OCCASION

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

DISCLAIMER

FAIR USE POLICY

CONTACT

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

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

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

20993

Distr.
RESTRICTED

ISED/R.2
17 January 1994

ORIGINAL: ENGLISH

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

FACT FINDING AND PREPARATORY ASSISTANCE MISSION FOR ASSESSING INDUSTRIAL UTILIZATION OF MEDICINAL AND AROMATIC PLANTS

REPUBLIC OF GUINEA

Technical report: Preparatory Assistance Mission*

Prepared for the Government of the Republic of Guinea
by the United Nations Industrial Development Organization

Based on the work of W.N. Walker, chemical technologist

Backstopping Officer: T. De Silva, Chemical Industries Branch

* This document has not been edited.

V.94-20244

ABSTRACT

A study was made of the cinchona plantations formerly established in Guinea and the processing facilities for conversion to quinine with a view to assessing the possibility of rehabilitation under the auspices of Sequina SA.

The study was necessarily supported by some financial assessment to determine the viability of such an operation.

Significant benefit could accrue to Guinea on re-juvenation of a valuable natural asset which can contribute to the health of the nation and other states.

It is concluded that a worthwhile project exists, which could introduce new technology and should be based initially on cinchona. It should, however, later be extended to a flexible operation for processing medicinal plants in a wider sense.

The project would benefit greatly from technical assistance and a suggested outline for a project paper is presented.

TABLE OF CONTENTS

Annexes

Abbreviations

QAA	= Quinine alkaloid anhydrous
TAA	= Total alkaloid anhydrous
SQ_2	= Quinine sulphate dihydrate = quinine sulphate
	= 1,2067 x QAA
km(s)	= kilometre(s)
m	= metre
cm(s)	= centimetre(s)
m.t.	= metric ton
kg(s)	= kilogram(s)
Ha	= Hectare
USD	= United States Dollar
FG	= Guinean Franc
BP	= British Pharmacopoeia
USP	= United States Pharmacopoeia
HPLC	= High Performance Liouid Chromatography
SER	= Shadow Exchange Rate
NPV	= Net Present Value
IRR	= Internal Rate of Return

Organizations.

EAD	= Economic Aid Development
APDF	= African Project Development Facility of Abidjan
CDI	= Central Development Industry (Brussels)
BARAF	= Bureau d'aide a la reconversion des agents de la formation publioue
USAID - FICA	= Fund for Investment in Commercial Agriculture
OPIP	= "Office for Small Industry" - Government Guinea
UNIDO	= United Nations Industrial Development Organization
UNDP	= United Nations Development Programme

INTRODUCTION

This report is presented by Dr.W.N.Walker in respect of an STAS mission to Guinea and Sierra Leone, West Africa in responce to a request of the Mano River Union (an organization committed to economic co-operation and integration of the three West African Member Countries, the Republics of Sierra Leone, Liberia and Guinea) in April 1993.

The purpose of the mission consisted of a fact finding and preparatory assistance mission to assess the potential for industrial utilization of medicinal plants, especially the bark of cinchona trees, in Guinea. Full terms of reference are reproduced in form of job description, Annex I.

The mission to Guinea, supplemented by meetings with the Mano River Union Secretariat representatives both in Conakry (Guinea) and at headquarters in Freetown (Sierra Leone), was conducted during a period of one month during October, 1993.

The main initial objective was to study a 1980 World Bank report on the rehabilitation of the cinchona plantations and factory, situated respectively at Kinadou and Seredou in South-west Guinea (see Annex II), and up-date as appropriate.

Privatisation of the facilities by the Government of Guinea led to purchase and the setting up of the Company Sequina, S.A. As a result of more recent studies the management is considering various options for the development of the Company and need advice on the best way to proceed.

Considering the length of time since the World Bank report in 1980 and the changes which have taken place during the period to 1993 it was considered more pertinent to carry out an independant up-dated assessment relating to current ideas rather than following the pattern originally considered.

It is considered that the objectives of the mission were attained, although a more extended duration of time in Kinadou and Seredou would have been useful.

It will be demonstrated that a potential for the re-development of the cinchona plantations at Kinadou and re-habilitation of the quinine factory and complex at Seredou exists and warrants support.

The report concentrates on the production and processing of cinchona to produce quinine products. The production of such must be of significant importance to Guinea, as well as neighbouring and most other African states as a very useful medicinal product. The malady of malaria proliferates amongst the inhabitants of Guinea and large areas of Africa and quinine is a most valuable drug for treating the symptoms, particularly in radical cases.

While cinchona is grown in several areas throughout the sub-tropical belt of Africa it is used and processed only by European companies and only primary processing has been executed at sites where the cinchona trees are grown. The saving on the freight costs for selling cinchona bark (up to 13% of sales value) gives significant advantage against European processors and prestige of domestic production of quinine would be valuable.

The facts applied in the assessment were largely obtained from the Director General of Sequina S.A. as well as from his old staff who have significant experience in both agronomic and processing aspects.

Additionally several reports were available from which both historical and more recent information was abstrated and has been judiciously employed in the current assessment.

Documents mainly consulted comprised:
Report for World Bank 1981 (Sofreco)
World Bank technical profile 1982. (Omnichem)
Rehabilitation offer 1983 (Soberi)
APDF study 1989 (Science Sprl)
CDI study 1990 (Science Sprl)
Plantation records
Factory records

I. BACKGROUND HISTORY

1938: Cinchona seeds, procured from Cameroons and elsewhere sown. Satisfactory growth proven in 2 years.

1940: Urgency for plantations realised due to breakdown in East/West communications and shortage of quinine. Cinchona plantations established in mountain forest areas of Du Ziama at altitudes of 800 metre & 1,200 metre. Named Kinadou.

1945: First harvestings and bark exportation to France.

1952: French Government, through the French army, established the Company 'Station Autonome de Seredou' with the object of processing the cinchona bark to quinine. The factory complex to be established at Seradou, some 15 km. from Kinadou. Basic factory design by Belgian Company Omnium Chemique.

1954: Factory operable at design capacity of 12.5 metric ton salts per annum, extendable to 20 metric ton per annum working extended shifts. Produced two products, quinine hydrochloride and quinine formate, the latter peculiar to French requirements.

1958: Operation closed on departure of French management at the event of declaration of Independance of Guinea.

1960: Operation nationalised. Omnium Chemique, Belgium, granted management contract to operate factory and train local staff. Training completed 1967.

1967: Mr. Mamadou Oury Bah, of agronomic background, joined the Company. Operation and production continued to 1980, but at low capacity contributed to by many breakdowns and un-profitably.

1980: Government of Guinea appeal to World Bank for assistance in rehabilitation led to study by Company Sofreco making positive recommendations.

1982: World Bank agreement to fund Government of Guinea to the extent of USD 6.4 million to rehabilitate plantations and factory gave responsibility to Company Omnichem to draw up requirements and assess offers.

1983: Offer of Soberi at 215 million FB considered best, but in view of increased funding needs and at the same time declining quinine prices the World Bank decided not to fund.

1984: Proposition from Groupe francais G, in collaboration with Isochem (France), for revival of factory and exploitation of plantations at a cost of 106 million FF was not pursued.

1985: Another offer of Soberi at USD 4 million for rehabilitation with regards to another possible World Bank funding did not proceed.

1985: Government of Guinea decided to privatise State industries, notably the plantations and factory comprising the 'Station Autonome de Seredou' at the Industrial Centre of Seredou.

1987: Mr. Mamadou Oury Bah, together with 30 other investors applied to purchase the 'Station Autonome de Seredou' at a price of 12 million FG.

1988: President of Republic of Guinea made order under No. 004/PRG/SRG on 10 February 1988 to ratify purchase. Company Sequina S.A. formed on 15 December 1988 with capital of 20 million FG. Mr.M.O.Bah elected President Director General. Assistance requested from Government office BARAF in obtaining credit realised no positive result although support by the bank BICIQUI had been indicated.

1989: A study of agronomic aspects especially by Science SPRL, funded by ADPF, provoked interest in a feasibility study but funds for such were not available.

1990: Science SPRL, jointly funding with CDI and Sequina, performed further study to identify basic needs for factory rehabilitation.

1991-
1993: Experimental plots each of 2 hectares planted in 1991 and 1992 at Post 4, Kinadou.
Some tests performed in factory on extraction and nr. 1 sulphate production.
Discussions have taken place with certain European quinine manufacturers interested in procuring cinchona bark supplies on a regular basis, but unlikely to wish to participate in any funding for development.

1993: UNIDO approached by Mano River Union for assistance and leading to present study.

II STUDIES

A. Documentation

In-depth studies were made of the various reports listed in the introduction, the later ones having more relevance.

On studying the World Bank report of Sofreco, 1981, it was concluded that a strict up-dating of the study was not appropriate in the current situation.

A more radical up-dating of the factory facility was being proposed than would seem appropriate or necessary since levels of bark to feed the factory at its design capacity cannot be foreseen for some years.

The proposals for plant replacement indicated , while improved in some details, largely corresponded with original installations. Such was based on technology employing a high volume capacity of vessels relative to the production level possible and this would contribute to the rather high investment costs indicated in quotations.

Significant changes have been observed in the selling price of quinine salts over the years. Reference to Annex III indicates the dramatic changes which occurred over the period of the World Bank report of 1980/1 and evaluation of quotations in 1983. The financial projections used a price of USD 120 per kg, having dropped already from a peak of USD 180 per kg. in 1977. By 1982/3 the price had bottomed at USD 60 per kg. and it was inevitable that the World Bank withdrew its support.

Annex IV suggests that future prices, currently at USD 80/82 per kg. are forecast to be more stable, although increases could be experienced as a result of disease and loss of cinchona stocks in Zaire.

In view of these changes which have occurred, and that the more appropriate approach must be to utilise wherever possible functional items in the plant, a direct up-dating of the World Bank report was not considered most appropriate.

Science SPRL reports.

The more recent Science reports are more pertinent to the current situation and were found to provide useful input material for the current independant evaluation. Particular usefulness was found in some details of the equipment survey carried out and many of the costs for factory rehabilitation have been used as a base, with appropriate cost up-dating, for the current determination of investments necessary.

Plantation records.

Limitation of time precluded any significant study of the plantation records other than examining the layout and distribution drawings of the cinchona stands and some samples of planting records. Both these were well documented and recorded relevant data.

Harvesting records could be of much more interest and warrant study in evaluating the existing potential for harvestable cinchona, but such were not seen during the visit. The only information gained on this aspect came from Sofreco in 1985 when they made an offer for plantation rehabilitation and must be out of date to some degree.
Determination of the potential of the existing plantation areas for harvesting is a most important aspect for determining the level at which bark harvesting and processing could be maintained until any new plantations matured sufficiently for harvesting.

Factory records.

While a production record journal had been regularly completed it appeared to be incomplete in many instances and difficult to follow or analyse. Real overall yields achieved could not be determined from the figures studied.

The records did show that the quality of bark processed, with respect to QAA content, was generally good and rarely recorded below 6% QAA and more frequently in excess of 7% QAA.

No analytical laboratory results of either bark analysis or of intermediate products were located.

B. Site visits

The author was accompanied on the site visits by representatives of the Mano River Union, Mr.M.T.Diallo (Sierra Leone office) and Mr.T.Sakho (Guinea sub-office) together with the Director General of Sequina SA, Mr.M.O.Bah.

Transportation by Land cruiser was kindly provided by the Secretary General of the Mano River Union, Dr.A.Diallo. The four wheel drive was essential for the plantation visit.

Location and infra-structure.

The plantations are located at Kinadou in the Du Ziama forests, some 15 km. from the processing facility and factory complex at Seredou situate at about 500m in the plain.
Seredou in the south-east of Guinea, lies 800 km. from the capital Conakry, on the main road between Macenta and Nzerekore. The township is well connected by road although from Faranah through Macenta is very rough and seriously needs maintaining. Nevertheless bus and lorry transport uses the route Conakry to Nzerekore regularly.

The mountain route from Seredou to Kinadou was somewhat difficult in parts, but the local Region are due to maintain the road in the immediate future. Tractor is used to transport bark from the plantations.

Macenta, approximately 40 km. from Seredou boasts an airport with connection to Conakry. With the possible advent of the Mano River Union project 'Air Mano' inter-state commuting may develop.

Seredou has been an industrial centre, and although currently somewhat depressed, still boasts an active saw mill and furniture factory. A large chip-board manufacturing factory exists, but is not functioning and currently acts as a store house for food for refugees.

A very active on-going forest conservation operation, project IV, for the Du Ziama is well established and administered from offices in Seredou.

Seredou is an established small town and there is obviously no problem with respect to the procurement of labour either for the plantation work or the factory. Some experienced workers engaged

prior to 1980 are still available for employment especially in more senior positions.

Currently there is no local electricity supply and local diesel generators must be employed. There is no problem with water supply and quality is essentially good.

Plantation visits.

Kinadou comprises two stations designated Post IV and Post V.

Post IV is first reached at an altitude 800 metres. It is largely overgrown in the plantation areas apart from the newly planted area.

The existing buildings are not in use, but appear to be structurally sound. They need cleaning and a little renovation for future use.

The original bark drying area is derelict and would need complete clearing and re-laying before it could be used again.

Post IV covers some 64 hectares originally planted out in eight parcels. Apart from parcel A, which is presently being employed for new plantings, the area is largely overgrown and said to be sparcely stocked. The area requires clearing throughout to provide significant future planting areas and utilise existing stocks. The area as a whole is only very lightly stocked. It was not established whether many stumps of harvested trees exist. These would need to be up-rooted but might provide a significant quantity of additional raw material suitable for local processing.

No clear evidence was obtained whether growth or yields at the lower altitude of this post differ from those of post V.

Post V is situated at the full 15 km. from Seredou and at an altitude of 1,100 - 1,300 metres. Covering an area of 189 hectares it comprises essentially 33 parcels.

No extensive examination of all the various parcels could be carried out, but some of the more densely populated stands indicated good husbandry and generally good growth. In retrospect more attention would like to have been given to examination of the lateral growth with respect to the height of the trees since

may have a bearing on estimating bark yield.

Parcels are believed to vary from 25 - 50% of the original planting density of 10,000 trees per hectare. The majority of the immediate bark potential is located at this post.

Reference will be made later with regards to yields of old trees but, while limitation of time did not permit a clear or full assessment, it was interesting to observe one old tree felled recently. This had a trunk of about 15 cms. diameter and was found to yield 30 kgs. of wet bark!

The office and bark work-house and store at this station are in good condition. Harvesting and drying were in progress and though at low capacity was well organized. Lessons have been learn with regards av oiding heaping of wet bark and use of metal for de-barking.

The external concrete drying area is in poor condition and will require maintenance for future use. Use of polythene sheets for easy covering of bark in event of rain showers might be worth consideration and perhaps could reduce expenditure on concrete maintenance.

Several impressive, and substantial, houses exist in this location. They do not appear to require extensive expenditure for rehabilitation.

Seed beds and nurseries.

Only the seed beds and nurseries at Post IV were visited..

Although not measured probably some 60 m^2 of well laid out and shaded seed beds were observed. Seedlings were prolific, closely packed and looked very healthy. A high germination success rate was indicated. No forecast of seedling number was proposed, but could have been in excess of 100,000 which would be sufficient to ultimately plant out 10 hectares.

All plants consist of Ledgeriana or hybrid, principally type Malabar.

Adjacent to the seed beds were several nursery beds planted out

in November, 1992. Planting was in beds comprising rows of five plants 20 cms. apart and probably extending 10 metres at spacing of 10 cms. At least 14,000 plants were said to be ready for planting out.

The plants were observed to be well developed and healthy. One block in particular had shown spectacular growth and were considerably taller than normally would be used for planting out into the field.

Recent plantings in field.

The new plantations, each of 2 hectares, laid out in 1991 and 1992 were inspected. No significant mortality could be observed on cursory inspection. The growth of the plants was impressive, one year old plants having reached a height of 1.0 - 1.3 metres and the two year old about 2 metres. Trunks appeared reasonably sturdy.

Well defined planting pattern could be observed with plants laid out at 1.0 metres by 0.8 metres corresponding to just over 10,000 trees per hectare. Forest canopy was very light in this area.

Processing complex at Seredou.

A general picture of the complex as it existed under 'Station Autonome de Seredou' is indicated in Annex V.

The complete complex would not need to be rehabilitated to enable processing of cinchona to be re-instated. Attention was mainly given to the processing shop, utilities and effluent aspects.

The main areas necessary for a satisfactory processing unit are the production area, boiler house, electric sub-station, amenities block and some storage.

Chemical storage and bark storage areas were only observed superficially from the outside and did not need any significant attention.

The amenities block was also not entered. It is intended to use this building for both amenities and to house non-technical administration. No serious expenditure is anticipated here though it is expected that thorough cleaning is necessary, some attention to toilets and wash facilities and internal division to provide office areas.

Buildings are available for chemical and bark storage. Within the production area adequate space and conditions exist for the packaging and storage of intermediate and finished products.

Some attention needs to be given to improving the internal road systems to the main areas to be used.

The production building was found to be generally in good condition, but requires extensive scrubbing of walls, painting and floor cleaning.

Structurally the only significant repair is replacement of some 200 m^2 of acid damaged roofing. Although use of corrosive hydrochloric acid is not proposed for the initial re-instatement of the factory, replacement of the galvanised roofing with plastic would probably be easier and cheaper. When later plant is installed for quinine hydrochloride production it should be designed to preclude possibility of free hydrochloric acid vapours in the atmosphere.

Replacement and painting of some windows and attention to some doors is necessary.

Good office facilities exist in the building for technical staff as well as suitable accommodation for a laboratory, although this has been used as a store-room and will need fitting out.

The route to the cess pool where residual gas oil from bark is recovered will need to be cleared for good access. The drain channel from extractors appeared to be good, but a general checking of drains should be carried out.

A fairly close examination of the plant and equipment was carried out including rather detailed discussions with the former factory chief, Mr.B.Kolie. The situation was found to be similar to that reported in the Science SPRL report of August 1990.

Probably the most significant rehabilitation needs revolve around the items associated with the provision of services and electrical items. A more thorough examination of the electrical supply and distribution is necessary.

Overall the factory was in remarkably good condition and much more spacious than had been anticipated.

III TECHNICAL APPRAISALS

A. Plantation

General.

The potential of the plantations seems to be very good, benefitting from good soil, excellent humus and apparently good climatic conditions.

Some 99% of the trees comprise Ledgeriana or hybrids, especially variety Malabar. Only Ledgeriana is considered desirable for processing to quinine, but the remaining 1% of Succirubra trees may be usefully employed for grafting of good Ledgeriana stock in order to provide seed stock for subsequent seedling production.

Planting density used is high at 10,000 plants per hectare (spacing 1 metre x 0.8 metre) and quoted yields of 10 metric ton dry bark per hectare is very acceptable, especially if this can be related to 8 year old trees.

Information does appear to be lacking with respect to the general development of the trees in terms of bark weight yield and quinine content.

No clear impression could be gained from figures derived from harvestings during the last 4 years. In one instance average wet weights per tree were reported at 2.76 kgs. while later figures showed from 2.9 to 3.3 kgs. Actual dry weights were not available. Other aspects such as age, whether first or second coppicings or replantings were not clear, but the impression is that the weights might be somewhat lower than expected.

Quinine content in the bark of trees increases usually up to the age of about 7 years. Thereafter little change occurs but the weight of bark per tree has been seen to increase significantly (by about 8 - 10% per annum) up to 12 to 15 years life at least. Thinnings of trees in earlier years of life may contain only 2 - 4% QAA and are not suitable for export sale, though might be used domestically. Thinnings might comprise some 10 - 20% by weight of ultimate harvested bark. At maturity branch bark is found to have a QAA content about 80% that of the corresponding stem bark. In the case of root bark from up-rooted trees the content has been

found to be rather variable and more generally lower content than branch bark. It is nonetheless a possible supplementary supply.

Relatively small parcels have generally been planted at Kinadou allowing air circulation and this probably contributes to the apparent absence of disease recorded, especially Phytophthorus cinnamomi (stripe canker). It is suggested that planting in any low valley areas should also be avoided as a precautionary measure.

While essentially good agronomic knowledge on growing cinchona exists and the experienced staff could no doubt satisfactorily deal with clearing, cleaning, propagation and planting of new parcels, it is proposed that several other aspects require attention to attain optimum results and assure a successful project.

Proposals.

1) Primary importance is to determine with rather more certainty the current potential quantity of cinchona available for harvest to confirm that the production programme suggested later is sufficiently realistic. Thorough examination of records should be supplemented by physical examination considering not only numbers, but also some idea of bulk. A more clear picture is needed as to whether after harvesting further coppicing is realistic or up-rooting necessary. Experience indicates coppicing should not be applied more than twice.

2) Secondly, a survey investigation should be carried out to determine the general quality of trees available in the various parcels and with the onject of locating especially high testing specimens. Such testing needs to follow a determined plan and also incorporate physical measurements so that the vigour of growth can also be monitored. This information can lead to better clonal selection for production of seed and give information on which calculations can be based to determine whether it would be worth the investment to introduce meristem tissue culture as a preferred method of propagation to establish consistantly high quality

and reproducable stands.

Meristem tissue culture involves locating high quality trees and taking a mature shoot. Short meristems (Very small shoots) are then dissected out from this under the microscope in sterile conditions and grown in a specially designed jelly medium in laboratory flasks. After a short time side shoots are produced which can be cut into further smaller shoots and themselves grown into yet more shoots. While the original technique further rooted the plants 'in vivo' recent improvements perform growing on and rooting 'in vitro' which is much easier to handle and reduces costs. Technology and training in this special area are available.

Analysis of a relatively large number of samples may be necessary and cannot be performed by the standard Bruxelles method normally applied for bark analysis.

This type of study has been performed using fluorimetry, but this only gives limited information. The preferred method of analysis is considered to be using HPLC (High Performance Liquid Chromatography). Standardised methods have been developed using this method. An additional advantage of this method is that it also gives an indication of the level of other cinchona alkaloids present in addition to quinine. Such information is also useful in selection of elite trees and has some use in yield forecasts.

To perform this investigation it will be necessary to set up an analytical laboratory and provide equipment. Such is recommended later for installation in the Seredou factory and the facilities may be used for bark analysis, investigation work as above, control work for production and release analysis for final products.

The analysis of cinchona trees would probably span over a period of up to six months for the preliminary screening.

3) The general knowledge at Sequina SA regards the agronomic aspects of propagation, growing on and planting out appears to be good. Nonetheless it is considered that great benefit could be gained by technical assistance from an agronome well experienced especially in the growing of cinchona.

Some of the habits with respect to fertiliser treatment differ from other experiences, although are not necessarily inferior. In Guinea it appears that fertiliser is not used between years one and six of growth, whereas other growers have applied more consistantly. Such experience may prove valuable, as could be the setting up of some long term programme to evaluate the effect under Guinean conditions of different fertiliser patterns. This could also extend to the effect of density of planting.

Training could also be valuable on experiences with various aspects of the several aspects encountered during the production of mature stands. Special attention might be given to in-filling, pruning and coppicing techniques especially.

4) With sufficient availability of plants a further 2 hectares of cinchona should be planted now in 1993.
Consideration should be given to preparation of more extensive nursery beds to grow 100,000 + plants from seedlings assuming sufficient are available.

The clearing and cleaning of the plantations should be initiated.

5. It is suggested that after the harvesting during 1993 and early 1994 of the 80 tons of dry cinchona bark contracted for sale to DSM/Andreno no further bark should be scheduled for sale until such a time that it had positively been determined that no likelihood of cinchona processing to quinine existed at Seredou.

B. Factory

Technology.

The technology applied in the Seredou factory inevitably follows old traditional methods.

The extraction method is not necessarily the most efficient, but is appropriate for developing countries. The method used has the redeeming feature for the prevailing conditions whereby waste vegetable matter may be readily disposed of to the river system. Disadvantages are the use of large volumes of gas oil/petrol for extraction and significant losses of solvent. The losses mainly occur in the extracted marc since oil is recovered from this only by flotation in an intermediate cess pool. Cost is significant.

In the short term it would not be proposed to alter the method since the extractors are still essentially functionable and adequate capacity available. Gas oil and petrol are also readily available.

Complete extraction was claimed, but no analyses seen to substantiate this. Normal levels which should be reached vary with bark alkaloid content, 97.4% being expected for 6% bark and 98.4% for 10% bark. For low testing barks the efficiency may drop to 94%.

Originally a traditional method of alkalising in a mixer with a limited amount of water was employed. Later, due to the breakdown of the mixer, alkalisation was performed in the presence of a large volume of water in the extractors. No loss of efficiency was said to be observed. Again no analytical results were available to substantiate this claim. This is rather contrary to experience and theory that complete extraction would be found. The claim should be confirmed at an early date to ratify minimum equipment needs.

The tedious method of extraction of alkaloids from gas oil involves considerable plant capacity. This stage would benefit from updating with new and compact equipment which can also be operated to produce much more rapidly essentially pure quinine rather than sulphate nr. 1. Such will be included in proposed investments. Inclusion of this liquid/liquid extraction unit should be readily possible, as significant spare space exists, without disruption of existing agitated vessels which might be useful for other purposes.

While the proposed change in processing can produce a large proportion of the quinine directly and suitable for immediate conversion to salts, liquors will still need to be processed. The existing equipment used for nr. 1 sulphate and bisulphate production can be applied for this purpose. Only part of the capacity would be required, even at full production throughput, and minimum of items need rehabilitation. Within this section consideration may be given to the production of totaquina if domestic use of such would appear feasible for anti-malarial use.

This section of the production unit, in contrast to the extraction section, is not provided with electrics up to flame-proof or explosion proof standards.

Formally quinine hydrochloride and quinine formate finished salts only were produced. This latter product is unique to the French and production of it should not be contemplated in the future.

Quinine hydrochloride is used universally for both medical use, principally for malaria treatment, and in the food & drink industry.

The production of quinine hydrochloride is relatively more difficult to produce than quinine sulphate and equipment needs somewhat more stringent.

When later the factory can be supplied with more substantial amounts of cinchona bark the production of hydrochloride as well as sulphate should be considered. Less likely productions as finished products comprise quinine bisulphate, alkaloid and dihydrochloride, although no problems need be encountered in such productions.

New reactor capacity of a standard suitable for producing salts to meet current quality and pharmacopoeia criteria are to be included in the investment costs. The vessels may be selected to be capable of not only of use for production of sulphate, but for any salts including hydrochlorides.

New finished salts equipment should also be installed in flame-proof areas. Although not necessary for quinine sulphate this would give the oportunity for using more up-dated technology which has been found particularly useful for hydrochloride (and quinine bisulphate) products.

The apparent yields of quinine hydrochloride produced in earlier times appeared to be extremely low. No doubt only direct yields were recorded, but at the 47.4% reported is extremely low.

The yield norms which should be achievable are:

Extraction efficiency	95 - 98.5%	
Total yield	85 - 88%	(higher level includes totaquina)
Direct yield hydrochloride	72%	
Direct yield sulphate	80%	

All yields are based on QAA content relative to QAA charged in bark. Accordingly weight yields of salts are higher.

Original processing procedures called for a re-cycle of several liquors as water feed to the extractors. The philosophy is good, but in practice a review of which liquors are suitable for re-cycle should be performed.
So far as Sequina is concerned attention should be given only to the isolation of pure quinine salts. The incorporation of other alkaloids may be considered in situ in preparing totaquina. The isolation of any other alkaloids, such as quinidine, cinchonine or cinchonidine in particular is of no commercial interest although methods are available. Although natural quinidine was formerly of interest the level of content in Ledgeriana bark is usually low and after isolation is usually found to contain a high level of dihydro-quinidine and it is difficult to meet pharmacopoeia requirements.
For the above reasons it makes no real sense to re-cycle liquors predominant in these alkaloids and sparse in quinine.

Process equipment.

The bark treatment area may be considered functional for initial needs of low throughput when the small mill installed may be used. Attention to the filter, with element replacement, is essential to prevent dust loss and dirty working conditions.

In the long term, at high bark throughput, the position of the whole pre-treatment area may need attention and installation of a system operating under negative pressure might be considered. Incorporation of explosion relief panels should be incorporated.

The local claim that by-passing the lime mixer does not cause loss of extraction efficiency must be confirmed before making any decision to rehabilitate the mixer. Either a new motor & drive or replacement mixer may need to be considered, but has not been included other than under contingency.

As indicated earlier the existing system of extraction should be used and only minimal attention to the extractors is needed. Adequate capacity exists and at the 50 m.t. per annum level only one extractor needs to be used. Processing two batches per day is recommended, although only occupying the plant for 60+ days per annum, to minimise fuel costs.

Bark and waste water are dropped to a cess-pool for settling and subsequent removal of trapped gas oil. A new pump is required for this purpose.

In the event that nr. 1 sulphate has to be employed in the early days (depending on the time of design, procurement and installing of the proposed new acid extraction unit) sufficient capacity exists in the functional vessels used for acid extraction. All existing vessels should be retained for possible alternative use.

Vessels currently installed for the preparation of nr. 1 sulphate, and preparation formerly of alkaloid from bisulphate, total eight. While in varying states of repair with respect to motors and coils, where fitted, adequate capacity remains for processing of nr. 1 sulphate if necessary and later minor crops. Replacement FLP motors for three units and some coil repairs have been included in rehabilitation needs. This is in anticipation of a final decision to up-grade the area to FLP standards.

The vessel used for bisulphate preparation will still be employed although mostly for minor crops after installation of the new acid scrubbing system. If nr. 1 sulphate has to be used for some time it would be better to alter the conditions of preparation, using new filters rather than the existing Buchners since the condition of these appeared suspect. Crystallisation technique can be altered to allow the product to be centrifuged directly.

Centrifuges, of which three exist in the refining area, provide sufficient capacity. Observed to be in generally good condition, but the bearings of all should be checked and may need replacement, account of which has been made in expenditure. The condition of the motors may cause concern, certainly for reliability and it is proposed that these should be replaced with FLP versions if possible. A better solution which bears investigation is to convert to hydraulic drives, at which time it may be possible to also incorporate a two speed drive which is a great benefit.

It was observed that no safety interlock exists on the machines and a simple mechanical device should be designed and installed.

With respect to the vessels and equipment formerly installed for the preparation of quinine hydrochloride from alkaloid should be

stripped out of the plant, with the exception of the centrifuge, and the space re-organised for installation of new equipment for release quality quinine sulphate and later installations for the hydrochloride and other salts. Careful thought should be given to this installation with regards to segregation and GMP aspects. New equipment for pharmacopoeia quality quinine sulphate is included in initial investments and other salts after several years when more substantial bark supplies are available.

Past practice appeared to be that final product was simply dried by prolonged spinning on the centrifuge. It was also indicated that no washing of product was employed. To reach current purity standards demanded it is not considered that either of these practices could be tolerated.

Two electric drying ovens are installed, but require repair with respect to heating elements and possibly thermostatic control. Formerly these were used only for drying granulates for tabletting, but capacity for quinine sulphate drying should be sufficient. At higher throughput the situation may need review and consideration might be given to fluid bed drying.

The summary of plant & equipment needs are given in Annex IX.

Laboratory.

No laboratroy facilities exist at present. It is proposed one should be installed in the second floor of the production block in the section housing excellent office facilities. A large room currently employed for storage would provide suitable accomodation.

The laboratory would serve the needs of the plantation for bark analysis & screening, control of additives, process control, intermediate analysis, liquor analysis, marc analysis and final product analysis according to pharmacopoeia.

Techniques available should cover, in the case of bark analysis, both the traditional Bruxelles method and modern methods especially useful for analysis of large numbers of samples as required in plantation screening.

The setting up of this unit is of first priority and the engagement of the chemist to run it should be an early appointment. Some overseas training in the technique of HPLC would be envisuaged.

Some on-site technical assistance in sampling and analysis would also be seen to be valuable.

Factory staffing.

The staffing of the production unit will mainly comprise senior personnel, but ones who will be expected to work 'hands-on'.

The likely recruits are likely to be taken from previously employed personnel working at 'Station Autonome de Seredou'. Their experience is very valuable both for processing and future training activity.

Certainly the factory chief and laboratory chief must be engaged at an early date, together with the electrical/mechanical engineer. It would also be recommended to start selection of the other manual workers in order that they can benefit from the experience of the rehabilitation of the plant, an activity which always gives good working knowledge of the plant and its installation.

Main proposals with respect to factory.

1. To rehabilitate the production facility according to the outline indicated to enable processing initially at a level of 50 m.t. per annum.
2. Primary need is to thoroughly check utilities and services and draw up detailed requirements.
3. Perform a technical survey in more depth to confirm outline proposals, consider detailed design and preferred installation of new units and confirm viability of up-grading to FLP levels. This would be considered the prime objective of a technical assistance programme.
4. Prepare detailed list and specifications for replacement parts, repairs and new items, obtain competitive quotations, select and initiate procurement.
5. Tabulate materials required for building cleaning cleaning and rehabilitation, schedule and engage labour needs for the work.
6. As the first step engage senior staff and make immediate plans for the laboratory habitation. Define exact equipment needs, obtain quotations and start procurement at very earliest opportunity.

All the activities would be organized, and contributed to, within a Technical Assistance programme working together with the administrative and technical direction of Sequina SA. The composition of such a programme is defined later.

IV MARKET

No great problem would be seen in selling the levels of quinine output proposed for Sequina, even at the higher levels when new plantations mature.

Sales through European agents present a real opportunity although direct sale to members of the African continent, with special emphasis on West Africa, would be thought to be more appropriate.

While appliance with pharmacopoeia standards is essential, it should also be recognized that appearance, and in some instances physical characteristics, are also very important factors in competing for sale in the international market.

For Sequina, in the short term, quinine sulphate has been proposed as the preferred product since it is more easily prepared, and in higher direct yield.

No detailed market survey is to hand for Africa, but it is fact the normal production mixes of major quinine manufacturers consist of 40% quinine sulphate, 40% quinine hydrochloride and 20% others (dihydrochloride, bisulphate & alkaloid mainly). The mix may be distorted if quinine is being produced for conversion to quinidine, but nowadays it is expected that most quinidine manufacturers will produce from an intermediate rather than final salt.

Quinine sulphate is more particularly used for the preparation of tablets for anti-malarial use and compounded in cold and analgesic preparations.

Because of the historial French connection Guinea still markets quinine hydrochloride and quinine formate. The hydrochloride is mostly marketed in injectable form under the name Quinmax - a preparation which, in fact, also contains low levels of other cinchona alkaloids cinchonine, cinchonidine & quinidine. The sulphate does not appear to be sold in Guinea at this time. Some market resistance in Guinea could be anticipated from the French supplies and, perhaps, medical tradition. The situation

needs to be investigated and some Government assistance might be helpful.

Competition with French preparations may exist in other areas such as the Ivory Coast, but in Sierra Leonne it was established that only quinine sulphate tablets are prescribed. The distribution of use of quinine sulphate needs to be investigated by Sequina.
Some preliminary information of quinine consumption in the African continent has been gathered by Sequina, but the form of preparation not defined. Indicated consumption levels, which are rather significant, so far reported are: Guinea 500 kgs, Nigeria 1,000 kgs, Benin 1,000 kgs, Mali 1,000 kgs.

Consumptions, as well as form of application, should now be determined for other countries such as Sierra Leone, Liberia, Guinea Bissau, Cameroons etc.

The situation should also be investigated as to the possibility of the supply and use of the mixture of cinchona alkaloids as totaquina supplied in tablet form as a cheap form of anti-malarial particularly in areas where the populations are unable to benefit from it due to economic reasons. Competition even here does exist with other medicinal plant concoctions currently used by large numbers of people in rural areas. While these are no doubt helpful it is thought that totaquina would be more effective.
Many serious investigations have been carried out in the past suggesting the efficacy of totaquina mixtures and, in fact, that the presence of the alkaloids other than quinine have a beneficial effect and maybe useful where resistance has developed.

V FINANCIAL APPRAISAL

Project benefits.

The re-instatement of the cinchona plantations in the Du Ziama forests at Kinadou in Guinea is a most worthwhile and desirable object. It would preserve, and develop, the environmentally attractive, useful and important area of cinchona stands. It would also contribute to the general improvement of the area as a result of the regular maintenance involved in preserving the stands and could even develop into a natural national attraction.

Processing of cinchona is also desirable to provide Guinea and other neighbouring African states with a nationally controlled supply of quinine. This is a most important drug for the relief of malaria symptoms which, unfortunately, beset the vast majority of the population.

Another important effect would be some re-vitalisation of industry in the Beredou area. Although the factory processing would not provide employment for a large number of people it would utilize valuable expertise residing in the area. The overall picture, including administration and plantation opportunities does, in contrast, provide a very significant level of employment for both men and women.

Need for financial appraisal.

Various factors obviously affect whether a project may be financially and economically feasible. In this project these include :-

(1) Cost of cinchona bark. The availability of in-company locally produced bark must be very advantageous.

(2) Whether plantations and/or factory facilities need to be invested in from 'green field' sites. This is not the case with Sequina SA.

(3) Availability of technology and trained/trainable labour. In this instance while sufficient basic knowledge and expertise is available it would benefit from expert technical assistance.

(4) Production levels possible or proposed. This is one of the major aspects which necessitates the projection of financial figures. Initial production level is restricted by immediate availability of cinchona bark.

In present days it is considered that starting from a green field site, even assuming adequate immediate and sustained availability of good quality cinchona bark, it would be difficult to justify a throughput of less than about 600 m.t per annum throughput of bark. This figure could be less where bark is grown in-house.

In the case being studied here, where much infra-structure already exists, the level may be considerably less.

(5) Marketability of products. Considering local, neighbouring & international levels of demand this is no problem.

(6) Availability of assistance, funding and cost of same. These need to be considered in the context of the outcome of the study.

The Sequina project benefits from availability of some inherent cinchona stocks at low cost, plantations which are known to produce good quality cinchona and may relatively easily be re-instated, the existance of a basic production unit and equipment. While this is old it appears that it can be rehabilitated at relatively low cost. Also technology is available (albeit old it may be improved) as well as relevant technical expertise.

The two factors which are uncertain and necessitate performing some financial projections are the relatively low throughput of cinchona bark and the extended time of financing new plantation crops which tie up funds for several years.

Financial projection inputs.

The main input figures are presented in the various Annexes VI to IX inclusive.
Some additional points and explanations may be presented here.

Bark input.
The current stock has been taken at 330 m.t., with a committed sale of 80 m.t. during 1993/4. The forecast possible annual availabilty is calculated in Annex VI showing assumptions.

To calculate output of finished quinine sulphate the quality of bark is taken at 6% QAA and a direct yield of 80% relative to QAA charged.

Output salt (quinine sulphate dihydrate)

$$= 50{,}000 \times \frac{6}{100} \times \frac{80}{100} \times 1.2067 = 2{,}896 \text{ kg. finished salt}$$

The bark quality chosen is likely to be very conservative and might well prove to be between 10% & 20% higher. At these figures an additional net income of USD 22,000 to USD 44,000 per annum could be expected.

A further additional asset not included could be derived if it is found possible to market the totaquina (it is still an asset even if not sold since it can be re-cycled to raise the total production yield from 80% to between 85 & 88% based on QAA overall).

From residues it is calculated that sufficient totaquina could be produced to provide complete cycle treatment (at 18 gm. p.a) for 60,000 radical cases of malaria (on basis totaquina dose similar to quinine).

Raw material bark cost is charged simply as the cost of harvest collection, de-barking, drying, packaging & transport to Seredou. The cost of fuel used in the aspects of harvesting for saws, wet bark transport and power could not be readily separated from costs for general plantation infra-structure maintenance and the whole of these charges have been applied as an overall indirect charge against production.

Cost of bark per hectare (assuming full planting = 10 m.t per Ha)		
Cutting $\frac{10,000}{83}$ = 120 man-days @ 1,200 FG	=	144,000 FG
De-barking 30,000 kg. wet x 20 FG	=	600,000 FG
Driver, collectors (2), driers (2),	=	106,000 FG
		850,000 FG
Cost per kg. bark, dried	=	85 FG
Packing, weighing & packaging	=	10 FG
Transport Kinadou - Seredou	=	8 FG
		103 FG
Cost charged to process		0.110 USD/kg.

The actual cost of harvested bark (including growing) is likely to be in the order of USD 0.525 per kg. dried.

In 1993/4 the sale of 80 m.t. of bark has been agreed. In this case Sequina has to bear the cost of transportation from Kinadou to Maarsen in Holland. Costs established for this have been included as sales/distribution cost at USD 19,677.

Investment items.
These have been referred to in various sections of the text. They are summarised in Annex VIII, with further elaboration in Annexes IX & X.

Other production cost inputs.
These are to be found in Annex VIII.

Additives: consumption of some additives is based directly on the weight of bark extracted. Adjustment on basis of TAA content can be made but is not normal.

This means that processing low testing barks is relatively more expensive, and this is further accentuated since efficiency of recovery from low testing bark may be considerably reduced. The consumption of other additives is based on the quantity of quinine contained in the bark.

In the first case costs have been based on Seredou experience, while in the second they are based on technology experience for production of pure quinine sulphate.

Costs are based on processing 6% bark and allowing for current chemical and fuel costs were calculated at:
USD 0.364 / kg. on bark and USD 1.26 / kg. on SQ_2 produced.

For 6% bark this becomes:	17.26 kg x 0.364	=	USD 6.29
	+ 1 kg x 1.26	=	USD 1.26
	SQ_2 Total cost/ kg	=	USD 7.55
For production 2,896 kg SQ_2	= 2,896 x 7.55	=	USD 21,871

Costs include for re-cycle and production of totaquina.

Utilities.
Based essentially on disclosed levels for recent tests on the production of nr. 1 sulphate with adjustments from experience for finished salts production.

Direct labour.
Indicated in Annex VIII. For simplicity factory chief and workers charged at full annual cost (although they will be engaged in other tasks while production is low) against production direct costs. Other workers charged as indirect labour.

Labour force will be increased in years 2001 & 2002 on occassion of higher throughput.

Maintenance & spares.
Arbitrary estimates.

Factory overheads.
Based on determined disposables such as filter cloth, protective clothing, packaging etc.

Administration overheads.
Arbitrary and minimised to needs.

Administration salaries.
Also indicated in detail in Annex VIII. Based on indicated needs and salary levels. Other than factory direct labour, all salaries (administration, plantation direction etc) charged to this heading.

Costs of labour for plantation workers are included within harvest costs, development of plantations and maintenance of plantations.

Plantation development costs.
These have been based essentially on current planting practice, except that they have been supplemented by appropriate in-filling which is considered necessary. Detailed calculation is given in Annex VII which covers both new plantings and coppicings.

It has been assumed that 10 Ha. per annum new plantings are made from years 1994 to 2003 inclusive.

Repairs, maintenance of plantations.
This covers general maintenance of plantation facilities including access roads to parcels etc. For convenience, with the exception of fuel costs for transportation of dried bark from Kinadou to Seredou, all fuel costs for diesel generators, pumps, saws etc have been allocated to this cost centre.

Depreciation.
Rates used are found in Annex VIII.

Cash flow inputs.

Sales.
Production of quinine sulphate only has been assumed, and sold as bulk at a level of USD 80 per kg. (current world level about USD 82 - 84 / kg.).
Further profitability of tabletting has not been considered.
A direct yield on of 80% on QAA charged has been used and based on 6% QAA bark corresponds to sales of 2,896 kgs quinine sulphate dihydrate.
No allowance has been made for the additional sale of totaquina since such is not established.

Net working capital.
Method of calculation given in Annex VIII.

For assessment purpose a funding of USD 450,000 has been used.

It has been assumed that this is made up of:

Sequina contribution	USD 150,000	from increased capital + bark revenue net sales
Bank loan	USD 100,000	interest rate 15%, repayment over 5 years after one year grace.
Other contributions	USD 200,000	technology assistance & hardware.

Projections.

The following projections are presented in the Annex:

Current investment	Annex XI
Production costs	Annex XII
Net working capital	Annex XIII
Cash flow	Annex XIV
Profit & loss	Annex XV

For convenience all projections are presented only in terms of USD.

The official UN rate of return at time of reporting was :

1 USD = 940 FG

No economic projections, with SER adjustments, are given since the ultimate marketing situation is not clear. For this reason no indication has been given as to foreign:local breakdown.

VI ANALYSIS OF STUDY.

Financial projections.

The projections highlight the fact that this project has to be considered a long term investment, due to the length of time to establish the new cinchona stands.

This is clearly demonstrated by comparing the results of the discounted cash flow in terms of the NPV at a discount rate of 15% and the IRR at 10 years and 15 years operation.
At 10 years the NPV of -127.1 and IRR of only 8.4% is not particularly attractive. However, at 15 years the NPV changes to +122.4 and the IRR becomes a respectable 18.7%.
The projection of cash flow & profit/loss also indicate that the project could also probably support a greater onus of loan capital under favorable terms than has been included.

The figures do not bring to attention the considerable asset

accruing during the maturing of the cinchona plantations, other than high profitability in later years which at the same time causes no depletion of this asset.

On the basis of these results it is suggested that this is a very worthwhile project which deserves support and which can contribute to the health and wealth of Guinea.

Susceptibility of project.

No break-even points have been determined, nor effect of variation of bark input prices or sales prices nor production level.

Such were not presented for various reasons.
(1) The input of bark is restricted by availability and a break-even production level has little meaning since it is not easily controlled. The only way to do so would be for Sequina to purchase bark from outside and this is not considered appropriate.

(2) Bark input prices have little significance when produced as in-company raw material. The situation would be different if consideration was given to supplementing feed stock by purchase.

(3) Sales prices can have a very significant effect and, as can be seen in Annexes III & IV, such is possible. The forecast is that prices under current conditions have reached a reasonably stable level, any movement being more likely up-wards. The large fluctuations in the past have been due to the level of availability of cinchona bark.
Should sales prices fall at any time to a level where profitability was treatened, Sequina should be in a reasonably good position as a grower. The bark can be left on the trees to accumulate in bulk with time and ultimately no doubt also in value. Restricting the harvesting could itself contribute to eventual rise again in salts prices.
The present situation with regards to other plantations, especially in Africa, does not suggest any possibility of over-production for many years. Disease and limitations of planting, and possibly maintenance, is more likely to cause shortage of supply.

(4) Disease in the cinchona trees, particularly caused by Phytophthorus cinnamoni, must be bourne in mind. The plantation

at Kinadou shows little sign of disease and no Phytophthorus. This is probably contributed to by the planting in relatively small parcels with good air circulation. With good attention and planting technioue there should be no great fear of problems.

The opportunity of considering meristem tissue culture is also available and this technique can be adapted not only to provide high quality, high yielding trees, but also disease resistant ones.

(5) While risks are not considered great, it is nonetheless suggested that the factory operation should not confine itself only to processing cinchona. After rehabilitation and satisfactory re-instatement & improvement of cinchona processing very serious attention should be given to diversification into processing of other plant products, especially medicinal plants, available in Guinea. Opportunities can be seen to exist.

Capacity and space are available in the production unit and probably no significant additional expenditure would be needed in the short term. The plant could then become a flexible unit and could adapt to changes which can always take place with respect to supply and demand of different products.

Although establishment of the quinine production must be first priority it is suggested that it could be appropriate for long term development in improvement of quinine processing methods and to investigate the extraction of other plant products to seriously consider the installation of a modern pilot extraction unit.

Overall, and with the consideration of long term development of flexibility it is considered that the risk factor of this project is relatively low, but would be greatly enhanced with the provision of a technical assistance programme.

VII PROJECT ASSISTANCE

Discussions with the executives of the Mano River Union were held both prior to, and after the site visits, in Freetown, Sierra Leone.

Informal talks were also possible in Conakry, Guinea with the Secretary General of the Mano River Union and other members present locally.

Discussions were of a more general nature since a critical analysis was not complete at the time. The situation regarding funding was broached.

Similar discussion took place during the visit to Guinea with the Sequina Director-General and a visit was paid to the Government office administrating BARAF.
The information derived, and as understood, from these sources is summarised here.

The summary considers the sources from which assistance might be forthcoming.

USAID - FICA (Fund for Investment in Commercial Agriculture)

This might present some possibility on the plantation side, but it is not clear if this would need to be segregated from the factory function.
Membership of FICA is apparently possible at two levels for nominal fees of 100,000 FG or 600,000 FG. Benefits of the different grades are believed to be reflected in the levels of loans which may be on offer. A project study is needed by FICA, the cost of which could be included in any loan given. Loans can reach 80% of need provided the 20% balance is private. Loans may be used for both equipment and working capital.

OPIP - Office of Promotion of Private Investment.

May grant loans for micro-projects for 5 years at interest rate of 15%, but the level is understood to be only up to 50 million FG.

APDF - African Project Development Facility of Abidjan

The joint funding agency set up for African projects by the World Bank and PNUD would presumably still need a feasibility study before any consideration would be given.

CDI - Central Development of Industry

Some possibility of funding might exist but with joint participation, but the situation was not clear and it was felt that careful consideration might need to be given by Sequina to any proposal since it might be restrictive for the Company. Outside interests involved need to be considered.

BICIQUI - Guinean Bank.

Discussions have been held before, initially indicating possibility

of support, but it is now suggested that they are not a realistic possibility.

Government of the Republic of Guinea - direct or through BARAF

Assistance here is likely to be mostly possible in the form of granting certain incentives such as relaxation of import duty on plant & equipment, granting of tax holiday etc.

It was indicated that a contribution might be possible in the assistance with setting up of a laboratory. This might well be limited to building expenditure for adaptation, provision of furnishings and possibly service needs where expenditure is in local currency. This should be explored further.

UNIDO/UNDP

A technical support project to cover both plantation and the processing aspects is most appropriate.

In terms of any capital assistance the most appropriate in the immediate term might relate to laboratory equipment and some new plant items particularly associated with improving of technology.

Joint ventures.

Sequina SA would openly consider joint ventures. Present contacts with European manufacturers do not indicate any significant interest except in procuring and buying bark. Even here there has been no indication of willingness to contribute to the funding for developing plantations.

Sequina must take great care in considering joint venture particularly with partners already involved in the quinine business, since a great danger exists that the benefit might be found to be less than good for Guinea in the long run.

There could, perhaps, be better opportunities of joint venture with organizations dealing in venture capital and not tied to specific areas. Means of contacting such investors exist.

RECOMMENDATIONS

1. It is recommended that rehabilitation of the cinchona plantations at Kinadou and processing facilities at Seredou, in Guinea, under the auspices of Seouina SA is a reasonable objective and worthy of support.

2. To realize the aim it is recommended that a Technical Assistance programme would be most appropriate and beneficial.

3. Such a programme could be executed through UNIDO and possibly supported by the UNDP.

4. While any Technical Assistance programme should include co-ordination for all activities it should especially include the following aspects:
   (a) setting up and eouipping an analytical laboratory at the Seredou factory, arranging fellowship training abroad for one chemist graduate in the relevant techniques and including expert training and assistance on-site after establishment of the laboratory.
   (b) assistance in evaluation of current plantation stock.
   (c) analysis of results of analytical and physical survey and location of elite species followed by recommendation whether the possibility of procuring and using the technology of meristem tissue culture is appropriate.
   (d) supervise and assist in safety check on factory piping and electrics.
   (e) survey needs for repairs, replacements and prepare schedules for nationals procurement.
   (f) present designs for introduction of new acid scrubbing and final product technology, schedule and put to tender.
   (g) perform a general survey with relation to the utilization of facilities for more general extraction and processing of medicinal plants. Consider the benefit of the installation of a small pilot plant for general investigation of improvement of extraction technology and for use to evaluate other available medicinal plants as sources to broaden the base of the operation, with appropriate recomm-

endations for a second phase development.

(h) provision of experts in the areas of agronomy, analytical chemistry and chemical engineering who have specialist knowledge in the field of cinchona and a broad knowledge of medicinal plants. Apart from the overseas training indicated under 4(a) training in all aspects is envisuaged on-site.

5. For particular attention of the Nationals, it is recommended (irrespective of the granting of technical assistance) that the following considerations should be observed:

(a) no further immediate commitment should be made with respect to either spot or long term contracts for the sale of cinchona bark until overall strategy has been determined.

(b) that it is recommended finished quinine sulphate should selected as the preferred salt initially.

(c) it is suggested that the production of nr. 1 sulphate is of low interest and should only be considered as a fall-back situation as an alternative to bark sale and then would be best considered on fixed contracts with users with most careful attention given to price agreement.

(d) the suggested level of new plantings should be 10 Ha. per annum for a minimum of 10 years. The level may be slightly modified, as necessary, when the plantation survey is complete such that the proposed ultimate steady level of 150 m.t. bark per annum is achieved.

(e) a 1993 planting of about 2 Ha. using presently developed nursery plants should proceed and larger nurseries prepared in anticipation of planting 10 Ha. in 1994.

(f) investigation of African markets in terms of both consumption and form of medicant traditionally used.

(g) investigation further of the various funding sources for provision of equity or loans.

ANNEX I.

PROJECT IN GUINEA

JOB DESCRIPTION

Post Title: Chemical Technologist

Duration: 1.0 m/m

Date Required: July 1993

Duty Station: Republic of Guinea

Purpose of Project: Fact-finding and preparatory assistance mission to assess the potential for the industrial utilization of medicinal and aromatic plants.

Duties: The expert will carry out the following in collaboration with the management of the Sequina SA Factory in Senedou, Republic of Guinea:

1) Study the 1980 World Bank report on the rehabilitation of the factory and update recommendations as necessary.

2) Advice on the alternative actions presently being considered by the management.

3) Assess the potential for restoring the present plantation of cinchona and recommend methods for extending the cultivation to meet the demand of raw materials for the factory.

4) Recommend the requirements for rehabilitation of the factory including equipment, training of personnel and experts.

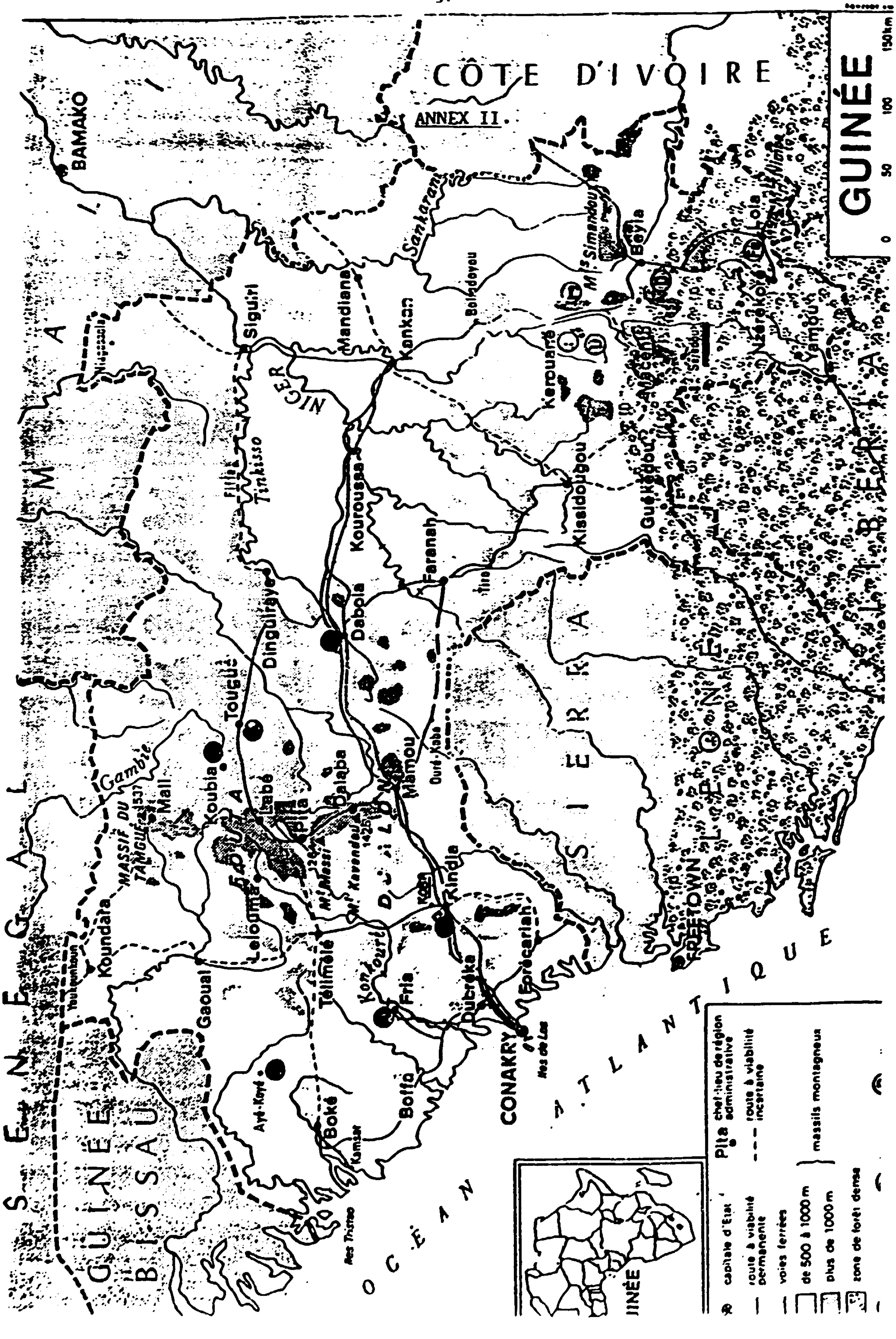
5) Recommend the processes for improvement of the production of quinine and other pharmaceuticals from cinchona.

The expert is expected to prepare a comprehensive report containing his findings, conclusions and recommendations on the basis of the above, and to recommend therein the mechanisms and modalities of a technical assistance project for the rehabilitation of the factory including a draft project document containing the inputs in terms of equipment, training, expertise and other infrastructural requirements and discuss with the Government and the Mano River Union on ways to finance such a technical assistance programme.

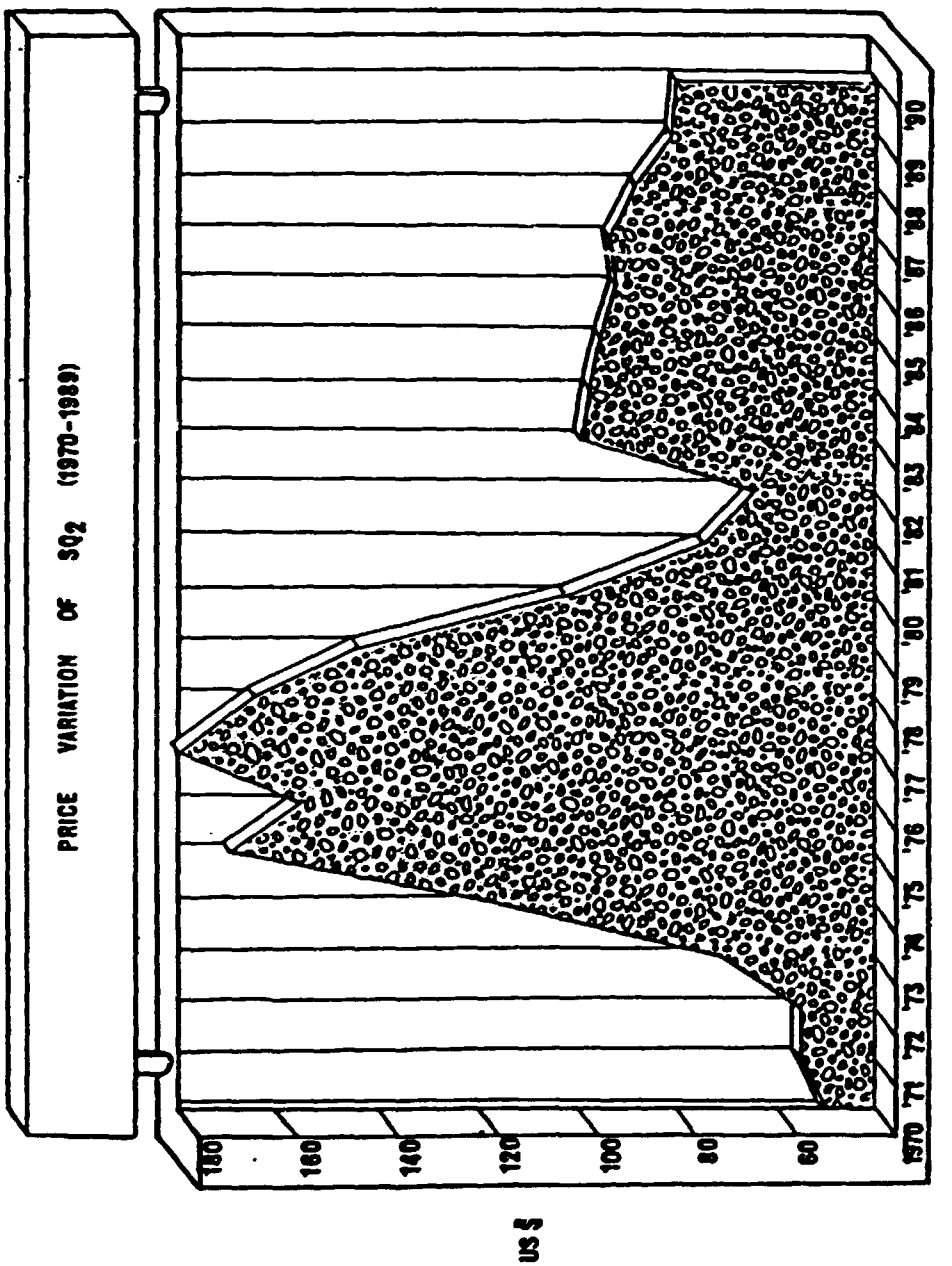
Qualifications: A Pharmacist/Chemical Technologist with at least 10 years experience in industrial utilization of medicinal and aromatic plants Cinchona in particular and with experience in developing countries

Language: English

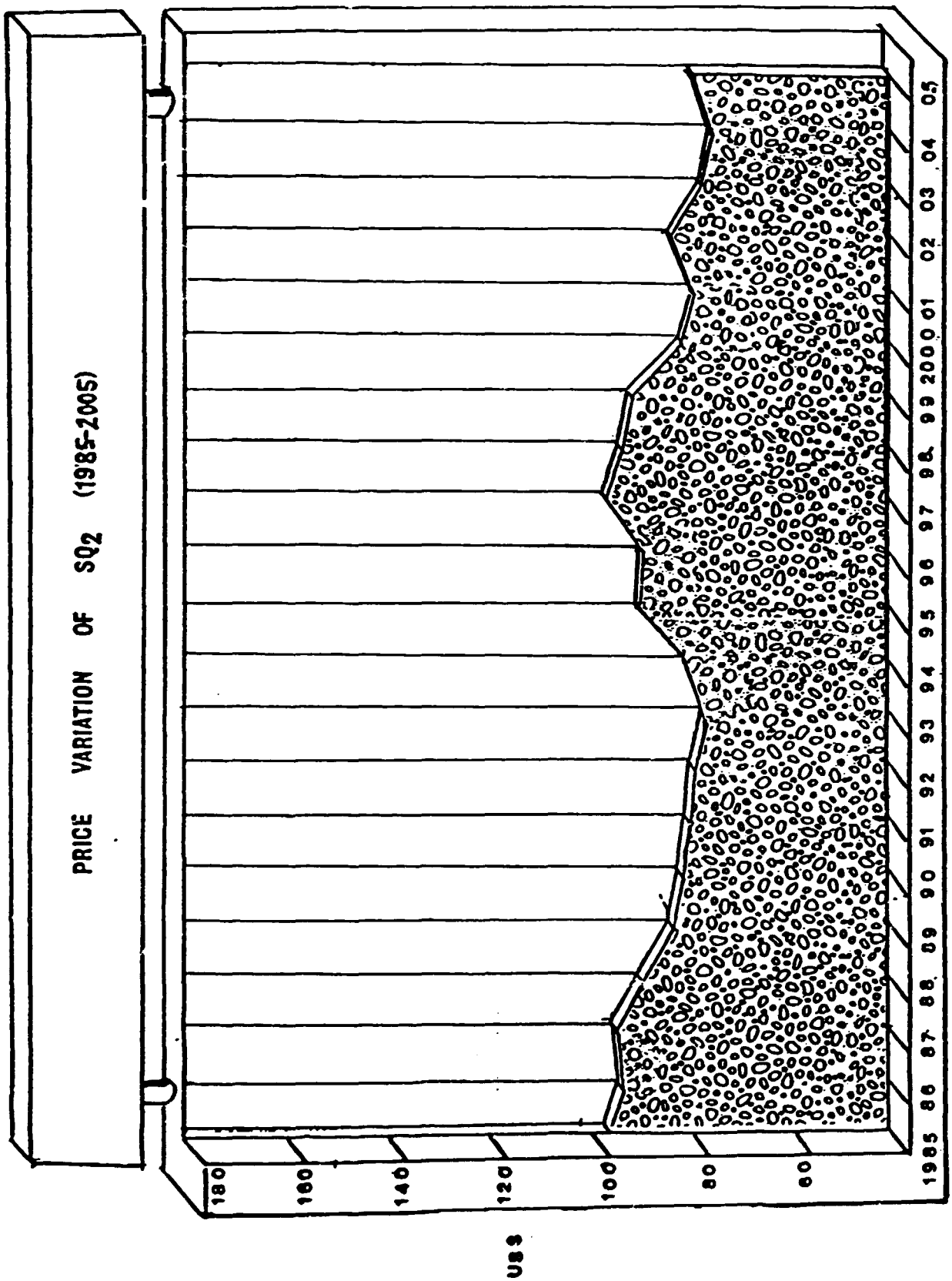
ANNEX II.


GUINÉE
0 50 100 150 km
CÔTE D'IVOIRE
SENEGAL
MALI
GUINÉE BISSAU
SIERRA LEONE
LIBERIA
OCÉAN ATLANTIQUE
BAMAKO
CONAKRY
Îles de Los
Boké
Boffa
Kamsar
Gaoual
Koundara
Youkounkoun
Télimélé
Fria
Dubréka
Forécariah
Kindia
Kolenté
Konkouré
Lelouma
Labé
Pita
Dalaba
Mamou
Ouré-Kaba
Koubia
Mali
Tougué
Dinguiraye
Dabola
Faranah
Kouroussa
Kissidougou
Guéckédou
Kerouané
Macenta
Nzérékoré
Yamou
Lola
Beyla
Bolindoyou
Kankan
Mandiana
Siguiri
Niagassola
NIGER
Tinkisso
Gambie
Sankarani
Fouta Djalon
MASSIF DU TAMGUÉ
Mt Simandou
Mt Nimba
Mt Kavendou
FREETOWN
Pita chef-lieu de région administrative
capitale d'Etat
route à viabilité permanente
route à viabilité incertaine
voies ferrées
de 500 à 1000 m
plus de 1000 m
massifs montagneux
zone de forêt dense

ANNEX III

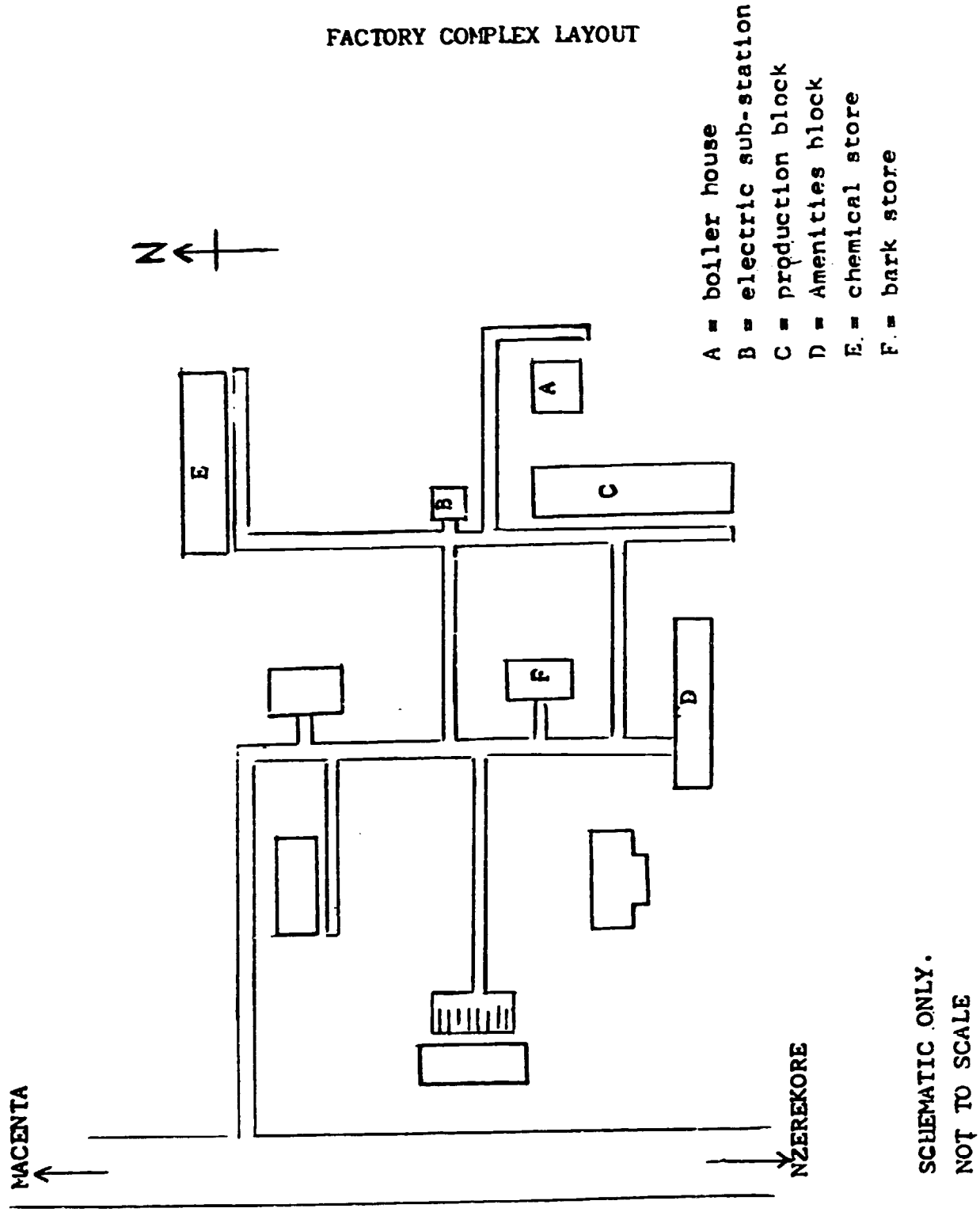

PRICE VARIATION OF SO_2 (1970-1989)
US $
180
160
140
120
100
80
60
1970 '71 '72 '73 '74 '75 '76 '77 '78 '79 '80 '81 '82 '83 '84 '85 '86 '87 '88 '89 '90
YEAR

ANNEX IV


PRICE VARIATION OF SO_2 (1985-2005)
US$
180
160
140
120
100
80
60
1985 86 87 88 89 90 91 92 93 94 95 96 97 98 99 2000 01 02 03 04 05

ANNEX V.

FACTORY COMPLEX LAYOUT



STOCKS & HARVESTING PROGRAMME FORECAST

metric tons.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
New plantings						20	20	20	100	100	100	100
Coppicings								15	25	25	25	25
Estate stock	330											
Harvest	30											
Estate stock		300										
Harvest		50										
Estate stock			262									
Harvest			50									
Estate stock				223								
Harvest				50								
Estate stock					182							
Harvest					50							
Estate stock						158						
Harvest						50						
Estate stock							133					
Harvest							50					
Estate stock								122				
Harvest								50				
Estate stock									197			
Harvest									80			
Estate stock										248		
Harvest										150		
Estate stock											228	
Harvest											150	
Estate stock												207

Note: Coppicings - assumed only 50% suitable for coppocing. Any replanting of remaining up-rooted trees not included.

For existing stock trees assumed after clearing, cleaning and maintenance after 1994 that bark on trees increases 5% per annum.

ANNEX VII

BASIS FOR COST CALCULATIONS IN ESTABLISHING AND MAINTAINING NEW PLANTATIONS

The projection assumes harvesting after 7 years growth. Maintenance costs include costs for pruning. Materials costs are for fertiliser & insecticide and the level of application according to current practice (& referred to in Science report 1990)

Since in-filling is considered necessary cost of plants for doing this have been included in years 2 & 3 although not indicated as being done at Kinadou.

Original costs indicated by Science SPRL in 1989 have been applied with an inflation factor of 19% to correspond to current levels for labour & materials.

Cost of plants has also been based on information from Science SPRL report of 1989 indicating consumptions of 971 man days, 200 kg fertiliser + 1.0 kg insecticide to provide 1 Ha planting. Applying current labour rates of 1,200 FG/day, est. cost of fertiliser at 180 FG/kg and 3,600 FG/kg the cost of plants may be calculated.

Cost for growing	971 x 1,200	=	1,165,200 FG
plants for 1 Ha	200 x 180	=	36,000 FG
planting:	1 x 3,600	=	3,600 FG
			1,204,800 FG
Plants per Ha = 10,000 , unit cost plants		=	120 FG
		=	0.128 USD

Annual schedule costs (in FG)

Year	Cleaning land	Plants	Maintenance & planting	Materials	Harvest	Total
1	100	1,282	262.2	39.6	-	1,683.8
2	-	77	257.3	3.6	-	337.9
3	-	24	263.4	10.8	-	298.2
4	-	-	336.6	10.8	-	347.4
5	-	-	399.6	10.8	-	410.4
6	-	-	472.8	64.8	-	537.6
7	-	-	489.1	64.8	-	553.9
8	-	-	-	-	850	850.0

These figures used as basis of calculating plantation development costs charged against production cost.

ANNEX VII

BASIS FOR COST CALCULATION FOR COPPICED AREAS.

Costing for coppiced areas is lower than for new plantations in that initial plants are not needed. In-filling in years 2 & 3 is somewhat increased. Costs again in FG.

Year	Cleaning land	Plants	Maintenance & planting	Materials	Harvest	Total
1	-	-	262.2	39.6	-	301.8
2	-	385	257.3	3.6	-	260.9
3	-	24	263.4	10.8	-	298.2
4	-	-	336.4	10.8	-	347.4
5	-	-	399.6	10.8	-	410.4
6	-	-	472.8	64.8	-	537.6
7	-	-	489.1	64.8	-	553.9
8	-	-	-	-	850	850.0

ANNEX VIII

FINANCIAL ASSESSMENT INPUTS

		USD
Current investments		
Infra-structure	Factory stocking wuth basic supply gas oil, petrol & water treatment chemicals	12,511 (yr 1995)
Land rehabilitation	Clearing 180 Ha. during 1994/5 & re-cultivate 73 Ha.	9,223 (yr 1994) 11,344 (yr 1995)
Building rehabilitation	Factory roofing repair, windows, doors, painting etc.	5,098
	Plantation	354 5,452 (yr 1994)
	Amenities block modification	2,000 (yr 1995)
Machinery	Detailed in separate Annex IX	95,255 (yr 1994) 80,500 (yr 1995)
Installation of machinery	Materials, freight & labour	47,884 (yr 1994) 24,150 (yr 1995)
Tools	Plantation tools	4,302 (yr 1994)
Laboratory	Furnishing & servicing Equipment (see Annex X)	20,000 60,000 80,000 (yr 1994)
Vehicle	4-wheel drive	20,000 (yr 1995)
Preliminary pre-production project costs	These are detailed separately in the draft project document, Annex	80,500 (yr 1994) 89,000 (yr 1995)
Future investments		
Vehicle	Further 4-wheel drive vehicle	20,000 (yr 1999)
Machinery	Outline also found in Annex	100,000 (yr 2000)
Installation of machinery	Materials, freight & labour	40,000 (yr 2000)

All investments further adjusted for 10% contingency in projections.

ANNEX VIII

Net working capital

Accounts receivable	mdc*	30	based on annual operating costs less depreciation
Raw material	mdc	0	inter company supply
Additives/marerials	mdc	90	most imported materials
Energy, fuel	mdc	30	local stockists
Spares	mdc	60	imported
Work in progress	mdc	0	ignored as capacity low
Finished product	mdc	30	factory cost + administration
Cash in hand	mdc	30	total production costs lees raw material + utilities + depreciation
Accounts receivable	mdc	30	based on factory costs

* mdc = minimum days coverage

Production costs

Depreciation:

Infra-structure, including plantation rehabilitation	over 10 years
Buildings; factory, office and plantation	over 15 years
Machinery, installed	over 10 years
Tools, plantation	over 5 years
Vehicles	over 3 years

Factory overheads

Comprise essentially disposables.

Protective clothing & eouipment	USD 750
Filter cloths	USD 1,000
Laboratory chemicals	USD 1,500
Intermediate, final packaging etc	USD 300
	USD 3,550

ANNEX VIII

Staffing, salaries & wages.

	FG,	FG.	
Director general (gross)		7,600,000	
Secretary	432,000		
Cashier	1,260,000		
Personnel chief	936,000		
Agronomes (2)	900,000		
Nursery staff (2)	840,000		
Tractor driver	468,000		
Guards (4)	1,440,000		
*			
Factory chief	1,800,000		
Laboratory chief	1,800,000		
Electrician/mechanic	500,000		
Workers (2) *	840,000		
Guards (2)	720,000		
	11,936,000		
Social costs (14%)	1,671,000		
Sub-total		13,607,000	
Grand total		21,207,000	= USD 20,570

* Charged in input as Direct labour against production.

ANNEX IX

PLANT & EQUIPMENT SCHEDULE

Immediate term

	Estimated cost USD 1994	1995
Utilities		
Cold water circulation	5,454	
Boiler, auto water feed	4,380	
Refrigeration system	9,430	
Compressor	5,130	
Total	24,399	
Services		
Electrical circuit & elements	8,572	10,000
Steam, service & plumbing piping	5,513	
Acid piping	291	
Insulation	4,458	
Total	18,834	10,000
Replacements, repairs, up-grades		
Pumps	15,376	
Motors	7,372	
Gauges, thermometers etc	470	
Heater elements	4,169	
Coil replacements/repairs	2,000	
Total	29,287	
New items		
Filter presses	15,537	
Weighing machines	4,183	
Workshop tools	3,015	
Acid separation unit, inc structure etc		25,000
Water sterilisation unit		500
Final salts reactors (2)		45,000
Total	22,735	70,500
Laboratory		
Furnishings, servicing	20,000	
Equipment	60,000	
Total	80,000	

ANNEX X

LABORATORY EQUIPMENT & FITMENTS.

Basic furnishing needs.

Benches with cupboards & min. working surfacr 9 m. & sinks.

Fume cupboards (2) with fume extraction.

Partitioned area for instruments.

Washing area with drying racks.

Chemicals & sample storage cupboards or area.

Desk & filing facility.

Servicings: drainage, electrical single phase supply & good supply of sockets, water supply, lighting.

Safety equipment: fire extinguishers, blanket, eye wash bottles.

Equipment, basic.

Laboratory glassware to include selection beakers, flasks, test-tubes, volumetric flasks, condensers, adapters, measuring cylinders, pipettes, weighing bottles, petri dishes etc.

Soxhlet extraction units with integral heating units. Minimum of 3 units x 4 flasks. Large stock thimbles.

Analytical balance and general purpose single pan balance.

Titration unit and Karl Fischer unit.

Ovens - vacuum & air drier. Glassware drying cabinet.

Polarimeter for optical rotation measurement with cells.

HPLC unit complete with U/V detector and integrator, e.g. Varion 5000 type, U/V detector at 220nm, 10 µl injection loop, C_{18} column & Phillips PU 4811 computing integrator.

Refrigerator.

Reference books: Bruxelles method for cinchona analysis including Commelin tables; Pharmacopoeias, BP, USP, European as appropriate.

Estimated costs:

Furnishing & fitting	USD	20,000
Equipment	USD	60,000

CURRENT INVESTMENT — USD

	1994	1995	1996	1997	1998	1999	2000	2001
Infrastructure	-	12,511	-	-	-	-	-	-
Land rehabilitation	9,223	11,344	-	-	-	-	-	-
Building rehabilitation	5,452	2,000	-	-	-	-	-	-
Machinery	95,255	80,500	-	-	-	-	100,000	-
Freight/installation	47,884	24,150	-	-	-	-	40,000	-
Tools	4,302	-	-	-	-	-	-	-
Laboratory	80,000	-	-	-	-	-	-	-
Vehicles	-	20,000	-	-	-	20,000	-	-
TOTAL FIXED ASSETS	242,116	150,505	-	-	-	20,000	140,000	-
Contingency 10%	24,212	15,051	-	-	-	2,000	14,000	-
TOTAL FIXED ASSETS incl. contingency	266,328	165,556	-	-	-	22,000	154,000	-
Working capital	12.041	13,030	1,243	698	1,063	1,387	2,499	6,954
Preliminary pre-prodn project costs	80,500	89,000	-	-	-	-	-	-
TOTAL FUNDS NEEDED	360,869	269,631	1,243	698	1,063	1,387	2,499	6,954

CURRENT INVESTMENT (continued) USD

	2002	2003	2004	2005	2006	2007	2008
Infrastructure	-	-	-	-	-	-	-
Land rehabilitation	-	-	-	-	-	-	-
Building rehabilitation	-	-	-	-	-	-	-
Machinery	-	-	-	-	-	-	-
Freight/installation	-	-	-	-	-	-	-
Tools	-	-	-	-	-	-	-
Laboratory	-	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-	-
TOTAL FIXED ASSETS	-	-	-	-	-	-	-
Working capital	15,950	756	-6,023	1,635	945	1,211	724
TOTAL FUNDS NEEDED	15,950	756	-6,023	1,635	945	1,211	724

PRODUCTION COSTS.

USD

	1994	1995	1996	1997	1998	1999	2000	2001
Raw material	8,800	5,500	5,500	5,500	5,500	5,500	5,500	8,800
Additives	-	21,871	21,871	21,871	21,871	21,871	21,871	34,994
Utilities/energy	-	7,289	7,289	7,289	7,289	7,289	7,289	11,662
Labour, direct	-	2,834	2,834	2,834	2,834	2,834	2,834	3,753
Repair, maintenance	-	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Spares	-	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Factory overheads	-	3,550	3,550	3,550	3,550	3,550	3,550	5,680
FACTORY COST	8,800	48,044	48,044	48,044	48,044	48,044	48,044	71,889
Administration o/h	1,000	2,000	2,000	2,000	2,000	2,000	2,000	3,000
Sales/distribution	19,677	2,462	2,462	2,462	2,462	2,462	2,462	3,600
Admin. salaries	17,736	17,736	17,736	17,736	17,736	17,736	17,736	17,736
Plantation dev.	17,910	24,068	31,550	35,737	42,114	50,222	59,377	62,294
Repairs/maint. pln	2,154	11,313	11,213	11,213	11,213	11,213	11,213	11,213
Depreciation	-	37,843	56,109	56,109	56,109	29,443	35,209	49,249
TOTAL PRODUCTION COST EXCLUDING DEPRECN.	67,277	105,523	113,005	117,192	123,571	131,677	140,832	169,732
TOTAL PRODUCTION COST INCLUDING DEPRECN.	67,277	143,366	169,114	173,301	179,680	161,120	176,041	218,981

PRODUCTION COSTS (continued) USD

	2002	2003	2004	2005	2006	2007	2008
Raw material	16,500	16,500	16,500	16,500	16,500	16,500	16,500
Additives	65,614	65,614	65,614	65,614	65,614	65,614	65,614
Utilities/energy	21,867	21,867	21,867	21,867	21,867	21,867	21,867
Labour, direct	5,591	5,591	5,591	5,591	5,591	5,591	5,591
Repair, maintenance	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Spares	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Factory overheads	10,650	10,650	10,650	10,650	10,650	10,650	10,650
FACTORY COST	130,222	130,222	130,222	130,222	130,222	130,222	130,222
Administration o/h	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Sales/distribution	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Admin. salaries	17,736	17,736	17,736	17,736	17,736	17,736	17,736
Plantation dev.	61,568	65,864	32,236	39,545	45,211	52,476	56,822
Repairs/maint. pln.	11,213	11,213	11,213	11,213	11,213	11,213	11,213
Depreciation	49,249	42,583	42,583	27,229	14,496	14,496	14,496
TOTAL PRODUCTION COST EXCLUDING DEPRECN.	228,739	233,035	199,407	206,716	212,382	219,647	223,993
TOTAL PRODUCTION COST INCLUDING DEPRECN.	277,988	275,618	241,990	233,945	226,878	234,143	238,489

ANNEX XIII

NET WORKING CAPITAL

USD

	mdc	coto	1994	1995	1996	1997	1998	1999	2000
Accts receivable	30	12	5,606	8,794	9,417	9,766	10,298	10,956	11,736
Raw material			-	-	-	-	-	-	-
Additives/materials	90	4	-	5,468	5,468	5,468	5,468	5,468	5,468
Energy, fuel	30	12	-	607	607	607	607	607	607
Spares	60	6	-	833	833	833	833	833	833
Work in progress		-	-	-	-	-	-	-	-
Finished products	30	12	2,295	5,645	5,645	5,645	5,645	5,645	5,645
Cash in hand	30	12	4,873	7,728	8,348	8,697	8,228	9,907	11,626
TOTAL CURRENT ASSETS			12,774	29,075	30,318	31,016	32,079	33,416	35,915
CURRENT LIABILITIES									
Accounts payable	30	12	723	4,004	4,004	4,004	4,004	4,004	4,004
NET WORKING CAPITAL			12,041	25,071	26,314	27,012	28,075	29,412	31,911
INCREASE IN WORKING CAPITAL			12,041	13,030	1,243	698	1,063	1,337	2,499

NET WORKING CAPITAL (continued)

USD

	mdc	coto	2001	2002	2003	2004	2005	2006	2007	2008
Accounts receivable	30	12	14,144	19,062	19,420	16,617	17,222	17,669	18,304	18,666
Raw material			-	-	-	-	-	-	-	-
Additives/materials	90	4	8,749	16,404	16,404	16,404	16,404	16,404	16,404	16,404
Energy, fuel	30	12	972	972	972	972	972	972	972	972
Spares	60	6	833	833	833	833	833	833	833	833
Work in progress			-	-	-	-	-	-	-	-
Finished products	30	12	7,719	12,580	12,580	12,580	12,580	12,580	12,580	12,580
Cash in hand	30	12	12,439	15,854	16,222	13,003	14,029	14,501	15,107	15,469
TOTAL CURRENT ASSETS			44,856	65,675	66,431	60,409	62,044	62,989	64,200	64,924
CURRENT LIABILITIES Accounts payable	30	12	5,991	10,852	10,852	10,852	10,852	10,852	10,852	10,852
NET WORKING CAPITAL			38,865	54,823	55,579	49,557	51,192	52,137	53,348	54,072
INCREASE IN WORKING CAPITAL			6,954	15,958	756	-6,022	1,635	945	1,211	724

ANNEX XIII

CASH FLOW — USD

	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL CASH INFLOW	607,703	231,760	231,760	231,760	231,760	231,760	231,760	370,816
Financial resources	450,000							
Sales	157,703	231,760	231,760	231,760	231,760	231,760	231,760	370,816
TOTAL CASH OUTFLOW	428,145	390,154	149,248	149,670	153,634	206,070	341,460	237,425
Total assets	360,868	269,631	1,243	698	1,063	23,337	156,490	6,959
Operation costs	67,277	105,523	113,005	117,192	123,571	131,677	140,832	169,732
Cost of finance	-	15,000	15,000	12,000	9,000	6,000	3,000	-
Repayment	-	-	20,000	20,000	20,000	20,000	20,000	-
Corporate tax	-	-	-	-	-	25,856	21,088	60,734
Dividends paid	-	-	-	-	-	-	-	-
SURPLUS (DEFICIT)	179,558	(158,394)	82,512	82,070	78,216	24,890	(109,700)	133,391
CUMULATIVE CASH BALANCE	179,558	21,164	103,676	185,746	253,962	288,852	179,152	312,543
NET CASH FLOW	(360,868)	(158,394)	82,512	82,070	78,216	24,890	(109,700)	132,391
CUMULATIVE NET CASH FLOW	(360,868)	(519,262)	(436,750)	(354,680)	(276,464)	(251,574)	(361,274)	(228,883)

CASH FLOW (continued) '000s USD

	2002	2003	2004	2005	2006	2007	2008
TOTAL CASH INFLOW	695.3	695.3	695.3	695.3	695.3	695.3	695.3
Financial resources	-	-	-	-	-	-	-
Sales	695.3	695.3	695.3	695.3	695.3	695.3	695.3
TOTAL CASH OUTFLOW	411.6	399.0	374.7	392.9	400.7	405.3	407.4
Total assets	16.0	0.8	6.0	1.6	0.9	1.2	0.7
Operation costs	228.7	233.0	199.4	206.7	212.4	219.6	224.0
Cost of finance	-	-	-	-	-	-	-
Repayment	-	-	-	-	-	-	-
Corporate tax	166.9	165.2	181.4	184.5	187.4	184.4	182.7
Dividends paid	-	-	-	-	-	-	-
SURPLUS (DEFICIT)	283.7	296.3	320.6	302.4	294.6	290.0	287.8
CUMULATIVE CASH BALANCE	596.2	892.5	1,213.1	1,515.5	1,810.1	2,100.1	2,387.9
NET CASH FLOW	283.7	296.3	320.6	302.4	294.6	290.0	287.8
CUMULATIVE NET CASH FLOW	54.8	351.1	671.7	954.1	1,268.7	1,553.7	1,846.5
NET PRESENT VALUE NPV at 15%		-127.1					+122.4
INTERNAL RATE RETURN IRR		8.4%					18.7%

PROFIT & LOSS (NET INCOME) USD.

	1994	1995	1996	1997	1998	1999	2000	2001
TOTAL SALES	157,703	231,760	231,760	231,760	231,760	231,760	231,760	370,816
Cost production	67,277	143,336	169,114	173,301	179,680	168,120	176,041	218,981
Operational margin	90,426	88,394	62,646	58,459	52,080	70,640	55,719	151,835
Cost of finance	-	15,000	15,000	12,000	9,000	6,000	3,000	-
GROSS PROFIT	90,426	73,394	47,546	46,459	43,080	64,640	52,719	151,835
Tax	-	-	-	-	-	25,856	21,088	60,734
NET PROFIT	90,426	73,394	47,546	46,459	43,080	38,784	31,631	91,101
ACCUMULATED, UNDISTRIBUTED PROFIT.	90,426	163,820	181,040	227,499	270,579	309,363	340,994	432,095

PROFIT & LOSS (NET INCOME) continued '000s USD

	2002	2003	2004	2005	2006	2007	2008
TOTAL SALES	695.3	695.3	695.3	695.3	695.3	695.3	695.3
Cost production	278.0	282.3	242.0	234.0	226.9	234.1	238.5
Operational margin	417.3	413.0	453.3	461.3	468.4	461.1	456.8
Cost of finance	-	-	-	-	-	-	-
GROSS PROFIT	417.3	413.0	453.3	461.3	468.4	461.1	456.8
Tax	166.9	165.2	181.3	184.5	187.4	184.5	182.7
NET PROFIT	250.4	247.8	272.0	276.8	281.o	276.7	274.1
ACCUMULATED, UNDISTRIBUTED PROFIT.	682.5	930.3	1,202.2	1,479.0	1,760.1	2,036.8	2,310.8

ANNEX XVI

CONTACT PERSONNEL

Dr.A.Diallo	Sec. General Mano River Union
Mr.I.George	Dep. Sec. Gen. Mano River Union
Mr.I.Marue	Director EAD, Mano River Union
Dr.S.M.B.Kanu	Dep. Dir. EAD, Mano River Union
Mr.J.B.Bangura	Industrial Dev. Officer, Mano River Union
Mr.M.T.Diallo	Economist/Statistician, Mano River Union
Mr.A.T.Sakho	Regional Officer (Guinea), Mano River Union
Mr.M.O.Bah	Director General, Seouina SA
Mr.Z.Guilavogui	Plantation & nursery chief
Mr.B.Kolie	(Former) Factory chief
Mr.M.Diauna	(Former) Electrician/mechanic
Mr.A.A.Camara	Assistant National Director, Natioal Industrial Development Office (OPIP)

Annex XVII

Backstopping Officer's Technical Comments based on the work of Mr. W.N. Walker

The report has comprehensively dealt with the historical background, present status and future prospects of the cinchona plantations and the quinine factory in Seredou. The consultant has made an evaluation of the state of the plantations and the factory and made specific recommendations for their rehabilitation and improvement.

The surveys and analytical work that have to be done to collect useful data for making definite decisions with regard to improvements and activities have been included as his mission was short to conduct such detailed surveys.

Cost benefit analysis and projections for future production have been included. Financial assessments done would be very useful in supporting loan applications for rehabilitation of the factory. Assessment of the equipment and the safety factors in the factory have been done and specific matters to be attended have been detailed. The equipment needed for the quality control laboratory and for upgrading technology have been listed.

Based on his findings, a draft project document has been prepared for technical assistance from UNIDO. Mano River Union, the Government of Guinea and Sequina S A will find the report very useful for rehabilitation of the plantations and the factory.

Recommendations made by the consultant are valid and it is hoped that urgent follow up action would be initiated. UNIDO would be willing to give the technical assistance needed for upgrading the technology for quinine production and improving the plantations provided a funding source could be identified.

The consultant has discharged his duties very efficiently and hope that his findings and recommendations would be considered for urgent follow up action.