A wide variety of techniques from the areas of economics, management, sociology and planning are relevant for carrying out research into non-industrial forestry. This module introduces some of the more widely used of these techniques, which are discussed in more detail in later modules. On the basis of experience in a forestry research group, comments are made about relevant applications of these research techniques.

1. INTRODUCTION

To provide input to forest policy, it is necessary to understand the priority that different groups within the community place on forestry, and the costs and benefits of various kinds arising from forestry. There is a need to generate information which will assist decision makers, in government and the private sector, in regard to forestry investment and management. Government is concerned with strategies to promote forestry for timber production and wider community benefits, and also to regulate the use of native forests and plantation land for the public good. Investors and landholders seek to manage their resources in forestry in such a way as to make a satisfactory return on their investment and effort and promote their livelihood.

Forestry training has traditionally concentrated on large-scale production and silvicultural technology, relevant to the maximization of forest biomass production, from monoculture plantations of a few well-known conifer species. A policy interest in small-scale forestry – particularly farm and community forestry – is relatively new. In these areas, financial aspects usually remain important, but there is also considerable emphasis on social and environmental objectives. Research in this situation requires a different mindset to that of traditional silviculture.

Another point of departure in this module is that it is concerned with forestry in the tropics, and the challenge is to induce more landholders to plant trees. In contrast, in some European countries, forests have been in the hands of the same families for hundreds of years, and approach the concept of a normal or even-aged forest. In such cases, the research interest may then be in monitoring economic performance of forestry and its relationship with other farm activities, harvest scheduling and marketing strategies, and intergenerational transfer of forest resources.

A wide variety of economic and other social science research techniques are available for tropical forestry research. These approaches are the central theme of this module, although it is necessary to place them in a decision-support perspective. Material in this module on socio-economic research techniques in small-scale forestry arises in particular from activities carried out in the Rainforest Cooperative Research Centre in Queensland, and draws on Harrison (2001).

This module first outlines the nature and role of socio-economic analysis, with particular emphasis on natural resource and environmental economics. The role of government in forestry is then examined, including the instruments which governments use to support farm and community forestry. Next, various research techniques are outlined briefly, and comments are made about the relevance of these techniques to address particular planning and management issues. Finally, some speculation is made about research issues and methods which are likely to figure prominently in the future. A brief discussion section follows.
2. THE NATURE OF SOCIO-ECONOMIC RESEARCH IN RELATION TO SMALL-SCALE FORESTRY IN THE TROPICS

Plantation forestry as a long-term investment, usually with the predominant objective of producing lumber and other wood products for sale, and providing uncertain financial returns to growers. It also generating positive externalities for the community. In the case of small-scale forestry in particular, plantations are often grown for multiple objectives. The management of native forests, on the other hand, is increasingly dominated by environmental objectives. For both plantation and native forests, government has an important role to play, though largely as a facilitator in the former case and as a regulator in the latter case.

Formulation of appropriate government policy has high information needs. Economics is one the disciplines which can provide policy-relevant information. The orientation of economics is essentially anthropocentric, i.e. management policies are examined in terms of their contribution to satisfying the needs and wants of humankind.

A distinction is made between positive and normative economics. Positive (or 'what is' economics) attempts to explain how economic systems work, by hypothesising and testing theories on the basis of empirical evidence. Normative (or 'what ought to be') economics attempts to analyses consequences of alternative courses of action in terms of specific objectives, and hence derive prescriptions for management. Sometimes the term conditional normative is used, in that optimal management policies are prescribed, conditional on specified objectives, constraints and environments.

A distinction is sometimes drawn between financial and economic analysis. Financial analysis takes account of costs and returns which can be identified through market transactions. Economic analysis takes a broader perspective, and includes for example the opportunity cost the unpaid inputs, e.g. of the labour and financial inputs of managers of small firms including farms. The term 'social economic' is also used sometimes, e.g. in social cost-benefit analysis. This does not refer to combination of economics and sociology, but rather to making allowance for impacts beyond the boundaries of the firm, i.e. typically called spillover effects or externalities. This would include impacts of environment and communities, viewed in terms of their (unpriced) costs and benefits.

Within the discipline of economics, there are many areas of specialisation. In broad terms, these involve macroeconomics (dealing with national economies) and microeconomics (dealing with firms and industries). At a more specific level, there are specialisations in international economics, monetary economics, development economics, transport economics, health economics, econometrics, and so on.

During the last 20 years, there has been rapid development of the fields of natural resource and environmental economics. These are essentially areas of applied microeconomics, although they also draw on macroeconomics (e.g. in relation to green national accounts) and development economics. Within natural resource economics, there is further specialisation, e.g. into land economics, forestry economics, fisheries economics, water resource economics, energy economics, and the economics of outdoor recreation. The areas dealing with agriculture, forestry, fisheries and wildlife (a sub-group of the renewable resources) are sometimes referred to as bioeconomics. In the last decade, ecological economics has also emerged as a recognizable economics specialisation.

The discipline of natural resource management has also undergone rapid development in the last 20 years. This is a field concerned with economics, geography, conservation biology and other areas, but with a focus on improving the performance of bioeconomic systems.

Economists and natural resource management professionals working in the fields of agriculture and forestry require a sound understanding of biology. Often they will work in multidisciplinary teams, which also comprise specialists in other fields, including the natural sciences. No one discipline has a mortgage on all the
knowledge and analysis skills necessary to guide efficient, equitable and sustainable management of natural resources. If research is carried out from a multidisciplinary (or even interdisciplinary) perspective, then managers can have more confidence that the advice provided to them will be sound. There is a lower risk that decisions will be criticised for overlooking important perspectives. Sometimes it is argued that what is needed is a transdisciplinary team, in which members are multi-skilled. While this has obvious benefits, it is also necessary that disciplinary rigour be applied in research.

While early forestry research tended to take a reductionist approach of investigating specific relationships, there is now strong emphasis on a systems philosophy, which takes an holistic approach to defining and examining forestry systems.

Any structured research activity can be viewed in the context of the scientific method of inquiry, in that a set of implicit steps can be recognized. In general terms, these include identifying a decision problem and an associated system (e.g. a collection of resources and their interactions), posing questions or making hypotheses about this system, collecting data, and analysing these data to draw inferences.

In economics, there has been a tendency to rely heavily on quantitative research techniques, and mathematical and statistical models, particularly in North America. However, in recent years there has been increased interest in qualitative techniques, the usefulness of which has been clearly demonstrated in other social sciences (e.g. see Patton 1990).

When collecting and analysing social and economic data (as indeed in most technical research), it must be recognized that while objectivity is sought, nevertheless a good deal of subjectivity will be involved. That is, to some extent researchers subjectively chose their research topics, sites and methods, and the data they will collect, through to subjectively choosing the significance level at which they will declare significant differences.

3. THE ROLE OF SOCIO-ECONOMIC RESEARCH

Governments play a major role in forest industries, and particularly non-industrial forestry. This includes support programs to enhance the profitability of forestry and the attitudes of potential tree growers, and to overcome various impediments to tree planting. It also includes the regulation of forestry, and designed to achieve environmental and social sustainability.

In general, the objective of economists and natural resource management professionals is to provide information to agencies and individuals who have the task of managing natural resources. That is, they produce quantitative or qualitative information, within a normative framework, which fulfills a decision-support role. This information augments (but does not replace) the information, judgments, hunches and tentative decisions of managers.

Socio-economic research is in general designed to support government policy-making, i.e. a social rather than private-producer perspective is taken. The research output augments the information that decision-makers already have, confirming or challenging tentative decisions. The aim is to generate qualitative and quantitative information with will assist in the making of good decisions from the viewpoint of the wider community. The spatial focus may be on a community, district, watershed or wider region.

Socio-economic research provides one of the inputs to government policy. It moves beyond technical considerations and examines the impact of forestry policies on people and on the environment. In the case of environmental impacts, these may be assessed by scientists, but again the view of the community towards environmental issues is critical to policy. For example, if deforestation is leading to flooding of coastal cities, sedimentation of fisheries and depletion of groundwater supplies, then these issues very much affect human settlements and place high priority on reforestation.

Desirable policies are not static, but rather evolve over time, for example as
technology, environmental conditions and community attitudes change. Governments do not automatically support environmental and social causes, but need to be convinced or pressured into recognizing their worth. Strong environmental lobbies are now well established, and do not appear to be losing their influence. In some cases, ‘green parties’ have gained considerable power with parliaments. In low-income developing countries, environmental pressure often comes for external loan agencies and donors.

The emphasis of this module is on research into small-scale forestry in the tropics and sub-tropics, and this has some differences from small-scale forestry in developed countries in temperate zones. Typically, there is a history of relatively recent deforestation, and recognition of the critical need for reforestation. Forestry activities typically involve reforestation of agricultural land, rather than management of a relatively ‘normal’ forest. There is greater emphasis on impediments to planting, benefits of reforestation (including carbon sequestration and watershed protection benefits) and government assistance programs, and less on financial monitoring and harvesting systems.

4. SOCIO-ECONOMIC RESEARCH METHODS IN SMALL-SCALE FORESTRY

A wide variety of research techniques, both qualitative and quantitative, have been applied to examine socio-economic issues in small-scale forestry. Some of the more important of these are listed in Table 1.

When a problem in relation to natural resource management has been defined, it is important to determine who are the affected parties of stakeholders who have a vested interest in policy outcomes (Harrison and Qureshi 2000). It is then necessary to collect data which will shed light on resource management. If appropriate experts can be identified, it may be possible to collect data by discussion with these experts and from informal surveys not using a probability sampling framework. Considerable use was made of informed sources in the study of potential for adoption of Australian tree species in the Philippines reported by Harrison and Herbohn (2000).

More formal methods can be applied to elicit expert opinion. *Delphi* surveys seek to obtain group consensus views while minimizing the interactions between experts so as to prevent domination on the basis of personality or rank. This was used to predict harvest ages and stand yields to be used in financial modeling of non-traditional tree species in farm forestry in North Queensland, Australia (Herbohn et al. 1999, Herbohn and Harrison 2000). *SWOT* analysis (group identification of strengths, weaknesses, opportunities and threats) is sometimes used when evaluating a specific program or enterprise and exploring improvement measures, e.g. see Hobbs et al. (2001). *Focus group* meetings are a means of generating and testing ideas as an aid to further analysis, such as setting up scenarios for non-market valuation.

*Case studies* of particular systems (e.g. nurseries, Community Based Forest Management (CBFM) sites, timber processing plants, lumber dealers, furniture manufacturers) may provide important insights into the role and management of these systems. There has been increasing recognition of these qualitative research techniques in recent years, particularly when a relevant population of substantial size is not available from which to draw data (e.g. see Patton 1990).

The various methods of participatory rural appraisal (PRA) also fit within this qualitative research sphere. PRA has been found useful in designing research programs in relation to small-scale forestry in the Philippines (e.g. Singzon et al. 1993). PRA is ‘a systematic, semi-structured approach and method of assessing and understanding . . . village situations with the participation of the people and through the eyes of the people. It comprises a rich menu of visualisation, interviewing, and group work methods that have been proven valuable for understanding the local functional values of resources, for revealing the complexities of social structures and for mobilizing and organizing local people. It is therefore a family of methods and approaches to enable local people to present, share, and analyze their

An alternative to these qualitative methods is to identify a target or reference population and develop a sampling frame (containing as comprehensive representation of this population as possible), and conduct a sample survey. For example, landholder surveys are used to obtain information about attitudes and impediments to small-scale forestry.

While these ‘stated’ opinions may not match exactly the real decisions of landholders, attitude surveys are much easier to carry out than observing actual behaviour, and in practice a combination of both may be the optimal approach. For sample surveys, it is necessary to choose a sampling design (often a form of stratified or multistage sampling), and to develop and test a questionnaire. Sometimes a semi-structured approach will be useful, where some questions are of closed format (e.g. recall a specific fact, respond yes or no, state a degree of belief or preference on a Likert scale), some are open ended (e.g. list reasons for a belief) and some allow free-form discussion (which may be voice recorded for later qualitative analysis).

Survey results are typically entered onto a computer package. Electronic spreadsheets have become extremely popular for data entry and storage, and for deriving relatively simple descriptive statistics (frequency distributions, means and variances) and making presentation (line and bar graphs, pie diagrams). Spreadsheets also have some capability for statistical inferences to be made concerning the underlying population. The Statistical Package for the Social Sciences (SPSS) has proved useful for more complex analysis, e.g. cluster analysis for identifying distinctive groups of landholders in terms of their attitudes to tree planting (e.g. Emtage et al. 2001). A variety of statistical time series analysis techniques have been developed, which are powerful methods of explaining observed data and making forecasts of future values of variables. Scenario development is designed to describe and understand what future types of situations might arise.

Over about the last 20 years, non-market valuation techniques have become widely applied in forestry research. The (zonal) travel cost method (TCM) allows demand to be estimated for recreation sites. The hedonic price method involves a multivariate analysis of past transaction records to determine the relationship between the market value of an asset and its characteristics, including environmental characteristics such as freedom from pollution and good views. In this way, the value placed by the market on environmental characteristics can be estimated statistically. The contingent valuation method (CVM) and choice modeling (environmental choice modelling, choice experiments) are used to estimate total economic value (TEV) of natural assets such as forests, including use and non-use values. CVM has been controversial due to the large number of potential biases and apparently unrealistically high values obtained in some applications. Benefit transfer – inference of values from a source site to target site – provides a time-saving alternative to making new estimates for each specific new site. In practice, benefit transfer methodology is the most widely used approach to non-market valuation, and is being supported by development of databases of environmental values (e.g. see Morrison 2001).

Agencies concerned with forest management have a reporting responsibility to government in regard to the achievements from spending public funds.
### Table 1. Socio-economic research methods in small-scale forestry

| Data collection | Stakeholder analysis  
|                 | Elicitation of expert opinion (including consultations with experts, SWOT analysis, the Delphi method, focus groups)  
|                 | Case studies  
|                 | Participatory rural appraisal  
|                 | Sample surveys using probability sampling  
| Data analysis | Analysis of survey data – descriptive statistics  
|               | Multivariate analysis (including cluster analysis and factor analysis)  
|               | Price forecasting (time series models)  
|               | Scenario analysis  
| Non-market valuation | Valueing non-wood forest products and services  
|                   | Evaluation of forest recreation benefits using the travel cost method  
|                   | Estimation of total economic value – the contingent valuation method  
|                   | Choice modelling or choice experiments  
|                   | The hedonic price method  
|                   | Benefit transfer  
| Reporting | Reporting systems for forest enterprises and agencies  
| Physical and financial modelling | Stand yield modelling (including under sparse data)  
|                     | The optimal economic rotation (the Faustmann formula)  
|                     | Discounted cash flow analysis and sensitivity analysis  
|                     | Development of financial models of forestry investments and overall enterprises  
|                     | Modelling carbon sequestration  
|                     | Cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA)  
|                     | Risk or venture analysis  
| Watershed and regional modelling | Geographical information systems (farm, watershed and regional level)  
|                                 | Interindustry input-output analysis  
|                                 | Transhipment modelling (locational efficiency and logistical analysis)  
|                                 | multicriteria analysis (and the analytic hierarchy process)  
|                                 | Resource allocation models – linear programming  
|                                 | Resource allocation models – goal programming  
|                                 | Regional development models  
| Policy analysis | Synthesis of policy directions (transferring research to policy)  

While financial outcomes are normally reported, it is only in recent times that serious attempts are being made in environmental reporting (Herbohn 2000), and these reporting systems are still very much at a research stage.

A special type of forestry reporting – that of carbon accounting, reporting and monitoring – is now under development and will become critical if carbon sequestration credits from plantation forestry become available and subject to trade (e.g. see Lamb 2000).

A variety of modelling approaches are used by researchers in relation to small-scale forestry. On the physical side, it is necessary to generate estimates of the yield of woodlots and small border plantings. This can involve particular difficulties in the case of small-scale forestry, where yield observations upon which to base modelling are scarce and performance is generally considerably
below that of research trial and commercial plantation yields. This problem is compounded when non-traditional species are grown. Stand yield prediction in such situations using the Chapman-Richards model has been employed by Venn et al. (2000).

The Faustmann optimal economic rotation model (Pearse 1990) provides an appropriate economic framework for estimating the returns from forestry and comparing the economics of alternative forestry systems. Financial modelling – which requires yield and price estimates, and is usually carried out using a spreadsheet package and applying discounted cash flow functions – allows the payoff from forestry to be predicted; this may be restricted to modelling of a forestry enterprise or involve modelling the overall business undertaking (e.g. farm business or community development program). This analysis could be extended to determining the financial performance and rent sharing at various stages of the timber production pipeline, including milling and timber merchandising.

Economic modelling may be viewed as an extension to financial modelling, in which an effort is made to include shadow prices rather than simply market prices, and in which non-market values are included, typically in an extended cost-benefit framework. Where a specific objective is to be achieved (e.g. the planting of 200 ha of community forestry) or performance can be measured in specific units (costs per hectare planted), cost-effective analysis (CEA) rather than CBA may be employed, thus averting the need for estimation of economic benefits.

Since forestry is a long-term enterprise, with uncertain stand yield and future timber price, some form of risk analysis is normally attached to the financial analysis, as a sensitivity analysis or a risk simulation, say using the @RISK simulation add-on to Excel or Lotus 1-2-3 (Harrison et al. 2001).

A variety of approaches have been developed for forestry planning at a regional level. Methods of spatial modeling using geographical information systems (GIS) are being used increasingly in socio-economic studies, particularly with regard to conservation objectives. The application of GIS in riparian revegetation studies is reviewed with a case study by Harrison et al. (1998).

Inter-industry input-output analysis is designed to estimate the impacts of a change of expenditure (e.g. large on-off investment) in an enterprise, and yields various types of ‘multipliers’ (income, output and employment) which are indicators of community benefit from the investment. Multiplier values for a ‘normal forest’ are reasonably well established, but when it comes to reforestation the evidence is sparse. In practice, the upstream investment in tree planting (from expenditure on inputs and the consequent economic activity driven by this expenditure) is usually modest, with a long delay to harvesting, so that the multipliers tend to be quite small (e.g. Todd et al. 1999), raising questions about the usefulness of estimating multipliers.

When dealing with a number of stakeholder groups with often conflicting objectives, it has become apparent that the method of analysis should take account of multiple goals. In recent years, there has been much interest in multicriteria analysis (MCA) or multi-objective decision-support systems (MODSS) as an approach to planning landuse at a catchment level, including for reforestation planning (e.g. RAC 1992; Robinson 2000; Qureshi and Harrison 2001). The analytic hierarchy process (Saaty 1995) is sometimes used to elicit stakeholder preference weights in relation to various goals in MCA (e.g. see Harrison and Herbohn 2002). MCA and MODSS approaches are able to take into account the preferences of the various stakeholder groups, to utilize both quantitative and qualitative information, and are reasonably rapid to apply. A criticism can be the high level of subjectivity involved.

One form of MCA which can be carried out using mathematical programming software is goal programming. Here a number of aspiration levels for specific goals are set and the objective is to minimize the sum of appropriately weighted shortfalls (weighted goal programming) or to select activities such that the goals are satisfied in priority
order (lexicographic or preemptive goal programming). Goal programming is being applied by Venn to compare alternative forest utilization policies by the indigenous community in Cape York in Australia.

Mathematical programming has further applications in forestry, such as harvest scheduling and determining the least-cost transport allocation between supply origins and demand destinations and the optimal location of processing facilities.

Devising strategies for small-scale forest industry development in any particular region is a challenging task. Theoretical foundations for this kind of analysis are provided by Tykkyäinen et al. (1997). The FLORES model of Vanclay et al. (2000) is an attempt to develop structured methodology for examining the requirements for more rapid adoption of small-scale forestry, and is to be trialed in the Philippines. In contrast, the collection of papers of Hyttinen et al. (1996) examine the role of forestry in regional development.

The output of research has to be communicated to policy makers, and taken up by them, if it is to have practical outcomes. This requires assembling the information as an integrated package which can be comprehended by officers of the relevant administrative staff, and is viewed by them as sensible and politically acceptable.

5. DISCUSSION

Socio-economic analysis of forestry systems has been a neglected research area. It is unlike silvicultural research, and draws on the techniques of the social scientist, recognizing the community setting and multi-goal nature of small-scale forestry. Particular issues arise in the tropics and sub-tropics, where reforestation is urgently needed following extensive forest logging and clearing. There is a severe lack of information about the performance of non-traditional species and mixed-species plantations. Small-scale forestry is found to face a large number of constraints and to present a wide variety of policy issues. Critical amongst these issues is how to promote new forest industries, the role of government (if any) in supporting farm and community forestry investments, and the potential contribution of venture capital, bank loans, NGO funds, and ethical or green investments. A number of innovative methods appear to offer promise for enhancing the economic attractiveness of small-scale forestry.

A wide variety of research approaches are available in relation to small-scale forestry, with techniques of the economist, sociologist, environmentalist and planner found relevant to analysis of forestry issues, to generate information for policy-makers. Economics provides both a conceptual framework for analysis (e.g. the cost-benefit analysis framework) and specific tools (e.g. discounted cash flow analysis, goal programming, transshipment models, interindustry input-output analysis). Some approaches consist of a diverse collection of related techniques, e.g. MODSS. Some are tools which allow models to be developed, e.g. the simulation modeling computer languages such as Simile (used in development of FLORES).

Further improvement in – and greater acceptability of – socio-economic research methods can be expected in the future. Attention may be paid to refinement of research methodology. It is likely that there will be greater integration of methods of analysis, e.g. of MCA, financial and discounted cash flow (DCF) analysis and GIS, to develop a more powerful research approach.

The need to have sound information to support policy for small-scale forestry can be expected to intensify, particularly as governments appear to be reducing the level of support for tree planting. While it is critical to appreciate the various research techniques, any research program needs to be viewed in a broader context, including research objectives, project design, team building and project management, and the policy context in which results will be viewed.

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