A Timber Harvesting Decision Framework for Ethiopian Forests*

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Abstract
Ethiopian forests provide significant benefits to the 73 million Ethiopians through environmental protection and as a valuable, widely used resource base. Current use and demand for fuel wood and lumber exceeds the local forest capabilities and the industrial capacity to process and deliver lumber to the market. Intense demand for forest products has lead to overexploitation of the existing forests, imported wood from abroad, and the substitution of other products to meet these needs. Unsustainable forest utilization for lumber production is one area that could be improved in order to help decrease impacts on Ethiopian forests. Forest harvesting is one of the first and most visible steps in the lumber production process where sustainability improvements could provide more economic returns, decrease environmental impacts, and enhance socially responsibility. An investigation to identify the critical decision and issues facing forest managers in forest operations was completed using social science research methods combining aspects of ethnographic, grounded, and participatory research theories. Compiled decisions and issues were then organized into a structured decision framework that can be used by land managers to implement improved harvesting approaches. The framework is based on basic concepts of decision support and draws upon multi-criteria decision making and prioritization techniques to facilitate the development of meaningful solutions that are possible to implement. This paper presents the theory and process used to develop the decision framework in the context of forest operations in Ethiopia. While sites in Ethiopia were used to develop this framework, many parts of the developing world face similar questions and situations that fall into the same decision making categories. The adaptation of this process for decision framework development outside of Ethiopia is possible with only minimal adjustments for local conditions.

1. INTRODUCTION

Ethiopian forests provide significant benefits to the people of Ethiopia through environmental protection and as a valuable, widely utilized resource. Rural villagers often rely on forests for sustenance, fuel, shelter, livestock grazing, non-timber forest products, while urban Ethiopians depend on forests for building and construction materials, furniture, handicraft supplies, and other products. Unfortunately, the current use and demand for wood exceeds the local forest capabilities and industrial capacity to process and deliver these products to the market. This disparity between natural and industrial production and demand results in the overexploitation of the existing forests, imports from abroad, and the substitution of other products to meet these needs. Both unsustainable forest utilization and substitution help perpetuate the cycle of poverty, food insecurity, and natural resource degradation. (EFAP 1994)

With a one of the largest population in Africa at over 73 million people and growing at 2.36% a year (CIA 2005) the demand for forest products and land uses that are not congruous with forestry will only increase in the coming years. As the formal forest industry in Ethiopia is very small in size and output, very little development and government emphasis is placed on the forest industry. The historic trends of poor funding, little concern for updating current policies, and removing barriers to new investments and development of the industry are currently being maintained or worsened. A strong, sustainable forest industry can help provide the raw materials that feed growing economies and assist in rural development throughout the country. Annual industrial wood production in 1994 was estimated at 150,000 to 2000,000 cubic meters which was only half of the domestic demand for wood. (EFAP 1994) While good estimates of the current overall production are lacking, many mills in the natural forest have shut down and mills working with plantation wood have maintained or slightly increased their production while demand has continued to grow. Improvements to the harvesting, transportation, and other log supply process components can provide the raw material necessary to open the existing mills and promote new investments to fill the gap between local supply and demand.

An investigation to identify the critical decision and issues facing forest managers in forest operations was completed in order to build a decision framework that can be used to improve the sustainability of forest operations. Social science research methods combining aspects of ethnographic, grounded, and participatory research theories were used to populate the concepts that create the decision framework. The framework itself is based on the basic concepts of decision support and draws upon multi-criteria decision making (MCDM) and prioritization techniques to identify meaningful solutions that are possible to implement. This paper presents the theory and process used to develop the decision framework in the context of forest operations in Ethiopia.

2. SITE DESCRIPTION

Three sites were identified for investigation in this project. One natural forest site was used for natural forest logging data collection and two plantation forest sites were used for production forest harvesting data.

2.1 Natural Forest

Harvesting and sawmilling sites in southwestern Ethiopia’s natural forest areas near the towns of Meti and Tepi (Figure 1) were selected for this project to illustrate current approaches to natural forest timber harvesting. This area has common tropical natural forest harvesting conditions with widely scattered large diameter indigenous trees. The commercial trees often occur in low densities of less than five trees per hectare. The species found here include adolfi-fiederici, Croton machrostachyus, Olea species, Cordia abyssinica, and Hagenia abyssinica and many others. While over 300 species have been identified in these forests, only 25 were utilized commercially. Another 30 have commercial potential, although many of these species like Cordia Africana, Juniperus procera, Podocarpus falcatus, and Hagenia abyssinica have been declared “protected” by the federal government and are illegal to harvest.
The state owned Sawmill and Joinery Enterprise (SJE), headquartered in Addis Ababa is the primary enterprise responsible for the milling and production wood products from the natural forest. They own and operate over 22 sawmills and joinery factories throughout the country, with primary focus on the south-western forest areas. The sawmills are 40 to 50 years old, well beyond the typical economic lifespan of this type of equipment. Additionally, only minimal investments have been made for repair and maintenance over the last 30 years, adding additional stress and strain to an already tired infrastructure (EFAP 1994).

The natural forest sites were selected to incorporate the different range of equipment, techniques, environment, and log sizes that occur in the natural forest harvesting operations. Harvested logs are commonly large diameter and distributed sparsely through the site. Typically, logging in the natural forests has a significant impact on the site with roads and skid trails required to be constructed in order to access the timber. The site is located at an elevation of approximately 1000 m with topography that is gently sloping. The average annual temperature is between 20 and 25°C, with a mean annual rainfall of approximately 2,000 mm. While more rain falls in September than other months, there is no true rainy season in this area as rain falls year round (Abebe and Holm 2003).

2.2 Plantation Forests

Plantation forestry projects were established in the late 1960’s in the south central part of the country through the work of a local development organization, the Chilalo Agricultural Development Unit (CADU) with assistance from the Swedish Development Cooperation (SIDA). Land that was previously under the direction of the State Forest Development Agency was brought under management of CADU for the establishment of the first large scale logging and plantation projects. The existing natural forest lands were clearfelled and plantations were established on these sites and in some adjacent farmlands (Bekele 2001; Chaffey 1979). Over then next several years, approximately 6,100 hectares of plantations were established with *Eucalyptus, Cupressus, Pinus*, other exotic species, and even some indigenous species.
The forest is currently managed by the Shashemene Forest Industry Enterprise (SFIE), an organization that has some governmental ties, but is primarily lead by a board of directors and investors. There is now over 98,000 hectares of which about 6,100 hectares are in plantation forest cover and an estimated 8,000 hectares are in natural or disturbed natural forest cover. The remaining lands are in bush, bamboo, woodlands, open, or agricultural lands (Silvi Nova AB 1996). The objectives of the enterprise are to manage the enterprise’s forest resources for sustainable use, generation of revenue, reinvestment of these revenues to further develop the forest resources (Bekele 2001). Additionally, the enterprise recognizes its role in rural development and the overall development of the forest products industry in the country. Even though all land and the natural resources on the land is officially owned by the state, the SFIE is in a unique situation as they have secured the rights to retain and reinvest the revenues that they generate from the harvesting and sale of forest products (Bekele 2001).

The SFIE was included in this study as they are the largest and most organized plantation forestry operation in the country. They have resources and production schedules that are relatively dependable and a desire to improve their operations. The site that was selected for this project is located in the southern part of the Oromiya State near the village of Sole (Figure 1). The village has a two semi permanent portable sawmills and is located less than 10 km east of the central Rift Valley town of Shashemene. A compartment was selected that was to be harvested during the field data collection time period and that was typical of harvesting areas in the district. The selected compartment was located in the Ansawae Plantation, approximately 1 km from the sawmill. The site is located at an elevation of approximately 2200 m with topography that is gently sloping. The average annual temperature is approximately 16° C, with a mean annual rainfall of approximately 1,075mm. The primary rainy season is in July and August and a smaller rainy seasons during March (Abate 2004).

Smaller scale plantations have also been established on the campus of Wondo Genet College of Forestry (WGCF), a part of the newly formed Debub University. Although the overall university is relatively new, WGCF has been involved with forestry education for many years. In 1978 the Wondo Genet Forestry Resource Institute was formed in order to provide diploma level courses in general forestry. Over the years additional efforts within the country and with assistance from the Swedish University of Agricultural Sciences (SLU) the institute was upgraded to a college and was able to offer both Bachelor and Master of Science degree programs. The only other forestry program in the country at Alemaya University of Agriculture was moved to WGCF in 1996, creating a single strong professional forestry educational faculty.

WGCF is located at the base of a large escarpment on the edge of the Rift Valley in south central Ethiopia. The campus is located approximately 10 km from the larger town of Shashemene. The campus has over 600 hectares of forest lands that it manages for teaching, research, and revenue production. Approximately 110 hectares of plantation forests of exotic and indigenous species have been established on the campus. There are an additional 490 hectares of natural forest lands that are effectively reserved from timber harvesting as they are some of the last remaining remnants of the forest that once covered this area. There is tremendous pressure on this forest from the local population, resulting in illegal pit sawing, grazing, and other damaging practices.

The campus forest plantations were included in this study because they utilize harvesting techniques that are more advanced than others in the industry. The college has many local and expatriate researchers involved in forest management, high quality maps and imagery, and access
to appropriate tools and equipment that other enterprises and organizations might not have. These additional resources provide a research opportunity to investigate alternative timber harvesting processes that may not yet be implemented in other areas of the country and identify barriers that impede the knowledge transfer to the clients of the College.

The Wondo Genet (Figure 1) site that was selected for this project is located on the campus in the southern part of the Oromiya State near the village of Washa. Compartments were selected that were being harvested during the field data collection time period and that were representative of typical harvesting units on the campus. The plantation is located at an elevation of approximately 1900 m with topography that is gently sloping. The average annual temperature is approximately 19.5°C, with a mean annual rainfall of approximately 1,200 mm (Gindaba et al. 2004). The primary rainy season is in July and August with a smaller rainy season during March.

3. METHODS:

Each of the forest harvesting operations was observed and formal and informal interviews were conducted with different individuals and groups. Collaborative participation in the planning and harvesting process provided additional insight and details of the harvesting practices. Through this data collection process, many of the opportunities and constraints pertaining to improved forest harvesting sustainability were revealed. Data was organized and processed using a defined strategy to ensure the usability and integrity of the data. Collection and analysis of data was conducted simultaneously in order to develop interpretations that would closely represent the field experiences and interviews (Marshall and Rossman 1999). Detailed notes were recorded during all interviews, field observations, and participation activities. An in-depth review and additional annotation was completed after data was collected to ensure that all pertinent information was properly recorded and clear. As data was accumulated, it was processed to identify prominent themes, recurring ideas, and other patterns. These concepts were then categorized in order to search for the “the salient, grounded categories of meanings held by participants in the setting” rather than the exhaustive and mutually exclusive categories of the statistician (Marshall and Rossman 1999). Data was manually coded using a generative scheme that focused on the nature and the delivery of the content in order to develop the concept categories. This process was used in order to minimize the influence of prior assumptions of possible results (Kerlin 2005). Testing the emergent patterns and concepts was completed through a process that searched contrary situations and constant comparisons with the emerging ideas in order to build a stronger overall framework theory. As the theory develops, triangulated analogous data from multiple sources, locations, and times help strengthen confidence in the overall process.

4. RESULTS

Data coding and analysis of the harvesting process revealed many prominent topics and themes. The main categories identified were: strategic planning, information resources, timber harvesting (planning, access, in forest operations, and finally landing and hauling operations).
These main topic areas were constructed into a decision framework process that could identify specific issues and develop solutions to improve forest operations sustainability.

This decision framework combines core sustainability concepts of environmental, economic, and social responsibility with forest harvesting operations. This process facilitates the collection of necessary site specific information and provides the structure to develop appropriate, sustainable improvements to current forest harvesting operations. The framework is broken down into five phases: strategic guidance and purpose, information and data (available information resources), harvesting process, solutions and outcomes, and ranking and prioritization. (Figure 2). This approach uses the principle categories and themes identified in the data collection phase with decision support concepts to develop solutions that meet the particular needs of an organization, site, or individual.

Figure 2. Five phase sustainable harvesting improvement identification decision framework

In the first three phases of the framework, similar questions covering different operational levels of timber harvesting programs are answered to develop an understanding of the overall situation. This process starts with the identification of basic sustainability issues, current conditions and issues, and potential improvements. Following collection of this data, expected outcomes are identified and a priority is assigned to the particular issue. This process provides the researcher the ability to develop an understanding of the local situation through experiences and interviews with many different levels in the organization, before generating solutions and outcomes to be implemented. Phase III (Forest Harvesting) requires the most effort in order to cover the full breadth of different operations and sample of involved people. This phase generates large quantities of data as many levels of the organization and local communities are involved. Upper management and day laborers both have potential feedback about the harvesting process at this level, where day laborers may have limited exposure and therefore input to some of the other phases such as strategic goals, long term planning, and operational data requirements.

The data collected during the first three phases produces a collection of different issues and opportunities to improve forest harvesting operations. Potential solutions both large and small along with ideas of priorities and scope of impacts from the first three phases will be collected in Phase IV (Solutions and Outcomes). In this phase different identified potential
solutions are grouped into broad solution categories of harvest planning, tools and equipment, research, social programs, extension and training, and political. This process combines the diverse range of solutions into action areas that can be addressed by different individuals, approaches, or financing. Solutions in the political category may be more difficult to implement unless an organization has sufficient political influence, whereas the tools and equipment solutions may be relatively simple with the purchase of an inexpensive hand tool or locally produced sulky (Seymour 1996). Once solutions have been grouped, each of the categories should be prioritized and ranked for implementation (Phase V). Many tools are available to facilitate this process ranging from simple ranking, composite scoring, and more complex systems such as analytical hierarchy process procedures and multi-criteria decision making tools.

5. DISCUSSION

In field timber harvesting experiences and data collection provided the required range of information to develop a decision framework that responds to the environmental, economic, and social conditions in Ethiopia. These local responses and experiences provide the germane areas of concern without unnecessary emphasis on topics of little interest and relevance. On the other hand, topics that were frequently repeated by multiple respondents are elaborated and elevated in the process to develop meaningful and implementable solutions. Without on the ground interactions, the prescription of existing approaches to timber harvesting from the temperate or the more developed regions might dictate improvements that may not be appropriate, possible, or provide the desired benefits. In many cases the best solutions and improvements come from within, from the people closest to the activity. The use of social science research methods to have participants lead discussions and the development of ideas provides solutions that are grounded in the actual environment and chances for successfully improving operations are good. Simply imposing solutions best suited for European or American forest operations fails to recognize the unique local sustainability conditions of focus in this study.

In the use of this framework, a small group of researchers would be used to collect local data from respondents and other activities utilizing common development tools and techniques that are designed to provide ownership to the local groups. The research group will lead the collection of data from experiences, observations, and through guided informal interview discussions that attempt to encourage a broad examination of the range of possible issues and opportunities. If left to simple discussion without guidance through the decision framework, identified solutions and issues were often rudimentary and failed to probe issue areas and potential solutions covering multiple concepts or layers of an operation.

The use of multiple research sites attempted to address the wide range of different harvesting conditions in Ethiopia. Issues and solutions in the natural forest area have some similarities to those in the plantation forests, however both areas have unique and important components that need recognition in any decision tool. Even the two different plantation forest operations of the SFIE and the WGCF each have distinct characteristics that provide additional enrichment. By incorporating experiences and data from all research sites, the overall decision framework recognizes the scope of potential differences. This also challenges participants to be aware of other harvesting operations conditions and types to develop solutions and avoid pitfalls in their own operations. While sites in Ethiopia were used to develop this framework, many
parts of the developing world face similar questions and situations that fall into the same categories for decision making. This decision framework would be appropriate in other areas outside of Ethiopia with appropriate adjustments for the local conditions.

6. CONCLUSION

Forest utilization is an important component in the daily lives of most Ethiopians for fuel, fodder, coffee cultivation, and other many other uses. Improvements in commercial forest harvesting to move towards more sustainable operations can help decrease the impacts of this one type of forest utilization. A decision framework has been developed using experiences and discussions with those involved with many different levels of operations. This development process has incorporated social science data collection processes and harvesting operations in different organizational and physical conditions in order to capture diverse issues and appropriate solutions. Through use of this decision framework, solutions to improve the economic, environmental, and social conditions of operations can be identified and implementation planning can begin.

7. LITERATURE CITED

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