Crops as a Means of Diversification in Agriculture in Uttaranchal” and the response of the AERC, Delhi on these comments

1. Date of Receipt of the Report 17-04-07

2. Date of dispatch of the comments by the designated Centre 9-05-07

3. Detailed comments on the methodology adopted for the study

The study follows common methodology

4. Comments on the adequacy and quality of coverage of each objective of the study

The coverage is adequate but the sample size of the competing crops needs to be mentioned.

The information on sample size is given in Table 1.1 and has been repeated at relevant places in Chapter III.

5. Comments on the presentation and get up of the report

In the first chapter while setting the objectives of the study, an objective of “estimation of domestic and international demand for the selected medicinal and aromatic crops in the light of the effect of new IPR regime on pharmaceuticals” is excluded. Please provide information on this.

The required information has been added

6. Chapter Six can be renamed as “Conclusions” in which the main findings of the study should be precisely stated before going in policy suggestions

The suggested modifications have been done

6. Overall views on the acceptability of the report

Incorporate the above comments and finalize the report
Please send a soft copy after the above comments are incorporated