3. IMPROVING THE TRIPLE BOTTOM LINE RETURNS FROM SMALLHOLDER TREE FARMS IN THE PHILIPPINES: A SYSTEMS APPROACH

John Herbohn, Steve Harrison, Jerry Vanclay, Eduardo Mangaoang, Nestor Gregorio, Edwin Cedamon, Iean Russell and Grant Wardell-Johnson

---

This paper[1] outlines the application of systems thinking in investigating ways to improve the returns to smallholder tree farmers in the Philippines. The paper illustrates how a systems approach was used in the conceptualisation of the project and how systems thinking facilitated a shared understanding of the how each individual's research contributed to the broader project activities. Systems thinking has also been used in the design and implementation of various project activities. Three examples are provided. The first example illustrates how a systems diagram was developed which outlined the direct and indirect linkages between biophysical data on tree farms and various activities designed to increase returns. The second example illustrates how the suggested approach for improving the flow of information concerning tree registration, harvest and transportation regulations and approval mechanisms link with various project activities and have been informed by a series of action research workshops. The third example illustrates how systems thinking has been applied to understand the factors affecting the production of high quality tree seedlings and to investigate the effect of policy interventions on improving the quality of seedlings available to smallholders.

INTRODUCTION

Previous research indicates that Leyte tree farmers could receive much higher financial returns from their tree farms if they had better market access and knowledge of prices, produced greater volumes of timber per unit of cost, and could better produce timber of appropriate species, log size and quality as desired by the market. In order for smallholders to access markets they must first obtain log transport permits and sometimes harvest permits. In order to do this, they must first register their tree farms with the DENR. There are many institutional impediments restricting the ability of farmers to register trees, which act as a barrier to them gaining access to markets, thus restricting timber sales to local markets, which are often thin and non-competitive. In addition, many smallholders lack information about how and where to market their trees, and lack knowledge of the current market value of their trees. Smallholders also lack knowledge about what the market requirements are for timber and as result do not manage their tree farms to optimise the output of these desired products. In many cases, the smallholders are achieving timber yields that represent only a fraction of the potential site productivity, on average about 30%. This failure to capture the potential productivity of the tree farms is due to a combination of factors including poor site preparation and early weed control, use of poor germplasm and poor silviculture practices involving a lack of thinning and pruning.

[1] This paper is based on one presented at an International Conference organised by the IUFRO 3.08 Small-scale Forestry Research Group on the theme of 'Improving the triple bottom line returns from small-scale forestry' held in Ormoc City, the Philippines, 17–21 June 2007.

Low yields combined with poor market access mean that financial returns to smallholder tree farmers are low. The environment that smallholder tree farmers are operating within is also complex − from a social, environmental, economic and political context. Therefore, there is no one ‘magic bullet’ that can improve financial or other returns from tree farms. In order to improve one or more of these triple bottom line returns, it is necessary to examine the smallholder tree farms in a broader context − there are many interacting factors that affect returns to smallholders growing trees.

This paper outlines the application of Systems Thinking in investigating ways to improve the returns to smallholder tree farmers in the Philippines. The context of this project is first outlined, including the results of a brainstorming session which developed a systems framework that guided the conceptualisation of the project are reported. The goal and objectives of the project which were articulated using the framework are then presented and the research strategy outlined. Three examples are then provided as to how a systems approach has been applied in the implementation of project research activities.

USING SYSTEMS THINKING TO CONCEPTULISE THE PROJECT

As discussed in Bosch *et al*. (2007), conceptualisation of the ACIAR smallholder tree farmer project occurred over a period of one week during a visit by researchers to the Philippines (to incorporate feedback on the initial project proposal following discussions with ACIAR as funding body). During that week, a number of visits to smallholder tree farms and communities was undertaken, and discussions held with a variety of stakeholders including tree farmers, officers from the Department of Environment and Natural Resources (DENR) and Local Government Units (LGU). These discussions, combined with experiences from the precursor four-year project (ASEM/2000/088), suggested that a complex range of interacting factors influence the lack of current uptake of smallholder forestry in Leyte. For example, it became apparent that a large number of tree farms existed that were established about 10 years ago, with trees ready to be harvested, and smallholder farmers were asking where they could find a market for their trees.

Following the field visits, a workshop was held where researchers discussed the observations made over previous days, discussions tended to focus on separate studies that could be undertaken to address one or more of the issues identified. In an attempt to integrate the disparate discussions, a brainstorming session was held to create an overall *influence diagram* that connected the various aspects of possible research opportunities. Two observations were represented by boxes placed on a blackboard, namely (i) the existence of a large number of tree farms and (ii) the need to improve current low returns to tree farmers. From this basis, researchers brainstormed the factors that influenced the current low returns and how these linked back to the existing smallholder tree farmers. The influence diagram that was developed on a blackboard is presented as Figure 1. The initial starting points are contained in elliptical shaped objects and linked by arrows.

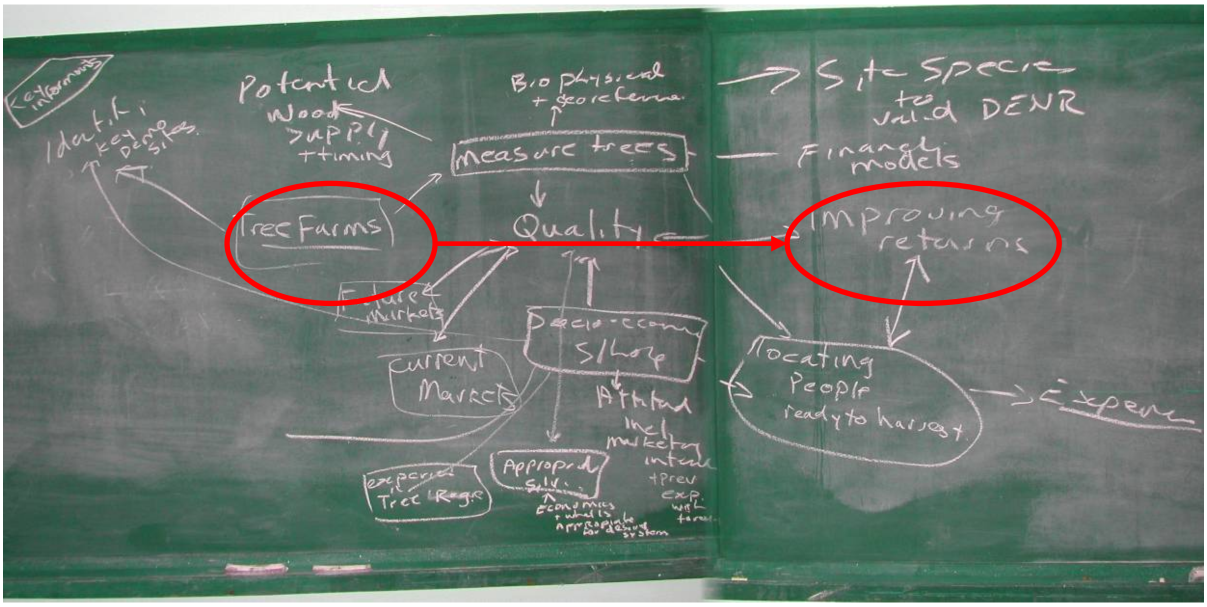

Figure 1. Influence diagram developed for planning the research project

The construction of the influence diagram provided a shared understanding to all of the researchers in the project of how their particular area of expertise contributed to the broader project objective of improving financial returns to smallholders. A key element that was recognised from field observations was that most of the current tree farms have been poorly managed and most of the logs that will be produced will be of low quality − hence the location of 'quality' between 'tree farms' and 'improved returns'. Estimating (measuring) and improving the quality of logs from existing and future tree farms thus became one of the foci of project activities. In addition, the influence diagram recognises the importance of log quality for the types of markets that smallholders can currently access. In terms of identifying industry development strategies, it was also recognised that identifying the log quality required to access particular markets (e.g. export markets) was necessary in order to identify the type (quality) of silviculture that smallholders needed to implement to achieve, for instance straight and defect-free logs of a particular length and diameter or flitches cut into particular dimensions by circular saws as opposed to chainsaws. Another key influence on the quality of logs produced is socio-economic factors such as household income, general education and specific training in forestry, as well as the way these factors affect the ability of the smallholders to access timber markets. The influence diagram also recognises the importance of gathering data on the expected yields of timber from current tree farms, data which are needed to estimate potential wood supplies and timing, and to develop financial models which can be used to both predict financial returns from existing tree farms and to also model likely impacts of improved silviculture and access to markets.

The goal of the smallholder forestry project was identified as being 'to increase financial returns to existing and intending smallholder tree farmers'. The research strategy is reflected in the following objectives.

Objective 1: Assist DENR to overcome policy implementation constraints to tree registration and log transport currently restricting access to markets
Objective 2: Assist smallholder tree growers to satisfy market requirements and improve productivity
Objective 3: Identify and promote livelihood systems and policies which incorporate forestry and which recognise the socio-economic circumstances of smallholders

In that a systems approach was used in the conceptualisation of the project, this is an example of how systems thinking can be applied at a broad ‘project’ scale. That is, the issues associated with increasing financial returns to smallholders have been conceptualized as being interrelated such that they cannot be addressed in isolation (as would be the case in a reductionist research approach). At a finer or operational level, systems thinking is embedded in supply or value chain management, which is the framework on which many of the activities in falling under Objective 2 are based. Also, a systems approach is embedded in the investigation of livelihood systems in Objective 3; this approach recognizes that forestry cannot be undertaken by (or recommended to) smallholders in isolation without consideration of the broader context (or livelihood system) of which it will form a part.

SYSTEMS APPROACHES EMBEDDED IN THE RESEARCH STRATEGY

Three case studies are now presented that illustrate how system thinking has been applied in the research strategy for the ACIAR tree farm project. The first case study concerns the formulation of the research proposal for the tree farm project. The other two studies are based on material from Bosch *et al.* (2007).

Case Study 1: Linking Biophysical and Socio-economic Data

A key activity in the project has been the estimation of the yield of timber from existing tree farms. This data have been used to construct yield tables and growth models for the common species grown by smallholders, including *Gmelina arborea*, *Swietania macrophylla* and *Acacia mangium*. The key biophysical information collected about site, plot, tree and log variables is summarised in Figure 2. Data on DBH and log length are used to construct yield tables for commonly grown species and to construct growth models. Typically, this type of biophysical data is not used directly as input into socio-economic studies. Socio-economic studies involving the estimates of timber turnoff and market modelling do often draw on such biophysical data. These data are typically obtained from secondary sources rather than collected as part of an integrated study. Drawing such data from secondary sources usually limits their application for the desired use.

By designing the project within a systems framework, it has been possible to identify how the biophysical physical data collected from the tree farms could be used as part of other interrelated activities within the project (Figure 3). In particular, Figure 3 illustrates how data and results from the tree inventory research is linked to other project activities with an economic and social focus. Having this understanding at the outset of the project allowed sampling strategies to be designed that produced data suitable for use across a range of project activities. For instance, a group of researchers were responsible for collecting data from tree farms in order to develop yield tables and growth models of key species grown by smallholders. Typically, this would be where the use of such biophysical data would end. However, socio-economic project researchers outside the biophysical team also required these data to estimate the current timber inventory from smallholder tree farms on Leyte as part of their research to develop timber supply models. Stratified random sampling is the procedure typically used to identify plots from which to collect data on tree growth for yield tables and growth models. However, stratified random sampling would have been impractical for collection of data to estimate total timber inventories because of the need for collection of data across a suitably wide range of municipalities and barangays, which would have resulted in significant time and financial costs gaining access to burangays across a large number of municipalities. As a consequence, a two-stage, probability proportional to size (PPS) sampling framework was used to select municipalities and then barangays from which tree farms were selected (as described in Herbohn *et al.* 2005). Information from surveys of timber processors and furniture manufacturers collected as part of other project activities will be used in developing demand-side models which in turn will feed into supply and demand and transhipment models.

Growth models based on the tree data, along with the supply and demand and transhipment models also drawing on the tree data, are linked to the financial models developed to estimate the profitability of tree farms (with linkages as illustrated in Figure 3). The financial models then feed into activities associated with the development of improved livelihood systems incorporating tree farms. Data on crown diameters are not collected routinely during measurement of trees within inventory plots. However, such data were identified in the systems analysis as being required for modelling stocking rates and thinning regimes associated with potential agroforestry systems, and the biophysical teams included these measurements as part of their data collection activities.

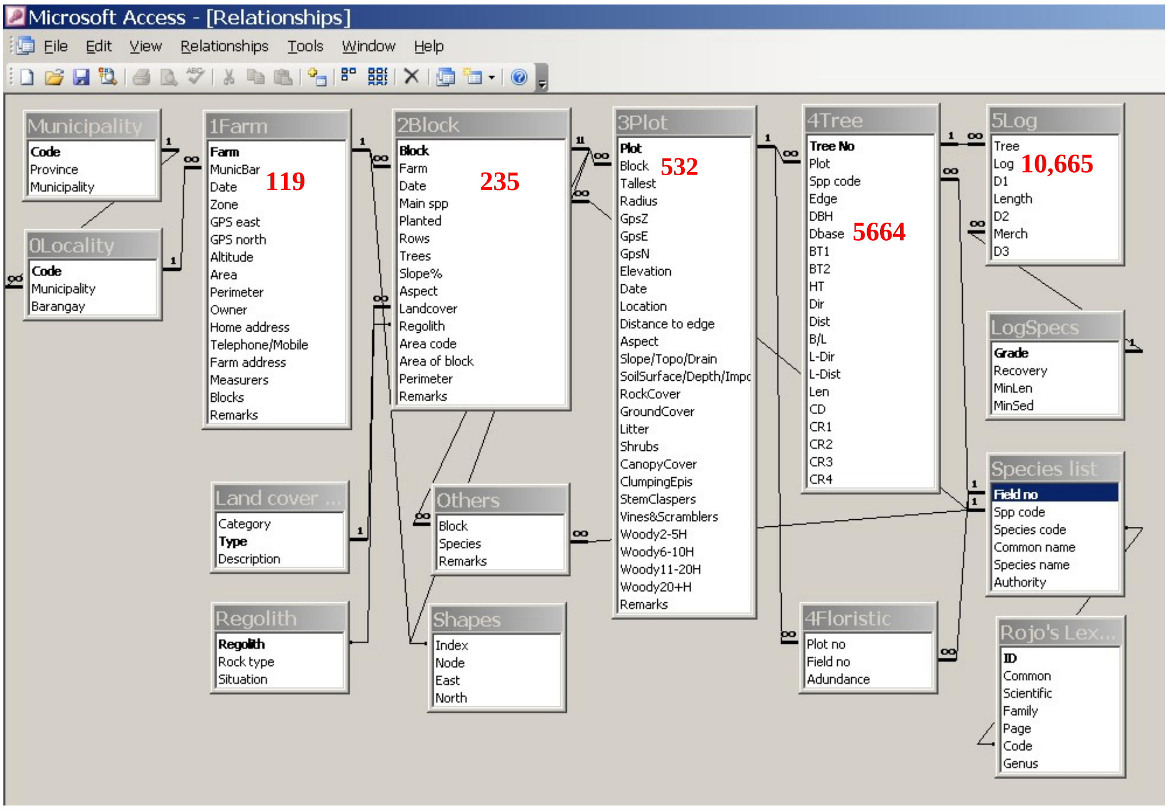

Figure 2. Screenshot of ACCESS database illustrating key site, plot, tree and log data collected from smallholder tree farms

Biodiversity data collected from each tree farm, along with socio-economic data collected from the owners of the tree farms, will also be used in the development of models of improved livelihood systems. The Microsoft ACCESS database illustrated in Figure 2 is currently being updated to include results from the socioeconomic survey of smallholder tree farmers, thus allowing researchers to link directly the socioeconomic and biophysical data.

The financial models can also be used to explore ways to improve financial returns to smallholders, including demonstrating to smallholders the benefits of improved silviculture, and the need to improve the flow of information about regulations affecting tree registration, log transport and harvesting (direct linkages not shown in Figure 2).

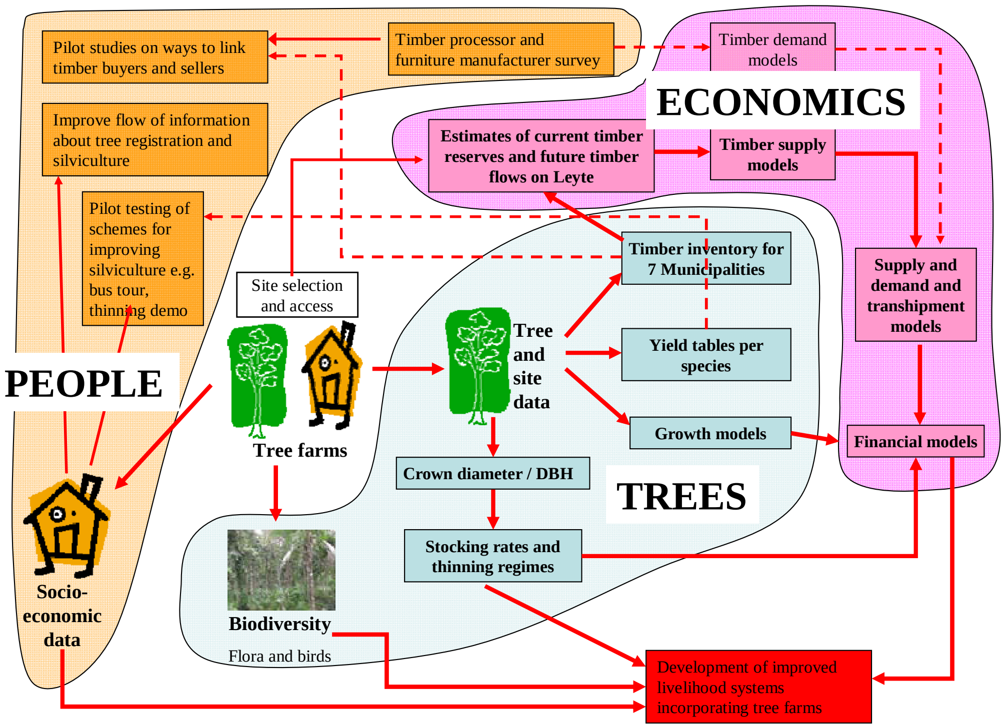

Figure 3. Major linkages between biophysical and socio-economic research activities in the project. Not all linkages are shown.

Case Study 2: Improving the Flow of Information for Forestry Regulation

In conceptualising the smallholder tree farm project it became apparent that tree registration and log transport regulations enforced by DENR appear to be restricting access of smallholder tree farmers to timber markets. Rather than the regulation per se, this barrier seems to be the result of how regulations are enforced due to lack of funding to the DENR, and the lack of understanding of the regulations by smallholders. If the individuals with the greatest influence on the flow of information are directly involved in recognising the existing problems and formulating solutions to these problems, there is greater likelihood that strategies will lead to sustainable changes. In order to achieve these changes, the motivations and actions of the various stakeholder groups must be examined in the light of the institutional arrangements governing them. It is also essential that the strategies devised for improving information flow link closely with other project activities so that the changes occur at three levels (i.e. farm households and community, DENR staff operations, and policy). A systems approach is therefore an implicit component.

Figure 4 shows the relationship between various project activities and the action research workshops which lie at the core of the suggested approach for improving the flow of information concerning tree registration, harvest and transportation approval mechanisms. The action research workshops provided opportunities to (i) monitor and report via information bulletins, what the tree farmers involved in the project demonstration plots are required to do to register their trees, and (ii) to report and compare this information across the project. The steps involved in bringing the action research teams to life were to (i) confirm the aim with key stakeholders, (ii) secure sponsors' commitment, (iii) identify the participants, (iv) design and schedule regular workshops, including a training workshop, (v) secure the necessary resources for the project activities, (vi) conduct workshops and implement activities to improve information flow, and (vii) reflect on achievements and implement changes.

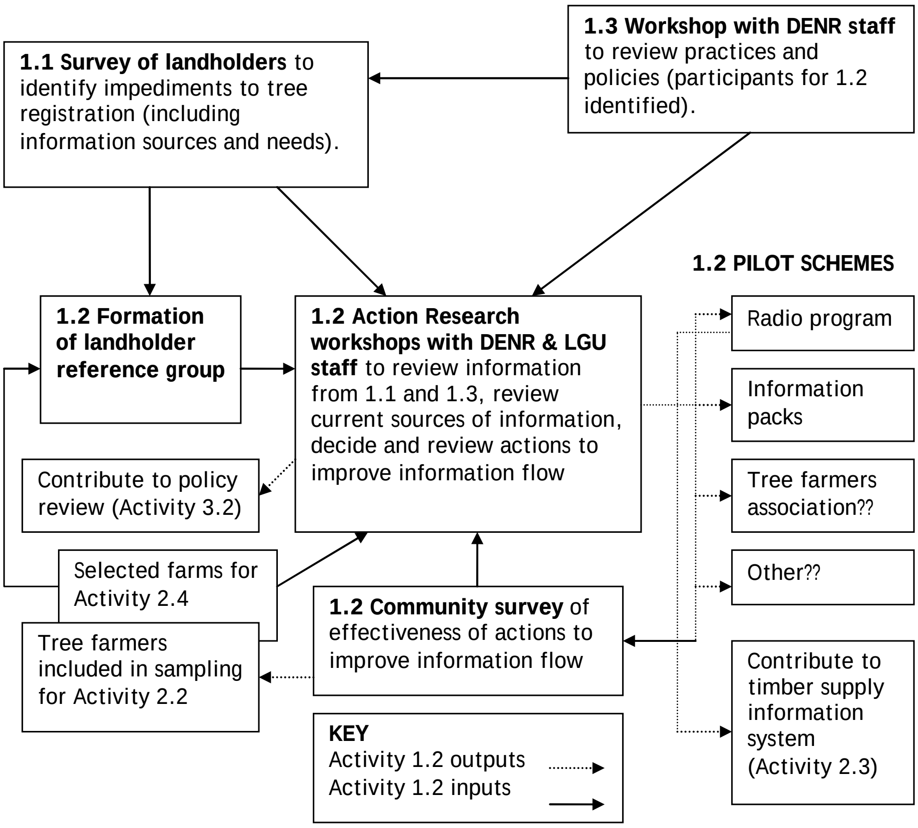

Figure 4. Relationship between activities concerning the development of strategies for improving information flow about tree registration, harvest and transportation regulations and approval mechanisms (1.1, 1.2 and 1.3 refer to specific project objectives).

Case study 3: Making Sense of the Tree Nursery Sector in Leyte

Systems thinking has also been applied to understand the factors affecting the production of high quality tree planting stock and to investigate the impact that a variety of policy interventions may have on improving the quality of planting stock available to smallholders.

To conceptualise the nursery sector, a Bayesian Belief Network (BBN) was constructed for each of the nursery sub-sectors (private, community and government). The data to construct the model (Figure 5) were obtained from a combination of quantitative and qualitative methods. For example, surveys were used to collect responses from nursery operators in Leyte and Southern Leyte Provinces, and the *nominal group technique*, as well as individual discussions, was used to collect expert opinion. This model is an example of a dynamic systems model which can be used to explore the likely impacts of a range of policy interventions on a particular industry or sector and which was constructed using data obtained from a range of stakeholders using surveys and other social research methods, including focus group discussions and the nominal group technique. The model has subsequently been used to identify which factors have the greatest influence on key outcomes such as seedling quality, nursery sustainability and nursery efficiency. In addition, it has been used to explore the likely impact of various policy interventions including developing training programs for nursery operators.

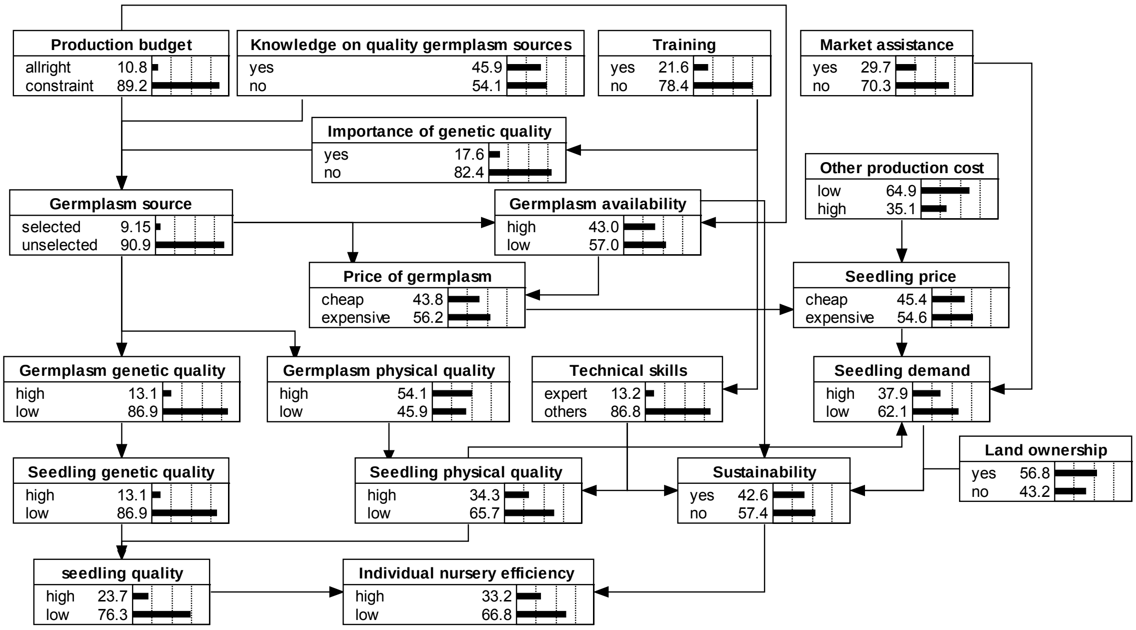

Figure 5. Nursery efficiency BBN for an individual nursery group

Source: Gregorio (2006)

CONCLUDING COMMENTS

The environment that smallholder tree farmers are operating within is complex, from social, environmental, economic and political perspectives. Hence, there is no one ‘magic bullet’ that can improve financial or broader social returns from tree farms. In order to improve one or more of these triple bottom line returns, it is necessary to examine the smallholder tree farms in a broader context, taking into account that there are many interacting factors which affect returns to smallholders growing trees. This paper has illustrated how a systems framework has been used to conceive and plan a major research project addressing the problem of how financial returns can be increased to smallholders. The systems framework has also proved an effective means to integrate research activities of various researchers from disciplines in the social and physical sciences that are involved in the research. Importantly, the process of developing and then articulating the systems framework has been useful in giving team members a shared understanding of the scope of the project and how their activities fit into the broader picture. The three case studies presented in the paper clearly illustrate the utility of this type of approach in coordinating and integrating research projects involving researchers from diverse fields.

ACKNOWLEDGMENTS

The authors wish to acknowledge the contributions of other ACIAR team members in this research, including Jack Baynes, Samuel Bernaldez, Janet Cedamon, Glen Monterola, Chris Solano and Florante Morales.

REFERENCES

Bosch O, King C, Herbohn J, Smith C and Russell I (2007) Getting the big picture in natural resource management − systems thinking as a ‘method’ for scientists, policy makers and managers. *Systems Research and Behavioral Science* Special Issue 20: 107–118

Emtage N (2004) An Investigation of the Social and Economic Factors Affecting the Development of Small-scale Forestry in Leyte Province, the Philippines, PhD thesis, School of Integrative Systems, The University of Queensland, Brisbane

Gregorio N (2006) Improving the Effectiveness of the Forest Nursery Industry in Leyte Province, the Philippines, PhD thesis, School of Integrative Systems, The University of Queensland, Brisbane

Herbohn JL, Harrison SR, Vanclay J and Wardell-Johnson G (2005) Designing a strategy to sample tree farms on Leyte. In: J Suh, SR Harrison, JL Herbohn, EO Mangaoang and J Vanclay (eds) ACIAR Smallholder Forestry Project, ASEM/2003/052, *Improving Financial Returns to Smallholder Tree Farmer in the Philippines*, Proceedings from the Planning Workshop held in Ormoc City, the Philippines, 15−17 February 2005, pp. 203−210