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# Socio-economic Research Techniques in Non-industrial Forestry

**Steve Harrison**

*School of Economics, The University of Queensland, Brisbane, Qld.4072, Australia*

## ABSTRACT

This paper examines some of the techniques which are applicable in socio-economic research in forestry, with particular emphasis on non-industrial forestry in a developing country context. A variety of quantitative techniques is found to have relevance. The techniques may be grouped as data collection and analysis, physical and financial modeling, valuation and reporting methods, and policy analysis. In general, social cost-benefit analysis provides an appropriate framework within which these techniques can be viewed. In some applications, alternative techniques are available, and factors influencing the appropriate choice can be identified.

Keywords: policy questions; data collection and analysis; multicriteria analysis; cost-benefit analysis; environmental valuation.

## INTRODUCTION

A wide array of research techniques have been used in socio-economic investigations into small-scale or non-industrial forestry. The socio-economic research program in the Rainforest Cooperative Research Centre in North Queensland, Australia, has provided valuable experiences in this area. This paper draws on these experiences in setting out a framework for viewing these techniques, and examines implications for choice of approach in particular research settings, particularly in relation to farm and community forestry in the tropics. The techniques are discussed in the context of supporting government policy-making, i.e. a social rather than private producer perspective is taken.

Non-industrial forestry in the tropics and sub-tropics has some differences from that 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 usually involve reforestation of degraded uplands and sloping lands, rather than management of a relatively long-established and approximately 'normal' forests (with a uniform distribution of stand ages). This leads to 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 and marketing strategies. Terms such as 'community forestry' and 'smallholder forestry' rather than 'woodlot owners' are used.

The paper first reviews the types of research questions which often provide the background for socio-economic research in forestry. Various research techniques are then discussed, after which comments are made about choice of technique to examine particular research issues. A brief discussion follows.

## POLICY QUESTIONS AND PROBLEM DEFINITION

The nature of socio-economic research is directed by what issues in forestry management are perceived in the community and via the government as being important. Some of these are perennial, and some change over time as community attitudes change. A number of issues or questions which experience suggests are important are listed in Table 1.

Table 1. Current research areas in non-industrial forestry

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|---|
| *To what extent is government support for small-scale forestry warranted?* |
| *How can assistance programs be targeted for greater cost-effectiveness?* |
| *What government policies or practices impede development of small-scale forestry?* |
| *Can we expect widespread adoption of forestry by smallholders?* |
| *Is farm forestry a profitable investment?* |
| *Will timber prices increase in the future (in real terms)?* |
| *What are the advantages and limitations of common property forestry arrangements, and how can these advantages be maximized?* |
| *If governments reduce or eliminate direct support for small-scale forestry, what new measures may be introduced to encourage tree planting?* |
| *Can small-scale producers come up with a high-quality product?* |
| *Can small-scale growers ever expect to obtain 'fair' prices for their timber?* |
| *How equitable is the distribution of resource rents from small-scale forestry?* |
| *How real are the non-wood benefits of small-scale forestry?* |
| *How important are the negative environmental externalities of small-scale forestry?* |
| *Will small-scale forestry have much impact on regional economies?* |
| *To what extent should biodiversity be pursued in plantation forestry?* |
| *What is the potential role for vegetation corridors?* |
| *Should government policy favour native species?* |

Source: Adapted from Harrison (2001).

In a sense, these are all questions relevant to development of non-industrial forestry as an important sector for socio-economic and environmental benefits, in a developing country. They relate to landholder attitudes, impediments to the

uptake of forestry, valuation of market and non-market (including environmental) goods, production and marketing issues, regional development, and finance and assistance programs.

Prior to carrying out research, there are a number of steps to undertake in terms of what may be broadly called *problem definition*. When dealing with regional forestry planning, the important stakeholders need to be identified; these include landholders and communities who may grow trees, but also resource suppliers, people in the processing chain, and those with an administrative or monitoring role (Harrison and Qureshi, 2000). A host of property rights and responsibility issues may arise (Harrison, 2003). Various potential impediments and facilitation measures for farm and community forestry need to be kept in mind (e.g. see Venn *et al.*, 2000b for the Philippines; and Vize and Creighton, 2001 for tropical Queensland).

Research opportunities have to be identified, and research steps defined, bearing in mind budget and time constraints. Where research funding is not yet in place, a cycle of project proposal, grant application and budget preparation, and developing a research team have to take place. Once the research has commenced, the focus switches to managing the project (planning, supervision, reporting), as well as the technology transfer (including publication) strategy.

## SOCIO-ECONOMIC RESEARCH METHODS IN NON-INDUSTRIAL FORESTRY

A wide variety or research techniques have been applied to examine socio-economic issues in small-scale forestry, some of the more widely encountered of which are listed in Table 2.

### Data Collection Methods

A common myth is that research techniques must always be 'objective' in nature. This tends to be a hangover from the reductionist approach of physical science. But even then, a high degree of subjectivity may arise in choice of research topic, methods and materials, through to the number of 'magic asterisks' required in interpretation of experimental results. In the social sciences, increasing attention is being paid to *qualitative* research methods, often involving case studies, particularly when a relevant population of substantial size is not available from which to draw data (e.g. see Patton, 1990; Herbohn and Henderson, 2002).

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; Dayananda *et al.*, 2002). *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.

Table 2. Socio-economic research methods in non-industrial forestry

| | |
|---|---|
| Data collection | Exploratory data collection (sleuthing) |
| | Qualitative research methods, including case studies |
| | Elicitation of expert opinion (including consultation with experts, SWOT analysis, the Delphi method and focus groups) |
| | Participatory approaches (PRA, RRA) |
| | Sample surveys |
| Data analysis | Analysis of survey data – descriptive statistics |
| | Multivariate analysis (including cluster analysis and factor analysis) |
| | Price forecasting (time series models) |
| Non-market valuation | Valuing 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) |
| | Discounted cash flow analysis and sensitivity analysis |
| | The optimal economic rotation (the Faustmann formula) |
| | Development of financial models of forestry enterprises |
| | Whole property financial modelling |
| | Systems simulation and modelling |
| | Modelling carbon sequestration |
| | Supply chain or timber production pipeline cost and markup analysis |
| | Cost-effectiveness and cost-benefit analysis |
| | Risk or venture analysis |
| Watershed and regional modelling | Geographical information systems (farm, watershed and regional level) |
| | Inter-industry input-output analysis |
| | Transhipment modelling (locational efficiency and logistical analysis) |
| | Multicriteria analysis (and the analytic hierarchy process) |
| | Multiple-objective decision-support systems (MODSS) |
| | Resource allocation models – linear programming and goal programming |
| | Regional development models |
| Policy analysis | Synthesis of policy directions (transferring research to policy) |

The various methods of participatory rural appraisal (PRA) or rapid rural appraisal (RRA) 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 knowledge of life and conditions, to plan, to act, monitor, and evaluate*' (PROCESS Foundation, 1996, p. 2)[1]. Pratt (2001) provided a recent evaluation of PRA applications in Nepal.

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. 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.[2] 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).

**Data Storage, Processing and 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

[1] PROCESS Foundation (1996) observed that PRA draws on five traditions – activist participatory research, agroecosystem analysis, applied anthropology, field research in farming systems, and rapid rural appraisal – in an attempt to achieve 'people empowerment' and avoid the mistakes of 'rural development tourists'.

[2] Some frequently misused terms are 'survey', 'questionnaire', 'sample' and 'observation'. Typically, a single survey is carried out, in which there are a number of sample members, to each of which is administered a single questionnaire. The sample consists of a subset of members from the population; a set of observations of each variable under investigator make up a single sample to be used in a single survey.

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.

**Non-market Valuation**

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 the relationship between the market value of an asset and its characteristics. When applied to property these characteristics can include environmental attributes such as freedom from pollution and attractive views. The contingent valuation method (CVM) and choice modeling (environmental choice modelling, choice experiments) are used to estimate total economic value (TEV) of forests, including use and non-use values. Benefit transfer – inference of values from a source site to a target site – provides a time-saving alternative to making new estimates for each specific site.

**Environmental Accounting, Auditing and Reporting**

Agencies concerned with forest management have a reporting responsibility to government in regard to the achievements from spending public funds. While financial outcomes are normally reported, it is only in recent times that serious attempts are being made in environmental and 'triple bottom line' 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).

**Physical and Financial Modelling**

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 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 trial and commercial yields. This problem is compounded when non-traditional species are grown. Stand yield modelling in such situations using the Chapman-Richards model is examined by Venn *et al.* (2000a).

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 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 at overall farm business or community forestry level. 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). 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.

Systems modelling and simulation have great potential for application to forestry systems. In the past this involved developing computer programs in languages such as FORTRAN, Visual Basic and C. Newer programming media such as Stellar and Simile allow the development of a flowchart which effectively becomes a 'live' program and documentation, and can greatly speed up the model development and testing stage.

**District, Watershed and Regional Modelling**

A variety of approaches have been developed for forestry planning at a regional level. 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. One approach has been goal programming, in which a number of goals can be specified, and given differing weights (weighted goal programming) or priorities (preemptive goal programming). Goal programming is currently being trialled by Venn to compare alternative forest utilization policies by the indigenous community in Cape York in Australia.

In recent years, there has been much interest in multicriteria analysis MCA or multiobjective 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. Transhipment modelling provides a useful approach for examining locational efficiency and plant location issues in forest industry development.

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) – developed using the Simile package mentioned above – 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.

**Policy Formulation**

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 a synthesis of a threshold quantity and breadth of information from various sources into an integrated package which can be comprehended by agency staff, and is viewed as sensible and politically acceptable.

## MATCHING RESEARCH TECHNIQUES TO INFORMATION NEEDS

The various techniques listed in Table 2 have their particular application areas, although sometimes a choice must be made between them. This applies for example in designing and conducting sample surveys, for which the most common approaches are 'capturing' respondents as a group, carrying out postal surveys and conducting personal interviews. These approaches involve increasing statistical representativeness of the reference population, but also increasing cost. For moderately short questionnaires, it has been found that postal forestry surveys of landholders in Australia are reasonably successful. Greater assurance that non-response error is not too large can be gained by say telephone survey of non-respondents. In some cases, bringing members of the reference population together as a group for interview is a more suitable approach, this could be the case for landholder surveys in the Philippines.

When attempting to develop stand yield models, particularly for non-traditional or mixed species planting, it is unlikely that yield observations will be adequate for a comprehensive statistical analysis. Options then arise such as applying statistical methods to develop yield models on the basis of sparse data (as carried out by Venn *et al.*, 2000a), or applying the Delphi method to elicit expert opinion about likely growth rates (as adopted by Herbohn *et al.*, 1999).

The use of various non-market valuation techniques has been somewhat controversial. TCM now seems widely accepted for estimating the value of recreation benefits of natural areas including forests. The hedonic price method similarly allows acceptable estimates of the property value impacts of trees and views to be derived, provided transaction data are available (a major proviso). CVM has been used extensively but remains controversial due to the large number of potential biases and apparently unrealistically high values obtained in some applications (Harrison, 1999). Choice modeling (a form of conjoint analysis) is being increasingly applied as an alternative to CVM, which is considered to provide additional information about respondents tradeoffs, and better control some of the potential biases of CVM (Rolfe and Bennett, 2002). 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).

Inter-industry input-output analysis is designed to estimate the impacts of a change of expenditure (e.g. a large on-or-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 production forests are reasonably well established, but when it comes to reforestation the evidence is sparse. In practice, the upstream investment in tree planting is usually modest, with a long delay to harvesting, so that the multipliers tend to be quite small (e.g. Todd *et al.*, 1997), 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; Harrison and Herbohn, in press). The analytic hierarchy process (Saaty, 1995) is sometimes used to elicit stakeholder preference weights in relation to various goals in MCA (e.g. Harrison and Herbohn, in press). Relative to other small-region analysis techniques (including goal programming), the MCA and MODSS approaches have the advantage of being able to take into account the preferences of the various stakeholder groups, to utilize both quantitative and qualitative information, and to be reasonably rapid to apply. A criticism can be the high level of subjectivity involved. The approach of Vanclay *et al.* (2000) is more relevant for larger regions such as states and provinces.

Opportunities sometimes arise for using a combination of the various research techniques in combination to address a particular problem. In this context, geographical information systems are often combined with other modeling approaches. For example, Qureshi and Harrison (2001) combined geographical information systems, the analytical hierarchy method and cost-benefit analysis in the evaluation of riparian revegetation options.

## DISCUSSION

Non-industrial (farm and community) forestry faces a large number of constraints and presents a wide variety of policy issues. Socio-economic analysis of forestry systems has been a neglected research area. It draws on the techniques of the social scientist, recognizing the community setting and multi-goal nature of non-industrial forestry. Particular issues arise in the tropics and sub-tropics, where reforestation is urgently needed following extensive deforestation. There is a severe lack of information about the performance of non-traditional species and mixed-species plantations.

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.

In the future, there are likely to be changes in the issues facing small-scale forestry, and changes in the type of socio-economic analysis conducted. Reduced public sector support may place a greater imperative on adopting innovative measures to make small-scale forestry more attractive, particularly in terms of generating an earlier cash inflow. Saleable carbon and other environmental credits could be important in this context, if efficient market mechanisms can be established, and a demand can be created through industry or international organisations (including environmental or aid organisations). The relative larger scale of community forestry projects relative to farm forestry could make these candidates for trade in environmental credits.

Development of research methods is in itself an active area of investigation, and further improvement in – and greater application of – socio-economic research methods can be expected in the future.

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