OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

RESTRICTED

16813

DP/ID/SER.B/607
25 April 1988
ENGLISH

PROCESSING OF MEDICINAL PLANTS CULTIVATED AND COLLECTED IN NEPAL

DP/NEP/80/044

NEPAL

Terminal report*

Prepared for the government of Nepal
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of Mr. Klaus A. Duerbeck,
associate expert on processing of medicinal plants

Backstopping Officer: R.O.B. Wijesekera,
Chemical Industries Branch

United Nations Industrial Development Organization

Vienna

---

* This report has been reproduced without formal editing.

V.88-24224

Table of Contents

I. Summary

My assignment started January 16, 1987 and will end on January 13, 1988 with my debriefing in Vienna, UNIDO Headquarters.

The main purpose of the assignment was to assist in increased production of raw material from medicinal and aromatic plants for the processing from cultivated sources.

For the final year of the project DP/NEP/80/044 "Processing of Medicinal Plants Cultivated and Collected in Nepal" the duties had been according to the job description TF/NEP/85/001/11-01/32.1.D., specified by the CTA on January 3, 1987.

Between January and July 1982, I focussed my activities on the main areas of cultivation, the HPPCL-farm in Tamagadhi - for aromtaic plants only - and in collaboration with private farmers in Kavre-District with its centre in Khopasi (A. belladonna).

On July 20, 1987 I began the execution of field work and related studies for the feasibility study "Prospects of Extension for Agroforestry and Cultivation of Indigenous and Exotic Medicinal and Aromatic Plants" to raise income for rural people . This study was completed until the December 20, 1987 and is included herein.

It was thus been possible from my assignment to highlight some problems in production and processing, to recommend measures to overcome these problems and to identify areas where future development of extension for production and processing and species would be most feasible.

II. Introduction

Objectives

The propagation, harvesting and preparation for processing of medicinal and aromatic plants cultivated in Tamagadhi Herbal Farm and extension.

Evaluation of the costs of acquisition of herbal raw material for processing from cultivated and the spontaneous flora.

Generally assist the CTA and other experts with the work of the project in the processing, quality control, formulation of new products and monitoring activities.

Terms of reference

- Main job would be to assist in increased production of raw material for processing from cultivated sources.
- Look after extension work of belladonna and other species of aromatic and medicinal plants for processing.
- To improve the level of knowledge within the country for the establishment of ecological and economic plant profiles, and appropriate technology for farming and primary processing.
- Assist in introduction and trial cultivation of exotic and local species of promising aromatic and medicinal plants for eventual large scale cultivation and processing.
- Evaluation of cost of production for cultivated materials both in the farm and under extension.
- To undertake field-trips in Nepal with the view to:
  a) Assess availability of aromatic and medicinal plant material from natural sources for eventual processing in Herbs Production and Processing Company Limited.
  b) Look into the possibility of cultivation of medicinal and aromatic plants in different parts of Nepal through farmers and panchayats. Gather data on meteorological and soil conditions etc. for the selection of plant species suitable to the area.

c) Recommend suitable locations for establishing purchase centres.

III. Main Recommendations

- Inter-cropping and agro-forestry have a good scope in the remaining forest at Tamagadhi Herbal Farm.
- Assignment of an agriculturist and Junior Technician and/or Junior Technical Assistants to take care of seed procurement, soil reclamation and proper management and timing of a coordinated schedule for agriculture and processing.
- The introduction of drying chambers at the farm level is suggested to assure the quality of the herbal raw material.
- The introduction of medicinal plants at Tamagadhi is proposed.
- The selection of a area suitable for A. belladonna is recommended.
- To achieve representative results from the trial plots, a substancial renewal of the soil conditions in the HPPCL-compound in Koteswore is advised.
- Further collection of the production data of the crops is necessary to provide a more comprehensive basis for cost-benefit-analysis.
- With priority the Annapurna -, the Dhading - and the Jiri-Sallery areas are proposed for future extension centres.
- The economic surveys shall be completed.

IV. Body of the Report

Activities and Output

Tamagadhi Herbal Farm - The account of the actual situation, the problems and lines of development for the solutions had been prepared in my Status Report I on Tamagadhi Farm in March 1987.

Since that date my possibilities to assist in increased production of raw material for processing from cultivated sources had to compete with strong limitations and constraints.

The progress in Tamagadhi Herbal Farm due to my assistance:

1. Introduction of representative soil sampling in Tamagadhi Farm.

2. Recommendations for the Tamagadhi Agriculture on the basis of the results received from Department of Soil Science, Khumaltar.

3. Recommendations for the Tamagadhi Agriculture on the basis of climatological records introduced for the first time to the farm management.

4. Preparation of know-how for an economical procedure for the uprooting of Vetivera zizanoides and uprooting of 7 ha. with equipment already available at Tamagadhi Herbal Farm.

5. Assistance for the improvement of maintainance of the farm machinery through repairing of tractors, raising awareness for the importance of spareparts availability and procurement, building of one shade for most important farming machinery.

6. Installation of the Sprinkler Irrigation System (FAO).

7. Installation of a field distillation unit for outgrowers.

8. Extension with outgrowers in the vincinity of Tamagadhi on approx. 35 ha of palmarosa and mentha.

9. Lay-out for the new farm-design and the establishment of the new farm design.

10. Preparation of a report, "Production and Utilization of Plant Derivatives Preparations in Plant Protection and Post Harvest Procurement" (March 1987).

11. Recommendations for the Tamagadhi agriculture on the basis of this report on local available natural pesticides in coordination with farm incharge.

12. Establishment of trials with lime application in palmarosa 1 T/ha.

13. Establishment of composting in Tamagadhi. It is now going on simultaneously with the distillation activities at the farm, training of selected labours.

14. Establishment of mulching in Tamagadhi in mentha and citronella.

15. Establishment of a nursery for afforestation and agro-forestry to feed the fuelwood demand of the distillation unit in future with the assistance of the CTA, Dr. Wunder (FAO) and extensionists of the Terai Forestry Project, Hetauda (UTE/NEP/038/NEP).

16. Establishment of nurseries for seed multiplication of crops for greenmanuring, intercropping and weedcontrol.

17. Trials with bullock drawn implements (Agricultural Tools Factory Birgunj) for weeding (dis-harrow and cultivator) resulting the recommendation of the cultivator as appropriate for the Tamagadhi agriculture.

18. Recommendations for the more efficient and economic use of the available equipment through proper timing and management.

19. Design for a drying unit.

Atropa belladonna Extension - The progress in Atropa belladonna cultivation in Kavre District due to my assistance:

1. Collection of representative soil samples in the area of cultivation.

2. Recommendations for the belladonna farmers on the basis of the soil-datas and climatological records applicable to their fields.

3. Agro-forestry with A. belladonna.

4. Collection of information of already in Nepal available designs of drying chambers appropriate for the farmer level.

5. Construction of a pilot drying chamber on the basis of local available technology.

6. Trials with two units in the compound of HPPCL and recommendation of one design appropriate for implementation in field.

7. Analysis of Shivapuri - Tanavir and Koteswore conditions for the feasibility of A. belladonna cultivation.

8. Report on the Atropa belladonna stressing appropriate cultivation practices and economic aspects.

Trials in HPPCL-Compound, Koteswore, Kathmandu - The trials with medicinal and aromatic plants in the compound of HPPCL in Koteswore is going on.

We face the following limitations and constraints:

1. Due to the lack of suitable soil conditions, the introduction and trial cultivation of exotic species of promising medicinal and aromatic plants for large scale cultivation and processing is without value for the practice of field cultivation.

2. There is no programme for the introduction of local species of promising aromatic and medicinal plants in trial cultivation in HPPCL-Compound.

3. No compositing is done with the organic waste from the factory.

4. No application of lime to level up the low pH.

Evaluation of Cost of Production - The evaluation of costs of production of A. belladonna is shown in the report.

For the other crops in Tamagadhi and the extension the cost data are available as a result of work by Cost-Benefit Analyst of the Project and by the Accounts Section of HPPCL. For calculating such data on other newly introduced crops, it can be taken up later on after more study is done.

Feasibility Study - Prospects of extension for agro-forestry and cultivation of indigenous and exotic medicinal and aromatic plants to raise income for rural people.

1. Collection of basic data of concerning plants and areas on July 20, 1987 this duty had been assigned to me by the CTA, Dr. Baldev Gulati in consultation with the NPD, Dr. Sheak.

   A bibliography of the collected basic data of the concerning plants and areas for fieldtrips is added as an annex.

2. Selection of plants and locations.

   The selection of 20 plants to be the subject of the surveys was based on the following data and criteria:

   a) Proposals of the CTA, Dr. B. Gulati and NPD, Dr. A. Sheak.

   b) Suggestions from the Herbal Farm Center, Department of Medicinal Plants.

   c) Suggestions from the HPPCL - Extension and Sales Units.

   d) Market prices of HPPCL-products.

   e) Market studies of concerning international agencies.

   The available data had been compiled for a preliminary ecoprofil of each of these plants in collaboration with the HPPCL-extension unit.

   My selection of areas for field-trips was based on the following criteria:

   a) Ecological maps of Nepal, Department of Medicinal Plants.

   b) Suggestions from the fieldsurvey-workers from the Department of Medicinal Plants.

c) Climatological records.

d) Available soil records in the Soil Survey Department Khumaltar and FRP, Babar Mahal, Kathmandu

e) Land Utilization Report.

f) Report on feasibility of purchasing herbs, HPPCL purchasing unit.

I have carried out the following field trips together with my national counterpart, Mr. V.R. Duwadi, HPPCL.

a) Jumla and Dang-Deokhuri Districts.

b) Manang, Mustang and Kaski Districts.

c) Dhading, Rasuwa and Nuwakot Districts.

d) Dolakha, Ramechhap, Solukhumbu Districts.

e) Morang, Dhankuta, Jhapa and Ilam Districts.

A map showing the route of the different trips is added as an annex.

3. Assess availability of aromatic and medicinal plant raw material from natural sources for processing.

The assessment of the availability of medicinal and aromatic plant material from natural sources for processing has been reported in separate working papers to CTA and NPC.

4. Look into the availability of energy sources for processing directly at the production site. Due to the scarcity of firewood in the local markets and the restrictions imposed by forest authorities the availability of firewood as basic energy source for field-processing units at the spot is nil today.

Though we took a look into possibilities of electroenergy supply from local and regional hydropower stations.

In every area we evaluated sources of hydroenergy ready for the supply:

Jumla	200 KW.
Dang-Deokhuri	Connection with the East-West-Tension-Line.
Chame	40 KW.
Humde-Manang	85 KW.
Jomsom	260 KW.
Dhading	Connection to Trishuli and Marsyangdi
Jiri	50 KW from Barabaise.
Solusallery	200 KW. with 200 KW spare, if required.
Ilam	260 KW.

Except for Dhading,which is easily approachable for the supply of HPPCL central factory in Koteswore, we have discovered in these areas workable sources for future processing at the spot.

5. Look into possibility of agroforestry and cultivation of exotic and indigenous medicinal and aromatic plants through farmers panchayats, technical schools, development projects and forest authorities.

The response of farmers and institutions to our discussion concerning agroforestry and cultivation had been always positive and subject to serious discussions.

Regularly we had beentaught,that herbal production has not to compete with the production of food in these areas.

This fact matches with one of our basic principles,that the production of raw material for the processing of medicinal and aromatic plants shall not displace the production of nutriments for the rural people.

The list of institutions and farmers visited during our field trips is added as an annex.

6. Soil-sampling activities - On the basis of the results from soil samples taken at localities with natural occurance of important indigenous medicinal and aromatic plants we are now in a position to compile ecological plant profiles of many indigenous herbs.

   A description of the soil sampling localities and the results are given as an annex.

7. Evaluate ecological plant profiles of endangered indigenous - medicinal and aromatic plants with high potential for production taking these plants into cultivation.

   For the ten most important indigenous herbs ecological plant profiles had been evaluated on the basis of the available datas and the results of the soil samples taken during our fieldtrips.

	Texture	pH	OM%	N	P	K
Malagiri	L	6.9	5.0	v.H	v.H	v.H
Zanthoxyllum	L	5.0	7.9	v.H	M	H
Swertia chirata	sL	5.5	15.4	v.H	v.H	v.H
Valeriana	sL	5.5	5.3	v.H	H	M
Rh. anthopogon		4.6	9.0	v.H	M	v.H
Nardostachys	sL	7.4	13.8	v.H	H	v.H
Leucopodium		5.2	6.7	v.H	L	v.H
Rheum emodi	sL	6.4	12.3	v.H	M	v.H
Picrorhiza	sL	6.6	12.9	v.H	M	H
Acorus calamus	silty clay loam	5.4	2.6	v.H	L	v.H

8. Selection of plant species suitable for cultivation and agroforestry in the different areas visited:

	Jumla	Dang	Annapurna	Dhading	Sallery	Illam
Malagiri		X			X	
Zanthoxyllum	X	X	X	X	X	
Orchis incarnata	X		X		X	
Swertia chirata				X	X	X
Rheum emodi			X	X	X	
Leucopodium				X	X	X
Nardostachys	X		X	X	X	
Valeriana			X		X	
Gaultheria				X	X	
Picrorhiza	X		X	X	X	
Acorus calemus (Jiri)	X				X	X
Podophyllum			X		X	
Cinchona						X
Dioscorea			X		X	X
Rh. anthopogon				X	X	
Aconitum	X		X		X	X
Verbascum	X		X			
Iris	X		X			
Tussilago	X		X			
Secale sereale	X		X		X	
Thymus	X		X			
Origanum	X		X			

9. Special findings -

The Jumla District

This area and the districts further north are characterised by low rainfall.

A very different flora occurs under this special conditions.

Iris, Carum arvi, Verbascum thapsus, Thymus and Oreganum, Plantago and Equisetum occur abundantly. European plants like Matricaria chamomilla and Salvia sclarea can be grown. Even Angelica and Crocus sativus have a good scope.

Although this area is very remote in Nepal it has to be taken in consideration for future activities.

Only in the Jumla-area economic mapping had been done (Bojor, 1984).

Malagiri

New locations with natural occurance of Malagiri had been recorded for the first time near Solusallery.

The plant samples had been identified by HPPCL botanists.

10. Special characteristics of the different areas -

Annapurna area

In this area all the contrasts in rainfall pattern, vegetation and geology concur.

In the Manang and Mustang Districts, the pH is around neutral and alkaline, the rainfall is less. The glaciers release a steady flow of water, which is a natural irrigation scheme for this low rainfall-area.

This situation is very much suitable for plants like Picrorhiza, Podophyllum, Nardostachys, Verbascum, Iris, Thymus and Origanum, Tussilago and Rheum or Plantago and Zanthoxyllum. This climate and the soils on the backside of the Annapurna range are suited for exotic plants like A.belladonna, Salvia sclarea and Secale cereale.

The Annapurna front side between Ghorepani and Ganpokhara is ideal for cultivation and agroforestry with plants like Aconite, Valeriana, Orchis incarnata or Tagetes glandulifera and Dioscorea.

This statement is strengthened through results of our soilsampling and the climatological records.

The availability of three airports around the Annapurna together with road connections to Pokhara and Besisahar make it easily approachable.

Sallery area

This area has to be seen in the context with the Jiri-area. As a whole area it is quite similar to the Annapurna side (elevation, roads, airports, variation in the soil-pH and huge forest areas). The variation of the climate exclude the dry component of the Manang and Mustang Districts and the soils are not alkaline. Together with its location more south it all provides on environment for quite a different type of flora.

With cultivation sides in the Annapurna and the Sallery-Jiri-area HPPCL will be in a situation to get an assured raw material supply for all the important items.

The hydropower station in Sallery is looking for new customers for their 200 KW. This can be a cheap source of hydroenergy for a future processing center near Phaphlu-airport.

The Jiri Technical School with its agritrade is very much ready to take ce for this herbal plants in their curriculum and especially in a training programme for scientific wild collection, cultivation, agroforestry and processing.

Students of this school can be trained to work as JTs or JTAs in the field of cultivation and processing of medicinal and aromatic plants in Nepal.

V. Recommendations

Considering the tasks for my field-trips I propose three areas with priority:

1. The Annapurna area with the main centre near Humde-airport in the Manang-District.
2. The Dhading area for the direct supply to HPPCL-factory in Koteswore.
3. The Solusallery-Jiri area with the main centres in Jiri and near Phaphlu airport.

Reasons for recommending priority to be given to these areas include:

Meteorological and soil data of the concerning areas are now available.

The selection of plant species suitable for cultivation and agroforestry in these areas is subject of this report. Accounts of the availability of medicinal and aromatic plants have been provided.

An economic survey for these plants has to be conducted in a future programme.

Ecological profiles of a number of indigenous medicinal and aromatic plants have been prepared.

The infrastructure (sufficient hydropower, airports, natural resources with a wide ecological range in walking distance) for setting up processing centres in Humde, Sallery and/or Jiri is already available. For the cultivation and agroforestry in these areas farmers, panchayats and forest authorities are very much interested for collaboration and extension serivce.

Out of 20 indigenous medicinal and aromatic plants taken into selection for extension, the following five plants are suggested to start with:

	in Annapurna area	Dhading area	Sallery-Jiri
Leucopodium clavatum (powder)		X	X
Nardostachys Jatamansi (Essential oil)	X	X	X
Rheum emodi (extract)	X	X	X
Swertia chirata (extract)		X	X
Zanthoxyllum armatum (Ess. oil)	X	X	

We have registered different herbal plants on our fieldtrips, which have a good market in Europe, but they are not in popular use in Nepal.

Some of these plants shall be taken in consideration for future development.

The crucial point for all this kind of development is to make suitable land available for seed and seedling production. As the HPPCL-compound in Koteswore can not serve for this very important part of development, the specialisation for seed and seedling production can enlarge the connection to forestry institutions, private nurseries and/or the tissue culture laboratory at Godawari Botanical Garden.

The variation of the content of the active principles with the change in growing conditions needs acurate study and mapping.

VI. Conclusions

The famous indigenous medicinal and aromatic plants in the flora of Nepal shall get the axis of HPPCL cultivation, processing and sales. HPPCL shall give more emphasis for sales of their semi-processed and processed products.

To assure the future raw material supply more assignments for agriculturists and junior agricultural staff will strengthen the HPPCL production unit.

There are quite some new areas available with promising prospects for both indigenous and exotic plants cultivation and processing.

Tamagadhi:

- The potential of the cultivated crops can be used in a successful way to achieve the maximum output.
- There are a few management problems with less than 100 ha under cultivation (Total area 350 ha.).
- Inter-cropping has to be implemented in the remaining forest area.
- The improvement and the increase of the output per hectare should be first ranked compared with the expansion of the cultivation-area due to clearing of the remaining forest.
- For the success of Tamagadhi Herbal Farm the assignment of an agriculturist - supported by JTs - is suggested.
- Emphasis should be given on seed procurement, seed storage an soil reclamation.

VIII. List of Abbreviations

HMG	His Majesty's Government of Nepal
UNIDO	United Nations Industrial Development Organisation
FAO	Food and Agricultural Organisation of the United Nations
HPPCL	Herbs Production and Processing Company Limited
JT	Junior Technician
JTA	Junior Technical Assistant
ADO	Agriculture District Officer
CTA	Chief Technical Adviser
NPD	National Project Director
CDO	Chief District Officer
DFO	District Forest Officer
DFC	District Forest Contoller
FRP	Forest Research Project

IX. List of Reports

Duerbeck, K.A.
Production and Utilization of Plant-derivatives Preparations in Plant protection and post harvest procurement, Kathmandu, March 1987.

Duerbeck, K.A.
Status Report I on Tamagadhi Herbal Farm, Kathmandu, 1987.

Duerbeck, K.A.
Status Report II on Atropa belladonna Cultivation, Kathmandu, Kathmandu, October 1987.

Annex. I.

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

PROJECT IN THE KINGDOM OF NEPAL INTERNAL

JOB DESCRIPTION
TF/NEP/85/001/11-01/32.1.D

Post title Associate Expert in Medicinal Plants

Duration One year with possibility of extension

Date required 1986

Duty station Kathmandu

Purpose of project To enable His Majesty's Government (through the Herbs Production and Processing Company) to acquire processing technology for the production of plant-derived pharmaceuticals.

Duties

In the field the Associate Expert will work under the overall supervision of the UNIDO Chief Technical Adviser and/or any other UNIDO expert deputed by the Chief Technical Adviser to supervise his work.

The expert's main areas of duty will be as follows:

(a) The propagation, harvesting and preparation for processing of medicinal plants cultivated/ growing in herbal farms.

(b) Evaluation of the costs of acquisition of herbal raw material for processing both from the cultivated and the spontaneous flora.

(c) Generally assist the CTA and other experts with the work of the project in the processing, quality control and formulation of products and monitoring of activities.

The Associate Expert will also compile any special reports requested for by the UNIDO Special Technical Adviser at Headquarters. He will also be required to prepare a final report setting out his own observations during the mission, the progress made in the activities assigned to him and his own recommendations.

Qualifications: Graduate in a subject related to Botany, Chemistry or Agriculture with post-graduate experience in research on some aspect of medicinal plants viz. the production and quality control of plant-based pharmaceuticals.

Work experience in developing countries an added qualification.

Language: English

Background information:

The country has a population of approximately 12 million with an annual growth rate of 2.4%. Over 90% of the populace live in rural areas and over 60% of them in the mountain zones. Most of the rural folk utilise plant-preparations for their therapeutic requirements and the traditional system of medicine is very similar, and related to the Ayurvedic system prevalent in the Indian Sub-Continent. The wealth of medicinal plants can be considered as one of the country's most important natural resources. The country lies in the Central Sector of the great Himalayas and occupies one third of their total length. The diversity of physiography due to altitudinal and climatic variations has produced a great variety of species of plants within the flora of this small country (area - 145,305 sq.km.). Much of this flora is used in medicine and the Royal Drugs Research Laboratory (RDRL) is responsible for the R and D efforts leading to the production of pharmaceuticals based on the traditional remedies. The RDRL has been assisted by UNDIO-UNDP for the past two years to enhance its capabilities as R and D institution, and to provide technical assistance to the Herb Production and Processing Company. The Herb Production and Processing Company is charged with commercializing the technology generated by producing economically useful and export oriented products . The HPPC is the local executing agency for the present project. It is also the recipient of FAO assistance in developing capabilities for the large-scale cultivation of medicinal plants.

A suitably integrated institutional framework already exists in the country for the systematic cultivation, research and development and processing of plant-derived products. The present projects are designed to develop this capability further in order to enhance the Government's health-care programme.

Annex. II.

Bibliography

Malla, K.B.
Natural Resources of Marsyangdi Watershed Study Area
National Remote Sensing Centre
Kathmandu 1982.

Climatological Records of Nepal
Department of Irrigation, Hydrology and Meteorology
Volume I and II, Kathmandu 1986.

Dobremez, I.F. et al.
Ecological Maps of Nepal
University Grenoble, France.

Malla, S.B. and Shakya, P.R.
Vegetation and Medicinal Plants of Nepal
Department of Medicinal Plants, Kathmandu, 1968.

Malla, S.B.
Medicinal Plants of Nepal
F.A.O., Rome, 1982.

Malla. S.B. et al.
Medicinal Plants of Nepal
Department of Medicinal Plants, Kathmandu, 1970, 1984 (Supplement).

Majupuria, T.C.
Nepal Nature's Paradise
Kathmandu, 1985.

National Council for Science and Technology
Nepal - Atals of Economic Development
Kathmandu, 1980.

DON, D.
Prodomus Florae Nepalensis
London, 1885.

Atkinson, E.T.
Economic Botany of the Himalayan Regions
New Delhi, Reprint 1986.

Manandhar, N.P.
Medicinal Plants of Nepali Himalaya
Kathmandu, 1980.

Bhatt, D.D.
Natural History and Economic Botany of Nepal
New Delhi, 1977.

National Planning Commission Secretariate
Statistical Yearbook of Nepal 1987
Kathmandu, 1987.

Hagen, T.
Nepal
New Delhi, 1980.

Bojor, O.
Economic Mapping of Spantaneous Flora (Medicinal & Aromatic Plants) in Nepal
UNIDO, Vienna, 1984.

Tetenyi, P.
Availability, Cultivation, Introduction, Processing and Marketing of Medicinal and Aromatic Plants in Nepal
F.A.O., Rome 1985.

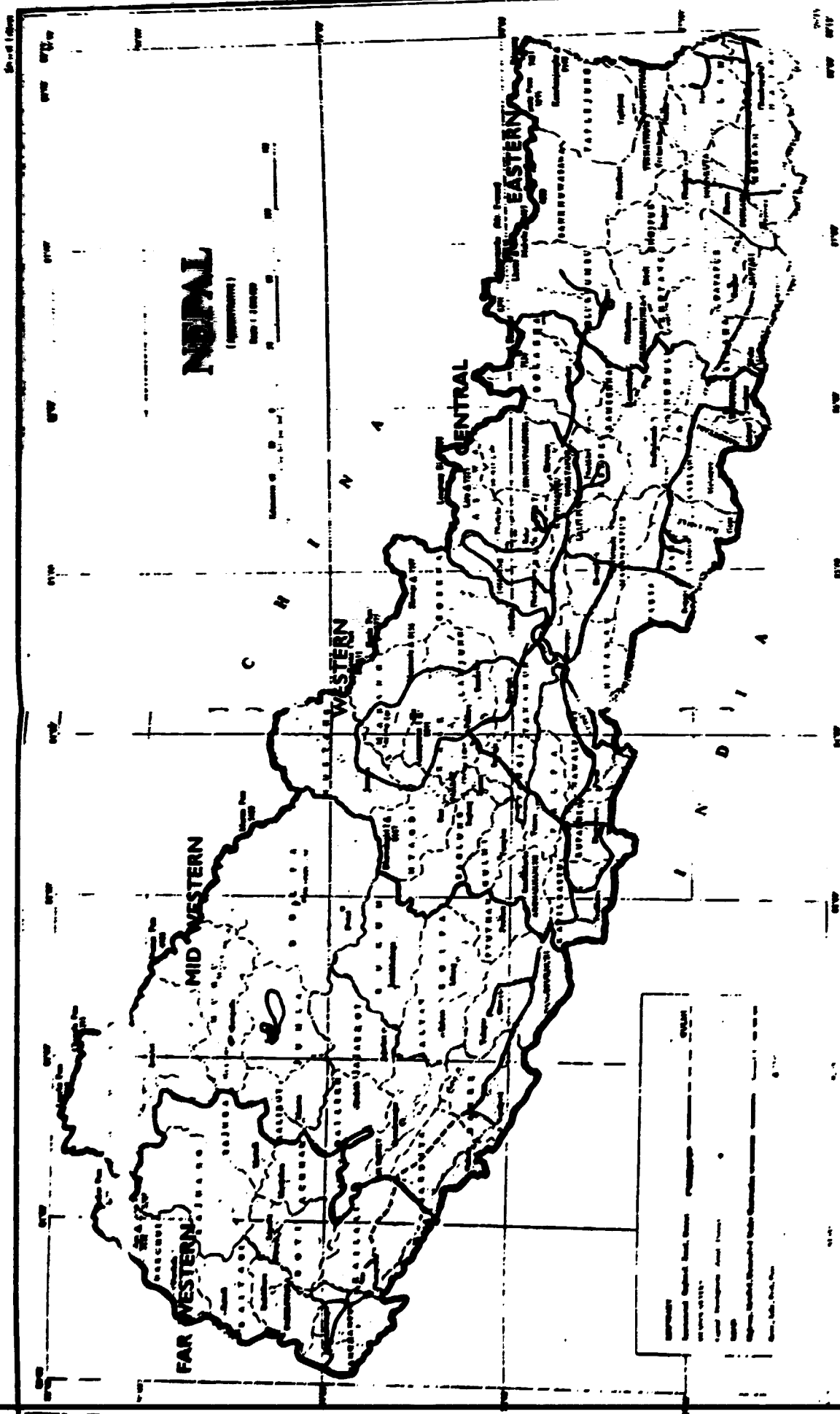
De Boeck, W.J.
Analysis of Cultivation Costs and Market Trends
UNIDO, Vienna, 1986.

Shrestha, T.B.
Ecology and Vegetation of North-West Nepal
Royal Nepal Academy, Kathmandu, 1982.

Burbage, M.B.
The Medicinal Plant Trade in the KARDEP-area
Tropical Products Institute, London, 1981.

Biswas, K. And Chopra, R.N.
Common Medicinal Plants of Darjeeling and the Sikkim Himalayas
New Delhi, Reprint, 1982.

Annex. III.


NEPAL
EASTERN
CENTRAL
WESTERN
MID WESTERN
FAR WESTERN
INDIA

List of Persons Contacted

Department of Medicinal Plants, Thapathali, Kathmandu

Malla, S.B., Director General
Rajbhandary, S.B., Deputy Director General
Shrestha, T.B., Scientific Officer
Manandhar, N.P., Scientific Officer
Joshi, D., Scientific Officer
Shakya, P.R., Scientific Officer
Bista, M.S., Chief Herbal Farms
Daman, Tistung, Vrindavan, Nepalgunj, Tarahara State Herbal Farms
Botanical Garden, Herbarium, Tissue Culture Lab. Godawari.

Other HMG-Institutions

Singh, K.M., Agriculture Development Bank Nepal (ADB/N)
Shrestha, R., Community Forestry
APPROSC, Kathmandu
Sagarnath Afforestation Project
IAAS, Rampur, Chitwan
National Oilseed Project Nawalpur
Dhungana, D., Horticulture Farm Nawalpur
Sherpa, P.K., National Temperate Horticulture Research Station, Marpha
Chaudhary, S.L., Tarahara Agri. Farm
Hardinath Agri. Farm
Thapa, S.D., ADO, Jumla
Singh, B.K., DFC, Jumla
Upadhya, D.P., DFC, Mugu, Gamgadhi
Adhikari, J.R., District Soil and Water Conservation Officer, Jumla
Gurung, K.B., ADO-Subcentre, Lamri
Adhikari, K.P., Agricultural Station, Jumla
Thapa, Y.B., DFC, Dang
Kaski, K.B., Forest Regional Director, Surkhet
Shrestha, M.K., ADB/N, Tulsipur
Project Manager, Appropriate Technology Unit

Ojhar, T.N., CDO Manang District, Chame
Devkota, J.N., Act. Asst. ADO, Chame
Thapa, R.K., Act. DFC, Chame
Pradhan, D.N., Asst. ADO, Besisahar
Khatiwada, B., DFC-Officer, Besisahar
Joshi, B.R., DFO, Ilam
Kurmi, S., Asst. ADO, Dhankutta

Farmers

Mahat, P.B., Mahatgaun 6, Jumla
Thami, S.S., Luma 8, Jumla
Shahi, G., Chandan Nath, Jumla
Dhakal, R.D., Barmajia, Dhanusha
Bastola, D.N., Sanishara, Jhapa
Nepal, C., Namsaling, Community Development Centre, Ilam
Sherpa, C.D., Sallery, Solusallery
Gurung, S., Humde, Manang
Singkhada, T.P., Suhaulo Bazar, Dhading
Chale, F.S., Labdung, Dhading

Private Enterprises

Pradhan, P., Botanical Enterprises, Lalitpur
Sakya, S., Director, Gorkha Ayurved Company (P) Ltd
Dhital, G., Gorkha Ayurved Company (P) Ltd
Pansot, G., Gorkha Ayurved Company (P) Ltd
Gyawali, K.K., Nepal Seed Co. (P) Ltd
Tamrakar, R.L. Kathmandu Metal Works, Kamal Pokhari, Kathmandu
Bira Furnitures, Patan Industrial Estate, Lalitpur

International Organizations

Wunder,W., CTA, FAO, Terai Forestry Project, Hetauda
Gilmour, D., Nepal-Australia Forestry Project, Kathmandu
Carter, A., Nepal-Australia Forestry Project, Kathmandu
Peet, C., Rapti Integrated Rural Development Project, Tulsipur
Treacy, M.W., Rapti Integrated Rural Development Project, Tulsipur

Lampe, S., FAO, Soil Science Lab. Khumaltar, Kathmandu
Rekhi, S.S., FAO, Vegetable Seed Production, Khumaltar
Howell, J., Forest Research Project, Babar Mahal, Kathmandu
Shah, A., Dhading District Development Project, Kathmandu
Dhakhawa, U., Dhading District Development Project, Kathmandu
Burger, V., Dhading District Development Project, Kathmandu
Riley, I., ITECO, Sallery-Kathmandu
Morley, G., Assistant to the Co-ordinator, K-bird Project Kathmandu
Mackay, L. United Mission to Nepal (UMN)
Alexander, J., United Mission to Nepal (UMN)
Kafle, A.P., Principal, Jiri Technical School
Adhikari, J.R., Vice-Principal
Pfeiffer, H.R., Co-Principal, SATA
Ter Horst, K. Agritrade, SATA

Annex. V.

Khurelter Index values for Soil values

Nitrogen :	Low	: 0 - 0.05	%
	Medium:	0.05 - 0.1	%
	High	: 0.1 - 0.2	%
	V.High:	>0.2	%

Phosphorus :	Low	: 0 - 30	kg/ha (0 - 9 ppm)
	Medium:	30 - 55	kg/ha (9 - 16 ppm)
	High	: 55 - 110	kg/ha (16 - 33 ppm)
	V.High:	>110	kg/ha (>33 ppm)

Potassium :	Low	: 55 - 110	kg/ha (0.05 - 0.10 meq/100g)
	Medium:	110 - 280	kg/ha (0.10 - 0.25 meq/100g)
	High	: 280 - 500	kg/ha (0.25 - 0.44 meq/100g)
	V.High:	>500	kg/ha (> 0.44 meq/100g)

If	Low	: Apply 100% recommendation
	Medium:	Apply 50% recommendation
	High	: Apply 25% recommendation
	V.High:	Apply 0% recommendation for 2 years.

(1 ha. x 22 cm (9 inch) weigh 3375 tonner)

F.S.R.O., Dept. of Forest, HMGN.

Soil Section

Soil test report interpretation.

Qualification:	E.C.	pH	% org. C	% N	C:N	ppmP	K	Na	Ca	Mg	T.E.B.	C.E.C.	% B.S.	ppm B
V. low	0.1	3.5	0.2	0.02	5	4	0.0	0.0	1.3	0.1		3	10	0.0
low	0.3	4.5	0.4	0.04	7	7	0.1	0.1	4.0	0.3		5	35	0.5
medium	0.5	6.0	1.5	0.08	10	14	0.2	0.2	6.5	0.5	n.a.	15	50	1.0
high	1.3	7.5	3.0	0.15	13	22	0.4	0.3	10.0	1.0		25	80	1.5
V. high	2.0	8.0	5.0	0.20	17	30	0.8	0.4	13.0	2.0		27	100	2.0

The values quoted above are intended as a guide to assess the soil nutrient status for forestry soils in Nepal; they will not be valid under all circumstances as a definate qualification.

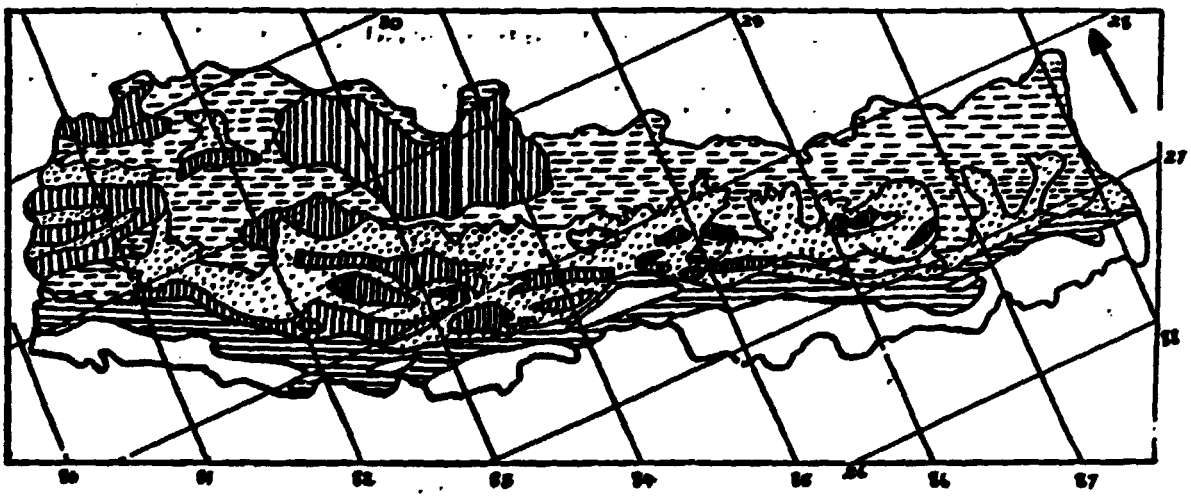
The 'medium' values for nutrients are intended to denote sufficient nutrient levels to sustain satisfactory tree growth in the plantation situation.

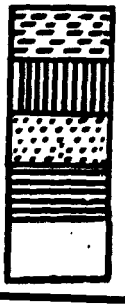
The 'V. low' values denote probable deficiency.

Nursery soils will require higher nutrient levels to promote healthy seedling growth.

संकेत :-

अम्लीय मृदा (ACIDIC SOIL)





Granite and gneiss

Limestone

Shales, schists, quartzites, phyllites

Soft sandstones and conglomerates of Churia Hills

Alluvium

SOIL TEST REPORT

F.S.R.O., Dept. of Forest, HMGN.

Sampling location : MANANG AND MUSTANG **File No:** **Page** ...1... **of** ... 2... **pages.**

Project's /Surveyor's name : Klaus Duerbeck (UNDP) Herbs Production and Processing Co. Ltd. Box 2679 Kathmandu **Chemist :** Jasutan

Reception date : 9-10-87 **Date :** 11-12-87

Physical analysis :

Sample Identification					% Moisture		W/V	Mechanical Analysis				AWC
Photo	Pit	Horizon	Sample No.	Lab No.	Field	Air Dry	g/cm³	%Sand	%Silt	%Clay	Texture Class	cm/m.
HUNTE			1	1365		1.9	0.85	63	28	9	SANDY LOAM	
BRAGA			2	1366		2.0	0.56	19	56	26	SILT LOAM	
KHANGSAR			3	1367		1.4	0.89	55	38	7	SANDY LOAM	
MANANG			4	1368		4.9	0.54	50	45	5	SANDY LOAM	
KHANGSAR			5	1369		5.1	0.45	55	37	8	SANDY LOAM	
JURELATA		(MOIST)	6	1370		4.1	0.52	48	48	4	SANDY LOAM	
JURELATA		(DRY)	7	1371		6.3	0.35	57	38	5	SANDY LOAM	
MUKTINATH			8	1372		10.4	0.64	37	56	7	SILT LOAM	

Chemical analysis:

							OLSEN		EDTA							
Lab.No.	E.C.	pH	Org.C	% N	C:N	ppm P	K	Na	(Ca+Mg)	Mg	T.E.B.	C.E.C.	%B.S.	ppm B		
1365	0.32	7.9	6.0	0.32	18.7	13	0.2	0.2	51.2							
1366	0.75	7.8	4.0	0.29	13.8	4	0.5	0.2	58.4							
1367	0.18	8.1	3.0	0.17	17.6	7	0.2	tr	58.0							
1368	0.23	6.7	13.5	0.89	15.2	9	0.3	tr								
1369	0.31	6.6	12.9	0.75	17.2	10	0.3	tr								
1370	0.44	6.4	12.3	0.90	13.7	12	0.5	0.1								
1371	0.52	7.4	13.8	0.92	15.0	25	0.9	0.1								
1372	0.10	7.2	5.3	0.43	12.3	1	0.1	tr								

Notes: Exchangeable K, Na, Ca and Mg, and Total Exchangeable Bases and Cation Exchange Capacity are all quoted in me/100g. air-dry soil.

% B.S. = % Base Saturation.

V.(C)

SOIL TEST REPORT

F.S.R.O., Dept. of Forest, HMGN.

Sampling location : Nagyadi File No: Page ... 2 .. of ... 2 ... pages.

Project's /Surveyer's name: Klaus Duerbeck (UNDP) Herbs Production and Processing Co. Ltd., Box 2679, Kathmandu Chemist :

Reception date : 9-10-87 Date :

Physical analysis :

Sample Identification					% Moisture		W/V	Mechanical Analysis				AWC
Photo	Pit	Horizon	Sample No.	Lab No.	Field	Air Dry	g/cm^3	%Sand	%Silt	%Clay	Texture Class	cm/m.
GHORGPANI			9	1373		1.7	0.58	62	28	10	SANDY LOAM	
THAPLA DEURALI			10	1374		11.4	0.54	62	31	7	SANDY LOAM	

Chemical analysis: BRAY BRAY

Lab.No.	E.C.	pH	Org.C	% N	C:N	ppm P	K	Na	Ca	Mg	T.E.B.	C.E.C.	%B.S.	ppm B		
1373	0.13	5.5	5.3	0.31	17.1	17	0.2	tr.								
1374	0.12	5.6	9.3	0.62	15.0	16	0.5	0.1								

Notes: Exchangeable K, Na, Ca and Mg, and Total Exchangeable Bases and Cation Exchange Capacity are all quoted in me/100g. air-dry soil.
% B.S. = % Base Saturation.

V. (d)

H.M.G./NEPAL
Food and Agriculture Ministry
Department of Agriculture
Division of Soil Science and Agricultural Chemistry

Kumaltar, Lalitpur

Sender and Name: Herbs Production and Processing Co. Ltd.

Place of Sample taken: Zumla and Dang

SN	Lab No.	Description	pH	Nitrogen %	Ava Phosphorus Kg/ Ha	Ava Potasium Kg/ ha	Organic matter %	Soil texture	CEC m.e. 100 gm	Ca m.e. 100 gm	Mg m.e. % 100 gm	Na m.e. % 100 gm	K m.e. % 100 gm	Remarks Locatic
1	192	Soil Sample 1	6.2	0.106	26.78	516.1	2.27	SL	(Sandy Loam)					Mahatgaun
2	193	" 2	5.3	0.484	87.08	241.9	13.05	SL	(Sandy Loam)					Sankher Pani
3	194	" 3	5.5	0.144	89.14	403.2	3.63	L	(Loam)					Cherechaur
4	195	" 4	5.1	0.337	89.14	392.4	9.79	SL	(Sandy Loam)					"
5	196	" 5	5.6	0.179	47.38	290.3	3.57	SL	Sandy Loam)					"
6	197	" 6	6.4	0.248	28.84	198.9	6.32	h	(Loam)					"
7	198	" 7	6.4	0.048	41.2	241.9	6.64	SL	(Sandy Loam)					Satwaria
8	199	" 8	6.5	0.048	61.8	107.5	0.68	h	(Loam)					Lalmatiya

SOIL TEST REPORT

F.S.R.O., Dept. of Forest, HMGN.

Sampling location: **File No:** **Page** 1 **of** 1 **pages.**

Project's /Surveyor's name: .Medicinal Plants - Klaus Duerbeck Box 2679 **Chemist:** .Jasuton

Reception date: 12-11-87/DHADING - JIRI **Date:** 23-12-87

Physical analysis:

Sample Identification					% Moisture		W/V	Mechanical Analysis				AWC
Photo	Pit	Horizon		Lab No.	Field	Air Dry	g/cm^3	%Sand	%Silt	%Clay	Texture Class	cm/m.
	SITAL BAZAR		1	1443		1.1	0.91	39	45	16	LOAM	
	SITAL BAZAR		2	1444		1.3	1.07	32	45	23	LAOM	
	BORANG		3	1445		3.3	0.59	41	38	21	LOAM	
	LABDUNG		4	1446		3.4	0.60				VIOLENT REACT. WITH	
	SINGLA-PASS		5	1447		7.2	0.39				H_2O_2	
	JIRI-DHUNGE		6	1448		0.9	1.00	49	32	19	LOAM	
	JIRI HOSPITAL		7	1449		3.4	0.95	18	49	33	SILTY CLAY LOAM	

Chemical analysis:

Lab.No.	E.C.	pH	Org.C	% N	C:N	BRAY'S ppm P	K	Na	EDTA (Ca+Mg) Mg		T.E.B.	C.E.C.	%B.S.	ppm B		
1443	0.08	5.3	1.7	0.15	11	171	0.4	trace	2.5							
1444	0.06	5.7	1.5	0.13	11	62	0.4	0.1	4.5							
1445	0.09	5.0	7.9	0.55	14	11	0.3	0	9.5							
1446	0.07	5.2	6.7	0.49	18	2	0.5	0	8							
1447	0.13*	4.6*	9.0	0.88	10	9	1.1	trace	15.5							
1448	0.06	5.4	1.6	0.05	32	14	0.2	trace	4.5							
1449	0.05	5.4	2.6	0.23	11	5	0.5	0	4							

Notes: Exchangeable K, Na, Ca and Mg, and Total Exchangeable Bases and Cation Exchange Capacity are all quoted in me/100g. air-dry soil.
% B.S. = % Base Saturation.

* Those figures obtained with 1:3.5 soil to water mixture because the soil absorbed most of the water.

V. (F)