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ASSISTANCE TO THE PERFUMERY INDUSTRY OF KANNAUJ DISTRICT

UC/IND/86/016

INDIA

Terminal Report*

Prepared for the Government of India
by the United Nations Industrial Development Organization

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EXPLANATORY NOTES AND ABBREVIATIONS

UP	Uttar Pradesh
RRL	Regional Research Laboratory
otto	Steam volatile flower oil
HBTI	Harcourt Butler Technological Institute, Kanpur.
CIMAP	Central Institute of Medicinal and Aromatic Plants, Lucknow
NBRI	National Botanical Research Institute, Lucknow.
CSIR	Council for Scientific and Industrial Research
UPSIDC	Uttar Pradesh State Industrial Development Corporation
ESCAP	Economic and Social Commission for Asia and the Pacific
EOAI	Essential Oil Association of India
attar	a steam volatile oil (usually from flowers) absorbed by a base oil (usually sandalwood or parrafin)
lakh	100,000
crore	10,000,000
rupee	approximately $US 1 = 12.7 rupees (1/10/86)
concrete	the solvent extract of a plant (usually perfumery)
absolute	the dewaxed plant extract obtained after the alcoholic solution of a concrete has been filtered and concentrated.
ISI	Indian Standards Institute
BP	British Pharmacopoeia
ISO	International Standards Organisation
GLC	Gas Liquid Chromatography

I. INTRODUCTION

The Indian Government has recently recognised the need of assistance for the essential oil industry in the Kannauj district of the state of U.P. (Uttar Pradesh) in India (Annexes I-III)

The city of Kannauj has a population around 60,000 (1981 census) with the surrounding area Tehsil Kannauj (population 600,000) District Farrukhabad occupying around 90 square kilometers at 27°N, 80°E on the River Ganges. Average yearly rainfall in this subtropical climate is 793 mm. Annex IV gives rainfall figures for 1985 along with available temperature data. No rain was recorded for February, March, April, May and November. The wettest month was September with 541.2 mm. Temperature maxima and minima vary from around 23 to 44°C in summer and 5 to 22°C in winter. Kannauj is situated on a railway line of 1 metre gauge and consequently suffers higher transport costs for necessary commodities (e.g. coal) than centres on the main broadgauge Delhi-Kanpur line. Detailed soil analyses for the Kannauj district are not available. The soil is gangetic alluvium of high pH (9.5).

This former mighty Hindu city was simultaneously a leader in the development of perfumes. Evidence exists for organised trade in perfumes in Kannauj as early as 1000 A.D. (Ref.1,Annex V). Documentary evidence also exists to indicate that the perfumery industry was well established in the reign of Emperor Akbar (1556 - 1605 AD) and rose otto is said to have been first noticed in 1612 AD. A world wide reputation for perfume production from Kannauj and other U.P. centres was maintained for centuries. With the recent advancement of scientific knowledge and the development of distillation technology, the world-wide impact of these centres diminished.

The technological status of the traditional perfume industry in the area has been well described by Guenther in 1949 (Ref.2) and a team from the Harcourt Butler Technological Institute (HBTI) in 1958 (Ref.3,Annex 5). The U.P. state government sanctioned a scheme for the development of the essential oil industry in the state in the year 1948-49. Initially this took the form of two consecutive 5 year plans. HBTI was selected to study the cultural and chemical aspects of Indian perfumery and essential oil bearing plants. Thus the development of the industry was approached with enthusiasm at HBTI until the mid 1970's when a revision of priorities and re-allocation of funds severly curtailed this research and development. Although other institutions (e.g. CIMAP - Central Institute of Medicinal and Aromatic Plants, NBRI - National Botanical Research Institute and

RRL Jammu; for publications see Annexe V, References 1, 4-7) continue some developmental work on species relating to the Kannauj district, their geographic and communicative distance from the Kannauj planters and processors results in minimal benefit to local producers. These institutions are all controlled by the CSIR (Council for Scientific and Industrial Research) and are not related to state industries (for infrastructure, see Annex VI). One of these institutions published a review of the essential oil and perfumery industry of north India (Annex V, Ref.1). The objectives were to "establish the lost image" of the industry and as a result twenty five rather general recommendations for enhancing the industry were made. A brief overview of the industry in India was presented at the UNIDO/Govt. of India/ESCAP Workshop on the Essential Oil Industry (1981) (Ref.8) and more recent research and development emphases are seen in references 9,10 (Annex V).

With the Kannauj District industries thus "at the c sroads", the Indian Central Government Ministry of Industries, New Delhi, through the United Nations Development Programme sought assistance for the industry. The immediate objective was to field a 2-man mission comprising a Chemical Technologist and Industrial Economist to assess the present status of the industry and determine the nature of the assistance required to enhance its capability and utility with a view to maximum utilisation of local resources. The mission then was exploratory, seeking to accomplish a first hand survey of the industry in order to assess its present merits, defficiencies and needs.

II. SUMMARY

The mission took place from 14 September to 1 November 1986. After briefing in Vienna and Delhi, the consultants were attached, through the Central Government Ministry of Industries to the U.P. State Industries Development Corporation(UPSIDC), the government implementing agency. U.P. desk and consultive work was carried out in Kanpur, the closest industrial city to the Kannauj district. Kanpur (population around 2 million) has developed a reputation in its own right in the field of essential oil and perfumery distillation, research and development.

Factory inspections and plantation visits, with one exception (Annex VII -No.1) were restricted to the Kannauj district. In Kannauj itself, a meeting was arranged for all persons interested in the local essential oil and perfumery industry. About fifteen local perfumers and distillers attended to discuss the needs of the industry with the consultant (Chemical Technologist) and the UPSIDC.

Visits were made to institutions undertaking research, development and quality control of essential oils. These were situated in both Kanpur and Lucknow, the U.P. State capital.

Inspections took place from 30 September to 10 October 1986 and all industries, plantations, institutions visited and people with whom discussions were held are listed in Annex VII.

On 9 October the Industrial Economist arrived in Kanpur and provided economic and marketing input to the work of the mission.

The latter part of the mission was spent organising and analysing information and data, and compiling this report and associated project document. Throughout the mission, discussions with various members of the government Industries Ministries were held.

III. FINDINGS AND OBSERVATIONS

The perfumery products for which the Kannauj district is most famous are sandalwood oil and rosa attar. The enhancement of the industry would then primarily concern the more efficient production of higher quality samples of these two oils. These improved methods, when applied to secondary or new products from Kannauj would enhance the total industry.

The UPSIDC provided a basic list of Kannauj produced oils (Annex VIII). The major products then are sandalwood (Santalum album) oil (35 tonnes, 700 lakhs), attars[(mainly of rose, Rosa damascena; jasmin: Jasminum Sambac, "bela"; J. grandiflorum, "chameli"; J.auriculatum, "juhi"; fragrant screw pine, Pandanus odoratissimus,"Kewda";"Mehndi" Lawsonia alba and hina (a mixture))(20 tonnes 500 lakhs), vetiver (Vetiveria zizanioides) or "khus" oil (3 tonnes, 120 lakhs), seed (dill, celery, carrot etc.) oil (3 tonnes, 90 lakhs), rose (Rosa damescena) oil (0.025 tonne, 25 lakhs), nagarmotha (Cyperus scariosus) or cyperus oil (1.5 tonnes, 15 lakhs), perfumed waters (mainly rose or Kewda) (30 tonnes, 3.6 lakhs) and calamus (Acorus calamus) oil (0.5 tonnes, 2.5 lakhs).

Kannauj producers have extensive price lists which include many products not distilled in the area and many products not in stock, but which can supposedly be provided at the customer's request.

There are points of the present industry worthy of commendation. The very fact that so many producers are still in business in Kannauj making a reasonable living for themselves and providing employment for hundreds of the local community, is of merit. Distillers are showing enterprise by making the most of i) their wide range of raw materials, ii) their abundance of inexpensive labour, iii) simple and economical distillation processes, iv) the world wide demand for their quality products and v) their return from sales.

There are however many difficiencies that can be highlighted as well. To quote a recent Indian reviewer "Indian rose oil which was once known in the world market for its quality is now losing its significance due to high prices and deterioration in quality" (Annex V - Ref.1).

Our observations have also indicated that the cultivation of raw materials seemed minimal and basic, processing, although generally effective was antiquated and inefficient, quality control was only available from a distance (and after considerable time) and marketing was lacking in thrust and initiative.

Consequently, in order to enhance the industry, the needs at every level

must be addressed.

III.A. Raw materials

At least three fairly complete lists of the commercial essential oil bearing plants of the world have been compiled in recent years (Annex V-Refs.8,11,12). Of these, India is indicated as producing 35 (1981-Ref.8) or 43 (1984-Ref.11). These are contained in Annex 9. Around 50% of these are listed as being available from the Kannauj perfumers.

Observations relating to the raw materials used by the Kannauj perfumers were as follows.

III.A.1. Sandalwood The valuable oil (Rs 2000/kg.) obtained from this raw material is the pivotal product around which the Kannauj industry rotates. It is India's most valuable essential oil export crop. Recently however Indonesia has overtaken India as the world's chief supplier of sandalwood oil (Annex V, Ref.11). Present production of around 35 tonnes gives a total value of around 700 lakhs to the Kannauj district.

The oil is distilled from the heartwood and roots of Santalum album after they have been chipped and reduced to powder. Chipping is labour intensive as it is done manually but powdering is accomplished by electrically driver hammer mill grinders. Most of the raw material is obtained from the Mysore district of Karnataka where the Department of Forests controls the harvesting, sale by auction and regeneration of Sandalwood for supply to other centres. It is said that Karnataka itself is now constructing a large scale distillation plant for the processing of the wood. Whether these schemes will restrict the supply of Sandalwood to the north remains to be seen. It is claimed that some Kannauj attar producers are already buying the oil rather than the wood for processing. Such a trend would lead to a severe under-utilisation of the distillation capacity in Kannauj. Although it may sound uneconomical to transport the sandalwood all the way from Karnataka to Kannauj before distillation, transport costs are low (approx. Rs.2/Kg.) compared to the cost of raw materials (Rs.50/Kg.) (See Annex X)

Steps need to be taken to ensure a continual long term supply of sandalwood to Kannauj. No serious attempts seem to have been made to cultivate the species in the Kannauj district. Some reported attempts at cultivating the species outside the Mysore area have met with no success as the oil quality has not been maintained. It is unlikely though that a scientific approach that documented environmental, soil, and climatic conditions over a period of time was used.

Such trials are naturally long term as the tree itself cannot be harvested before 30 years and reaches optimum maturity only after 50 or 60 years.

To have a plantation in the Kannauj district would not only ensure future supplies of the raw material but minimise transport costs when harvesting had commenced. Such a long term proposal would hardly be of interest to the local distillers but may be necessary to ensure supplies of raw material. The Sandalwood oil that was once produced in Australia from Santalum spicatum is now no longer available due to short-sighted management policies.

III.A.2. Rose: The flowers of rose, principally Rosa damescena, are used for the production of rose oil (or otto), rose attar, rose water, and in some countries, rose absolute. Natural rose oil is the steam distilled essential oil obtained from rose petals. An acceptable yield is about 0.03% and this product brings about Rs.50,000/Kg. on the international market. According to the U.P. government, annual local production is around 0.025 tonnes compared to 4-10 tonnes for the rest of the world.

For the production of rose attar, the oil obtained from the water distillation is passed directly into a fixative as base oil which is most commonly either sandalwood or paraffin oil. The exact quantity of rose oil in the fixative is not known. A chemical means of determining this has not yet been developed. The quality of an attar is then based on organoleptic evaluation. A rose attar in a sandalwood base will sell for around Rs.4000/Kg.

A third product, rose water, is the product obtained from the water distillation of fresh flowers. The water is left to mature for 2-3 months and sells for Rs.20-40/Kg. Rose water has medicinal as well as perfumery use as it is used to treat opthalmia. When rose petals are soaked with sugar, a "gulkand" is formed which is used to treat constipation.

Rosa alba grows with a white flower and is used for perfumery purposes in Bulgaria. Rosa centifolia has pinkish flowers and is grown in France and Morocco. There is also a second variety of Rosa damascena Bourbon hybrid called Rose "Edward" or "Cheenia" which grows well in the Kannauj district but has an inferior perfume and is used for attars. For the production of rose absolute, the petals are extracted with an organic solvent, the extract concentrated, the resultant concrete dissolved in ethanol the waxes filtered off and the filtrate concentrated. Rose absolutes are produced chiefly in France.

Rosa damascena has two flowering seasons in Kannauj but does not flower at all in South India. In the north the most abundant flowering occurs in March-April with a secondary burst of bloom in September-October. Bushes are usually pruned back to about 10 cms from the ground in November-December. Experimental plots have shown that 7,000 plants can be stocked per hectare and yield around 7 tonnes of flowers. The oil yield from flowers is a maximum after 4 years and the life of a plantation is from 15 to 25 years. Flowers need to be picked early in the morning and distilled as soon as possible to obtain maximum oil yield and quality. Storage in saline can retard breakdown.

In excess of 700 hectares of rose are under cultivation in U.P. Many growers are however switching to other more profitable crops. The soil for rose cultivation is light and alluvial and very alkaline (pH 9.5). New plantations are established from cuttings planted in rows 60 to 100 cms apart. Plucking is by hand and blooming can last 40-60 days. Little attention has been given to pests and diseases or fertilisation. The regular application of cow manure and irrigation water is practised. A recent extension article on rose cultivation (Annex V-Ref.7) is available but does not seem to have been read and studied by the Kannauj growers. CIMAP is also continuing research on rose (Annex V,Ref.4).

Obvious difficulties are encountered in delivering the rose flowers to the stills early in the morning so that distillation can be completed for optimum oil yield and quality. Many of the distillers claim yields than are about one tenth of the Bulgarian yields or even one tenth of the yields claimed for experimental plots in India (Annex V-Ref.4,7)

The largest proportion of rose is collected and distilled in the Aligarh district and the oil then transported to the distributors in Kannauj. Smaller quantities are processed in the Kannauj, Ghazipur, Lucknow, Kanpur and Bareli areas. Annual figures provided by the UPSIDC show that 20 tonnes of attars (predominantly rose) are currently produced which at an average price of Rs.2500/Kg bring a total of 500 lakhs into the region (Annex VIII).

The procurement of the raw material for rose distillation leaves much to be desired with respect to cultivation techniques and more importantly procedures whereby the flowers can be delivered to the stills without quantitative or qualitative loss of aromatic material.

III.A.3. (Vetiver (Khus): Vetiver is the third most important essential oil and perfumery product in terms of returns for the Kannauj industry. At present, an annual production of three tonnes at Rs.4000/Kg. bring in around 120 lakhs. The oil is obtained by the steam or water distillation of the roots of the grass, Vetiveria zizanioides and yields can vary even outside the typical 0.4-1.3% figures. The oil has great value in the perfumery trade as a fixative. Vetiver grass grows wild throughout India along the banks of rivers and marshy land. It grows in any soil with sandy loams the most suitable. Harvest conveniently takes place in winter when rose is not being distilled. One hectare can grow up to 2 tonnes of roots and oil content increases over a period of 12 months. The north Indian oil is sold at more than twice the oil from the south because of higher digging and distillation costs. Although some yield investigations have been carried out (Annex V-Ref.3) the cultivation of this species would benefit from more thorough investigations of an agronomic nature. The world demand for vetiver oil is encouragement enough to persevere with this species provided adequate quality and quantities can be produced.

A very recent press announcement of a grant to India of 10 crore from the World Bank for vetiver production indicates the potential this crop holds if cultivation and processing techniques are perfected.

III.A.4. Seed Oils: Although seed production in Kannauj was not observed, the distillers give high priority to processing seed oils. The western world however prefers to import seed and distill it themselves rather than import the oil. There seems to be enough demand for seed to encourage the cultivation of dill, celery, carrot, parsley and cumin seed oils. These oils find greater use in flavours and medicines than in perfumes.

III.A.5.Attars: Attar of rose was adequately described under III A.2. Other flower oils also have high priority with the Kannauj distillers. Three varieties of jasmin,"bela", "chameli" and "juhi" yield commercial attars. The area under plantation seems to be declining each year due to lower flower prices and the development of cheaper perfumes. "Bela" flowers are bought for Rs.5.50/Kg. somewhat more than rose (Rs.4.50/Kg.) or Mehndi (Rs.3.50/Kg.). Attar Gulhina is produced from Mehndi flowers in north India. They are widely grown on the roadside and at the edge of fields as they are taller than jasmin and rose which are cultivated in rows. A significant amount of Kewda attar is produced from Pandanus odoratissimus growing in Orissa. Hina attar is obtained by distilling a mixture of aromatic ingredients. The mixture of materials like vetiver, patchouli, saffron, musk, mehndi, ambergus, jatamansi, agarwood, nagarmotha etc. is usually confidential and hence unique to a particular producer. Some distillers produce a "clay pot" or "earth" attar which after 40-50 days of distillation give the odour of "earth-after-fresh-rain" arising from an aromatic component with an extremely low odour threshold value.

The demand for these attars does not seem high enough to devote intense effort into enhanced production.

III.A.6. Others: There are less significant species being distilled in the Kannauj district. For example nagarmotha (Cyperus scariosus) is currently produced at around 1.5 tonnes annually (value 15 lakhs) and calamus (Acorus calamus) at 0.5 tonnes (value 2.5 lakhs).

In conclusion, raw materials are available for the successful production of essential oils and perfumery products. Care is needed however on two fronts. Firstly the value of raw materials should be appreciated and every effort should be made to ensure their continual supply especially in the case of sandalwood. Cultivation methods need to be examined closely for the production or products in maximum yield with maximum quality especially in the case of rose. Secondly alternative raw materials need to be examined so that in the event of non-availabilit of a major raw material such as sandalwood, other options are available. For this to be achieved a thorough perfumery/flavour/medicinal evaluation of the Indian flora needs to be documented in a similar way to the Australian flora (Annex V-Ref13) Consequently a list of essential oil bearing plants that could be used by producers or cultivated for their use, needs to be maintained along with their appropriate cultivation agro-techniques.

III.B. Processing

Two types of distillation units were commonly employed in Kannauj. Both of these were constructed of copper and lined with tin internally. Copper, although more expensive as a raw material now, is still abundant in the district due to the antiquity of the industry and the consequent availability of copper from other factories. As it is also easy to work, it remains the preferred material for still construction even for new factories. These factors have then discouraged the construction of stills, condensers and separators from other materials.

III.B.1. Essential Oil Processing: For the distillation of essential oils such as sandalwood, cyperus and vetiver, steam is generated in a coal fired boiler (either an ex-locomotive or a locally constructed boiler) and passed into the still pot of capacity from around 0.5 to 1.2 tonnes. There are about 13 such distillation units in Kannauj. Distillation times are variable, particularly for sandalwood were from 5-15 days continual distillation is necessary to exhaust the charge. A general rule was that one day of distillation (24 hours) was required for each 100 Kg of sandalwood powder in the still pot. Very few distillers have attempted to insulate their still pots.

Condensers were of the "shell-and-tube" type and separation was usually done with at least 2 separators followed by a trap to remove any unseparated oil. Water, especially condenser water, was recirculated. Water shortage is not a problem due to the proximity of the Ganges and the consequent height of the water table. Powder shedding on the other hand is often a problem and emergency generators have been installed to ensure a continual electricity supply. Problems are sometimes encountered with coal supply. Increasing costs and poorer quality (greater dust content) have added to running costs. Transport costs for coal are higher for Kannauj on the one metre gauge than for places like Kanpur on the wide gauge railway line. Some distillers report only a 10% efficiency of energy transfer in the distillation process. Typical essential oil yields are 5.5 - 6.5% for sandalwood, 0.1 - 1.0% for vetiver and 0.4% for cyperus. These values seem acceptable for the industry.

III.B.2. Attars: Attars are obtained by the water distillation of about 40-50 Kg of plant material (usually flowers) in "Dag Bhapka" units (See Diagram-Annex XI) There are more than 50 distilleries with such units. The material is heated for 4-5 hours with firewood to give better control of temperature and rate of distillation. The vapour leaves the still pot via a goose-neck outlet and passes into an air-condenser tube and receiver sitting in a tub of water. The receiver contains 5 Kg of base oil (sandalwood or paraffin) to absorb the flower oil. Although there is no reliable way of measuring the percentage of flower oil in the base, it is estimated that 5 Kg is distilled giving an oil yield of around 0.01% (for rose) and an attar with 0.1% flower oil.

Attar production seems the most traditional of the Kannauj processes and hence most open for the application of more advanced technology. As India is the only attar producing nation, no overseas expertise can be drawn on for the enhancement of production. Improvements to the process would only be available after considerable research and development.

Some research and development resulting in suggestions for improved stills have been carried out (Annex V-Refs. 3,7). Knowledge of these possible improvements has not been adequately disseminated to the processors as no implimentations seem to have resulted. Further experimentation may be necessary and certainly better extension work, as the processing steps, especially for attars, should be able to be enhanced greatly.

III.C. Quality Control: Facilities for quality control at the production plant were non-existent in Kannauj. Quality control consisted of a simple organoleptic appraisal by the producer which could only be related to the previous experience that the producer had had in assessing similar oils. The producers are then very dependent on the goodwill of the purchasers in the trade.

The closest institution for the determination of the quality of essential oil products in accordance with the Indian Standards Institute (ISI), British Pharmacopoeia (BP), International Standards Organisation (ISO) or equivalent is 90 Km distant. H.B.T.I. has in the past, especially from 1950-1965 when essential oil research and development had high priority, investigated the physical (optical rotation, refractive index, relative density and solubility in alcohol) and chemical (alcohol, ester, cineole, etc. content) parameters of many oils. HBTI continues to provide this service for a fee even though research priorities have changed. Such analyses become practical laboratory exercises for students at the institute. This service however is too distant from the producers to reliably monitor the quality of their oils. Similar quality control services are available at greater distances (e.g. CIMAP, RRL Jammu and Central Control Laboratory Ministry of Food and Agriculture, Delhi).

Although ISI is not yet including gas liquid chromatographic (GLC) profiles in new standards, they are becoming routine for inclusion with ISO and national (e.g/ Australian) standards. Hence access to good quality GLC facilities is most important for the quality control of the Kannauj products. Although GLC facilities are available at HBTI they are in constant demand by other users and unable to be used for essential oil analysis. In addition these machines are outmoded and do not utilise the superior high resolution columns that are necessary and widely used internationally for routine essential oil quality control.

Such a facility would give the Kannauj producers quality control on their essential oils and should also be able to determine the quantity and quality of flower oils in attars. Some CSIR institutions (e.g. CIMAP, RRL Jammu) have better facilities that include not only high resolution GLC but nuclear magnetic resonance, and GLC-mass spectrometry but their distance from Kannauj, higher rates, the time required for analysis and the communication of results mean little benefit to the Kannauj distillers.

With the varying quality of the Kannauj products and the stringent requirements of standards at the International level, it is most important that the Kannauj producers have close access to optical rotation, refractive index, relative density, solubility in alcohol and gas chromatographic determinations.

III.D. Research and Development: Research and development within the perfumery industry in the Kannauj district is almost nil. The occasional farmer or producer has varied parameters (e.g. the application of manure and mulch to rose plantations) and noted results. The benefits of such trials are not evident as they remain undocumented and unbroadcast.

The research and development work carried out by institutions such as NBRI, HBTI, CIMAP, and RRL Jammu (See Annex V-Refs. 1,3,4,7) is very relevant to the Kannauj industry. Communication problems however have prevented these findings from reaching the people who would benefit most from them. Discussions with producers have shown that they are unaware of such research and development and find it difficult to obtain information relating to recommended improvements.

The research carried out has been of high standard. By necessity however, the cultivation plots (e.g. See Annex V, 3,5,& 7) are small, and although the results show trends, full extrapolation to commercial plantations may not be possible. The genetic improvement experiments on rose have shown individual plants with up to 0.06% oil yield. (Annex V-4). These are the results that need follow up so that benefits from such experiments can be passed on to the farmer.

The construction of improved processing plants on a pilot scale may not extrapolate fully either to a large commercial still. Thus some reluctance to impliment research findings into the distillery was evident.

Further research could be carried out on the chemistry of the lesser known oils and particularly on the structures of desirable components. Where some of this research is beyond the reach of the instrumentation available to the industry, simple parameters such as variation in oil composition in raw materials of different origins and collected in different seasons could be measured. Experiments measuring trends in oil yields are also important. For example factors like the post-harvest decrease in oil yield from rose need quantification if maximum yields are to be obtained. Also as already mentioned in Section III.A, reliable lists of alternate essential oil crops would be of value to the producer.

For example the potential of citrus oils as a by-product from the fruit juice industry has not been fully exploited in India.

Research and development into the areas of synthetic and semisynthetic perfumes would also be useful. This development would be completely new to the Kannauj district and would hence require the initiation of a new project relating to the chemical technology of synthetic perfumes. If some of the essential oils produced already can be used in synthetics then this avenue needs further investigation. The synthesis of camphor and menthol from turpentine oil, already taking place in parts of India, is a good example of this.

The fractionation or rectification of oils to produce pure components is a closer reality for the Kannauj distiller. In other parts of India menthol is being isolated from Mentha arvensis oil, geraniol from palmerosa oil and citral from lemongrass oil. Citral can be converted to ionone which in turn can be used to synthesiseVitamin A. The industry does however have a cheaper lemon oil from Litsea cubeba.

There is then a wealth of research and development that could be of great benefit to the present and future essential oil industry.

III.E. Management - Personnel Training: Very few of those involved with the Kannauj industry seem to have undergone specific training in the field. Some individual entrepreneurs attend the International Congress of Essential Oils held every three years in different parts of the world. Attendance at such Congresses enables the producers to learn of new crops, new products, improved techniques, the horticulture and chemistry of oil crops, the latest market developments etc.

The Essential Oil Association of India (EOAI) holds regular seminars and conventions (about 2 days duration) (Annex V-Ref.10) and also training schools (about 2 weeks duration) for the dissemination of information on the industry from the basics to the latest in research findings. The training school only attracts about 15 participants. The Association (EOAI) also publishes a quarterly journal "Indian Perfumer" for scientific papers relating to aromatic plants. The Perfumer and Flavourist's Association of India also publishes a quarterly journal which has less scientific emphasis and more space devoted to trade. The perusal of international marketing reports such as the New York "Chemical Marketing Reporter" is essential for keeping abreast with current prices.

The industry needs to present a united front on matters where it feels it is being unjustly treated. Perhaps through groups such as the Kannauj Perfumers Association, representation can be made to the EOAI, ISI and other bodies. For example, the fact that sandalwood root produces an oil so superior that it falls outside the wood oil specifications can be brought before the ISI essential oil committee with the request that a higher grade specification be written for ISI, ISO and BP standards. Also matters relating to excessive excise on sandalwood oil, the poor quality and high price of coal and transportation difficulties can be brought to the government's attention with a united front.

III.F. Marketing. Almost all the essential oil and natural perfumes ("attars") produced in the Kannauj district are sold within India. The ultimate destination of some of the products is the Arab world (especially the attars). Since very few of the Kannauj producers export directly, it is very hard to estimate the percentage finally exported. Of the essential oils produced, it would appear that only sandalwood is exported and it is dispatched in the same indirect way. Other essential oils are either not in demand internationally (e.g. nagarmotha oil) or their prices are not competitive on the international market.

In view of the scarcity of information readily available, and the short term nature of the mission, it was impossible to gather sufficient data to undertake a full costing of the different products. However in Annex X we produce some cost data that may serve as starting data for future cost analysis.

III.F.1. International Markets: Whereas previously, rose oil produced in the Kannauj district was exported (Annex V-Ref.1), this is no longer the case in view of the high price for this item with respect to world markets. For sandalwood oil, a similar development may take place. Already the prices quoted by Kannauj producers exceed world market prices (Annex V-Ref.5) and the cheaper Indonesian sandalwood oil seems to be cornering the world market (Annex V-Ref.11).

III.F.2. Domestic Markets: For essential oils, as for several other products, Indian government policy is to protect the national industry by means of import controls and import duties. This is especially so for essential oils produced in India. This may explain why many of the oils that are produced in the country are more expensive than the same products available on the international market. This is the case for essential oils e.g. rose, citronella, geranium, lavender, Mentha arvensis (Japenese mint), patchouli and vetiver. While a policy of

of continued protection of natural products may be desirable from a national viewpoint, it does not provide the necessary incentives to render the industry more competitive and enable it to compete internationally.

III.F.3. Market Threats: The essential oil and perfumery industry in the Kannauj district appears to have arrived at a crucial point in its history and certain modifications are required if the industry is to expand further or even maintain its present performance.

Several developments threatening the industry are occurring simultaneously:

i) In the national markets, the traditional products (mainly attars) are losing importance to the cheaper synthetic perfumery compounds. These have become more popular due to increased demand for newer consumer articles such as toiletives, cosmetics, aerosols and the like.

ii) At the local level, the industry is having greater difficulty in obtaining the required raw materials (e.g. sandalwood, see III A.1)

iii) Farmers are switching to other more attractive crops, rather than rose. This is possibly caused by the effects of improved cultivation techniques and higher yields for competing crops. These developments have not occurred with rose cultivation.

iv) Raw materials from wild sources are becoming more scarce as forest and marginal lands are increasingly brought under cultivation. This seems to be the case for vetiver (khus) among others. As a result, the cost of raw materials increase considerably (see Annex XII).

v) Traditional distillation processes rely heavily on fuelwood as an energy source. Due to deforestation, fuelwood prices have increased considerably in the last several years.

vi) The industry does not keep place with the developments in the international market by following international price movements or maintaining regular quality control and adequate sampling methods. This leaves the producers at the whim of the purchasers.

Kannauj essential oil and perfumery products will only survive in the market place if these threats are dispersed. This can only be done by completely overhauling the industry and providing some external support until it meets the challenges brought by a more competitive environment.

IV. CONCLUSI NS AND RECOMMENDATIONS

The chief short-comings of the Kannauj essential oil and perfumery industry relate to high prices and variable quality. The former can only be rectified by improving techniques that will increase the yield per unit cost. The latter can be overcome by checking oil quality frequently before products are mixed or dispatched to the purchasers. Attempts will subsequently need to be made to raise the standard of marketing at international levels.

To achieve this, the following is recommended:

1. that steps be taken to ensure the long term continuity of supply of raw materials such a sandalwood by a) encouraging sound, equitable management of such resources and b) investigating the possible long-term cultivation of such crops in Kannauj.

2. that the cultivation of raw materials be re-examined in the light of the latest agronomic techniques to produce maximum quantity and quality of raw material

3. that improved post-harvest treatment of flowers be investigated and implimented

4. that modern quality control facilities be made available to the Kannauj distillers in Kannauj itself.

5. that attempts be made to reduce costs. For example the cost of wood for fuel for attar production could possibly be reduced by planting a fast growing tree such as "ipil-ipil" and approaches could be made to the government about issues where the Kannauj industry thinks it is being treated unfairly(e.g. excise duty on sandalwood, the quality and cost of coal, and Kannauj's disadvantageous transport costs in being situated on the metre gauge track)

6. that attempts be made to increase oil yields through improved processing technology and pilot plants.

7. that research and development into alternate commercial essential oils, both established and new, be undertaken.

8. that research and development into alternate enterprises relating to the essential oil industry (e.g. pure isolates by fractionation, natural oils as a source of starting materials for semi-synthetic compounds, perfumery synthetics, the use of local perfumes in aerosol sprays, etc.) be considered.

9. that the effectiveness of marketing methods be increased by
   a) continually following up international market prices and communicating movements to the producers,
   b) introducing standardised sampling and packaging methods that are internationally accepted,
   c) introducing more attractive labels and price lists,
   d) keeping in touch with new developments in the industry by attending international congresses and seminars.

These recommendations could be best met by the establishment of an Essential Oil Service Centre in Kannauj with the following functions:

i) quality control of essential oil and perfumery products
ii) investigation of the agronomic and post-harvest technology required to optimise the quantity and quality of essential oils in raw materials before processing.
iii) investigation of improvedprocessing methods.
iv) research and development into alternate crops and alternate enterprises relating to the essential oil and perfumery industry.
v) investigation of ways of increasing marketing effectiveness.
vi) maintain a library and information service on all aspects of the essential oil industry relevant to raw material cultivators and collectors, harvesters, processors, formulators and marketers.

Kannauj would be the location of choice for such an institute because of it's proximity to the growers. Kanpur, although possessing better service facilities, is too distant as the results of the Essential Oil Scheme at HBTI indicate. Although the functions of such an institute fit well within the CIMAP programme at Lucknow, the distance to Kannauj is totally unmanageable unless a well equipped regional centre at Kannauj was established.

There are other areas in U.P.(Aligarh Jaunpur and Bareilly) that are closely associated with the Kannauj industry that would benefit from such a centre. Indeed for the benefit of the whole industry, the duplication of quality control, pilot plant facilities and investigative services at these centres as subsequent phases of this programme, would be desirable.

ANNEX I

UNITED NATIONS

R.O.B. Wijesekera

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

17 February 1986

JOB DESCRIPTION

Post title Chemical Technologist 11-51

Duration 1.5 mm.

Date required As soon as possible

Duty station Kannauj District (India)

Purpose of project To assess the present state of the Perfumery Industry in Kannauj district and determine the nature of assistance required to enhance its capability and utility with a view to maximum utilisation of available natural resources.

Duties

The consultant will make a study of the present condition of the Perfumery Industry in Kannauj with respect to the following:-

a. Raw materials available and presently processed.
b. Present processing technology
c. Present commercial practices

and recommend action to be taken in regard to:-

- Standardisation of procedures for plant propagation and raw material procurement;
- Introduction of modern methods of processing and quality assessment;
- R and D inputs needed to improve and sustain the industry including training and expertise.
- Introduction of improved marketing practices, and management techniques.

The consultant will furnish a report setting out the results of his findings and his recommendations.

..../..

Qualifications

Language

Background information

The Kannauj District, Farrukhabad, UP has been traditionally a perfumery producing region, with processing of perfumes and flavours including sandal wook oil. Some of the products are offerred to international markets as well.

There is considerable potential for modernising the industry and the government has recently requested assistance to this.

ANNEX II

UNITED NATIONS RW

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

17 February 1986

JOB DESCRIPTION

Post title Industrial Economist 11-52

Duration 0.5 mm

Date required As soon as possible

Duty station Kannauj District (India)

Purpose of project To assess the present state of the Perfumery Industry in Kannauj district and determine the nature of assistance required to enhance its capability and utility with a view to maximum utilisation of available natural resources.

Duties

The consultant will join a Chemical Technologist (Team Leader) who would be studiying the industry on site and assist him with economic and marketing inputs towards realising a programme for the modernisation of the industry.

..../..

Applications and communications regarding this Job Description should be sent to:

Qualifications

Language

Background information

The Kannauj District, Farrukhabad, UP has been traditionally a perfumery producing region, with processing of perfumes and flavours including sandal wood oil. Some of the products are offerred to international markets as well.

There is considerable potential for modernising the industry and the government has recently requested assistance to this.

ANNEX III

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT DOCUMENT

PART A - BASIC DATA :

COUNTRY / REGION	:	INDIA/ ASIA
PROJECT NUMBER	:	
PROJECT TITLE	:	Assistance to the Perfumery Industry of Kannauj District.
SCHEDULED START	:	
SCHEDULED COMPLETION	:	
ORIGIN AND DATE OF OFFICIAL REQUEST	:	
GOVERNMENT COUNTERPART AGENCY	:	Ministry of Industry. New Delhi INDIA
UNIDO CONTRIBUTION	:	
GOVERNMENT CONTRIBUTION	:	
CURRENCY REQUIRED	:	
FOR UNIDO INPUT	:	
CONVERTIBLE	:	
OTHER	:	
UNIDO SUBSTANTIVE BACKSTOPPING SECTION	:	Pharmaceutical Industries Unit Chemical Industries Branch/DIO
PROGRAMME COMPONENT CODE	:	32.1.D

PROJECT DOCUMENT

1. TITLE : Assistance to the Perfumery Industry of Kannauj District.

2. OBJECTIVES

(a) Development Objective: To enhance the present capability and utility of an indigenous rural industry.

(b) Immediate Objective: To field a 2 man mission that will assess the present status of the Perfumery industry in the Kannauj district and determine the nature of assistance required to enhance its capability and utility with a view to maximum utilisation of local resources.

3. SPECIAL CONSIDERATIONS:

The Kannauj district already possesses an important perfumery industry where the processing technology is largely traditional. Rural folk are employed in harvesting natural resources and modern processing methodology can eventually generate employment and supply valuable cosmetics to rural womenfolk in the district and outside.

4. BACKGROUND AND JUSTIFICATION:

The Kannauj District, Farrukhabad, U.P., has been renowned for its traditionally based perfumery industry. Indeed it is considered India's main region for the processing of natural perfumery substances and flavouring agents. Raw materials available within the region are utilised as well as those imported from other regions in India such as eg.: Sandalwood from Karnataka. The industry produces flavour materials as well as perfumes and some of the products are also offerred to export markets.

There is considerable potential for further development of the industry which will include inter alia the following:-

- Standardised methods for propagation of aromatic plant species, and post-harvest preparation
- Introduction of modern technology for steam-distillation, solvent extraction (if required), separation and purification of aromatic constituents.
- Establishment of criteria for quality assessment based on instrumental analyses and olfactory methods.
- Introduction of modern practices of storage and marketing.

Accordingly, the government has recently recognised that the perfumery industry in Kannauj is in need of technical assistance and that UNIDO assistance in this field would be extremely useful to the country. The project therefore seeks to accomplish a first-hand survey of the industry in order to assess its present merits, defficiencies and needs. The project will also seek to identify methods of improving the present situation by utilising to the maximum the resources available in the district as well as elswhere in India.

5. PROJECT OUTPUTS:-

The project output will be a report embodying the following:

(i) A brief review of the existing state of the perfumery industry in Kannauj. This will include, assessment of the agrotechniques, post-harvest methodology, processing technology, product preparation and storage practices.

(ii) The elements of technical assistance needed in expertise, training and equipment. This will also include elaboration of strategies for processing and marketing products of improved quality.

(iii) Recommendations regarding the attainment of internationally accepted standards of manufacturing and product quality.

(iv) Recommendations for quality assessment, formulation, costing and marketing of products.

6. PROJECT ACTIVITIES AND MODALITIES OF IMPLEMENTATION:-

It is proposed to field two experts as follows:-

A. A chemist/technologist with experience in the processing and analysis of essential oils and perfumery substances using modern instrumental methods.

B. An economist with experience in the economics of production of essential oils or related commercial natural products of plant origin.

The expert A will be fielded first for 3 weeks during which he will attempt to accomplish 5(i) above. At the end of this period, the expert B will join A in the field. The two will work together for a further period of two weeks including the completion and finalisation of the draft report. They will then spend a week at UNIDO headquarters, Vienna for discussions with the UNIDO Special Adviser after which they will forward their final report. (Vide Figure).

7. PROJECT INPUTS:-

a. Government inputs (in kind)

Office accommodation for work of experts, local counterpart personnel, administrative assistance and typing arrangements, and local transportation.

b. UNIDO Inputs

Services of two experts as indicated in 6 above A and B.

		Cost Estimate $
BL 11.51	Chemical Technologist: 1.5m/m the expert will survey the present state of the industry from a technological standpoint with due regard to the need for the attainment of internationally acceptable standards for future products.	11.400
BL 11.52	Industrial Economist: 0.5m/m . The expert will assist the Chemical technologist with assessment of the needs in regard to economic aspects of processing and marketing of products.	3.800
BL 51	Sundries and preparation of report	1.000
		16.200

8. EVALUATION:-

This will be carried out at headquarters.

9. ENVISAGED FOLLOW-UP

Based on the consultants report UNIDO will formulate suitable proposals for consideration of the government of India.

UNIDO

PROJECT BUDGET/REVISION

3. COUNTRY	4. PROJECT NUMBER AND AMENDMENT	5. SPECIFIC ACTIVITY
INDIA	UC/IND/86/016	32.1.0

10. PROJECT TITLE
Assistance to the Perfumery Industry of Kannauj District

15. INTERNATIONAL EXPERTS (functional titles required except for line 11-50)	16 TOTAL M/M	16 TOTAL $	17 1986 M/M	17 1986 $	18 M/M	18 $	19 M/M	19 $	20. M/M	20. $
11-01										
02										
03										
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
11-51 Chemical Technologist	1.5	11,400	1.5	11,400						
11-52 Industrial Economist	0.5	3,800	0.5	3,800						
11-50 Short term consultants										
11-99 Sub-total-International experts **	2.0	15,200	2.0	15,200						

21. REMARKS

** If more than 16 experts required check here ☐ and attach continuation sheet 1A. This sub total must include all experts

UNIDO

PROJECT BUDGET/REVISION

4 PROJECT NUMBER UC/IND/86/016	16 TOTAL		17 1986		18		19		20	
	M/M	$	M/M	$	M/M	$	M/M	$	M/M	$
OPAS EXPERTS (functional titles required)										
12-01										
12-02										
12-03										
12-99 Sub-total-OPAS experts **										
ADMINISTRATIVE SUPPORT PERSONNEL										
13-00 Clerks, secretaries, drivers										
13-50 Freelance interpreters (non-UNDP projects)										
13-99 Sub-total-administrative support personnel										
UN VOLUNTEERS (functional titles required)										
14-01										
14-02										
14-03										
14-04										
14-99 Sub-total-UN VOLUNTEERS **										
15-00 Project travel										
16-00 Other personnel costs (including UNIDO staff mission costs)										
NATIONAL EXPERTS (functional titles required)										
17-01										
17-02										
17-03										
17-04										
17-05										
17-99 Sub-total-National experts **										
18-00 Surrender prior years' obligations										
19-99 TOTAL-PERSONNEL COMPONENT										

** If additional individual budget lines are required, check here ☐ and attach continuation sheet 1A. These sub totals must include budget lines listed on page 1A

UNIDO

PROJECT BUDGET/REVISION

4. PROJECT NUMBER UC/IND/86/016	16. TOTAL		17. 1986		18.		19.		20.	
	M/M	$	M/M	$	M/M	$	M/M	$	M/M	$
SUBCONTRACTS										
21-00 Subcontracts										
28-00 Surrender prior years' obligations										
29-00 TOTAL-SUBCONTRACTS										
TRAINING										
31-00 Individual fellowships										
32-00 Study tours; UNDP group training										
33-00 In-service training										
34-00 Non-UNDP group training										
35-00 Non-UNDP meetings										
38-00 Surrender prior years' obligations										
39-99 TOTAL-TRAINING COMPONENT										
EQUIPMENT										
41-00 Expendable equipment										
42-00 Non-expendable equipment										
43-00 Premises										
48-00 Surrender prior years' obligations										
49-99 TOTAL-EQUIPMENT COMPONENT										
MISCELLANEOUS										
51-00 Sundries		1,000		1,000						
55-00 Hospitality (non-UNDP projects)										
56-00 Support costs (CC and DC projects only)										
58-00 Surrender prior years' obligations										
59-99 TOTAL-MISCELLANEOUS COMPONENT		1,000		1,000						
99-99 PROJECT TOTAL		16,200		16,200						

PART C - CLEARANCE AND APPROVAL

R.O.B. Wijesekera

PROPOSAL SUBMITTED BY: R.O.B. Wijesekera, Special Technical Adviser, Pharmaceutical Industries Unit — Date: 8th January 1990

IN CO-OPERATION WITH:

CLEARED BY : A. Tcheknavorian-Asenbauer, Head, Chemical Industries Branch — Date:

A.A. Vassiliev, Director, Division of Industrial Operations — Date:

APPROVED BY:

ANNEX IV

Temperature for Kannauj District

Minimum	Maximum
4.6	45.8

(monthly figures not available)

Rainfall

Average 793 mm

1985 rainfall

January	15.4 mm
February	Nil
March	Nil
April	Nil
May	Nil
June	46.6
July	199.8
August	105.4
September	541.2
October	269.0
November	Nil
December	9.0

Source: Directorate of Industries, U.P.

ANNEX V

REFERENCES

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10. Essential Oil Association of India. 29th Annual Convention and Seminar, RRL Jammu, April, 1986.

11. B.M. Lawrence. A Review of the World Production of Essential Oils (1984). Perf. Flav. 1985, 10(5) 1.

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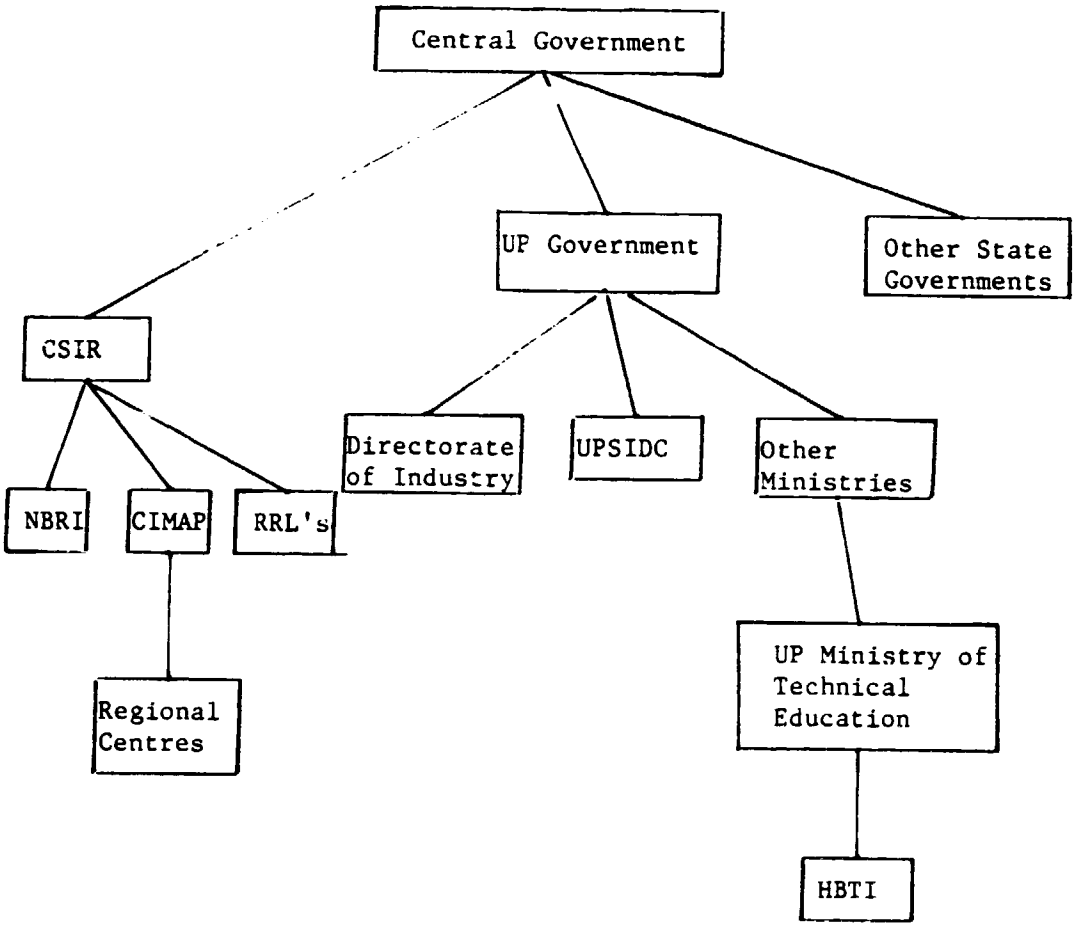
ANNEX VI

Infrastructure of Indian Government Scientific Research and Industrial Development in U.P.



ANNEX VII

List of industries and plantations observed, institutions visited and persons consulted

	Industries observed	Function
1.	Rakesh Sandal Industries, Kanpur	Essential Oil distillers, importers, exporters.
2.	Lala Pragdutt and Co., Kannauj	Essential Oil distillers and perfumers
3.	S.Mohd.Ayub Mohd.Yaqub, Kannauj	Manufacturing perfumers
4.	Kannauj Industries Co-op., Kannauj	Essential oil distillers
5.	Mannahal Sons & Co., Kannauj	Essential oil distillers
6.	Jagat Aroma Oils Distillery, Kannauj	Aromatic Oil distillers
7.	Ram Narain, Pratap Narain, Kannauj	Manufacturing perfumers
8.	Debi Prasad Sunder Lal Khattri	Perfumers
9.	H.N. Kapoor, Kannauj	Distillers of essential oils
10.	S.A. Essential Oils Pvt.Ltd. Kannauj	Essential Oil distillers

	Plantations inspected	Approx. area
11.	The Kannauj Scent Factory, Kannauj	12.5 ha
12.	Mannahal Sons & Co., Kannauj	8 ha
13.	Chandrabali and Sons, Kannauj	8 ha
14.	Lala Pragdutt and Co.(1),Kannauj	8 ha
15.	Lala Pragdutt and Co.(2),Kannauj	1 ha
16.	Lala Banarsi Dass Khattri, Kannauj	3 ha

	Institutions visited	Location
17.	Harcourt Butler Technological Institute (HBTI) (G.Chandra, retired Prof.of Chemistry)	Kanpur
18.	Indian Standards Institute, (ISI) (G.P. Saraswat, Head)	Kanpur
19.	Central Institute of Medicinal and Aromatic Plants (CIMAP) (O.P. Virmani, Project Co-ordinator)	Lucknow
20.	National Botanical Research Institute(NBRI) (A. Singh and M.L. Sharma)	Lucknow

ANNEX VII (Contd..,

Persons consulted		Position
21.	Dr. Ganesh Chandra	Retired Prof. of Chemistry, HBTI. Secretary, Essential Oil Association of India(EOA Editor, Indian Perfumer, Kanpur.
22.	S.N. Kapoor	Retired U.P.Government Industrial Chemist Hony. Secretary EOAI, Kanpur.
23.	Dr. G.N. Gupta	Retired Head, Essential Oil Scheme, HBTI, Kanpur
24.	Kannauj, Essential Oil & Perfumers Association	Approximately 15 representatives, Kannauj
25.	M.L. Shukla and Co.	Essential Oil Producer
26.	D. Dayal	Commissioner and Director of Industries, Kanpur
27.	S. Sainger	U.P. Industries Ministry, Kanpur
28.	R.N. Triveda	Managing Director, UPSIDC, Kanpur.
29.	S.K. Agrawal	Manager (Projects), UPSIDC, Kanpur
30.	G.R. Barua	Joint Director of Industries, Allahabad.

ANNEX VIII

Essential Oil products currently produced in the Kannauj District

Name	Approx.quantity (tonnes)	Value (Rs. per Kg)	Total value (lakhs) Rs.
Sandalwood Oil	35	2,000	700
Attars	20	2,500	500
Vetiver Oil	3	4,000	120
Seed Oils	3	3,000	90
Rose Oil	0.025	100,000	25
Nagarmotha Oil	1.5	1,000	15
Perfumed Waters	30	12	3.6
Calamus Oil	0.5	500	2.5

Source: UPSIDC

ANNEX IX

The commercial essential oil bearing plants of India

Common Name	Botanical Name
Agarwood	-
Ajowan	Carum ajowan
Ambrette seed	Hibiscus abelmoschus
Ammoniac gum	-
Anise seed	Pimpinella anisum
Artemesia	Artemesia vestita
Asafoetida	Ferula asafoetida
Balm	Melissa officinalis
Basil	Ocimum basilicum
Bergamot mint	-
Calamus	Acorus calamus
Cardamom	Elettaria cardamom
Cedarwood (Deodar oil)	Cedrus deodara
Celery seed	Apium graveolens
Celery herb	Apium graveolens
Chamomille	Anthemis nobilis
Cinnamom	Cinnamomum zeylanicum
Coriander	Coriandrum sativum
Costus root	Sausurea lappa
Cucuma	Cucuma longa
Cuperiol	Cyperus scariosus
Davana	Artemesia pallens
Dill seed	Anethum graveolens, A. Sowa
Eucalyptus	Eucalyptus sp.,E.citriodora, E.globulus
Galangal	Alpinia officinarum

ANNEX IX (contd..)

Galbanum	Ferula jaeschkaena
Geranium	Polargonium graveolens
Ginger	Zingiber officinalis
Jasmine flower	Jasminium grandiflorum, J.auriculatum, J. Sambac
Lavender	Lavandula officinalis, Lavandula sp.
Lemon Grass (E.Indian)	Cymbopogon flexuosus
Lemon Grass (Jammu)	-
Linaloe wood	Bursera delpechiana
Linaloe seed	Bursera delpechiana
Mentha arvensis	Mentha arvensis
Mentha piperita	Mentha piperita
Mentha citrata	Mentha citrata
Mullilam	-
Nutmeg	Myristica fragrans
Palmerosa	Cymbopogon martini
Parsley seed	Petroselinum sativum
Patchouli	Pogostemon patchouli
Pepper (black)	Piper nigrum
R [illegible] flower	Rosa damescena
Rosemary	Rosemarinus officinalis
Sage	Salvia scelera
Sandalwood	Santalum album
Skimia	Skimia laureola
Tomar seed	Zanthoxylum acanthopodium
Trechyspermum	Trechyspermum sp.
Valerian	Valeriana wallichi
Vetiver root	Vetiveria zizaniodes

Source: Annex V - Refs. 8,11

ANNEX X

Production and cost data obtained from a recently commenced (Jan.1985) Sandalwood distillation plant in the Kannauj district.

Investment: Rs.1,800,000 in plant and machinery of which 700,000 was in machinery*

Rs.2,000,000 as working capital.

Raw materials cost - Sandalwood : Rs.50-80/Kg.

Transport: Karnataka - Kannauj: Rs.2/Kg

Coal Rs.1000/tonne

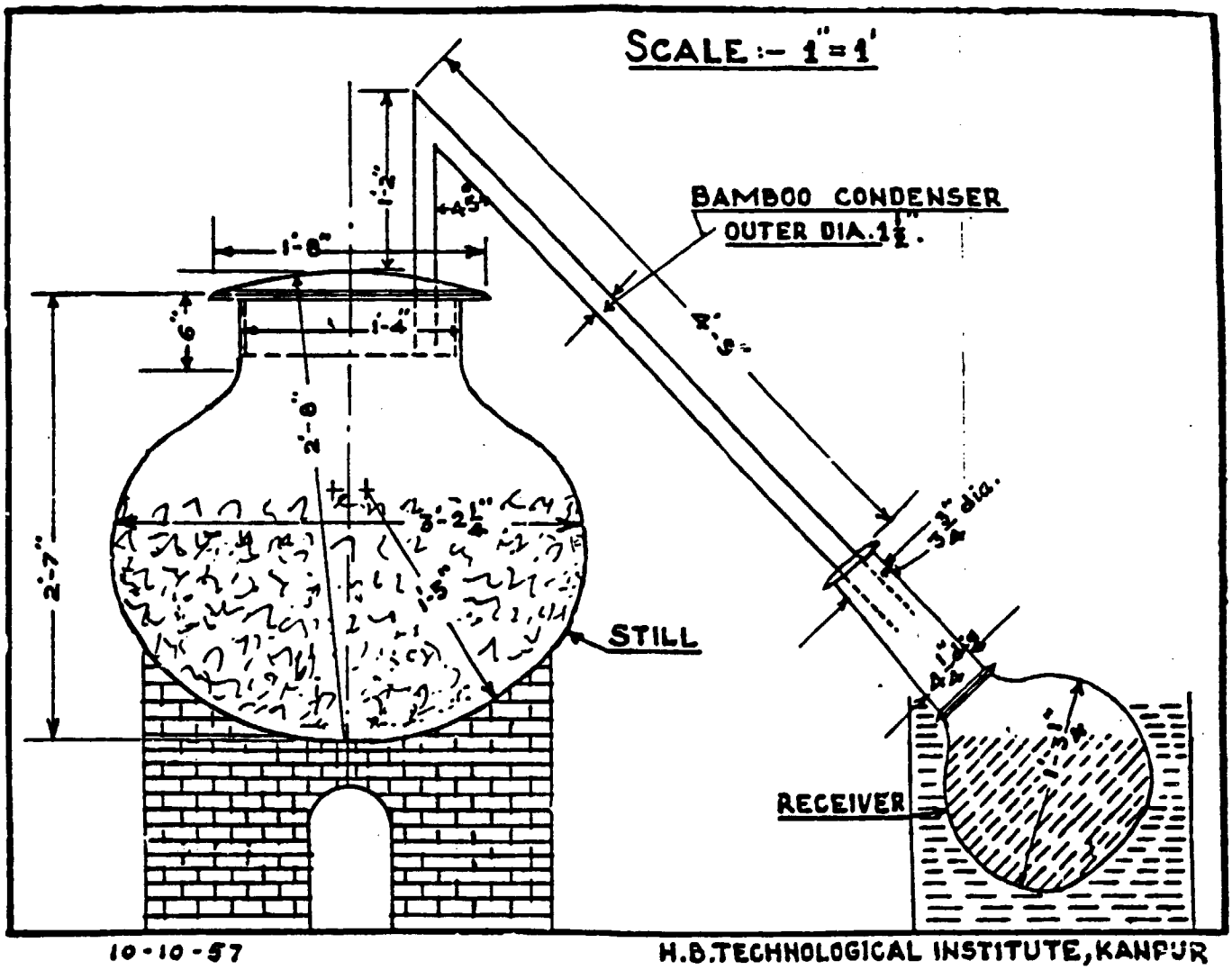
Some production data:

1 batch contains 600 Kg. of sandalwood and takes 6 days to distill.
Approximately 75 Kg. of coal are required per 100 Kg sandalwood.
Yields obtained are around 5-5.5%
Residues are sold for incense sticks/herbal teas etc. at Rs.1.25/Kg

* One of the main equipment items was a second hand coal-fed boiler, purchased at Rs.250,000.

ANNEX XI

The "Dag Bhapka" distillation unit for the production of attars.



Water distillation equipment.

ANNEX XII

Price evolution of some Kannauj perfumery products.

Item	1979[1] (Rs/ Kg)	1979[2] Inflation corrected (Rs / Kg)	1986[3] (Rs / Kg)	1986[4] International Market Price (Rs / Kg)
Sandalwood oil	900-1100	14,800 - 18,100	2,000	1798[5]
Vetiver Oil	1300-1600	2,140 2,630	4,000	629[6]
Rose Oil	40,000	65,700	100,000	47,740[7]

1. Source: Annex V Ref.1

2. Yearly inflation figures obtained from wholesale and consumer Price Index figures for 1979/80 to 1985/86.

3. Source: Trade sources in Kannauj

4. Source: Annex V - Ref.5.

5. Price for East Indian Sandalwood Oil. The price for Indonesian Sandalwood Oil was quoted at 1265 Rs./Kg.

6. Price for Haitian vetiver oil, the most expensive vetiver oil generally traded internationally.

7. Price for Bulgarian rose oil, the most expensive rose oil generally traded internationally.