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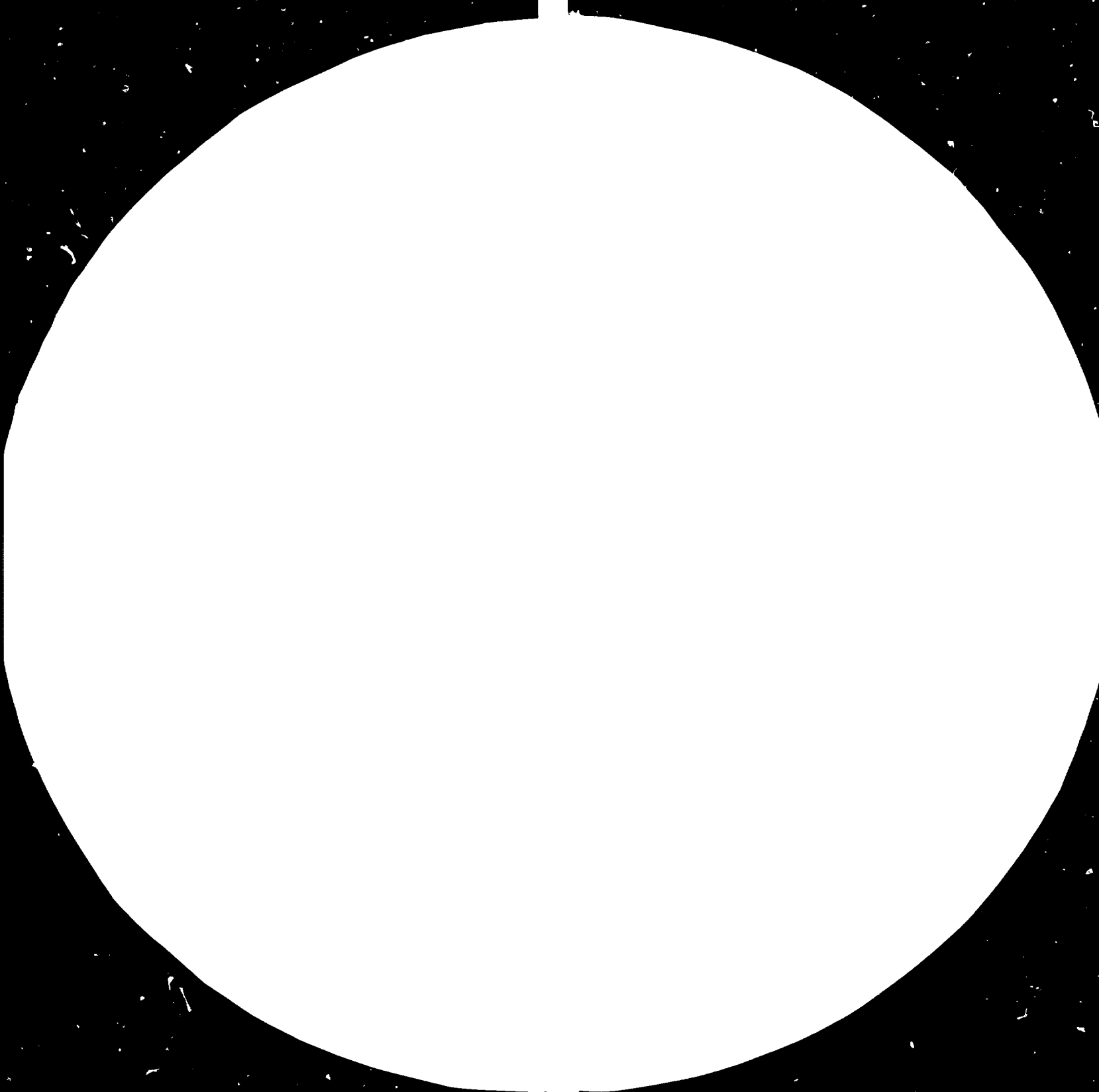
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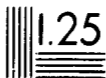
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MICROSCOPE REPRODUCTION TEST CHART

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RESTRICTED

13146

DP/ID/SER.B/428
11 November 1983
English

Nepal.

STRENGTHENING THE ROYAL DRUGS RESEARCH LABORATORY

DP/NEP/80/003

NEPAL

Terminal report*

Prepared for His Majesty's 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 W.J.De Boeck,
associate expert/economist

United Nations Industrial Development Organization
Vienna

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1. SUMMARY:

- a. The associate expert's work programme was aimed at providing useful information on the socio-economic side of the programme for the development of Nepal's resources in the field of medicinal and aromatic plants.
- b. Early on in the work programme, a "strategy proposal" was prepared for the overall programme, based on information gathered on cultivation and collection aspects, national and international market characteristics and the situation with regard to health care and drug supply in the country.
- c. As far as the agronomic aspects are concerned, the decision of HMG/N to set up a company for commercial exploitation of the country's resources in this field, will require some important changes with regard to:
 - cost-benefit conscious management for commercial farms
 - setting up a comprehensive and professional extension programme for cultivation by private farmers.
 - re-defining the roles of the departmental herbal farms as supporting agents to the commercialization programme.
- d. Cost-benefit studies were undertaken for following products:
 - *Atropa belladonna*
 - *Pyrethrum*
 - *Rauwolfia serpentina*
 - *Citrouda*
 - Lemongrass
 - Palmarosa
 - *Mertha arvensis*

Although a variety of methods had to be used and the estimate of cultivation costs and yields could not be based on long-term in-situ observations (for some plants the growth cycle is four years), the studies can provide information regarding the most

important cost components and could be helpful in the selection of an appropriate production-package and in setting farm gate prices for private growers.

- e. A detailed proposal for small-scale production of herbal medicine was worked out for the Far Western "Seti Zone". This programme should be combined with clinical testing of the proposed drugs through the health post and ayurvedic dispensary system.
- f. A status report on RDRL's pilot plant was prepared. At the pilot plant, many problems of an organisational and technical nature are encountered, and there is no clarity at present as to how the pilot plant's work fits into the overall programme.
- g. Although it was intended to prepare a feasibility study for large scale production of pharmaceuticals and essential oils by the Herb Production & Processing Company, this could not be done due to insufficient market information. It is envisaged that such a study can be made after approximately one year, when more information is available. This activity would then fall under the scope of the NEP/80/044 project.

2. Recommendations:

- a. It is of prime importance that more in-depth discussions are held on the strategy to be followed to develop Nepal's resources in the field of medicinal and aromatic plants, and to define RDRL's role in the eventually agreed-upon strategy. At present there is considerable wastage of available resources due to the lack of a concrete development programme. Research work should definitely also be looked at from a socio-economic angle, especially in a developing country, where resources are scarce.
- b. We have tried to offer some suggestions for an overall strategy. In our view, RDRL should not just stick to research subjects that have been chosen for whatever historical reasons, but should aim at developing those products that have readily accessible markets that

can be matched with present production capabilities. In our opinion, several simple herbal products are available and offer good scope for commercialisation. In the field of herbal medicine, due care should be given to developing products that can eventually be produced in rural areas, given the fact that inadequate logistics in drug supply is one of the main reasons for the faltering health system.

- c. It is hoped that the cost-benefit studies made during the associate expert's assignment will lead to a more cost-benefit conscious attitude. The establishment of a commercial company (the Herbs Production and Processing Company Ltd.) should certainly help in making this adjustment through the trimming of unnecessary and unproductive expenditures.
- d. The cultivation extension programme should be raised to a more professional level, where farmers receive regular technical advice, and are supported with the necessary inputs, guaranteed market and production loans. At present, a lot of improvement is necessary in terms of regular technical advice by extension workers, and in the logistics of plant material supply. Improving the present situation will involve strong continuing co-operation between the HPPC and the Department of Medicinal plants. It is hoped that an executive committee for the extension programme will soon be formed to start working on this.
- e. With the present "commercialization phase", the objectives of the Department's herbal farms should be re-defined as supporting agents to commercialisation. A number of recommendations for practical objectives have been formulated in this regard (see "agronomic aspects").
- f. The proposal for small scale, rural herbal medicine production in Seti Zone should be implemented by joint co-operation between RDRL, the HPPC and the appropriate institutions of the Ministry of Health. If this pilot project can be implemented successfully, it can lead to a breakthrough in rural health care based on indigenous resources in Nepal.

- g. The role of the pilot plant in the overall programme should be clarified, and a careful selection of products should be undertaken, taking due account of available information regarding markets and production technology.
- h. On the technical side, there is at present no need for a big increase in the pilot plant's capacity, but rather for shop-floor technical assistance and some minor ancillary equipment, in order to smoothe the production flow.

3. Body of the report

a. Main duties of job description

Duties, as stated in the job description, were described as follows:

"The expert will assist the Director, Royal Drugs Research Laboratory in the following activities:

- (a) Economic evaluation of production, agronomic and marketing aspects;
- (b) Feasibility studies of individual operations within the project as and when required;
- (c) Conduct such research studies on development economics related to the project as may be required;
- (d) Assist in other related matters."

The associate expert began his assignment in the project on 16 March 1982. As the CTA had not yet been fielded, some time was devoted in the begining in establishing a project office in a building kindly provided by RDPL. Up to the arrival of the CTA (August 1982) the associate expert took care of all matters of administrative nature, assisted in this by the project secretary.

During this period, reconnaissance visits were paid to four herbal farms (Doti, Vrindavan, Tamagardi and Manichur) in order to become acquainted with some agronomic and technical aspects of the cultivation and field processing of medicinal and aromatic plants. This was combined with literature study.

Early on also, a programme to investigate the cost-benefit of cultivation of *Atropa belladonna* by private farmers (in Panauti area) was started.

On the advice of Prof. F. Sandberg, Planning consultant to the project, a visit was paid to Mr. Sundaresh, Deputy Secretary of the Basic Chemicals, Pharmaceuticals and Cosmetics Expert Promotion Council, as well as to some user industries in Bombay (India), in order to obtain information on trade and marketing aspects of some specific herbal extracts and essential oils.

Subsequent to the planning consultancy of Prof. Sandberg, the following was decided:

"It was agreed upon that Mr. De Boeck should devote his time to cost/benefit studies for the following drugs:

- (a) Belladonna
- (b) Pyrethrum
- (c) Rauwolfia serpentina
- (d) Citronella oil
- (e) Palmarosa oil
- (f) Lemongrass.

It would be of great importance to evaluate the harvest of 1983 (from May to June) in order to obtain more reliable figures for the production costs than those for 1982. It is therefore proposed that Mr. De Boeck will obtain a prolongation of 3 months (taken from the expert in economic mapping).

Since the prices of the products manufactured by HPPC generally are higher than the world market prices, Mr. De Boeck should particularly look for the weak point in the cultivation/production sequence in order to reduce the cost." 1/

The associate expert went on home leave from 8 August until 3 October 1982. After this, a visit was paid to Helambu where farmers had started growing pyrethrum, in order to evaluate this programme from an agronomic as well as socio-economic angle.

1/ Prof. F. Sandberg, Terminal report, p.7.

Meanwhile, co-operation with an officer from the Netherlands Development and Volunteer Service was started. This co-operation came about since the Herbs Production and Processing Company was interested in availing itself of the services of Dutch Volunteers/extensionists for its cultivation programme and our angles of work were similar or even complementary (the assigned officer being an agriculturalist).

Based on the information gathered in the earlier months, a "strategy proposal" for the programme as a whole (covering research, cultivation and processing) was prepared. This proposal was discussed in a joint meeting of concerned HMG and foreign aid personnel. Although there were certain inhibitions about giving one's opinion in a large group of people coming from different disciplines and ministries, the meeting served some purpose by informing those concerned about the programme to be undertaken. In the months following the "strategy proposal" more data were gathered in order to substantiate the position taken in the paper.

In November 1982, a further field visit was undertaken to Doti in the Far Western Development Region, leading to a comprehensive proposal to restructure this branch office of the HPPC. This programme included, among others, the establishment of a rural medicine compounding unit, as well as a programme for testing herbal medicine in the Seti Zone of Far Western Nepal. Eventually, some of the new formulations developed at RDRL can be tried out in this setting, so as to fulfill outputs 5 and 6 of the project document.

During the first two months of 1983, cost-benefit studies on *Rauwolfia serpentina*, Citronella oil, Lemongrass oil, Palmarosa oil and *Mentha arvensis* oil were finalised, this following field visits to the growing areas for these plants, i.e. the southern terai plains. These visits further yielded:

- an analysis of the present status at Tamagardi herbal farm, and a proposal for development of the farm.
- a proposal for setting up an extension programme in Eastern Nepal.

On 18 March 1983, a work programme was agreed between Dr. S. B. Malla, Dr. R.O.B. Wijesekera and Mr. J.G. Meredith for the remaining period of the associate expert's assignment. This programme, which basically involved preparing a status report on activities in the pilot plant was considered to be of prime importance to allow further programming of pilot plant activities. Consequently, the cost-benefit analysis of *Atropa belladonna* and *Pyrethrum* had to remain somewhat sketchy, due to lack of time.

The work programme at the pilot plant led to a report consisting of a description of present operations as well as bottlenecks, a costing of the operation, and a system for record-keeping at the pilot plant.

At the request of Dr. S.B. Malla and Dr. A Sheak (General Manager of the HPPC), the associate expert devoted some time at the end of his assignment, to make an opportunity study for the Herbs Production and Processing Company Ltd., taking into account the equipment to be granted to the HPPC as part of the UNDP/UNIDO/FAO programmes of technical assistance.

b. Achievement of immediate objectives

1. General strategy for the programme

Research is not a goal in itself, especially so in the case of Nepal where facilities for basic research are miniscule compared to those available in neighbouring developing countries.

From this it follows that research should rather be aimed at specific applied usages. Here the question of the goals of the overall programme emerges. The spirit of the project document for NEP/80/003 is quite clear in this regard; besides institution building and drug quality control aspects, the project aims at developing pharmaceuticals and essential oils based on indigenous raw materials, so as to save foreign exchange (through import-substitution) as well as earn foreign

exchange (through increased exports). By developing cheap herbal drugs based on local raw materials, the project also aim at improving the health situation in the country.

When digging one level deeper, these broad objectives can be divided into:

- (i) developing new herbal drugs, looking into the feasibility of large scale production of these, and handing over the technology to commercial companies (Royal Drugs Ltd. being the most prominent among these).
- (ii) Developing processing technologies for intermediate pharmaceutical products (herbal extracts) and essential oils (and fractions thereof), investigate the feasibility for large scale production of these, and hand over the technology to commercial companies (the Herbs Production and Processing Company Ltd. has been set up to commercially exploit this sector).

As far as (i) is concerned, there is a problem, not so much in the high prices of drugs produced by the Royal Drugs Ltd. (these are generally quite low, compared to prices of Indian medicine) but in the faltering health delivery system in Nepal:

- the situation in most health posts is such that there is only a sufficient supply of drugs for approximately three months in the year.
- the less-than-optimal logistics system makes that the right kinds of drugs are most often not available at the right time, leading to inadequate prescription of drugs (This is also re-inforced by insufficient training of health post personnel).
- probably even more important than the above factors: the modern health care system is alien to and often distrusted by villagers, who comprise 95% of the Nepalese population.

Perception and cure of disease is quite different between the allopathic system and the healing systems practiced in the country. As long as this factor is not fully realised in all its implica-

tions, "primary health care" in Nepal will continue to bypass its goal of serving the mass of the people in the rural areas. At the upper level, HMG has now attached importance to the development of traditional medicine (especially ayurveda) alongside western medicine. Some action-research studies ^{1/} have indicated that it is possible to integrate traditional health practitioners in the health care programme, with stunning effects in terms of bringing health services closer to the people as well as cost effectiveness.

Whereas the health delivery system as such goes beyond the scope of the NEP/80/003 project, the project cannot afford to ignore the present status as well as developments in this field. In practical terms, taking full account of the situation, would mean:

- seeking co-operation with ayurvedic practitioners and compounders, not only in order to take the ayurvedic system as a "starting point" for developing "allopathic" herbal medicine, i.e. comprising alcohol extracts and chemicals but also to make the new drugs more compatible with the systems of medicine already in use in the country, at the same time adding notions of standardisation and quality control. Of course this approach requires an openness and respect for "the other side" from both disciplines, as well as a willingness to modify existing testing procedures to take account of the different perceptions of disease and curing of disease offered by e.g. ayurveda. China (and to some extent India) could stand as an example in this regard.
- care should be taken to develop drugs which can be manufactured locally, in order to overcome the logistic problems common in the drug distribution system. This means that the preparations have to be kept simple, and require as few "external" components (mainly chemicals) as possible. The local processing of medicinal herbs (rather than export of crude herbs to India) can give an important stimulus to the rural economy. To this end, a proposal for "local ayurvedic drug manufacturing" was prepared for Seti Zone, in Far Western Nepal. (see heading 4).

^{1/} Ramesh Man Shrestha, Faith healers: a force for change, UNDP report project NEP/77/003.

Dr. Ian Oswald, Traditional Medical Practitioners and rural health delivery in North Eastern Nepal, study for Netherlands Lepa Relief Association and British Medical Trust, Final report, December 1981.

Regarding the objective mentioned under (ii) a "strategy proposal" was developed in November 1982; and subsequently discussed in a large meeting of government officials and foreign aid personnel involved. The proposal started with an analysis of the market characteristics of the international trade in medicinal and aromatic plants and their derivatives. The characteristics of this market (closed market, strict qualitative and quantitative requirements "dumping" practices, competition from synthetic products.....) are such that it is not easy for new producers to enter the market.

The nature of Nepalese agriculture (small landholdings, difficult transport of produce to markets) is such that it will be difficult, at least in the initial stages, to set up a stream-lined, large scale production programme. For these reasons, it was proposed to take the national market as a starting point for putting together a production packet. This would have the advantages of involving smaller quantities, somewhat less stringent quality requirements, greater access to market outlets, and from a macro-economic point of view, a spin-off effect in stimulating user-industries in the country.

As far as the international market is concerned, we proposed to concentrate mainly on the regional market in the beginning and to try to establish long-term co-operation contracts with user-companies abroad.

In addition we recommend that the RDRL and HPPC co-operate in schemes for local compounding of simple ayurvedic medicines: in the long run this could prove to be an additional income-earning activity for the company, with relatively low investment costs.

2. Agronomic aspects

As per point (a) of the job description, attention was also given to evaluating the agronomic aspects of the programme. To this end, all six herbal farms in the country (Shivapuri farm has since been abandoned), as well as the Royal botanical garden and most of the places where extension programmes with private farmers were started, were visited.

Quite some work has been done by the Department of Medicinal Plants in establishing herbal farms all over the country, in different climate zones: three farms in the sub-tropical area, (Vrindavan, Tamagardi and Tarhara), two farms in the temperate zone (Tistung and Manichur), and one farm in the sub-alpine zone (Kaptar-Doti). One can safely state that agronomically it has been proven that certain medicinal and aromatic plants can be grown in Nepal.

However, with the establishment of the Herbs Production and Processing Company one and a half years ago, a new phase has been reached: HMG of Nepal has decided that the time is ripe to start cultivation and processing of medicinal and aromatic plants on a commercial scale. However, in order to make commercialisation viable, several changes have to be made in the existing operations:

- (i) The farms turned over to the HPPC (Doti and Tamagardi) have to be managed in a cost-benefit conscious way. This involves a careful scrutinizing of operating costs, as well as working out a profitable production package. For both farms, proposals to this end have been worked out, and implementation has already commenced. ^{1/}
- (ii) Extension work (already started before the establishment of the HPPC), has to be raised to a more systematic, professional level. In our opinion this involves:
 - first of all, investigating the agronomic and socio-economic feasibility of extending a certain crop in a certain area. This comprises checking whether the climatic and soil conditions of a certain area tally with plant requirements, investigating the profitability of the new crop compared to food-grains and alternative cash crops, determining how to introduce the new crop in the existing cropping pattern, checking the food balance situation in the area, investigating the status of communications in the area to transport finished products and required inputs etc... ^{2/}

^{1/} see W.J. deBoeck and B. Dominicus, Proposal for Restructuring the Doti branch of the Herbs Production and Processing Company, 28 December 1982 (38 pages); and W.J. deBoeck, G. Amatya, Proposal for the development of Tamagardi herbal farm, 15 February 1983 (10 pages).

^{2/} For a more detailed discussion on this subject, see W.J. deBoeck B. Dominicus, Pyrethrum cultivation in Helambu, field visit report, 15 December 1982, 11 pages + annex, pp. _____

- starting with a few interested farmers in each area, and providing them with intensive technical advice, so as to ensure a good start; later on, the extension programme can be expanded to other farmers in the area.
 - setting up a stream-lined system for provision of essential inputs to farmers (plant material, possibly fertilizer). In the beginning the herbal farms of the department can become production and distribution centres for plant material, while later on some private farmers can take up this function. 1/
 - organising field processing if required (distillation, drying, pulverising...) as well as transport to markets.
 - entering into contracts with private growers, whereby the HPPC guarantees supply of required inputs, technical advice, and market outlets, and assists farmers in obtaining production loans.
- (iii) The new "commercialisation" phase also involves a re-thinking of the roles of the research farms established under the department of medicinal plants (Vrindavan, Tarhara, Tistung, Manichur). So far the objectives of the farms have been largely translated in production targets. In our opinion, these objectives should be more detailed in future, and specifically aimed at serving the commercialisation programme. This has already started to some extent, but nevertheless we would like to offer some suggestions for "functional" research subjects.
- selection of plant material in function of higher yields, disease resistance, drought resistance etc....
 - research on practical and low-cost methods of manuring and weed-control. 2/
 - working out suitable low-cost land-tillage systems (e.g. animal traction).
 - research on introduction of medicinal plants in existing cropping patterns as well as developing mixed cropping methods. 3/

1/ As is the case for Belladonna cultivation in Panauti e.g.

2/ The development of a "mulching" system for pyrethrum at Tistung herbal farm could serve as an example here.

3/ E.g. mixed cropping of Rauwolfia serpentina with lentils, developed at Vrindavan herbal farm.

- research on appropriate and low-cost methods of pest-control
- for aromatic plants, research on:
 - * appropriate fuel-saving methods of distillation, research on alternatives to firewood as energy source.
 - * relation between moisture content of the herb, and the percentage of oil.
 - * relation between harvesting time and the percentage of oil.
- research on agro-forestry practices to preserve and "cultivate" indigenous plants.
- research on tissue-culture as a means to quick, virus-free multiplication of plant material. 1/

In addition to this research function, the farms should also serve as a source of plant material for the extension programme. At present bottle-necks occur in this field, and it is important to stream-line this aspect before large scale extension work can be tackled.

- (iv) As far as collection of medicinal and aromatic plants is concerned, it is widely appreciated that several important plants are threatened with extinction as a result of de-forestation and the growing needs for cash in the impoverished hilly and mountain areas. At present collection is going on without any awareness of the damage done to the environment. Important work needs to be done in terms of economic mapping/^{of}plants and extension work with collectors teaching sound methods of collection. We have proposed purchase centres in the West (Depayel) and in the East (Dhankuta) to make a start. Preferably this programme should be undertaken in co-operation with existing herb traders, in order to have a broader outreach.

1/ For pyrethrum, important progress has been made in this regard.

3. Cost-benefit analysis

Cost-benefit studies were undertaken for following products:

- a) Atropa belladonna
- b) Pyrethrum
- c) Rauwolfia serpentina
- d) Citronella
- e) Lemongrass
- f) Palmarosa
- g) Mentha arvensis

The lack of reliable data on costs and yields become clear after comparing some of the data provided by farm staff to first hand observations in the field, e.g. regarding oil percentages, yields per ha. etc.... On the other hand, there was not enough time nor manpower to establish a detailed observation-based cost-benefit programme for all herbs. (some of the herbs have a four year crop-cycle e.g. palmarosa).

Following methods of working were consequently applied:

- using farmer questionnaires as a basis for calculating cultivation costs (in the case of belladonna)
- using the data from the department as a starting point, and amending these according to first hand observation, literature information on cultivation practices and yields and proposed improvements in the existing practices at the farms (in the case of the essential oils and Rauwolfia).

Naturally, the results thus obtained are only approximations. Nevertheless, the opinion is held that the figures obtained can serve as guidelines as to:

- whether a certain crop can be grown profitably in Nepal depending on the maintenance of certain quality standards).
- whether they can be introduced in a cropping pattern in a way that is attractive to farmers
- establish reasonable farm-gate prices for private growers.

In addition, the studies revealed which were the largest cost components, especially in the case of government farming. As a result of this, it is hoped that action be undertaken to trim these costs.

In general, the studies also yielded the conclusion that in the long run, production through extension work with private farms will be cheaper than production on government farms, in view of:

- the lower level of overheads
- the more efficient utilization of labour,
- the greater possibility of mixed cropping on small private farms.

Below is a short summary of the main results for each product:

a) Atropa belladonna:

If grown as a half-year crop (in combination with paddy), this herb is very interesting for farmers possessing well-irrigated, well-drained lands. Also the processing of the product (total extract) in Nepal is profitable. So far, there is a ready market for belladonna extract inside the country. However, in view of the keen interest shown by farmers, the production is rapidly satisfying the Nepalese demand, and possibility for exporting preferably in the Asian region, should be explored vigourously.

b) Pyrethrum:

So far this plant has received little attention from private farmers because of low yields and insufficient extension work. However, some factors warrant a certain degree of optimism:

- the good results obtained with tissue-culture of pyrethrum at Godavari
- The introduction of a new cultivation method at Tistung herbal farm, by applying a thick layer of mulch, and resulting in lower evaporation, better weed control, added plant nutrition reduced labour costs and higher yields

- the plans of a Nepalese manufacturer to set up a mosquito-coil factory, thus creating a potential market for the pyrethrum.

Nevertheless, it will be necessary to:

- select climatologically suitable areas for cultivation.
- undertake more work to see whether tissue-culture methods can be used in a large scale extension programme.
- assure the market for pyrethrum in the country.
- set up and maintain a good extension programme for pyrethrum cultivation.

c) Rauwolfia serpentina

In view of the depressed market for Rauwolfia, it is not wise to go into large scale extension work for this herb at present. Nevertheless efforts should be made to find buyers for Rauwolfia and establish long-term contacts with them, in view of:

- the fact that Rauwolfia is known to farmers in Terai area, and cultivation poses little problems.
- Rauwolfia is very suitable for inter-cropping, which is interesting from the farmer's point of view, since he does not have to forego food crops or certain other cash crops. (It should be appreciated that in Nepal, very few farmers can wait three years to get some financial return their land, as would be the case if Rauwolfia is cultivated in an "orthodox" way).

As such, Rauwolfia can still be grown profitably at the present (depressed) price of 25 Rs N.C./kg.

d) Essential oils:

Nepalese products are conditioned by the market situation existing in India, given the fact that the Indian market is protected vis-a-vis imports of essential oils originating from third countries, but Nepalese oils have free access to the Indian market.

As such, market prices for citronella (Java) oil tend to be higher in India compared to world market prices, whereas Indian prices for lemongrass and palmarosa oil are lower than world market prices.

It should be noted that prices depend a lot on the quality of the oil offered, and that a serious effort to upgrade and maintain quality standards is necessary if Nepal is to succeed in this field.

On the cost-side, it is important to work on fuel-efficient distillation methods, in view of the high costs of fuelwood in most Terai areas.

Citronella grass seems to be only marginally profitable at this stage. The price demanded by the HPFC is too high when compared to the actual market price (which has a declining trend in view of increased production in India).

Lemongrass could be profitable if it can be grown on marginal land under agro-forestry conditions. However, more research is required in this field.

Palmarosa oil looks profitable at this point, in the international as well as the Indian market. The quality is accepted in the market.

Mentha arvensis produced in Nepal has a low menthol content, therefore the price offered is also low. It is necessary to remedy this through the introduction of improved plant material. Since the cultivation of mentha is relatively labour-intensive, it could become an interesting crop for extension to private farmers, once the quality problem has been solved.

4. Field testing of herbal drugs

As per immediate objective 4 and outputs 5 and 6 of the NEP/80/CO3 project document, herbal drugs would be "test-marketed" through pharmacies in Kathmandu and health posts spread over the country.

After visiting Doti farm in Far Western Nepal, the possibilities for setting up a field programme to carry out these components of the project, became clear. Since the Doti farm had been transferred to the HPPC, it became necessary to make the operation profitable. To this end, the above mentioned "proposal for re-structuring the Doti branch of the HPPC" was formulated. One of the new activities proposed was to set up a small ayurvedic compound manufacturing unit. The idea came about as follows:

- Doti is one of the more remote areas in Nepal, where provision of both allopathic as ayurvedic medicine produced in Kathmandu is totally inadequate.
- A large number of valuable medicinal plants can be found in the area.
- Ayurvedic medicine is popular in the area, but ayurvedic compounds are inferior to allopathic drugs in terms of appearance.
- Ayurvedic drugs produced in Kathmandu at the Singha Durbar Vaidya Khana are expensive due to:
 - * high number of raw materials contained in most preparations
 - * approximately 50% of raw materials coming from India.

In addition, manufacturing methods are very archaic and labour-intensive, and as such the advantages of a central production unit are largely by-passed, as is the case with allopathic drugs.

Therefore it was proposed to locally manufacture popular ayurvedic compounds, consisting of only a few components each. In order to enhance the appearance and hygiene of the medicines, some simple manufacturing machinery was proposed. (for drying and grinding, tabletting, capsul filling). The unit would be powered by a micro-hydro turbine, which are manufactured in the country and are becoming increasingly popular as "multi-purpose power units".

Together with the manufacturing unit, a mechanism for distribution through local health posts and ayurvedic dispensaries was proposed.

Dr. S.B. Malla expressed his interest in introducing some of the new RDRL formulations through the same channel. As such, the programme for field testing of herbal drugs could materialise in a setting which is fairly typical for rural Nepal.

5. Status report on present pilot plant operation

Before installing the enlarged pilot plant, it was deemed necessary to have an overview of machinery, on-going activities and possible bottlenecks at the present operation.

Activities at the pilot plant were followed during a period of over three months and consequently a status report was prepared.^{1/} We will try to give a brief summary of the findings:

- (i) At present five products are processed in the pilot plant. Diosgenine from *Dioscorea Deltoidea*, Solasodine from *Solanum Laciniatum*, Berberine from *Berberis aristata*, total extract from *Rauwolfia serpentina*, and rosin and turpentine from pine resin. A number of other products previously processed at the pilot plant, have been taken up by the HPPC; *Atropa belladonna*, pyrethrum, *Rheum emodii*, *Adhotoda vasica*.

It seems likely that in the near future also the extraction of *Rauwolfia serpentina* and the distillation of pine resin will be left to the company.

- (ii) It is necessary to have a clear look at the products going through the pilot plant in terms of economic and market potential before up-scaling to the new pilot plant in Godavari.
- (iii) There is a need for clear objectives for the pilot plant operators, in terms of processing efficiency to enable cost reduction, solvent recovery or any other possible targets. As a starting point for bringing in these targets, a record-keeping system was worked out for the pilot plant.
- (iv) Although the new pilot plant equipment on order is really of small capacity production nature, the situation at the pilot plant is not ready for regular production, due to:

^{1/} See W.J. deBoeck, Status report on RDRL's pilot plant, 18 July 1983 (23 pages and annexes).

- technical problems encountered (e.g. in the extraction of solasodine). None of the present staff at the pilot plant was specifically trained in phytochemical processing technology.
- bottlenecks in terms of solvent and percolate transfer, filtration, electricity breakdowns and irregular working hours.

Therefore, it was very difficult to make a proper costing of the operation and, not surprisingly, very high costs per unit of finalised product were obtained.

(v) Some of the present bottlenecks could be remedied quite easily with the purchase of some equipment items:

- proper filtration equipment
- installation of transfer pumps
- stand-by electricity generator.

(vi) Last but not least it is necessary to stress the lack of safety measures and protective clothing in the present operation, and this should be remedied immediately.

6. Feasibility of large scale production of pharmaceuticals based on indigenous raw materials (as per objective 5 of the project document)

Due to the delay in the pilot plant construction, and the lack of information of possible throughput of an enlarged pilot plant, it was impossible to make a feasibility study for a large scale pilot plant at this stage. The minimum requirements to do this would be:

- a list of products to be produced, together with targetted quantities
- a detailed description of the technical processes involved,
- a detailed flow diagram for the production, involving all machines and required labour time for each operation.

None of this information is available at the time of writing this report. As a matter of fact, it is still unclear whether (and to what extent) the new pilot plant will focus on total extracts, purified extracts, fractionation of essential oils, or production of finished

herbal drugs. The equipment on order creates the theoretical possibility to undertake all these types of processes. However, as we have concluded from the experience at the pilot plant, there are still too many technical and organisational problems in the present operation to assume an enlarged pilot plant operation feasible.

On the other hand, processing technology for producing "total extracts" and essential oils seems to be sufficiently known in the country to warrant moving on to a production stage, on the condition that a processing plant can be run without too many stoppages due to short working hours, holidays, and bottlenecks in water and electricity supply. This condition seems to be met (at least partly) by the Herbs Production and Processing Company. As such it was suggested that a feasibility study was prepared for the company, being the focal institution for "large scale production of pharmaceuticals based on indigenous raw materials."

However, when going through the information available, it was found that this was insufficient (especially on the market side) to warrant a full-fledged feasibility study. Consequently, a note was prepared outlining the most critical parameters to be monitored, in order to make the enterprise profitable.

c) Utilisation of results:

i) General strategy proposal

The "strategy proposal" was primarily meant as a document which should start discussion between all involved concerning the way the programme should follow. So far, we have been disappointed in this expectation. Very little in-depth discussions have taken place regarding this subject. It is hoped that this may change in future. Once some form of consensus is reached regarding this issue, it is important to move on to define practically every institution's and every researcher's role in this overall programme.

ii) Agronomic aspects:

It is hoped that the recommendations offered in this field can be utilised by:

- the FAO in the implementation of the NEP/79/007 project

(cultivation of medicinal and aromatic plants)

- the HPPC in the cost-conscious management of their farms and in the implementation of a cultivation extension programme
- the herbal farms of the department of medicinal plants in the re-definition of their role as supporting agents in the commercialisation programme.

iii) Cost benefit analyses:

This work should hopefully assist the HPPC in following respects:

- making a profitable product-selection
- determining adequate farm-gate prices for private growers
- carefully screening indirect costs (such as unnecessary supervisory personnel) and trimming these costs.

iv) Field testing of herbal medicine:

The Doti proposal should lead to a combined effort where:

- the HPPC (with possible financial support of "Appropriate Technology International"^{1/} will take care of small-scale rural production of herbal medicine.
- The RDRL will be involved in test-marketing some of the new herbal formulations coming out of its laboratories
- The Departments of Ayurveda and health services will participate by clinical testing of the drugs.

v) Pilot plant:

The status report on the pilot plant could serve as a basis for examining present difficulties and for working out a feasible programme for the pilot plant in future years.

- (vi) The opportunity study should be of help in the implementation of NEP/79/007 and eventually NEP/80/044 by high-lighting those variables that are to be monitored most closely in order to successfully implement the commercialisation programme.

^{1/} This is an American non-governmental organisation showing interest in partly financing the Doti proposal.

A N N E X:

Chronological list of reports submitted:

1. Belladonna cultivation in Paunati area - Preliminary report, 30 March 1982, together with M.S. Bista, Scientific Officer, Department of medicinal plants; 26 pages + annexes.
This report aimed at providing a preliminary estimate of cultivation costs and yields for belladonna production by private farmers.
2. Report on Field Visit to Kaptar, Seti Zone. 1 July 1982 (11 pages + Annex)
Given a brief description of the status of Kaptar herbal farm, and provides some suggestions for a new approach.
3. Project Status reports, 1 August 1982 (9 pages)
For the benefit of the CTA, who arrived one week later, a report was prepared on the status of the project on 1 August.
4. Marketing Visit to Bombay (25-28 July 1982): 3 August 1982 (9 pages)
Report of visit to the Basic Chemicals, Pharmaceuticals and Cosmetics Export Promotion Council, as well as to user industries in Bombay-India.
5. Cultivation, processing and marketing of belladonna by the "Herbs Production and Processing Company Ltd.", 5 August 1982 (14 pages).
Cost-benefit analysis based on preliminary report, harvest data of 1982, estimate of processing costs and brief analysis of marketing prospects.
6. A strategy proposal concerning the programme for development of Nepal's resources in the field of medicinal and aromatic plants, 1 November 1982, together with B. Dominicus, Netherlands Development and volunteer service (22 pages). Prepared as a discussion paper for those concerned with the programme. Starting from the objectives of the NEP/79/007 project, an analysis of the possibilities for international and national marketing was undertaken leading to a proposal for general approach to the programme. Other sections deal with "The importance of maintaining herb collection as an economic activity", a "Draft Blueprint for local Ayurvedic production", and "some project-specific suggestion".

7. Pyrethrum cultivation in Helambu, Field Visit Report, 15 December 1982; together with B. Dominicus, Netherlands Development and Volunteer service, (11 pages + annex).

An evaluation of pyrethrum cultivation by private farmers in Helambu, plus a proposal on how to set up and implement an extension programme for private growers in Nepal.

8. Proposal for re-structuring the Doti branch of the Herb Production and Processing Company 28 December 1982; together with B. Dominicus, Netherlands Development and Volunteer Service (38 pages)

Detailed proposal containing:

- analysis of present activities and proposal for new approach
- proposal for local production of ayurvedic medicine
- development of essential oils
- proposal for economic mapping
- suggested workplan for the Doti branch next year.

9. Proposal for the development of Tamagardi Herbal farm, 15 February 1983; together with G. Amatya, Extension Officer, HPPC (20 Pages)

Contains an analysis of the present farm operation and offers a proposal for further development.

10. Cost-benefit of cultivation of Rauwolfia serpentina in Nepal, 17 February 1983 (6 pages).

Based on production costs at Tamagardi, amended for some proposed improved practices.

11. Cost-benefit analysis on the production in Nepal of some essential oils 25 February 1983 (28 pages).

Covers citronella, lemongrass, mentha arvensis and palmarosa.

Also contains an estimation of operational costs at Tamagardi herbal farm.

12. Report on a visit to investigate the possibility of setting up an extension programme for herb cultivation in Eastern Nepal, 4 April 1983; together in with G. Amatya, Extension Officer, HPPC (7 pages).

Contains a proposal for an extension programme for belladonna, pyrethrum, Rauwolfia, and aromatic plants along the Tarhara-File corridor, using Tarhara herbal farm as a base. The paper also proposes a herb collection centre in Dhankuta, given the large quantities of herbs passing through the town.

13. Report of field visit to Doti, 22 June 1983 (6 pages)

In view of some changes in the situation, the "Doti" project had to be amended somewhat. The report gives recommendations regarding the selection of a new site, and proposes a work programme for next year.

14. Status report on RDRL's pilot plant, 18 July 1983

The report contains an analysis of present organisational and technical problems encountered, and a costing of the pilot plant operation. It also offers recommendations for future operation.

