Report on a consultancy to the Planning Branch, Ghana Forestry Department

15th-30th November 1996

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Executive Summary

This report describes a 12-day consultancy to review progress in permanent sample plot procedures, to provide training relative to PSP analysis, and to provide recommendations for planning and control systems for high forest management.

It was found that the recommendations made for modifying PSP field procedures during 1995 had been effectively implemented. Data processing procedures had also greatly improved. The consultant advised on selection of PSPs to be maintained under the Forestry Deartment's own budget, totalling 207 from the original 600 plots. He grouped remaining plots into several dispositions and recommended encouraging remeasurement of these plots by international research projects. He provided training in some programming techniques including shared access to network files and mapping programs for sample plots. It was considered further assistance would be desirable in developing the analytical programs to use the PSP data for management, but this is not immediately urgent, and could be deferred until 1998.

With regard to planning systems, he felt that the Planning Branch had lost its way with regard to forest management planning. A 3-tiered planning system needs to be created at the sector, forest and stand levels. Current methods and regulations focus on the stand, whilst higher-level procedures are confused or absent. He recommends introducing during 1997 a formal sector-level planning system based on digital mapping and database techniques. Associated with this would be a monitoring process based on aggregate analysis of LIF and Permit returns to the Accra office. The planning system would utilize existing data from the TSP inventory, and would delineate proposed TUC boundaries, characterise them to permit bidding, define felling series based on forest condition, and define protected areas on current criteria. The system would be largely map-based, with some tabular and statistical outputs, and would show plans, current operations, and deviations or conflicts between the two. It would be a continuously updateable system.

Some hardware requirements are needed as a pre-requisite, to be purchased for the Mapping Unit in Kumasi as soon as possible. A total of 6 months consultancy is recommended, broken into 4 periods of 6 weeks, to lead and expedite the development of the system. Draft terms of reference and equipment lists are given in annexes.

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Figures and Tables

Abbreviations

ERP .....Export Rehabilitation Project (World Bank, 1984-1989)
FD .....Forestry Department of MLF
FIP.....Forest Inventory Project (ODA, 1985-1989)
FIMP .....Forest Inventory and Management Project (ODA, 1990-1995)
FORIG.....Forest Research Institute of Ghana
FPIB .....Forest Products Inspection Bureau
FPS.....Forest Planning System
FSDP .....Forest Sector Development Project (ODA, 1996-1997)
GFS .....Ghana forest service* (successor organization to the FD)
GIS .....Geographical Information System
HCS.....Harvesting Control System
IRNR .....Institute of Renewable Natural Resources
LIF.....Log Information Form
MLF .....Ministry of Lands and Forests
MOP.....Manual of procedures
NTFP.....Non-Timber Forest Product
ODA.....United Kingdom Overseas Development Administration
PB.....Planning Branch of the Forestry Department
POM.....Point of measurement (height at which diameter is measured)
PSP.....Permanent Sample Plot
TCO.....Technical Co-operation Officer of ODA
TEDB .....Timber Export Development Board
TUC.....Timber Utilization Contract

Acknowledgements

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* The name of the Forestry Department successor organization had not been finalized at the time of writing.

Introduction

This report presents observations and recommendations made during a consultancy to the Forestry Department of the Ministry of Lands and Forests, Ghana. The mission was undertaken between 15-30 November 1996 in accordance with the terms of reference given in Annex A. It formed part of the Forest Sector Development Project, which is an ODA-supported project.

There were three objectives to the mission:

- To review revised procedures for re-measurement of the permanent sample plots established since 1989, and to make further recommendations on procedures and data processing methods.

- To provide training in programming techniques relevant to PSP analysis.

- To provide recommendations for the immediate and longer-term support and training needs relevant to planning and control of high forest management.

PSP procedures and analysis

Revisions to field procedures

Between 1989 and 1994, the Forestry Department established 600 PSPs within the high forest zone as an aid to future forest management. The objective of these PSPs was to provide information on the dynamics of tropical high forest in order to optimize forest management and timber production in the context of long-term forest conservation.

In July and August 1995, the author was invited to analyse data from the first re-measurement of 80 of these plots[1]. He found that there were a large number of errors in the data, arising principally from weak field and data processing procedures. He made several recommendations to deal with these problems. These covered changes to field procedures, development of a data processing system for the plots, and a reduction in the total number of plots supported from 600 to 200.

Table 1 shows the original recommendations and the current status[2] found during the consultancy. In general, procedural changes appear satisfactory, although not all details have been verified on the ground.

The manual of procedures for PSPs, which will document demarcation and re-measurement work, is only available in early draft form. The author would suggest that this is kept as concise as possible, and gives examples of field forms and lists of codes for tree notes and site factors. The rationale and more detailed procedures for PSP measurement can be found in Tropical Forestry Paper 25[3].

Table 1 1995 recommendations and current status of PSP measurement procedures

Topic	Recommendation *July 1995*	Current status *December 1996*
Number of plots	*Of the 600 established PSPs, 200 to be retained by FD, and 400 made available to FORIG or external research projects, with agreements to share data back to FD*	207 plots to be retained. Dutch ECOSYN project may support some other plots and will contact FD formally. Plots available to projects may be notified to CIFOR/IUFRO.
Distribution of plots	*Recommended that 200 retained PSPs be distributed at average intensity 1/75 km^2 by vegetation zones*	A selection has been made of 207 PSPs throughout high forest zone, as discussed on page 3.
Tree numbering	*Recommended using painted sequential numbers*	Adopted as current practice. Forms re-designed to allow new numbers to be recorded alongside old numbers. A field will be required in the database to hold the new number.
Tree list	*Recommended that a tree list from the first measurement be taken to the field.*	A form has been designed output from the database that lists trees, species, approximate size, location.
Plot demarcation	*Fibreglass tapes to be used instead of metal chains.*	Adopted as current practice.
Height of POM	*Height of point of measurement should be recorded*	Record form, field procedure and database all modified to allow this.
Painting of POM	*A band should be painted around the entire tree at the POM*	Adopted as current practice.
Minimum diameter	*The minimum diameter should be raised from 10 to 20 cm.*	Adopted as current practice.
Recruit trees	*Potential recruit trees should be screened using wooden calipers.*	Trial instruments have been made but are not yet staisfactory for field use.
Ladders	*Two sets of double aluminium ladders should be taken to the field to allow the larger trees to be manually measured up to 5 m height.*	Adopted as current practice.
Double measurements	*Double measurements on buttressed trees should be restricted to the case where butresses are growing into the POM.*	Apparently adopted. However, neither field forms nor database structure provide for second diameter.
Relascopes	*Relascopes need to be factory re-conditioned or replaced.*	Relascopes have been replaced.
Quadrat record	*A quadrat record form with site codes should be designed.*	This needs to be done.
Checksums	*Checksums should be calculated for the diameter field on each quadrat.*	Checksums have been adopted for all numeric fields and are being entered for all the 600 original PSPs. This will provide strong validation for the data input and file integrity.

Analysis and data processing

Progress has been made in revising the data entry system for the PSP data in line with the 1995 recommendations. The system provides for a clearer input form with online checks of data ranges and of diameters relative to previous measurements. A unified menu system is being built for data entry, editing, checking, and analysis. Some further modifications are needed and will probably be completed after this consultancy. These include a conversion of double diameter entries from a 2-record system to a 2-column format, and the provision of 2 diameter fields on the input and field forms.

Development of the analysis programs may require some technical assistance. There is a handbook of methods for the analysis of PSP data which gives example programs in FoxPro-compatible code[4]. It is possible that the responsible PB staff will feel able to develop the necessary programs of their own initiative, using this reference manual and examples of other programs supplied. If not, the author is available to provide assistance as may be judged necessary.

The two basic analysis programs needed are:

- *Stand increment, mortality, and recruitment*. This can be expressed in terms of volume or basal area, with summaries grouped flexibly by species.

- *Species group increment, mortality and recruitment*. This should allow for classification by size or crown classes, or by coding factors indicating damage.

The stand increment analyses can be used directly to monitor current accruals of volume to the growing stock. The species group analysis provides the needed input into various types of stand projection method and growth model. Growth model development will be straighforward once a body of clean PSP data has been compiled, although the accuracy of the models will depend on having data over several remeasurement periods, and is likely to be progressively improved over time[5]. Even preliminary models will however be a great improvement over current methods of estimating felling cycle, diameter limits, and annual allowable cut.

Selection of PSPs for retention

The consultant has reviewed the list of PSPs and prepared a schedule showing those which should be maintained by the FD or its successor organization. This comprises a total of 207 plots. The remaining plots have been grouped into geographic units which are suitable for cooperative arrangements with other research institutions. This can be done either directly, or preferably through arrangements with FORIG.

Table 2 Allocation of retained PSPs by vegetation zones

Vegtn. zone	Original PSPs	Retained PSPs	*1995 report*
DSFZ	60	30	*27*
MSNW	229	60	*61*
MSSE	82	31	*31*
WE/ME	10	5	*6*
WE	50	21	*13*
UE/MS	10	5	*4*
ME	160	55	*58*
Total	**601**	**207**	***200***

The general principles governing the selection of plots are as follows:

- Where a large number of plots exist within a small locality, as in Asukese, Bobiri, Muro and Tano Suhien FRs, these have been extracted as potential research sites.

- Plots in Bia Game Park Reserve have been extracted as a potential research group as Bia GPR is not under Forestry Department management.

- Plots in the Afram Headwaters area covered by the survey for the Plantation Preparation Project lie close to Teak plantations and are in very degraded DSFZ forest. As they are likely to be converted to plantations in future, they have been extracted.

- The remaining widely distributed plots have been divided into maintained and non-maintained units. The latter can be made available to research groups. The general principle is to ensure wide spatial distribution. The plots were generally established near the margins of forest reserves. Where several plots are on the same tie line, the one deepest inside the reserve has been retained.

Table 3 Groups of PSPs available for allocation to external projects

Code	Zone	Location	PSPs
A	MSNW	*Asukese FR*	30
B	MSSE	*Bobiri FR*	22
G	ME	*Bia GPR*	10
M	MSNW	*Muro FR*	48
P	DSFZ	*Afram Headwaters etc.*	30
S	MSNW	*Tano Suhien FR*	61
Other PSPs not currently maintained			193
Forestry Department maintained PSPs			207
Total			**601**

The arrangements whereby groups of plots are *adopted* by external agencies will need to be discussed in each particular instance. However it is recommended that:

- Cooperating agencies take over entire groups of the letter-coded plots in Table 1, and they are not split up.

- The uncoded plots can be made available individually or in small units for minor projects, but should preferably allocated as a whole to projects where a good spatial distribution of data is important.

- A formal data sharing arrangement is entered into and agreed between the FD/GFS and the institution undertaking the project. The project should be required to adopt the same measurement standards as the FD for trees 20 cm and above, and to hand over to the FD all collected data, reports and publications as and when required. The FD should have unrestricted right to use this data and results as it sees fit for its own purposes.

- Wherever possible, external arrangements are made through FORIG, in order to transfer research skills and technologies to Ghana.

High forest planning and control

The current status of planning and control systems

At the present time the planning process in the natural forest is fairly incoherent. There are rules, more or less arbitrarily derived, on felling girths for different species. There are other rules regarding conservation areas. There is a general 40-year felling cycle which is being applied in a piecemeal fashion to the delineation of felling series. There is the interim yield formula (IYF) which is used to determine how many trees may be felled in a compartment. There are local conservation rules relative to watercourses, and rules to the effect that two trees of each commercial species should be left in each compartment. Permits to enter a compartment require in principle a stock survey and the selection of trees according to these rules. Mechanisms are in place for controlling trees removals by many checks against the stock survey.

However, there is currently little effective monitoring of these processes, and a lack of priorities and scheduling in the planning process. Many of the low-level rules have been arbitrarily proposed by inexperienced technical assistance staff. Since the primary control on all operations is presumed to rest with the DFO, there is very much pressure on this position by contractors to bend or break these rules. Constant changes in rules on the ground, combined with stop-go enforecment, has been very destructive to the timber industry and is a serious disincentive to investors.

An effective monitoring system does not really exist. The process of compiling monthly, quarterly and annual reports involves almost no real cross checks and is primarily a bureaucratic task. Management cannot ask for any simple statistical information on current operations and expect a reply. For example: What area of forest is covered by 1996 felling series as compared with the area for which permits were issued in 1996? Where are the forests falling into 1997 felling series?

It is clear that current systems require a considerable overhaul if there is to be genuine control of forest management. It is especially necessary that planning and monitoring at the sector level is introduced if the proposed GFS is to function as a quasi-commercial institution with strong fiscal and operational control. Otherwise it will simply remain a bureacracy with many dysfunctional and wasteful elements, and of little influence on the ground.

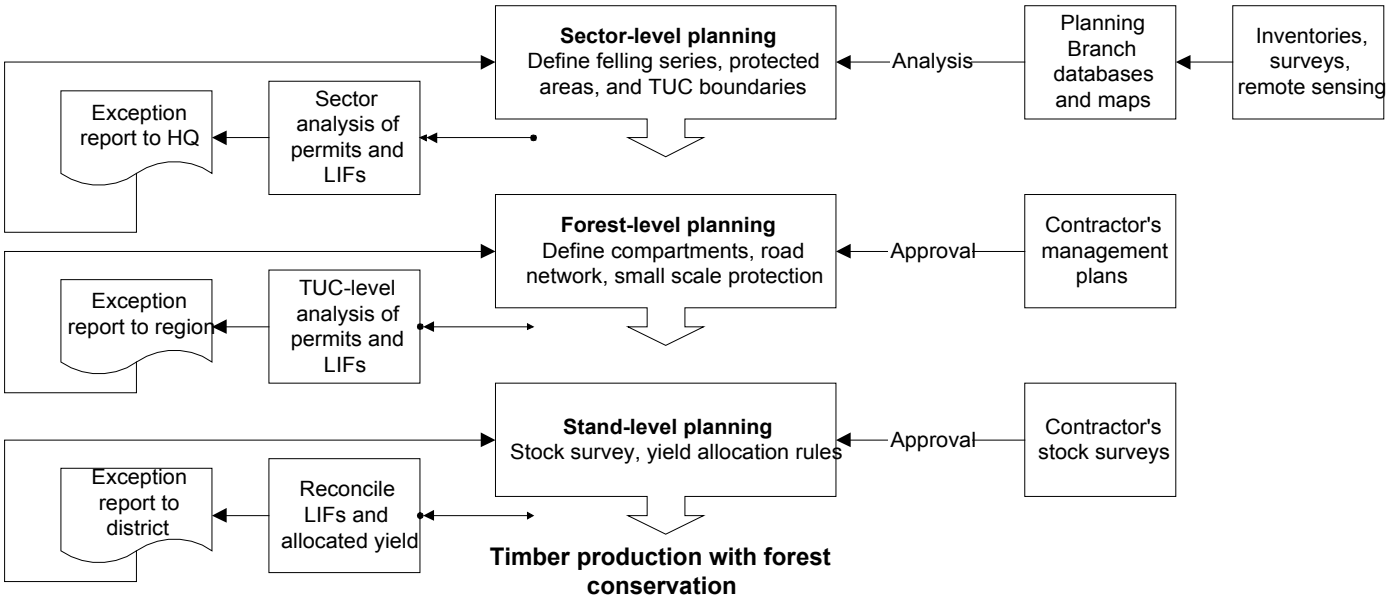
Development of a forest planning system

The proposals made here are intended to be basic, robust, effective, and realisable within 2-3 years with project support. They are based around a number of existing operations which have been introduced, and do not imply any totally novel elements. However, better technical support is required for forest planning techniques than has been provided

in the past. The objective is an integrated forest planning and management system based on simple and appropriate forms, computer databases, and linked digital maps. However, the reform of forest planning and monitoring in Ghana is not primarily a question of devising or introducing a piece of computer software. There is a need to establish and set in motion a 3-level hierarchical process with significant commercial and sub-contracted components. This is summarised in Figure 1.

At the top level is the delineation within the high forest zone of felling series and protected areas. Some of these exist. Others can be determined rapidly from the 1986-1992 forest inventory data combined with consultative information at the District level. Existing timber rights need to be overlaid on this to achieve a consistent pattern of felling series which prioritises better forest for felling, and delays that of lower basal area stands. From this, both felling series and a well-planned series of Timber Utilization Contracts

Figure 1 Sector, forest and stand planning and monitoring



can be defined.

The proposed Timber Rights Bill, assuming it is not aborted by the political process, will require that purchasers of TUCs will undertake to produce forest management plans, including roading plans, within 12 months. The GFS will approve and monitor these plans. The second layer of the hierarchy is the approval and digitization of these plans, so that they may be monitored and controlled.

At the lowest level, current operations will require a stock survey, again undertaken by the contractor and approved by the GFS. At this level, the Log Inspection Forms will be reconciled with the approved yield and stock survey, as shown in Figure 2. This shows LIF data which is currently processed in Accra on the left. On the right is the stock

survey data, which the consultant was assured is being processed in Kumasi*. The reconciliation routine requires networking the two databases, and the writing of software to compare records and list discrepancies between trees in the stock or allocated yield, and log and tree details identified on LIFs.

Many elements of the third level system already exist, and the process of implementing it can be completed fairly readily. However, because the higher echelons of the planning process are not functioning properly, effective reconciliation will initially show a somewhat chaotic picture of operations. As higher level planning is defined and becomes effective, this situation can be expected to improve.

Implementing the highest level will be greatly aided by the careful use of GIS, or digital mapping techniques. This does not require at this stage the use of satellite imagery, but is simply a question of digitizing forest boundaries, protected areas, and coding from TSPs the distribution of basal area and forest associations so that felling series can be coordinated and defined. Digital mapping will allow for redrawing of maps quickly at different scales, and the overlaying and coding of various types of information. This synoptic and thematic approach will greatly aid the planning process.

The process of digitizing forest boundary maps at this level is not difficult, and does not require great expertise or sophisticated equipment. Recommended equipment is shown in Annex B. However it is necessary to understand GIS programming and the data structures and principles of digital map representation in order to create routines to link the map information to the text-based forest planning and monitoring system. Once these routines have been programmed, the map digitization, plotting, and editing procedures will be perfectly within the competence of present PB staff. Some help will also be needed to set up the hardware and configure the software.

At a later stage, the use of satellite remote sensing will certainly be useful. However, the consultant does not see this as being central to an effective planning and monitoring system at this stage, and is best approached initially by establishing good contacts with other centres using remote sensing in Ghana. This will define better the needs for assistance that may be recommended for phase II of the FSDP from 1998 onwards.

Figure 1 also shows the monitoring and management response actions. At each level, the analysis of Permits and LIFs is important, but using different levels of grouping. For the sector level, operations are analysed by forest locations to establish spatial and temporal correlations with the plans. As with other levels of monitoring this is automated, and maps and reports generated showing anomalies. These are dealt with from headquarters in Accra. At the second level, data is aggregated and compared by compartment with the management plans submitted by contractors. Anomaly reports are circulated to regional offices for further action. At the third level, the reconciliation system shown in Figure 2 is used to analyse data at the tree level. Anomolies are referred to district offices. The monitoring process is conceived as a headquarters operation leading to line management

* He saw some evidence of this during his visit of August 1995, but none during the present visit.

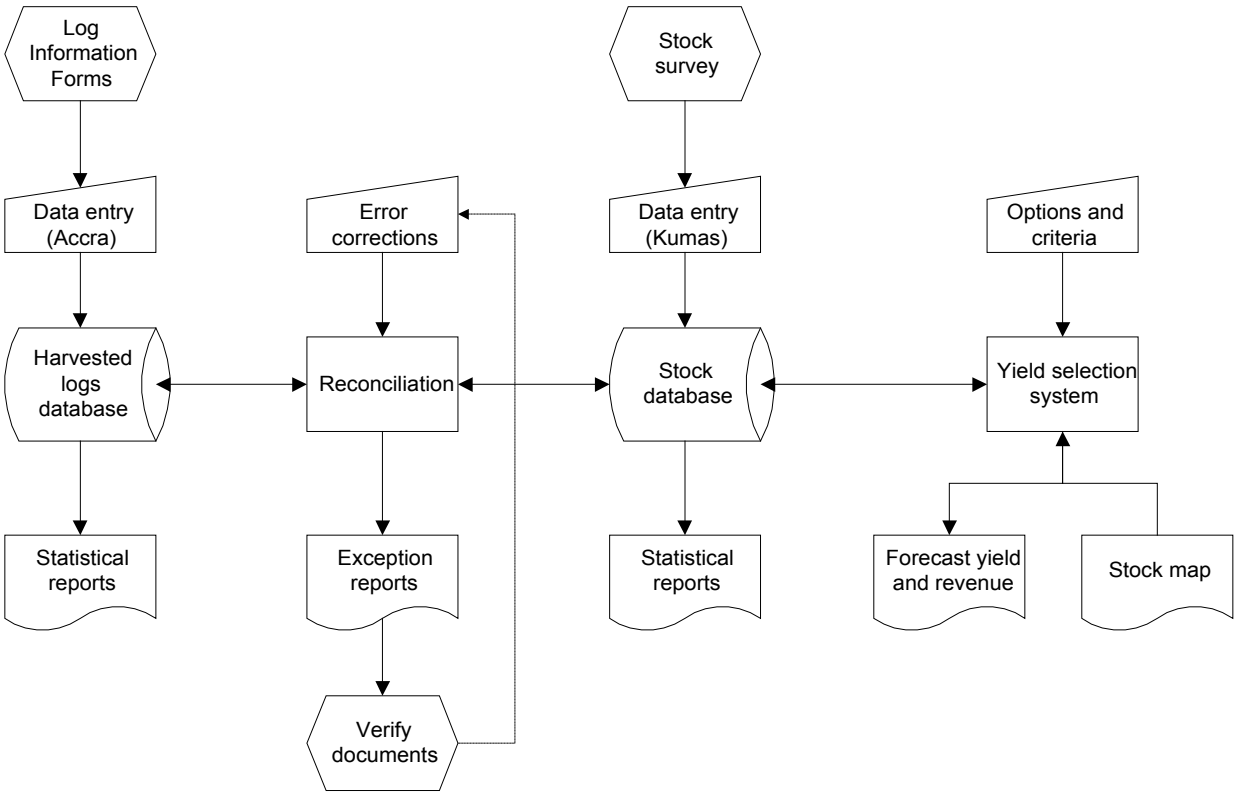


Figure 2 Reconciliation of log information with stock surveys and yields

responses. The generation of plans and the storage and acquisition of the necessary background information would be a function of the Planning Branch.

During 1997, about 6 months consultancy assistance is recommended to progress the development of this forest planning system. Formal terms of reference are proposed in Annex C.

The objectives during 1997 would be to achieve effective strategic planning and monitoring at the sector level, so that the process of identifying and offering TUCs is able to proceed smoothly without impediments due to lack of information, and is coherent with the forest management process. By the end of the year, the higher echelons of the new GFS should be comfortable with the management information available on the forest resource, current operations, allowable cut, and projected revenues. At the same time there should be clear information available in map form at the sector level on major deviations from effective control that can identify priorities for improved management at the regional and district level.

During phase II, the more detailed layers of planning would be perfected, especially in coordination with the new role of the private sector in developing forest management plans and undertaking stock surveys. It is considered that the consultant should at the same time revert from an implementation to training role, with annual inputs diminishing from 6 months a year in 1998 and 1999 to 3 months a year in 2000 and 2001.

Standards and documentation for data within the GFS

During the past decade, numerous substantive databases have been built up within the Forest Planning Branch, at FPIB, and at TEDB. Various standards exist for software. Most of these datasets are very little documented, and even within the same institution, there is significant incompatibility and potential confusion*. There is a need to agree standards and coding systems, to define access methods and permissions, and to maintain a working group of systems staff within these sister organizations to evolve and regulate these linkages. Some of the types of data that exist in various duplicated forms include:

- Species lists, including botanical, regulatory, and trade information, using various coding methods. Associated with these lists are royalties and volume functions that are species-based.
- Data from the 1986-1992 inventory sample plots giving species occurrence, size distribution and stem quality throughout the high forest zone, including plot locations.
- Data from the 1989-1995 PSP program for 600 1-ha plots, also giving species and size information, local spatial patterns, and potentially providing data on forest dynamics as the plots are remeasured.
- Data from the 1990-1992 inventory of non-timber forest products, collected in association with TSPs.
- The database of forest concessions developed under the ERP during 1986 and subsequently partially revised.
- Lists of forest reserves stored in various places, formats, states of accuracy and often with conflicting or confused coding methods, including supplementary information on areas, districts, planning units, plot numbers, sampling dates, vegetation types, and so on.
- Digitized geographic data on forest boundaries, and sample plot locations, largely undocumented and held in generally incompatible formats.
- Lists of property marks and owners.
- Lists of timber producers and exporters, together with locations, addresses, technical information on production facilities, and production statistics.
- The LMC database maintained by FPIB since 1987, with data on logs extracted including ownership, species, dimensions, and quality.
- Stock survey data which is said to be computerized in Kumasi, although this has not been verified by the consultant.
- The LIF database which is operational at the computer centre in Accra, and which is designed to serve the needs of royalty and forest fee accounting.
- The Permit database, also in Accra, which can be a central component of a monitoring system for forest operations.

This list of incompatible data is likely to grow rapidly as computer technology is more widely used. A positive approach is needed to agreeing standards if wasted effort and duplication is to be avoided. One of the roles of the proposed consultant would be to facilitate a working group on these issues.

Training requirements

In-service training for staff of is essential to raise standards and capacity in planning and monitoring systems, database programming, GIS methods, forest biometry, and quantitative forest management. Masters and Diploma courses offer the best compromise between depth and the need for relatively short courses. The consultant would need to compile a list of appropriate courses and identify the best candidates, but it is suggested

* The variety of mnemonic and number coding systems for forest reserves in the Planning Branch data sets is one example that leads to considerable waste of time and potential error.

that a minimum of 3 person-years of training should be budgeted for, preferably from September 1997. This would allow 2 1-year courses plus several shorter specialist courses. The availability of potential fellowships is also a powerful performance incentive for key personnel.

Conclusions

Permanent sample plots

The 600 permanent sample plots established under the ODA/FIMP from 1989-1994 had associated with them many problems, as was noted in a 1995 consultant's report. That report included a number of recommendations. The present assignment has reviewed progress towards meeting those recommendations.

With minor exceptions, the revised procedures recommended are now in place in all respects. Significant and encouraging progress has also been made towards developing software to input, edit and verify the data. This still needs a little fine tuning, but the consultant is confidant that the computer programmer at the Forest Department Planning Branch has the necessary expertise.

There remains a need for programs for analysis of the PSP data. It is probable that some further technical support will be required to assist in writing these. Once a useful body of clean data has been compiled, then it will also be possible to parameterize an existing forest growth model for application in Ghana. However, the PSPs will have to be maintained and measured at 5-year intervals over 20-30 years to give definitive data on high forest growth.

In this context, the consultant in the 1995 report also recommended reducing the number of plots from 600 to 200. It was felt that this was sufficient, and would avoid overloading the Forestry Department with a programme that went beyond the needs for forest management. In the present assignment, a selection has been made in consultation with Planning Branch staff, and a database prepared of 207 plots which are to be maintained by the Forestry Department. The remaining plots have been grouped into dispositions and should be offered to international institutions as a basis for research sites. It is recommended that formal agreements be entered into in such cases between the FD and the external institution to share data. Measurement standards for trees over 20 cm should be required to conform to the FD manual of procedures for PSPs.

The PSP manual of procedures is in preparation but not yet completed. Although the consultant is satisfied with the new procedures as discussed, there remains a need to complete the MOP, and to inspect operations on the ground based on the revised procedures to ensure that they are fully understood and executed by the field teams.

Planning and control of forest management

The consultant's time has been too brief to do full justice to this topic. However, some points have been noted which may be emphasised here:

- In spite of extensive past inputs by ODA, the Planning Branch's capacity in the core function of forest planning remains very weak, while there is virtually no effective monitoring.

- There is an urgent need to focus on this issue due to the formation of the GFS and the proposed revision of the concessions system.

- Proposals are outline for a three-layer forest planning and monitoring system that would be developed from the top down. All layers embody cartographic and database elements and rely on analysis of permits and LIFs for monitoring. The layers cover sector, forest and stand-level planning.

- Implementation of the sector level planning system would be the target for 1997. This will require simple and relevant use of digitized maps linked to databases which mostly exist in some form. Data gathered under the FIP or FIMP, the ERP concessions study, or held by the Planning Branch as maps will form the basis.

- The second and third layers of planning, at the forest and stand level, will be perfected during phase II of the FSDP, from 1998 to 2001. They will rely on data capture by the TUC purchasers, which will be presented in digital form as stock surveys, inventories, and roading plans. The project would supply licensed professional foresters with appropriate training and software to service TUC purchasers.

- Six months technical assistance by an appropriately experienced specialist will be required during 1997 to assist in implementing the first part of this system. Over the following four years, 32 months assistance would be applied, on a reducing basis, to support the implementation of the lower layers.

Ghana is in critical need of investment in the plantation sector if it is to meet its wood supply needs for economic growth. The perceived investment risk can be strongly influenced by the transparency and effectiveness of planning in the natural forest, and the presence there of a stable, reasonable and fair set of regulations for forest management.

Conservation of the natural forest also requires that whatever regulations and plans do exist are effectively monitored and controlled. The GFS will also require that the costs of these operations are minimized. The proposals made here are directed at these ends.

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[4] Alder, D (1995) Growth modelling for mixed tropical forests. *University of Oxford, Tropical Forestry Papers* **30**. 231 pp.

[5] Alder, D (1996) Models of basal area dynamics of mixed tropical forest: Neo-tropical experience and prospects for application in Ghana. *Paper presented at IUFRO Conference on "Growth Studies in Tropical Moist Forests of Arica", 17-21 November 1996, Kumasi. 14 pp.*

Annex A Consultant's terms of reference

Objectives

1. To review the draft PS manual of procedures for second enumerations and the associated data entry procedures and programs and make recommendations for their further development if necessary.

2. To provide training in the use of the programs that have been developed.

3. To make recommendations regarding both the immediate (to the end of Phase I of the current project) and long-term support and training needs of the FD PB that will be required to ensure that the PB as part of a reformed forest service has the capacity to effectively contribute to the implementation of high forest management systems.

Tasks

1. With the Mensuration Officer, review the manual of operations for PSP second enumerations.

2. With the Data Processing Officer, review the data entry routines for PSP data and make recommendations for their further development if required.

3. Conduct training in the use of programs and routines developed in FoxPro with the Data Processing Officer.

4. With the Mensuration Officer and head of PB to review progress on cleaning the PSP data and current field and office procedures.

5. With the PB staff and HQ staff to make recommendations for continued PB capacity to effectively contribute to the implemenation of high forest management systems.

6. To make a short presentation to the FSDP core team in Accra on the findings of the visit.

Outputs

1. Training of data processing staff in the use of PSP data and the preparartion of relevant programs.

2. A report on the current status of the work and recommendations for future support.

Annex B Equipment requirements for the Mapping Unit

The following equipment should be purchased before the arrival of the Forest Planning Specialist in order to avoid delays to implementation:

Qty.	Item	Observations
2	A1 digitizer tablets with stands	Needed for map input. The existing A0 digitizer will also be used, but for non-production tasks.
2	A1 plotters	Needed for map output
2	Computers, Pentium 200 MHz, 2 GB disk, CD-ROM drive, NE 2000 network cards, Windows 95, Microsoft Office installed, 16 MB RAM	This is a standard specification for a modern computer. The CD-ROM will be used to load software and also later for processing satellite images.
2	PC/ARCINFO, Windows version (ARCVIEW).	This is recommended for standardization with other installations in Ghana.
1	Network hub and cabling to link 2 workstations and server via hub, and PB and Mapping Unit via coaxial line.	This should be purchased and installed locally under a single contract.
	Sets of plotter pens, A1 plain paper, A1 width translucent drafting film (rolls), writeable blank CD-ROMS.	A recurrent budget will be required to replace these annually.
1	Network server with 4 GB disk and Novell 4 or higher, 5 user license, writeable CD-ROM drive. Including monitor, keyboard, and mouse.	The Mapping Unit will operate a separate server to the rest of the PB, but they will be interlinked. Writeable CD-ROMS will be used as the backup medium.
1	Large firesafe for media storage	Wooden buildings are a fire hazard.
3	UPS systems, 500 W, 220/240 V, including stabilization, over and under voltage protection.	For flexibility, each computer will be protected by its own small UPS.

It is recommended that Fountain Renewable Resources Ltd. prepare competitive quotations for this equipment in coordination with the consultant. Compatibility with existing suppliers and service contractors in Ghana is an important consideration. The cost of the items listed will total about £15,000.

Annex C Forest Planning Specialist Terms of Reference

Qualifications

The Forest Planning Specialist will have post-graduate qualifications in forest planning, with at least 15 years experience in the field, covering computer and database programming and design, installation of major networked database systems for planning and administration, installation and programming experience of GIS systems for forest mapping, extensive knowledge of all aspects of forest mensuration, inventory, growth and yield, experience of applications for natural tropical forests, good record of technical publications and senior project experience, good interpersonal and communication skills, including fluency in English.

Tasks

- Install and configure hardware and software, train Mapping Unit staff, design coding systems, and develop and monitor a production schedule to map forest boundaries into ARC/INFO compatible files for the high forest zone of Ghana.
- Facilitate and guide a working group of specialists within the Forestry Department to identify, standardise and document critical databases for the forest planning process.
- Develop a sector level planning system that will delineate, map and characterise forest reserve areas, internal protected areas, felling series, and TUC boundaries.
- Train users and programmers in the details of the planning system at both operations and programming level to ensure full competence in the system.
- Assist in development of the monitoring components of the planning system using Permit and LIF data processed in Accra.
- Support work in the capture of forest growth data through PSPs, with training on analysis and growth modelling methods.
- Facilitate and lead workshops to devise standards and procedures for forest-level planning to be adopted by TUC purchasers.

Outputs

- Digitized forest maps of the high forest zone, showing felling series, protected areas, and TUC boundaries.
- A functioning planning system at the forest sector level, able to produce maps, lists of relevant data, and summary statistics.
- A related monitoring system based on aggregated results from LIF and Permit inputs, anble to map and summarise current operations and deviations from plans.
- Staff trained in digital mapping techniques.
- Staff trained in programming and operation of the planning system.

Duration and location

4 periods of 40 working days each between March and December 1997. Based in Kumasi and Accra, with travel in the high forest zone as required.