

Discussion paper on

MEDICINAL AND AROMATIC PLANTS :

Their Use and Revenue Potential

Study Group II of

Parliamentary Standing Committee

on Agriculture

19th September 2001

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**LIST OF POINTS FOR DISCUSSION WITH THE REPRESENTATIVES OF
KAU & DARE ON MEDICINAL AND AROMATIC PLANTS –
THEIR USE AND REVENUE POTENTIAL DURING THE STUDY VISIT OF
STUDY GROUP – II OF PARLIAMENTARY STANDING COMMITTEE
ON AGRICULTURE ON 19TH SEPTEMBER, 2001 AT TRIVANDRUM.**

- 1. Please state the historical background of Kerala Agricultural University (KAU)?**

Deemed to have come into existence on February 24th 1971 by the Act 33 of 1971 of the Kerala State Legislature, entitled 'The Agricultural University Act, 1971', the Kerala Agricultural University (KAU) became operational since February 1st 1972 when the then existing two educational and 21 research institutions administered by the Departments of Agriculture and Animal Husbandry of the Government of Kerala, were brought under one umbrella for facilitating the sustainable and accelerated development of agriculture in the state.

- 2. What have been the objectives of University since its inception and how far these objectives have been achieved so far? Has there been any modification in the objectives in the last decades as per the changing times and needs?**

The Kerala Agricultural University is the primary and the principal instrumentality of the Kerala State in providing human resources, and skills and technology, required for the sustainable development of its agriculture, defined broadly encompassing all production activities based on land and water, including crop production (agriculture), animal husbandry, forestry and fishery through conducting, interfacing and integrating education, research and extension in these spheres of economic endeavour.

University has been successful in achieving the set objectives in teaching, research and extension to a great extent. The Academic Council, the Faculty Research Council and the Directorate of Extension review the progress of work for each year and take necessary measures to modify the short, medium and long term objectives with the changing times.



3. How many departments are functioning under the umbrella of the university and since when?

The University fulfils its obligations and commitments through a network of institutions spread over 36 campuses through the length and breadth of the state consisting of ten constituent colleges, six Regional Agricultural Research Stations, 26 Research Stations, three Centres of Advanced Studies, the Central Training Institute, the Communication Centre, the KAU Press, five Krishi Vignana Kendrams, and the Central Library.

The detailed list of institutions is furnished as appendix I

4. (a) Whether the University has a full-fledged department on Medicinal and Aromatic Plants (DM&AP)?

Yes.

(b) If so, since when it has been functioning?

Since the inception of the University in 1972. Aromatic and Medicinal Plants Research Station, Odakkali prior to becoming a part of the KAU, was functioning as Lemon Grass Research Station since 1951.

(c) What have been the mandate of this Department on M&AP and how far this have been achieved?

The activities in Medicinal and Aromatic plants in KAU is undertaken in a networking mode with **teaching** at UG and PG level primarily at College of Horticulture, Thrissur, College of Agriculture, Vellayani, and College of Agriculture, Padanakkad; **research and development** primarily at Aromatic and Medicinal Plants Research Station, Odakkali, AICRP (M & AP) and Department of Plantation Crops, Vellanikkara, CRS, Pampadumpara, RARS, Ambalavayal, RARS, Kumarakom and **extension** activities through KVKs and all the above teaching and research institutions.

The research mandate of Department of Medicinal and Aromatic Plants

(a) Exploration, collection and evaluation of germplasm of aromatic and medicinal plants.

Largest germplasm collection of lemongrass (450 accessions), palmarosa, vetiver, cinnamon, thippali, kacholam, Holostemma, Beetlevine (39) and herbal garden at Odakkali, Vellanikkara, Vellayani, Pampadumpara and

Neeleswaram centres. Alternative plant sources of *Cymbopogon parkeri* and *C. giberba* were identified

(b) Crop improvement in medicinal and aromatic plants.

Evolved improved varieties of lemongrass (OD-19, OD-23), palmarosa (ODP-1, ODP-2), vetiver (ODV-3), cinnamon (ODC-130), Thippali (Viswam) and kacholam.

(c) Standardization of agro-techniques for selected aromatic and medicinal plants as pure and intercrop.

Agrotechnology has been standardized for lemongrass, palmarosa, vetiver, patchouli, cinnamon, ocimum, eucalyptus, thippali, kacholam, Alpinia, Katurimanjal, Holostemma, Plumbago, Indigofera, Clitorea, mango ginger etc.

(d) Development of processing and extraction techniques

The processing and extraction technology for the above crops have been developed.

(e) Development of quality evaluation standards of essential oils and raw drugs

The quality evaluation standards for the above crops have been developed.

(f) Management of disease and pests of medicinal and aromatic plants

Work is in progress for the identification of pest and disease problems of medicinal and aromatic plants

(g) Biotechnological interventions

Rapid multiplication of endangered medicinal plants or those under threat like *Kaempferia galanga*, *Sida* spp., *Gymnema sylvestre*, *Holostemma adakodien*, *Tylophora indica*, *Trichopus zeylanicus*, *Cosciniium fenestratum*, *Habenaria latilabris* and *Terminalia chebula* was standardised.

(h) Utilisation and marketing of medicinal and aromatic plants.

Simple and cost-effective method for quality improvement in palmarosa was developed. Quality variation in market samples of crud drugs and finished products were undertaken.

(d) Please give details of physical and financial targets fixed and achieved under DM&AP during the last 5 years; year-wise along with the reasons for short fall; if any?

Item	1997-98 (lakhs)	1998-99 (lakhs)	1999-'00 (lakhs)	2000-'01 (lakhs)	2001-'02 (lakhs)
Teaching	20.80	9.20	17.40	25.30	26.30
Research & Development	77.28	68.71	82.07	68.26	69.57
Total	98.08	77.91	99.47	93.56	95.87

The physical and financial targets have been fully achieved.

(e) Please give details of courses, which the KAU is running for Graduation and Post-Graduation level with special reference to academic courses being run under DM&AP?

U. G. Courses

Hort 306 Medicinal and Aromatic Plants (1+0)

Importance of medicinal plants in Kerala and India. History, origin, area and production, botany, varieties, propagation, planting, management, extraction of active principles and uses of Atropa, Cinchona, Rauvolfia, Opium, Santalum, Acorus, Cannabis, Datura, Digitalis, Ephedra, Catharanthus, Nuxvomica, Aconitum, Neem, Senna, Chenapodium, Dioscorea, Costus, Solanum and other medicinal plants

Work experience

Hort 303 Medicinal and Aromatic Plants (0+1)

Identification of important aromatic and medicinal plants. Preparation of herbarium of medicinal and aromatic plants. Collection, extraction of seeds, raising nursery and nursery management, preparation of field and planting, harvesting, curing and extraction of essential oil of lemongrass and palmarosa. Visit to the medicinal plant collection gardens. Study of its pharmaceutical properties and uses.

P. G. courses

Pln. 605 Medicinal plants (1+1)

Theory : Importance of medicinal plants-origin, distribution, crop improvement, cultivation, post harvest handling, extraction of active principles and uses of Cinchona, Senna, Catharanthus, Dioscorea, Solanum, Datura, Atropa, Rauvolia, Acorus, Digitalis, Ephedra, Aconitum, Opium Poppy, Cannabis, Neem.

Kaempferia, Plumbago, Artemisia, Long pepper, Alpinia, Adhatoda, Asparagus, Indigofera, Holostemma, Isabgol, Liquorice and Withania. Emerging plant drugs-future and prospects of medicinal plants. .

Practical : Identification of spices and varieties of medicinal plants-preparation of herbarium of these plants-propagation techniques-post harvest handling, techniques of extraction procedures-study on field problems.

Pln. 606 Aromatic plants (1+1)

Theory : Role of aromatic plants in Indian economy-important aromatic plants in India-Origin, distribution, crop improvement, cultivation, post-harvest handling, extraction of essential oil and active principles and uses of Lemon grass, Java citronella, Palmarosa, Vetiver, Japanese mint, Artemesia, Rose, Tuberose, Basil, Eucalyptus, Sandalwood, Germanium, Jasmine, Patchouli and other under exploited and miscellaneous essential oil yielding plants.

Practical : Identifications of spices and varieties of major aromatic plants-preparation of herbarium of these plants-propagation techniques-post-harvest handling, techniques of extraction procedures-study of field problems.

Hort 718 Advances in production technology spices (1+1)

Theory : Major medicinal and aromatic plants, trends in medicinal and aromatic plant production. Problems and prospects. Effect of soil and climatic factors in crop production, scope of development of new strains in medicinal and aromatic plants, chemotaxonomy and its application in medicinal and aromatic plants. Cropping pattern studies. Mono and multicropping of medicinal and aromatic plants. Tissue culture for multiplication and for the secondary metabolites and its application. Ethno medico-botanical studies and surveys –weed control, pest and disease management in aromatic and medicinal plants, quality evaluation in medicinal and aromatic plants, change in horizon of medicinal and aromatic plants, emerging plant drugs. Impact of export and import of major medicinal and aromatic plants.

Practical : Identification of major medicinal aromatic plants, ethno medico botanical studies, cataloguing, preparation of herbarium, advances in post harvest handling of medicinal plants. Chemical analysis of major medicinal and aromatic plants. *In vitro* techniques in medicinal and aromatic plants, modelling herb garden, visit to commercial herb garden, visit to a pharmaceutical factory, visit to an ayurvedic factory.

(f) Please give details about on an average how many students get admission and how many students pass out every year after completing the courses under DM & AP especially during the last 5 years?

Sixty five students per year under UG programme. Ten students per year under PG programme in various disciplines taking up research on medicinal plants.

5. (a) What have been the various sources of finance available to the University? Please specify percentage of each component during the last 5 years, year-wise?

Year	1996-97	1997-98	1998-99	1999-00	2000-01
Amount (Rs.Crores)	71.50	85.20	81.35	92.33	125.22

The major fund support for the University is the statutory grant-in-aid under the non-plan and plan expenditure from the Government of Kerala which is about 70% of the total resources. ICAR extends support to the tune of 18%, other agencies 2% and the remaining 10% is met from internal resources of the University.

- (b) What percentage of the finance has been provided to DM&AP year-wise during the last 5 years?

Year	1996-97	1997-98	1998-99	1999-00	2000-01
Finance to DM&AP (%)	1.37	0.91	1.22	1.01	0.77

6. What are the criteria for deciding about the kind of plant especially about the Medicinal and Aromatic Plants from the point of view of carrying out its research and its marketing?

Priority is given for the medicinal plant species adapted to the specific agroclimatic situations of Kerala (Humid tropics) based on their medicinal importance, efficacy in curing ailments, market potential (internal and export) and demand of the industry.

Kerala Agricultural University is giving thrust in the domestication and cultivation of medicinal and aromatic plants through *ex situ* conservation of biodiversity, development of superior varieties, supply of quality planting materials and standardisation of agrotechniques, processing technology and quality parameters for the crud drugs.

7. How many types of (a) Medicinal and (b) Aromatic Plants are available in India?

Please give State-wise and UT-wise details.

About 80,000 higher plant species on earth are medicinal. Of these, about 15000-20000 species have good therapeutic value. However, only 8000 species are used for their medicinal values by traditional communities and 1100 species are reported to be aromatic. India shelters over 45,000 different plant species. India is tenth among the plant rich countries of Asia, sixth as far as centres of diversity, especially agro-diversity, are concerned. Nearly three fourth of the drugs and perfumery products used in the world are available in natural state in the country. In India, the *Ayurveda* system of medicine uses about 700 species, *Unani* 400, *Siddha* 500, Emchi (Tibetan) 300 and modern medicine around 30 species and around 50 species are commercially cultivated as aromatic plants. Major medicinal and aromatic plants grown in selected states in India are given in Appendix II.

8. The enlightened ancient Doctor named “Sushrut” has once asked his disciple to travel through out the world and test all the plants and vegetation on earth and come back and report whether he could find any plant/herb/vegetation which does not either in totality or partially have any medicinal properties. The disciple came back after travelling world-wide and submitted to the Master that he could not find any plant which either in totality or in some parts does not have some medicinal properties i.e. all plants/herbs/vegetation grown on the planet Earth have some medicinal properties.

(a) Does KAU and DARE agree with the discovery of the ancient Doctors of India?

Yes

(b) If so, what efforts KAU & DARE have made respectively to establish the ancient truth about the usage of medicinal and aromatic plants in India and abroad in a scientific manner?

The traditional knowledge on the use of herbs for the treatment of specific disease, when to collect, where to collect, which part to be used and how to be used are scientifically studied at the KAU by understanding the correct ecosystem, crop association, soil and climatic requirements and other environment factors required for the proper growth of the plant, diurnal/seasonal variations in quality, the chemical properties of the plants, possible changes that may occur in the medicinal properties

during domestication. Identification of major principles, their efficacies in single and combinations, use of traditional knowledge of Vrikshayurveda in integrated pest management in crop protection and in veterinary medicine.

KAU and DARE are engaged to develop high potent medicinal and aromatic varieties and also to develop their agro-techniques for successful cultivation so as to make them available for better and effective treatment of various diseases.

9. **In India, which is the deciding authority who declares whether a plant is a medicinal plant or aromatic plant or both? Please give details of the entire procedure how a plant comes under these categories?**

In the case of medicinal plants that are included in the classical Ayurvedic formulations, Drugs Controller of India is the deciding authority. As far as rest of the medicinal and aromatic plants are concerned, there is no official authority.

Aromatic plants are those that possess odorous volatile substances that occur as essential oils, gum exudates, balsam and oleoresin.

Medicinal plants are those having pharmacological properties due to primary/secondary metabolites. The classification is normally done based on the major traditional use.

10. **“Let thy food be the medicine”, is the very fundamental rule to be followed in the Naturopathy and Ayurvedic system of curing a disease. The modern system strongly believes in the synthetically /chemically prepared medicines for the treatment of any disease.**

- a. **What scientific research KAU and ICAR have done in scientific establishment of the ancient knowledge of power of positive food coming as a gift from plant kingdom in curing the diseases?**

The ancient faith on plants for human well-being is recognized by the University. The Nutrition Department is conducting research on the nutritional properties of various traditional plants that are used for foods. For example, the medicinal properties of common plants used in Kerala Culinary have been well recognized. Traditional fruits and vegetables like Papaya, Jack, Garcinia, Moringa, Amla. Cucumbers, gourds, bhedi, amaranthus, mango ginger are encouraged to be grown organically in homestead gardens for meeting their dietary and health requirements.

Moreover, the concept of home remedies for family health is encouraged by providing herbal garden kits comprising 10-15 common medicinal plants to each family. Medicinal plants such as Boerhaavia, Chikkurmanis, arrow root, Coleus etc. are also being popularised as health foods.

b. And how far they succeeded in restoring the lost faith of the modern educated doctors and people at large from the curative power of medicinal plants?

In the state of Kerala, there are modern medicinal practitioners who also recommend ayurvedic system of medicine/treatment where definite medicines are not available in modern medicine. This is a proof in itself on their trust in the curative properties of medicinal plants. More over, many of the plants, which are in use in the indigenous system of medicine, are being intensively screened for isolation of medicinal principles. The Traditional practices, like Panchakarma and rejuvenation therapy, herbal treatments for asthma, arthritis rheumatism, skin diseases and even for the treatment of HIV are getting more popular than yesteryears.

The University is promoting awareness programme on traditional uses of select medicinal species and familiarisation and their cultivation.

11. In how many agro-climatic regions/zones the state of Kerala has been divided and what is special about each region/zone?

Twenty agroclimatic zones are identified by superimposing six moisture availability regimes over seven soil groups identified in Kerala. Details given in Appendix III.

Under the NARP, the state is further divided into five agro-climatic zones taking into consideration its physiography, climate, soil characteristics, sea water intrusion, irrigation facilities, land use pattern and the recommendations of the "Committee on Agro-climatic regions and Cropping Patterns" constituted by the Government of Kerala in 1974. The zones are (I) Northern (ii) Central (iii) Southern (iv) High Range and (v) Problem areas. A brief account of each zone follows :

a) Northern zone : This zone consists of the four northern districts of Kerala viz. Kasaragod, Cannanore, Calicut and Malappuram. Geographical area of the zone is 10,94,600 ha covering 28.2 per cent of the area of the state. Agriculture is the main occupation of the people. The zone receives rains during both the monsoons, the south west and north east. The annual average rainfall is 3379 mm. The mean

maximum and minimum temperatures of the zone are 33 ° C and 23 ° C, respectively. The major types of soil in the zone are coastal alluvium, laterite and forest loam. Rice, coconut, arecanut, pepper, banana, cashew and rubber are the important crops of the zone.

b) Central zone : The central zone consists of three central districts of Kerala i.e. Palghat, Thrissur and Ernakulam, excluding the high ranges, the coastal saline tracts and other isolated areas like Kole lands with special soil and physiographic conditions. Geographical area of the zone is 9,73,689 ha covering 25 per cent of the area of the state. The zone is characterized by comparatively heavier rainfall during south west monsoon and less rainfall during north east monsoon period. The mean maximum and minimum temperatures of the zone are 31.4 ° C and 21.1 ° C, respectively. The soil type is mainly laterite. This zone is the major rice growing tract of the state and accounts for 50 per cent of the area and 52 per cent of production of rice in the state. Coconut, arecanut, ground nut, sesamum, pulses, banana and pine apple are the other important crops of the zone.

c) Southern zone : The zone comprises the districts of Thiruvananthapuram, Kollam, Pathanamthitta, Alleppey and Kottayam. Geographical area of the zone is 6,5,17 sq. km covering 16.8 per cent of the area of the state. The zone has a tropical humid climate. Rainfall is comparatively well distributed, with the results that the effective annual rainfall is more (2246 mm, 80 %) than that in the other zones. The mean maximum and minimum temperatures of the zone are 34.1 ° C and 21.7 ° C, respectively. The soils are lateritic, the texture ranging from sand to sandy loam and clay loam. The major crops are rice, coconut, tapioca, pepper, cashew, rubber, arecanut, sugar cane, pulses and banana.

d) High range zone : The zone comprises the districts of Wayanad and Idukki, the Nelliampathi and Attappadi hill ranges of Palghat; Thannithode and Seeththode of Pathanamthitta; Aryankavu, Kulathoopuzha and Thenmala of Kollam and Peringamala, Aryankad and Vithura of Thiruvananthapuram districts. Geographical area of the zone is 111,40,67 ha covering 28.67 per cent of the area of the state. The mean maximum and minimum temperatures of the zone are 29.6 ° C and 19.6 ° C, respectively. Soil type is forest loam. This region is famous for plantation crops and spices. The major crops grown in the zone are coffee, pepper, cardamom, ginger, tea, coconut, arecanut, cool season vegetables etc.

e) Special zone of problem areas : The zone comprises five areas, Onattukara, Kuttanad, Pokkali, Kole and sugarcane lands spread over six districts of Kerala i.e. Alleppey, Kollam, Kottayam, Ernakulam, Thrissur and Malappuram. The total geographical area is 72,550 ha. A very intensive cropping pattern of two rice crops and a sesamum, pulses, vegetables crop is followed in this area. The Kuttanad area lie at a level of 1 to 2.5 m below msl.

12. How many varieties of Medicinal Plants and Aromatic Plants are found in Kerala? Please give details

The western Ghats, one of the two hot spots of biodiversity in the country, harbour around 500 medicinal plant species of which around 150 species are used in Ayurveda; the rest contribute to the tribal and folklore medicines.

In Kerala, the annual sale of Ayurvedic medicine is about 150 crores. For the preparation of 500 types of Ayurvedic medicines 400 plant species are used. Among these about 150 species are collected for manufacturing of medicines, dyes, cosmetics etc on a commercial basis.

Kerala is one of the leading producers of oils of lemongrass, vetiver, palmarosa, eucalyptus, patchouli, ocimum, cinnamon, clove, nutmeg, pepper, cardamom, vanilla, ginger etc.

13. (a) What is the area under cultivation of medicinal and aromatic plants in India? Please give state-wise and UT-wise details?

Area under cultivation of major medicinal and aromatic plants in India is 173350 ha.

The state-wise data is given in appendix IV

(b) What is the consumption of medicinal and aromatic plants in India; State – wise and UT-wise and if a state has more production of Medicinal and Aromatic Plants than its domestic consumption what happens to the excess production of these plants?

Presently there are about 10800 licensed pharmacies. Indian systems of medicines and nearly 4,60,000 registered practitioners. About 1000 single drops and 8000 compound formulations are recognized in the country. Annual drug production estimated to be around Rs. 2000 crores and about 12% global demand is fulfilled by India.. Annual production of essential oil is around 13166 tonnes valued at Rs. 45509 lakhs.

There are about 750 registered Ayurvedic manufacturing units and 1000 unregistered units in Kerala. There about 7000 A class and 6000 B class medical practitioners in Kerala. The number of unregistered medical practitioners is about 5000. About 750 raw drugs are used in 500 Ayurvedic medicines on a commercial basis. The annual trade in Ayurvedic medicine is about 200 crores. Around 250-300 tonnes essential oils is produced in the state. The essential oil is largely processed and exported from the state. The surplus medicinal plants are sold to other States.

14. What sort of agro-climate is most suitable for the growth of Medicinal and Aromatic Plants?

All species of medicinal and Aromatic plants can not be grown in all agro-climatic regions. However, every agro-climatic region is suitable for certain species of medicinal and aromatic plants which are specific to that particular region only. There are some species which can be grown in a wide range of agro-climatic regions (Appendix V).

15. The other food grains/fruits/vegetables grown on chemical fertilizers and saved with chemical pesticides have been proved imbibe all the negative effects of these chemicals into them; This inorganic production of these items have been giving some carcinogenic (cancer-causing) effects on human health

(a) Whether these Medicinal and Aromatic Plants (M&AP) are also being grown in India with the help of chemical fertilizers and chemical pesticides?

Only around 40 species of aromatic and medicinal plants are commercially cultivated in India. In crops where intensive cultivation is followed chemical fertilizers are used in aromatic crops but to a lower extend in medicinal plants. Some of the improved varieties evolved demand higher levels of inorganic inputs like fertilizers and pesticides. Studies in the Kerala Agricultural University have shown that most of the aromatic and medicinal plants respond better to organic manures.

So far no chemical insecticides has been recommended by KAU, AICRP or NRCMAP for insect pest control of medicinal plants. However, very limited number of fungicides have been included in the package of practices and that too for a control of very limited number of diseases. Moreover, while doing so care has been taken to recommend only those chemical fungicides where residue did not exist at the harvesting stage.

- (b) If so, What are the reasons for the same and why an attempt has not been made by the KAU/ICAR to grow the M&AP organically so that these plants do not contain any chemical toxic and help to cure the disease rather than causing a disease?**

To augment production and productivity of the officinal drug, currently natural pesticides that are effective are limited. Hence emphasis on screening plants for 'biocide' potential and developing formulation field application is given at Kerala Agricultural University. In one of the examples biocide potential of *Ocimum* and its active principles is being thoroughly investigated and encouraging results are obtained. Extracts of *Boerhavia*, *plumbago* and *thespesia* were found effective against pumpkin mosaic virus.

The Kerala Agricultural University is conducting research on development of Good Agricultural Practices, including organic farming for the production of medicinal and aromatic plants.

- 16. (a) Since when NRC – Medicinal and Aromatic Plants and AICRP on M&AP have been functioning in the DARE?**

NRC on Medicinal & Aromatic Plants from November 24,1992 and AICRP on M&AP from 1972 have been functioning in the DARE. AICRP (M & AP) has been established at KAU in 1987.

- (b) What have been the financial and physical targets fixed and achieved under NRC M&AP and AICRP M&AP, respectively, year-wise, during the IX five year plan along with the reasons for short fall, if any?**

The details are presented in Appendix VI

- 17 (a) How much production of M&AP out of total has been exported during each year of the IX plan?**

About 26 medicinal species are being exported from India. About 1100 tonnes of essential oils is also exported.

Quantity in kg Exported

Item	1995-96	1996-97	1997-98	1998-99
Medicinal Plants	36134756	34839515	39444756	1395206816
Crude herbal drugs		6767158	6767158	3125708074
Aromatic Plant products	407560	795390	1103040	N.A.

(b) How much foreign exchange has been earned from the export of M&AP during each year of the IX plan?

As per the current estimates India is exporting herbal material and medicinal species to the tune of Rs. 550 crores and essential oils valued at Rs. 18967 lakhs.

Export value in Rs. in crores

Item	1995-96	1996-97	1997-98	1998-99
Medicinal Plants	254.51	246.62	261.76	251.22
Crude herbal drugs		137.82	161.01	163.82
Aromatic Plants	131.81	153.57	189.67	N.A.

(c) Please also give details of countries to which such exports have been made?

Countries to which *essential oils* are exported from India – USA, UK, Russia, France, Germany, Switzerland, Australia, Turkey, UAE, Singapore, Netherlands, Korea, Japan etc.

Medicinal plants

Cinchona bark – UK, Germany, France

Rauwolfia serpentina & R. vomitaria – Germany

Carica papaya – USA, Japan

Digitalis purpurea – Germany

Liquorice – USA, Japan, UK

(c) Which are the M & AP much in demand by the other countries? Please give details country –wise?

Crop	Country
Isabgol	USA, Spain, Sweden, Mexico, Japan, China, France, Australia, Bangladesh, UK, UAE, Nepal, Jordan, Canada, Germany, Argentina, Afghanistan, Sri Lanka, Pakistan
Senna	USA, Spain, Malaysia, Japan, Germany, China, UK, Newzeland, Denmark, Argentina, Australia, Brazil, Canada, France, Hong Kong, Italy
Opium poppy	Germany, UK, USA, Bangladesh, Venezuela, Japan, France, Australia
Other Ginseng roots	USA, UK, Netherlands, Italy, Germany, Japan, France, Korea, Saudi Arabia, South Africa, Mauritius
Vinca rosea (Periwinkle)	France, Germany, Malaysia, Denmark, China, Australia, UK
Garcinia	USA, Japan, China, UAE, Thailand, Italy, Netherlands, Spain
Neem	USA, UK, Spain, Singapore, Italy, Thailand, UAE, Canada, Denmark, Netherlands, Russia
Betel leaf	Pakistan, Uganda, UK, Saudi Arabia, Canada, Kenya, Hong Kong, Estonia, Nepal, Oman, South Africa, Sri Lanka, Tanzania
Belladonna	USA, UK, Spain, Netherland, Germany
Liquorice	Japan, Italy, Canada, UK
Lemongrass	Russia, UK, USA, Australia, France, Germany
Mints	USA, West Europe, Singapore, Germany, UAE, UK
Sandalwood oil	USA, West Europe, Australia, UK

17. a) Whether India, world –known for M&AP is also importing these plants from other countries?

Yes

(b) If so please give details of the M&AP imported during the last 5 years; year-wise, the name of the country from where imported; the monetary value of the import and the purpose of such import?

About 14 medicinal species are imported by India. In the International oil industry, jeranium oil, lavender oil and patchauli oil form the main items of import from countries like China, Japan, France, Italy, Netherlands, Spain, Bulgaria Germany & Australia.

Monetary value of essentail oil imports is Rs. 5630 lakhs

Medicinal Plants imported to India as raw drug material

Sl. No.	Trade Name	Scientific Name	Quantity in Tons	Value in Rs.	Country
1	Liquorice	<i>Glycyrrhiza glabra</i>	363	4436586	Afganistan
			126	190542	Iran
				887929	UAE
2	Belladona	<i>Atropa belladonna</i>	--	230235	German F. Rep.
3	Cubeb (Kankol)	<i>Piper cubeba</i>	184	5504054	Indonesia
			35	1054406	Singapore
4	Sarpagandha	<i>Rauwolfia serpentina</i>	28	514139	Mayanmar
5	Kusth	<i>Sassuria lappa</i>	40	163527	Bhutan
			65	910236	Mayanmar
			89	1586499	Nepal
6	Ginseng	Other Ginseng		81027	Bulgaria
			5	506866	Morocco
			4	91552	Pakistan
			11	119488	Singapore
			4	208953	UAE
7	Chirata	Swertia chirata	272	2282212	Nepal
8	Sariva	<i>Hemidesmus indicus</i>	7	146591	Mayanmar
				27054	Mexico
				6942	Morocco
9	Ayurved & Unani Herbs	-	-	3452	Afganistan
			-	199816	China
			21	265156	Indonesia
			121	946283	Iran
			714	17303260	Nepal
10	Kokum	Garcinia indica	192	12625666	Sri Lanka

(c) What DARE/KAU is doing in minimizing imports of M&AP and maximizing the exports of M&AP during the X plan?

1. Introduction and domestication of exotic medicinal and aromatic plants

We have introduced a number of medicinal plants species from other countries such as *Digitalis lanata*, *D. purpurea*, *Artimisa annua*, *Chamomilla*, *Mentha*, *Pogostemon*, *Salvia*, *Glycyrrhiza glabra*, etc. which are having demand in our country.

2. Increasing area and production of the indigenous plants

We are also trying to fill up the gaps of demand and supply by developing high yielding and improved quality varieties. As a result a number of varieties have been developed.

Kasargod District fully financed by KAU. There are five institutions under KVK pattern and one Central Training Institute under KAU to promote and impart knowledge in medicinal plants among farmers. The KVK Pattambi established a demonstration plot on 25 important cultivable species of medicinal plants in 1997. Important Topics like medicinal plants, and its nursery management were included in the training programmes intended for youth, voluntary organizations, farmers organizations and motivated the farmers. Exclusive training programmes on cultivation of medicinal plants was organised for 42 field level Extension Officers of Department of Agriculture as trainers training programme in 1999. The KVK has a collection of about 200 medicinal plants species and the clients were imparted training by collaborating the Kottakkal Ayurveda Vaidyasala, Kottakkal & Herbal Museum Vellanikkara for skill oriented training programmes.

The details of year-wise training programme and the number of farmers trained under IX Plan are furnished in appendix VI.

Apart from KVKs Information Sales Centre at AMPRS, Odakkali and AICRP on M&AP and Central Nursery undertakes training and extension activities as well as production and distribution of quality planting materials.

(b) What DARE is doing in promoting and propagating the latest knowledge of cultivation of medicinal and aromatic plants in India through their extension services network? Please give details of efforts made; the number of farmers who have shifted to cultivation of M&AP due to intervention of DARE; year-wise, during IX plan; state-wise, etc?

Not applicable

22. Whether there are any allopathic medicines, which are made using medicinal plants? Please give details.

Yes.

The important plant based allopathic medicines are Ajmalicine, Artemisinin, Etoposide, Ginsenosides, Paclitaxel, Tascotere, Silymarcin, Vincristine, Vinblastine, Reserpine, Atropine, Hyoscyamine, Digoxine, Glycyrrhetic acid, Valeporiates, Prednisolone, oestrogen, progestrone, Serpasil, etc. Selected medicinal plant species from which modern drugs are, manufactures are furnished in Appendix VII.

23. (a) Whether the KAU/DARE has realized the optimum revenue potential which can be generated through optimum utilization of M&AP in the country and through exports?

Yes.

(b) If so, the reasons for not achieving the desirable optimum growth level of production, productivity, consumption, processing and export of medicinal and aromatic plants so far?

The various constraints encountered are the following

Lack of improved varieties

Difficulties in the processing of essential oils at the farmer level

Lack of quality standardization at raw material stage.

90% of the raw drugs are still collected from the wild. Only very few (20-30) are cultivated.

This is mainly due to lack of knowledge on cultivation, non availability of quality planting materials and lack of quality standardization.

Farmer cannot compete with the cheaper raw material supply.

Lack of assured market and market intelligence

Trading on the basis of quality of the raw drug is absent and hence no incentive for production of quality raw material.

Many a times harvesting results in destruction of the whole plants in the wild. No measures are taken to replenish the natural resources.

Poor quality standards of finished products due to absence of good laboratory (GLP) and good manufacturing Process (GMP)

Lack of knowledge on post-harvest knowledge of raw materials.

Non-availability of quality planting materials of improved varieties

(c) Whether it is a fact that medicinal and Aromatic plants worth crores of rupees are being smuggled out of country through illegal channels owing to greater demand of Indian Medicinal and Aromatic Plants in other western countries? If so, the remedial measures taken or proposed to be taken or suggested by the KAU/DARE to the Central Government to check this huge revenue loss to the Nation?

Though there is no official records, many items are being taken out of the country due to the high demand in the international market. This includes narcotics, aromatic products like sandalwood, and many items of raw drugs.

Remedial measures suggested are:

Legalizing cultivation and bio production of medicinal species for product development and utilization should be encouraged

Enforcement of forest laws

Educating the public and authorities like customs, police, etc in the proper identification of the items under question

(d) How many Indian Medicinal and Aromatic Plants have been got patented so far? Please give details and whether any revenue has been generated owing to patent rights of these medicinal and aromatic plants? If not, the reasons therefore?

40% of all patents on herb or herbal-based products particularly herbal medicine are with China, closely followed by Japan. India has negligible patents on plant based formulations extracts and products.

Kerala has shown a way of commercial development of patented drugs (Jeevani) from native plant *Trichopus zylanicus* (aryogyappacha) sharing the right of intellectual property with the true bearer of the traditional knowledge, the Kani tribe of Agastymala. This is the first case of IPR Protection from India. Top 10 countries that have filed herbal patents at USPTO from 1996 to 2001 are given in Appendix VIII.

Appendix I

Institutions of Kerala Agricultural Univesriy

Teaching Institutions

- College of Agriculture, Vellayani P.O., Thiruvananthapuram- 695 522
- College of Horticulture, KAU P.O., Thrissur-680 656
- College of Agriculture, Padannakkad P.O Kasaragod - 671 328
- College of Forestry, KAU P.O., Thrissur-680 656
- College of Co-Operation, Banking & Management, KAU. P.O., Thrissur-680 656
- College of Veterinary & Animal Sciences, Mannuthy P.O., Thrissur-680 651
- College of Veterinary& Animal Sciences, Pookode, Wayanad
- College of Fisheries, Panangad, Ernakulam - 682 651
- Kelappaji College of Agri. Engineering & Technology, Tavanur, Malappuram- 679 573
- College of Dairy Science & Technology, Idukki Special Officer. 0487-372861

Research Stations

Northern Zone

- Regional Agricultural Research Station, Pilicode Kasaragod- 670 353
- Pepper Research Station, Panniyur,

High Range Zone

- Regional Agricultural Research Station, Ambalavayal, Wayanad - 673 593
- Cardamom Research Station, Pampadumpara, Idukki -685 556

Central Zone

- Regional Agricultural Research Station, Pattambi, Mele Pattambi P.O., Palakkad-679 306
- Banana Research Station, Kannara Marakkal, Thrissur -680 652
- Agronomic Research Station, Chalakudy, Thrissur- 680 307
- Cashew Research Station, Madakkathara, Thrissur- 680656
- Cashew Research Station , Anakkayam, Malappuram-676 516
- Aromatic & Medl. Plants Res. Station, Odakkali, Asamannoor P.O., Ernakulam- 686 670
- Pineapple Research Station, Vazhakulam, MuvattupuzhaErnakulam -686 670
- Agricultural Rsearch Station, Mannuthy, Thrissur- 680 651
- Plant Propagation & Nursery Management Unit, KAU P.O., Thrissur-680 656

Special Zone of Problem Areas

- Regional Agricultural Research Station, Kumarakom, Kottayam-686 566
- Rice Research Station, Vyttila, Kochi -682 019
- Rice Research Station , Moncompu,Thekkekara P.O., Alappuzha-688 503
- Sugaracane Res.Station, Thiruvalla, Kallungal, Pathanamthitta - 689101
- Agricultural Drainage Scheme, Karumady, Alappuzha -688 564

Onattukara Zone

- Regional Agricultural Research Station , Kayamkulam, Alappuzha - 690 502

Southern Zone

- Regional Agricultural Research Station, Vellayani, TVM- 695 52
- Cropping Systems Research Centre, Karamana, TVM-695 002
- Coconut Research Station, Balaramapuram, TVM - 695 509
- Farming Systems Research Station, Sadananthapuram, Kottarakkara -691 550
- Soil Conservation Research Centre , Konni, Pathanamthitta

Research Stations not covered under NARP set up

- Cattle Infertility Scheme, Vellimadukunnu, Kozhikode- 673 012
- Cattle Breeding Farm, Thumburmuzhi, Chalakudy, Thrissur-680 721
- Livestock Research Station, Thiruvazhamkunnu, Palakkad-678 606
- Poultry & Duck Farm, Mannuthy, Thrissur -680 651
- University Livestock Farm, Mannuthy Mannuthy, Thrissur -680 651
- Centre for Pig Breeding & Research, Mannuthy, Thrissur -680 651
- Fisheries Station, Puduveypu, Kochi- 682 508

Training & Extension Centres

- Communication Centre, Mannuthy, Thrissur-680651
- Central Training Institute, Mannuthy. Thrissur-680651
- Agricultural Technology Information Centre, Mannuthy, Thrissur - 680651
- Krishi Vigyan Kendra (KVK), Sadananthapuram, Kottarakkara-691 550
- KVK, Pattambi ,Mele Pattambi, Palakkad- 679 303
- KVK, Ambalavayal, Wayanad- 673 593
- KVK, Manjeswar, Vorkady P.O., Kasaragod

Appendix II

Major medicinal and aromatic plants grown in selected states in India

KERALA

1. Kacholam
2. Long pepper
3. Holostemma
4. Plumbago
5. Common indigo or Indian indigo
6. Coomb teak, Candahar tree or Kashmiri tree
7. Aloe
8. Kalmegh the Great or Green Chiretta
9. Tinospora
10. Glory lily
11. Gymnema
12. Satavari
13. *Garcinia cambogia* (Gamboge)
14. Ashoka
15. Bael

UTTAR PRADESH

1. Opium poppy
2. Lemongrass
3. Palmarosa
4. Vetiver
5. Javacitronella
6. Mentha
7. Rauwolfia
8. Isabgol
9. Asparagus
10. Matricaria

RAJASTHAN

1. Lemongrass
2. Palmarosa
3. Jwaragrass
4. Vetiver
5. Isabgol
6. Mehandi
7. Aswagandha
8. Assin
9. Trill seed

HARYANA

1. Isabgol
2. Kasuri methi
3. Desi methi
4. Coriander souf
5. Honey plant
6. *Hyoschymus niger*
7. Tulsi
8. Babchi
9. Kalmegh
10. Periwinkle
11. Sarpagandha
12. Ashwagandha

HIMACHAL PRADESH

1. Mukbala / Nihani
2. Dhoop
3. Chukri/ Rewardchini
4. Brahmi
5. Patlahan
6. Tejpatra
7. Kaur / Karn
8. Donghas
9. Guchhie
10. Birch/ Bhojpatra
11. Thuth
12. Bar - Yan / Bajh
13. Bach
14. Kuth
15. Bankari
16. Bhutkesi
17. Dioscorea
18. Chora
19. Neoza
20. Talish Patters
21. Mithi patters
22. Etedra
23. Kakar singi
24. Salam Misri
25. Banafsha

KARNATAKA

Aromatic plants

1. Jasmine
2. Tuberose
3. Chrysanthemum
4. Chempaka
5. Rose
6. Aster
7. Davana
8. Geranium
9. Citronella

Medicinal Plants

1. Periwinkle
2. Setawen
3. Sweet flag
4. Ghorkin
5. Coriander
6. Ginger
7. Turmeric
8. Garlic
9. Tamarind
10. Nilgiri
11. Neem
12. *Solanum viarum*
13. *Ravolfiam Serpentina*
14. *Dioseorea*
15. Aswagandha
16. *Gloriosa Superba*

Appendix III

Agro-climatic Zones of Kerala

No.	Zones	Location
1.	Dry Forest Loam	In and around Chinnar
2.	Semi Dry Red Loam	Isolated pockets in Trivandrum and Neyyattinkara Taluks
3.	Semidry Laterite	Parts of Quilon, Chirayinkil, Trivandrum, Neyyattinkara and Nedumangad taluk
4.	Semi Dry Alluvial	River beds and coastal areas of Quilon, Chirayinkil, Trivandrum, Neyyattinkara, Ottappalam, Thalappilli, Palakkad and Alathur Taluks
5.	Semi Dry Black Soil	Easternmost parts of Cittur and Palakkad Taluks
6.	Semi Dry Forest Loam	Kumili and parts of Peerumedu Taluks
7.	Subhumid Red Loam	Kasaragod and Kannur. Parts of Kasaaragod, Hosdurg and Thalipparampa Taluks
8.	Subhumid Laterite	Parts of Kannur, Tirur, Choughat, Parur, Kasaragod, Hosdurg, Thalipparampa, Tellichery,, Badagara, Thalappilli, Thrissur, Mukundapuram, Alwaye, Kanayannur, Alathur, Chittoor, Ernad, Mannaghat, Palakkad, Kunnathur, Kottarakkara, Pathanapuram, Neyyattinkara and Nedumangad Taluks
9.	Subhumid Alluvium	Coastal areas and riverbeds in the regions under item 8
10.	Subhumid Saline	Pokkali lands in the coastal parts of parur, Kanayannur and Cochin Taluks
11.	Subhumid Forest Loam	Parts of Ernad, Mannaghat, Devikulam and Pathanapuram Taluks
12.	Humid Laterite	Parts of Kasaragod, Thalipparampa, Tellichery, Quilandy, Kozhikkode, Badagara, Kunnathunad, Meenachil, Kanjirappali, Pathanamthitta, Chengannur, Mavelikkara and Nedumangad Taluks
13.	Humid Alluvium	Riverbeds of taluk areas decribed under item 12, western parts of Chengannur and Mavelikkara Taluks, Coastal areas of Shertalai, Ambalapuzha and Karunagappalli taluks
14.	Humid grayish Onattukara	Onattukara- Parts of Mavelikkara, Karunagapalli and Karthikappalli taluks
15.	Humid Saline	Around Vembanad lake (areas with acid saline soils)
16.	Humid Forest Loam	Parts of Ernad, south Wayanad and noth wayanad, Kasaragod, Hosdurg, Thalipparampa taluks; Tellicheri, Pathanamthitta, Pathanapuram, Neyyattinkara, Devikulam and Peerumed Taluks
17.	Per Humid Laterite	Parts of south Wayanad, Quilandy, Ernad, Kunnathunad, Devikulam, Thodupuzha, Kothamangalam, Menachil and Kanjirapalii taluks
18.	Per Humid Forest Loam	A small pocket in and around Vythiri, parts of Devikulam, Thodupuzha and Peerumed Taluks
19.	Wet Laterite	Parts south Wayanad, Ernad, Mukundapuram, Devikulam, Peerumeduand Pathanamthitta Taluks
20.	Wet Forest Loam	Parts of Neriamangalam, Devikulam, Thodupuzha, Kanjirappali, Meenachil and Peerumed Taluks

Appendix IV

Statistics on area and production of medicinal and aromatic plants

Medicinal / Aromatic Plants	Area (ha)	Production (tonnes)	Year	Source
KERALA				
Lemongrass	1601	93	1999-00	Department of Economics and Statistics, Kerala
Kacholam	33			
Tobaco	44	245		
ANDHRA PRADESH				
Geranium, Methol, Lemon grass, Plama Rosa (Aromatic Plants)	1040	20800	1998-99	Commissioner of Horticulture, AP
KARNATAKA				
Aromatic plants				
Jasmine	597.00	1623.00		
Tuberose	27.00	3.00		
Chrysanthemum	112.00	15.00		
Chempaka	32.00	124.00		
Rose	29.00			
Aster	10.00			
Davana	81.07	568.50		
Geranium	2.10	17.20		
Citronella	3.08	60.16		
Total	893.25	2410.86		
Medicinal Plants				
Periwinkle	23.00	2250.00	1998-99	Department of Horticulture, Karnataka
Setawen	10.00			
Sweet flag	8.00	80.00		
Ghorkin	46.00			
Coriander	1337.00			
Ginger				
Turmeric	121.00			
Garlic	831.00			
Tamarind	1015.00			
Nilgiri	6.50	1.00		
Neem	5.50	0.75		
Solanum viarum	1.60	5.20		
Ravolfiam Serpentina	0.50	0.12		
Dioseorea	0.40	0.08		
Asvagandha	0.30	0.10		
Gloriosa Superba	0.10	0.13		
Total	3405.90	2337.37		

Medicinal / Aromatic Plants	Area (ha)	Production (tonnes)	Year	Source
TAMIL NADU				
Senna	17	13	1995-96	Directorate of Horticulture, TN
HARYANA				
Mentha	920	7	1997-98	Directorate of Horticulture, Haryana
Roses	17	35		
Plamarose, Lemongrass, Moochati	15	51		
HIMACHAL PRADESH				
Mukbala / Nihani		211.2	1996-97	Chief Conservator of Forests, Himachal Pradesh
Dhoop		148.5		
Chukri/ Rewardchini		107.9		
Brahmi		82		
Patlahan		81.7		
Tejpatra		44.5		
Kaur / Karn		36.2		
Donghas		33.4		
Guchhie		27.5		
Birch/ Bhojpatra		27.2		
Thuth		19.4		
Bar - Yan / Bajh		19.1		
Bach		12.4		
Kuth		11.5		
Bankari		8.6		
Bhutkesi		6.8		
Dioscorea		6		
Chora		4.8		
Neoza		4.3		
Talish Patters		3.9		
Mithi patters		3.5		
Etedra		1.8		
Kakar singi		1.4		
Salam Misri		0.8		
Banafsha		0.2		
Others		755.9		
Total		1660.5		
RAJASTHAN				
Isabgol	97848	60974	1997-98	Directorate of Horticulture, Rajasthan
Mehandi	18629	15425		
Asvagandha	4760	2310		
Assin	227	40		
Trill seed	3837	19802		
Opium	6115	152		
Total	131416	98703		

(Source: Directorate of Arcanut and Spices Development, Calicut)

The area and distribution of major medicinal plants in India.

Sr. No.	Common Name	Botanical Name	Producing states	Estimated area (ha)
1	Psyllium	Plantago ovata	Rajasthan and Gujarat Mdhya Pradesh	55,000
2	Opium poppy	<i>Papaver somniferum</i>	Madhya Pradesh, Uttar Pradesh and Rajasthan	20,000
3	Senna	<i>Cassia senna</i>	Tamil Nadu, Rajasthan, Gujarat and Uttar Pradesh	20,000
4	Chinchona	<i>Cinchona spp.</i>	Darjeeling (West Bengal) and Tamil Nadu	8,000
5	Ashwagandha	<i>Withania somnifera</i>	Madhya Pradesh, Rajasthan, Gujarat and Uttar Pradesh	5,000
6	Safed musli	<i>Chlorophytum borivilianum</i>	Madhya Pradesh, Gujarat & Uttar Pradesh	5,000
7	Periwinkle	<i>Catharanthus roseus</i>	Andhra Pradesh, Karnataka and Maharashtra	4,000
8	Khasi kateri	<i>Solanum sp.</i>	Maharashtra	4,000
9	Sarpagandha	<i>Rauvolfia serpentina</i>	Madhya Pradesh	2,500
10	Ipecac	<i>Cephaelis ipecacuanha</i>	Darjeeling (West Bengal)	100

(Source: Kumar, S (1997): CIMAP-records)

Appendix V

Major Medicinal and Aromatic plants in different regions of India

REGION	IMPORTANT MEDICINAL AND AROMATIC PLANTS
Western Himalayas	<i>Atropa belladonna, Aconitum spp., Allium spp., Adhatoda zeylanica, Berberis spp., Bunium persicum, Centella asiatica, Colchicum luteum, Dioscorea sp., Ephedra gerardiana, Ferula spp., Gentiana kurroo, Holarrhena antidysentica, Inula racemosa, Mentha spp., Nardostachys jatamansi, Ocimum spp., Orchis latifolia, Picrorhiza kurroa, Rheum spp., Swertia chirata, Salsurea lappa, Thymus serpyllum, Terminalia tomentosa, Valeriana grandiflora, Zingiber spp.</i> <i>Rose, cedar, pine, tuberose, lavender,</i>
Eastern Himalayas	<i>Aconitum spp., Berberis spp., Chlorophytum arundinaceum, Cinnamomum spp., Coptis teetha, Curcuma spp., Dioscorea spp., Gentiana Kurroa, Mentha, Nardostachys jatamansi, Podophyllum hexandrum, Piper spp., Rheum spp., Rauvolfia serpentina, Swertia chirata, Taxus baccata</i> <i>Citronella,</i>
North Eastern Region	<i>Aristolochia bracteolata, Alpinia galanga, Aquilaria agallocha, Coptis teetha, Curcuma spp., Cymbopogon spp., Centella sciatica, Clerodendron spp., Dioscorea spp., Hydrocarpus kurzil, Mucuna pruriens, Mucuna nigricans, Piper spp., Rauvolfia serpentina, Smilax chinensis and Solanum sp.</i> <i>Citronella, lemongrass</i>
Gangetic Plains	<i>Aegle marmelos, Cassia fistula, Crataeva nurvala, Curcuma spp., Dioscorea spp., Pluchea lanceolata, Psoralea corylifolia, Phyllanthus fraternus, Sida spp., Tinospora cordifolia, Terminalia spp., Vetiveria zizanoides and Zizyphus spp.</i> <i>Palmarosa</i>
Semi Arid Region	<i>Aloe barbadensis, Balanites aegyptiaca, Boswellia serrata, Calotropis procera, Citrullus colocynthis, Commiphora wightii, Diospyros melanoxylon, Tribulus terrestris, and Withania somnifera.</i> <i>Lemongrass, palmarosa, geranium, eucalyptus</i>
Western Ghats	<i>Amomum aromaticum, Curcuma spp., Chlorophytum sp., Cinnamomum tamala, Elettaria cardamomum, Piper nigrum, P. longum, P. betel, Strychnos nuxvomica, Terminalia spp., Zingier spp.</i> <i>Lemongraa, cinnamon, vetiver, sandalwood, eucalyptus</i>
Eastern Ghats	<i>Latonia scholaris, Azadirachta indica, Boswellia serrata, Curcuma spp., Cassia fistula, Curculigo orchioides, Celastrus paniculatus, Clerodendron serratum, Diospyros spp., Dioscorea spp., Grewia spp., Hemidesmus indicus, Laptadenia reticulata, Phyllanthus amara, Plumbago zeylanicum, Pterocarpus marsupium, Santalum album, Terminalia sp.</i> <i>Eucalyptus, lemongrass, palmarosa</i>
Andaman Nicobar Islands	<i>Terminalia bilata, Pandanus fascicularis, P. learus, Aglaia argentea, Alstonia macrophylla, A. Kurzii, Amomum fenziel, Ardisia solanaceae and other Ardisia spp., Costus speciosus, Dischidia bengalensis, Myristica elliptica, Phyllanthus gomphocarpus, Uncaria ferrea.</i> <i>Lemongrass</i>

Appendix VI

Financial and physical targets under NRC M&AP and AICRP M&AP, respectively, during the IX five year plan

Statement showing ixth plan outlay and year wise expenditure of NRCMAP

Head	IX Plan outlay	Actuals				Allocation
		1997-98	1998-99	1999-00	2000-2001	2001-2002
1. Pay & Allowances	126.15	3.12	14.99	20.00	22.51	27.00
2. T.A.	9.87	0.77	1.99	3.10	3.70	4.50
3. Recurring Contingency	69.98	7.16	14.73	7.82	10.93	13.48
4. H.R.D	20.00	----	----	----	---	---
Total	226.00	11.05	31.71	30.92	37.14	44.98
5. Non-Recurring contingency						
a) Works	265.00	23.45	----	91.35	67.00	156.23
b) Equipment	93.00	1.00	11.47	34.46	25.55	20.52
c) Vehicle	4.00	----	----	----	--	4.00
d) Land	----	----	----	----	--	--
e) Library books	12.00	1.37	6.72	0.27	0.28	0.50
f) Others	----	----	----	----	--	--
Total	374.00	25.82	18.19	126.08	92.83	181.25
Grand Total	600.00	36.87	49.90	157.00	129.97	226.23

Statement showing sixth plan outlay and year wise expenditure of AICRP on medicinal and aromatic plants (ICAR share released during the ix plan : 75%)

(Rupees in Laksh)

Centre	1997-98	1998-99	1999-2000	2000-2001	2001-2002
Akola	0.000	1.507	4.425	6.713	8.213
Anand	8.000	6.460	9.4875	14.540	13.290
Faizabad	3.800	9.560	8.8125	15.480	11.790
Hisar	4.330	7.440	7.515	10.440	10.815
Indore	10.060	11.3625	10.745	18.290	13.290
Mandsaur	8.580	10.6875	10.3125	5.895	6.477
Solan	8.690	13.9455	11.4375	14.790	11.865
Trichur	5.490	7.762	7.7025	16.362	11.645
Udaipur	8.650	10.3125	9.562.5	20.490	12.615
Total	57.60	79.0370	80.000	123.000	100.00

Appendix VII
Training programmes conducted by the KVKs attached To KAU

Sl. No	Year	Name of Institution	Name of the training	Duration of the training	Date of the training	No. of farmers trained	No. of farmers practising	Re-marks
1	1996	Central Training Institute, Mannuthy	Training in Medicinal Plants	1 day	25-1-1996	26	Nil	
2	2001	Central Training Institute, Mannuthy	Training on Herbal Nursery Techniques	3 days	17-5-2001 to 19-5-2001	17	Nil	
3	2001	Central Training Institute, Mannuthy	Training on Herbal Nursery Techniques	3 days	28-5-2001 to 30-5-2001	7	7	
4	2001	Central Training Institute, Mannuthy	Training on Herbal Nursery Techniques	3 days	21-6-2001 to 23-6-2001	11	Nil	
5	2001	Central Training Institute, Mannuthy	Training on Herbal Nursery Techniques	3 days	28-6-2001 to 30-6-2001	10	Nil	
6	2001	KVK Manjeswar	Identification, uses and propagation of Medicinal Plants	1 day	25-1-2001 and 27-1-2001	47	4	
7	2001-02	KVK Kumarakom	Plan to conduct training on Medicinal Plants in the current year.					
8	2000	KVK Ambalavayal	Propagation techniques for spices and Medicinal Plants	2 days	7-12-1999 to 8-12-1999	12	12	
		1 day		22-3-2000	15			
		3 days		2-11-2000 to 4-11-2000	13			
		3 days		7-3-2001 to 9-3-2001	12			
					52			

Appendix VIII
Selected medicinal plants species from which modern drugs are
manufactured

1. <i>Acorus calamus</i>	15. <i>Digitalis lanata</i> *	29. <i>Podophyllum emodi</i>
2. <i>Artemisia annua</i> *	16. <i>D. purpurea</i> *	30. <i>Rauvolfia serpentina</i>
3. <i>Asparagus officinalis</i>	17. <i>Dioscorea deltoidea</i>	31. <i>Secale cereale</i> (ergot)
4. <i>Atropa belladonna</i>	18. <i>D. floribunda</i> *	32. <i>Solanum khasianum</i>
5. <i>Cassia angustifolia</i> *	19. <i>Glycyrrhiza glabra</i> *	33. <i>S. lanciniatum</i>
6. <i>Catharanthus roseus</i>	20. <i>Humulus lupulus</i> *	34. <i>S. viarum</i>
7. <i>Cephaelis specauha</i>	21. <i>Mucuna pruriens</i>	35. <i>S. xanthocarpum</i>
8. <i>Crysanthemum cinerareifolium</i> *	22. <i>Duboisia myoporoides</i> *	36. <i>Trigonella foenum-greacum</i>
9. <i>Cinchona officinalis</i>	23. <i>Hyoscyamus muticus</i> *	37. <i>Taxus baccata</i>
10. <i>Coleus forskohlii</i>	24. <i>H. niger</i>	38. <i>Swertia chirata</i>
11. <i>Commiphora mukul</i>	25. <i>Panax pseudo-ginseng</i>	39. <i>Valeriana wallichii</i>
12. <i>Costus speciosus</i>	26. <i>Papave somniferum</i> *	40. <i>Withania somnifera</i>
13. <i>Datura metel</i>	27. <i>Picorrhiza kurroa</i>	
14. <i>D. stramonium</i>	28. <i>Plantago ovata</i>	

* Exotic (Introductions)

Appendix IX
Top ten countries that have filed herbal patents At uspto from 1996-2001

Sr. No.	Country	No. of patents filed
1	United States	134
2	Canada	66
3	Great Britain	25
4	China	23
5	India	18
6	Israel	15
7	Japan	13
8	MD	12
9	Australia	9
10	Columbia	9
11	Others	92
	Total	416

Source : Gupta, 2001, IIM, Ahmedabad