DFID FRP project R6915:

Growth and yield modelling framework to determine ecological and economic sustainability of managed tropical moist forest systems

Final Technical Report

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Executive Summary

The project delivered approaches to integrate tools and approaches for growth and yield prediction to empower target institutions to improve forest management in tropical countries. The methods developed by R6915 have been linked to outputs from the closely related DFID-FRP project R7278 (*Humid and semi-humid tropical forest yield regulation with minimal data*) through combined pilot application studies in Indonesia and Guyana. It has been shown that the combined outputs of these projects will together better meet the needs of the target institutions.

The development of tools for forest growth and yield prediction has been one of the most important researchable constraints to the development of sustainable forest management and associated certification schemes. The modelling framework produced by this project has integrated and extended existing models describing aspects of ecology, silviculture and economics for tropical moist forest systems. The framework has been implemented using existing datasets from the network of permanent sample plots (PSP) in Kalimantan, Indonesia, and in Guyana. The models within the framework have been applied to predict the response of tropical forests to a variety of management options, and to develop indicators of sustainable management.

Background

Alleviation of poverty in communities dependent on tropical forests depends on the sustainable and equitable use of the forest resource. Technical knowledge of the forest resource can inform forest management decisions at all levels to improve sustainability of forest resource usage, and can empower marginalised stakeholder groups to help increase equity. This cannot be expected to alleviate poverty without the addition of suitable reform of the social and political constraints to development, however.

In order to develop reliable knowledge regarding the sustainability of tropical forest management we need to be able to model the response of tropical forests to a variety of management options. Appropriate models should firstly confirm whether any particular management regime is sustainable in the long term, and secondly assist in the identification of suitable indicators for monitoring such a regime. Conventional models of growth and yield are inadequate when used to evaluate the ecological and economic sustainability of forest systems, as they are based on projection of previous data. The development of combined models of management, economics and ecological processes were required for the development of sustainable forest management knowledge, criteria and indicators (C&I) of sustainability and associated certification schemes. The lack of such knowledge represented a significant technical, researchable constraint to development, alongside social and political constraints to development in many developing countries.

The specific development constraints relevant to this project are:

- Poor understanding of the theory of yield regulation in natural tropical and sub-tropical forests and woodlands;
- Legislation and regulations weakly grounded in sound forest management theory;
- Limited capacity to manage and interpret data from static and dynamic forest inventories;
- Low numbers of trained and reliable staff for planning, supervision of harvesting and monitoring.

The initial phase of the project was developed to address the above constraints in Indonesia. During the exit strategy, the project implemented linked pilot studies in Indonesia and Guyana to addressed these constraints. The pilot studies were implemented by partner organisations in both countries supported by FRP projects R6915 and R7278.

Political reform occurred in Indonesia during the period of the project. Decentralisation and associated decreased marginalisation of poor groups increased the number of stakeholders actively involved with forest management. In this environment, the lack of knowledge regarding the forest resource became more important as a basis for debate and development. The technical researchable constraints to development remained although the social and

political constraints had changed, and that in turn changed the environment for application of the technical research results.

The same technical constraints to development applied in Guyana as for Indonesia (described above), although the social and political constraints were different.

- *Summary of any significant research previously carried out.*

The project generalised, extended and applied outputs from the bilateral technical co-operation programme, the "Indonesia-UK Tropical Forest Management Programme" (ITFMP; 1992-2000). Two ITFMP outputs, a growth and yield model, "SYMFOR"; and a database for forest growth and yield data, were available as starting points for the project.

The EU funded Berau Forest Management Project (BMFP) has developed a Yield Scheduling System (YSS) for Indonesia that acts as a yield model. It does not respond to changing ecological conditions, however, so does not meet the requirements specified above, since it was designed for a different purpose.

A stand projection model had been developed for Guyana, but this acts as a yield model for the next generation of trees. It does not respond to changing ecological conditions, however, so does not meet the requirements specified above, since it was designed for a different purpose.

- *Some reference to how the demand for the project was identified.*

Demand for the project was originally identified by consultation with, and in documents by, international research organisations (CIFOR), bilateral aid projects (ITFMP and BFMP) and national governments (Indonesian National Research Plan). On-going demand was continually re-assessed, and is documented in various "Back To Office Reports" (BTOR) of project staff during the project (1-14). Much subsequent activity of the project was directed in response to demand from partner and external institutions.

The demand for the project is more fully documented in the project memorandum

Project Purpose

Strategies developed and promoted to maximize the benefits to artisans, traders and small-scale entrepreneurs accruing from current **global issues or generic tools**[1].

The revised purpose was specified at output level in the revised strategy document of DFID's centrally funded Forestry Research Programme (Palmer & MacQueen, 2000)[2].

The project has developed knowledge and generic tools for yield regulation of natural forests in tropical developing countries. These outputs (a) provided knowledge supporting the revision of policy to develop an enabling environment to improve the sustainable livelihoods obtained from forest resources, (b) provided knowledge to empower stakeholder groups to enter policy debates and processes leading to conflict resolution, (c) provided tools enabling the target beneficiaries to better manage forest resources.

[1] It is likely that benefits will accrue to beneficiaries in other FRP focus groups particularly to poor landless families at the forest margin.

[2] J. R. Palmer and D. J. MacQueen. (2000) DFID's centrally funded Forestry Research Programme: revised strategy 1995-2005, Chatham, U.K. Natural Resources International Ltd . 84 pp.

Research activities:

1. Development of SYMFOR framework (15 and 16)
2. Collation and analysis of Indonesian PSP data (17, 18, 19).
3. Species grouping of Indonesian data (17 and 18)
4. Ecological Model of Indonesian data (19 and 20)
5. Application of SYMFOR to C&I (21)
6. Ecological Models of Guyanese data (22 and 23)
7. Integration and application of SYMFOR with financial models (26)
8. A financial and economic analysis of Yield Regulation options for logged over forest at PT Inhutani I, Labanan Concession (24)

Outputs

1. Integrated modelling framework developed for the sustainable management of tropical moist forest systems

SYMFOR has been produced, documented and disseminated (see the accompanying CD for all outputs, including software and dissemination). It is a modelling framework that integrates representations of forest management strategies and ecological processes. Models within SYMFOR have been developed for East Kalimantan, Indonesia, and two regions in Guyana. SYMFOR models are used with PSP data to simulate the effects of forest management on future forest structure and composition, and hence future timber yield. Its application in regions other than Indonesia has been demonstrated and documented. Management alternatives may be used to investigate sustainability criteria and limits.

2. The ecological and economic sustainability of silvicultural management systems tropical moist forest in SE Asia evaluated through the application of the SYMFOR modelling framework linked to economic models

See van Gardingen *et al*. (24) and (15, 16, 17, 19, 21, 25, 26).

3. Application of models and data analysis by Indonesian stakeholders to enhance rural livelihoods derived from natural forest systems.

SYMFOR (15, 16, 20, 27, 28) has been applied in Indonesia (17, 18, 19, 21, 24, 25) to produce new knowledge regarding the effects of alternative management scenarios in terms of changes in timber yield, forest structure and financial returns. This knowledge has been used by Indonesian stakeholders (30, 31) to influence decisions affecting rural livelihoods derived from natural forest systems. The process has operated by levelling the playing field and creating common points of reference to empower previously marginalised groups that they may participate in and promote debate related to such decisions. Examples of this are the KKIP cluster of projects (11, 12) which arose from the R6915 project workshop in Bogor, Indonesia, in June 2000 (29, 32), and contributions to the process of decentralisation in East Kalimantan, Indonesia, through the Universitas Mulawarman (UnMul), Samarinda, Indonesia (33, 34, 35).

4. A strategy developed to ensure the application of new knowledge to solve development constraints to poverty alleviation through growth and yield management tools including SYMFOR.

This strategy was developed (36). The strategy focused on promotion of the external use of SYMFOR, both to develop and apply models. This was particularly successful in the cases of the University of Utrecht and the University of Florida, working in Guyana and Bolivia, respectively, and the Brazil-UK DFID Dendrogene project. The KKIP cluster of projects, the Indonesian SYMFOR user group, and training and implementation within national and regional institutions (Guyana Forestry Commission, UnMul, BFMP) are applying the results of SYMFOR. The strategy also helped cement the focus of application of SYMFOR as a strategic management tool, paving the way for further project proposals to DFID, Defra and the EU FP6.

5. Analysis of opportunities for the application of SYMFOR in other target countries and forest ecosystems documented with potential development partners.

These are documented in (2, 5, 6, 9, 13).

6. Allowable extraction levels defined for timber products through the development of a local version of SYMFOR developed for one South American Country

A version of SYMFOR has been developed for Guyana in conjunction with local partners. Implementation included analysis of local data for calibration and documentation of the local version of the system. The model was used to define sustainable harvesting levels for the local forests through pilot studies (41, 42).

7 Comparative examples of sustainable forest management developed through case studies applying SYMFOR in Indonesia and South America.

One pilot study of the application of SYMFOR for timber yield regulation was produced for each of Indonesia and Guyana. The results of the pilot studies were compared with equivalent studies from R7278 applying MYRLIN and the results presented at workshops by local partners (38, 39, 40). Lessons learnt from the application of yield regulation tools by projects R6915 and R7278 were documented for Indonesia and South America (41, 42, 43, 44, 45). The DFID Dendrogene project (087-502-025) has adopted the core components of SYMFOR as the growth and yield model to support the development of management systems for the Brazilian Amazon by local stakeholders.

Contribution of Outputs

DFIDs developmental goals may be summarised as the reduction of poverty. Poverty may be reduced by empowering poor forest stakeholders to increase their equity in control of the forest resource. The outputs of this project have contributed to such empowerment by developing knowledge relating to the forest resource and disseminating that to all stakeholders. This forms a common ground on which to begin discussions and negotiations relating to the resource use.

Stakeholder empowerment through increased knowledge dissemination was demonstrated in the workshops in Bogor (Indonesia) June 2000, Samarinda and Jakarta (Indonesia) in February 2002, and in Georgetown (Guyana) in March 2002. The establishment of the KDIP programme (by NGOs, local research and development organisations, community groups, national government and international research organisations) in Indonesia resulted from the workshop in Bogor in June 2000, and represents local commitment to the application of knowledge for the more equitable use of resources (46).

The pilot study applying SYMFOR and MYRLIN in Guyana (41) produced knowledge for a loggers community, as part of the process of their application for official recognition. This process was overseen by the Guyana Forestry Commission, who are in a position to apply the same process to other groups, increasing equity between stakeholders in Guyanese forests.

Continual dissemination and training exercises have increased awareness in the forestry communities in Indonesia and Guyana of the importance and potential influence of the application of data in relation to the sustainability of forest resource use. In particular, dissemination of knowledge produced by the project regarding the inadequacies of current policy in Indonesia (34) has led to increased awareness and local pressure for change.

Increased knowledge and awareness of forest ecology and management helps the forest sector to manage the forest resource sustainably. A sustained forest resource, equitably managed, represents reduced vulnerability for poor people. Appropriate regulation of a sustainably managed forest resource enables government to increase captured revenue from the forest sector. This provides the government with increased power to support the poor.

- *The identified promotion pathways to target institutions and beneficiaries.*

Training of developing country nationals in the application of SYMFOR
→ increased ability to produce relevant knowledge and ownership of it
→ increased ability of developing country to manage forest sustainably
→ **sustainable resource available to poor stakeholders**
→ **decreased vulnerability of forest-dependent poor**
→ increased ability to involve stakeholders in discussion
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**

Policy briefs
→ increased ability of developing country to manage forest sustainably
→ **sustainable resource available to poor stakeholders**
→ **decreased vulnerability of forest-dependent poor**
→ reduced wastage and increased efficiency to maximise government revenue
→ ***increased governmental power to support poor***

In-country workshops
→ increase awareness of forest knowledge, issues and potential solutions
→ change of forest policy/practice
→ increased ability of developing country to manage forest sustainably
→ **sustainable resource available to poor stakeholders**
→ **decreased vulnerability of forest-dependent poor**
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**
→ provide level playing field and neutral arbitration in discussions
→ resolves conflict, bypasses authority control
→ increased ability to involve stakeholders in discussion
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**
→ increase communication between organisations
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**
→ promote multi-stakeholder collaboration
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**

Research publications and international conferences
→ **increase effectiveness of other pathways described here**
→ raises awareness of tools/approaches to increase knowledge of tropical forests
→ increase new knowledge production across the tropics
→ increased ability of developing country to manage forest sustainably
→ **sustainable resource available to poor stakeholders**
→ **decreased vulnerability of forest-dependent poor**
→ increased ability to involve stakeholders in discussion
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**
→ **enable the pathways described here to be applied in other countries/regions**

Website

→ raises awareness of tools/approaches to increase knowledge of tropical forests
→ increase new knowledge production across the tropics
→ **enable the pathways described here to be applied in other countries/regions**
→ enables passive, worldwide dissemination
→ **increase effectiveness of other pathways described here**
→ encourages collaboration for increased application of new tools
→ increase new knowledge production across the tropics
→ **enable the pathways described here to be applied in other countries/regions**

Newsletters

→ raises/maintains awareness of new knowledge of tropical forests
→ increase new knowledge application in developing countries
→ **enable the pathways described here to be applied in other countries/regions**

Pilot Studies

→ create new knowledge for a specific area
→ increased ability of developing country to manage forest sustainably
→ **sustainable resource available to poor stakeholders**
→ **decreased vulnerability of forest-dependent poor**
→ increased ability to involve stakeholders in discussion
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**
→ demonstrate and promote process to increase uptake
→ increase new knowledge production
→ increased ability of developing country to manage forest sustainably
→ **sustainable resource available to poor stakeholders**
→ **decreased vulnerability of forest-dependent poor**
→ increased ability to involve stakeholders in discussion
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**
→ disseminate new knowledge
→ increased ability to involve stakeholders in discussion
→ empowerment of poor stakeholders
→ **increased equity in forest resource use for the poor**

Active external linkages (University of Utrecht; Tropenbos; University of Florida; BOLFOR; Fundación Jatun Sacha/Project SUBIR Quito, Ecuador)

→ increase new knowledge production across the tropics
→ **enable the pathways described here to be applied in other countries/regions**

- *What follow up action/research is necessary to promote the findings of the work to achieve their development benefit?*

Uptake of the research results by development programmes, integrated with governance reform and social integration priorities, will sustain the application of the new knowledge generated, and enhance their development benefits. In part, this will be achieved by removing non-researchable constraints to development, such as governance, empowerment and equity.

- *This should include a list of publications, plans for further dissemination, as appropriate.*

For the full text of all references, see the accompanying CD, "Final R6915 Project Web-site".

Plans for further dissemination:

- Encourage FRP to continue dissemination of project outputs beyond the end of the project;
- Solicit support for the MOFORM initiative (http://www.moform.org) that will integrate, develop and promote holistic ecological and economic approaches to address development constraints.
- Solicit support for other initiatives that apply SYMFOR and similar approaches;
- Maintain the project website, while this is possible.

Lessons learned

(i) Project/Programme Level Lessons

MOUs (Memorandum of Understanding) have been useful to facilitate the sharing of data and resources with partners in developing countries and have facilitated collaborative research. The implementation of the MOUs was very time consuming and would have been helped if a template had been available.

There are benefits to having standardised methods and formats for internal reporting within the project. A standard format and requirement for Back to Office Reports assists in the communication between partners.

(ii) Sector Level of Thematic Lessons

In-country partnerships that involve local researchers and clients for knowledge create an environment that can enhance uptake of research. These local partners are likely to require external assistance from international development partners to support uptake, in the form of workshops and training. This requires a long-term commitment for training and other uptake activities by the international partners.

The choice of developing country partners to host dissemination activities can have significant impact on the success of dissemination and developmental uptake. Local universities can be very effective because they are often seen as being relatively independent of vested interest groups (e.g. industry, NGOs, Government, etc.).

Developing country researchers and consultants can make significant contributions to projects but generally have difficulties with meeting accepted practice for project management, reporting and accounting. Specific training in these areas would increase efficiency of delivery of outputs from contracted-out activities.

Dissemination via the web and electronic publication allows easier and faster communication of knowledge. It can also give worldwide audience to interim or incomplete results that would not reach peer-reviewed journal level but that represent valuable information nonetheless. It complements traditional dissemination methods, is immediate, free and readily available, thus removing barriers to knowledge transfer that existed previously.

(iii) General Developmental Lessons

Developing country partners (Ministry of Forestry and private companies) and in-country development projects (DFID and EU) helped to establish the demand for the research and specify the form of outputs. This involvement increased local ownership and assisted in the developmental uptake.

The transfer of technology and results to developing countries can be relatively rapid when partnerships involving local clients for knowledge and local researchers are supported by external development agencies.

Project impact increases exponentially with the length of the project. Figure 1 shows the number of dissemination items (published items relating to the project that mostly are outputs of the project) per year over the lifetime of the project (July 1997 – December 2002). 113 dissemination items were produced during project extensions following the initial 3 year period, out of 180 dissemination items in total.

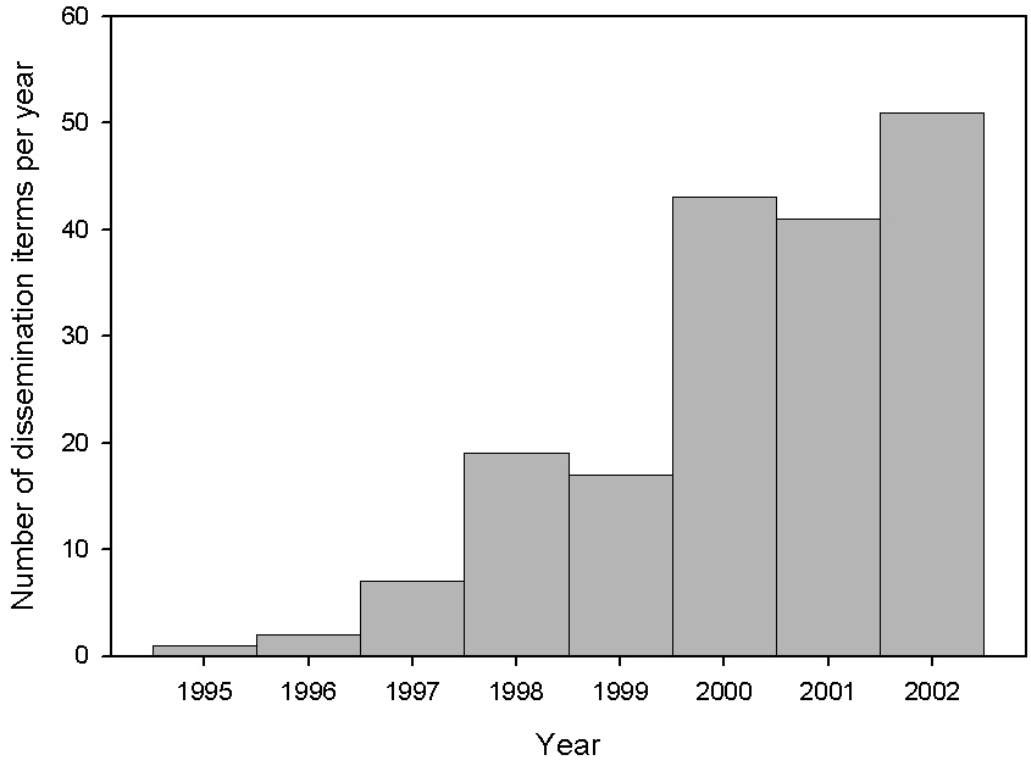

Figure 1: The number of items published per year relating to project R6915 and its products over the lifetime of the project.

(iv) Finally, do you think there are issues arising from this project or programme which would make further research (e.g.: an ex-post evaluation) useful?

Yes

If your answer is yes, please give brief reasons below:

Developmental issues associated with forests are complex and multi-faceted in nature. This project addressed one constraint to the reduction of poverty in forest-dependent people. A holistic approach to the issue would link the solutions to researchable constraints and socio-political constraints. The researchable constraints are summarised, and a proposal to address them made, at "http://www.moform.org". This approach links ecological and economic knowledge research together with the development issues of governance and equity, such as is required for the reduction of poverty in the forest-dependent poor.

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For the full text of all references, see the accompanying CD, “Final R6915 Project Web-site”.

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