Working Paper

A Conjoint Analysis of Farmer Preferences for Community Forestry Contracts in the Sumber Jaya Watershed, Indonesia

Bustanul Arifin, Brent Swallow, Suyanto, Richard Coe

Southeast Asia

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Correct citation: Arifin B, Swallow B, Suyanto, Coe R. 2008. A Conjoint Analysis of Farmer Preferences for Community forestry Contracts in the Sumber Jaya Watershed, Indonesia. ICRAF Working Paper 63. Nairobi: World Agroforestry Centre. 36 pgs

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Published by the World Agroforestry Centre
United Nations Avenue
PO Box 30677, GPO 00100
Nairobi, Kenya

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Working Paper # 63

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Abstract

A wide range of policy instruments have been devised and applied to support the goals of sustainable forestry management. Community forestry programs can contain elements of several of these instruments. This paper considers the design of community forestry contracts in Indonesia. In the research site, community forestry contracts are contracts between the Forestry Department and community groups that provide group members with time-bound leasehold rights to protection forests, provided that farmers abide by specified land-use restrictions and pay any required fees. Farmers perceive that the contracts represent a bundle of restrictions and instruments, some of which are explicitly stated in the contract and others that are implied by the contract. Conjoint analysis was used to quantify farmers' tradeoffs among the explicit and implicit attributes of the contracts. The results of bivariate and ordered logit models show that farmers are most concerned about the length of the contract, and surprisingly unconcerned about requirements on tree density and species composition. An implicit attribute, greater access to forestry and agroforestry extension, emerged as an important implicit attribute. The results imply that farmers in this part of Indonesia would be willing to abide by fairly strict limitations on land use, provided that they can be assured of long-term rights to the planted trees.

Keywords

Community forestry programs, community forestry contracts, conjoint analysis, Indonesia; ordered logit

Acknowledgements

The study reported in this paper was conducted under a project entitled: "Property rights, Environmental Service Mechanisms and Poverty in Indonesia." The project was supported by the Strengthening Input Systems (BASIS) Collaborative Research Support Program (CRSP), funded by the United States Agency for International Development. Financial support was also provided by the European Union and the International Fund for Agricultural Development. The contents of this publication are the sole responsibility of the authors and can in no way be taken to reflect the views of the funding agencies. The study benefited from useful comments from Meine Van Noordwijk, Peter Frost, John Kerr, John Pender and members of the faculty of the Department of Agricultural Economics at Lampung University. Edwin Jonson, Noviana Khususiyah, Hutman Kariadi and Rio Jaladri administered the survey and assisted with data management.

Contents

1. Introduction

Tropical forested landscapes are prototypical multi-value resources. Different portfolios of private, collective and public goods and services are produced by those landscapes: products of interest to a range of local and external stakeholders. Research conducted across the humid tropics shows that there are almost always tradeoffs between the extremes of intense production and complete conservation of tropical forested landscapes. Between the extremes there is considerable scope for achieving outcomes of mutual benefit for different stakeholder groups (Tomich et al. 2005).

A wide array of policy instruments has been devised for promoting the management of tropical forest landscapes. These include "traditional" instruments such as state forest ownership, timber harvest concessions, public tree planting programs and restrictions on commercial trade of forest products. They also include a variety of community and co-management tenure arrangements, decentralization to local government authorities, agroforestry extension, conservation trust funds, product certification, and conditional payments for water quality preservation or carbon sequestration (Cubbage, Harou and Sills 2007 p.839; Swallow et al. 2007).

In any particular context, governments and other organizations interested in the management of forest landscapes need to make informed choices about which instruments to apply. Cubbage, Harou and Sills (2007) propose that the choice of instruments should be guided by benefit-cost analysis, with gaps between private and social returns defining the need for particular policy instruments. An alternative approach is to design the policy instrument to balance the interests and perceptions of key stakeholder groups. In this paper we show that conjoint analysis can be a powerful tool for understanding the way that farmers perceive the attributes of community forestry contracts in Indonesia. Results from the study can smoothen the processes of negotiation between farmers and other key stakeholders in community forestry. Depending upon the context, a similar study could also be done with representatives of other stakeholders or other communities in order to identify areas of similarity and difference in preferences (e.g. Tsalikis, Seaton and Tomaras 2002).

Forest landscape management in Indonesia is an instructive case of multiple values, multiple interests, and multiple policy instruments. After many decades of top-down regulation and central government ownership of large tracts of land, Indonesia's forest policy began in 1998 to slowly evolve toward decentralization, forestry extension, and stronger ownership rights for communities and indigenous peoples. Although the

central government Forest Department continues to exert overall control over a large portion of the Indonesian land mass, some progress has been made in opening the space for negotiation between communities and the government (Fay, Sirait and Kusworo 2000). Community forestry contracts (HKm) provide one possible avenue for negotiated settlements of mutual benefit for government and community interests.

This paper addresses the challenge of understanding farmer perceptions of community forestry contracts in Indonesia. The paper focuses on a case study in the Sumber Jaya watershed in Lampung Province on the island of Sumatra. The contract can be conceived as a bundle of policy instruments, some of which are explicitly stated in the contract and others implicitly implied by the contract. This study applies conjoint analysis to understand the way that farmers value and tradeoff the different policy instruments – expressed as different attributes of a possible contract. The results, many of which were unexpected, have important implications for community forestry contracts in Lampung province, and potentially other community forestry contexts in the developing world.

2. Background

2.1 Forest Policy in Indonesia

Indonesia inherited its approach to forestry law from the Dutch colonial government. In that view, forests are viewed as strategic assets that a government should protect and manage in order to generate income and secure environmental services of general public benefit. Government agencies in charge of the forests generate income from the sale of timber concessions, but do not yield ownership rights to individual forest owners or communities. This approach to foreset law was institutionalized over a twenty-year period, beginning with the Forest Act of 1967. Based on the Forest Act of 1967, the Ministry of Forests asserted control of more than 70 percent of the total area of the country, despite the fact that those areas were home for as many as 90 million people. The Ministry of Forests classified the forest estate into conservation forests, production forests and protection forests, with little or no recognition of the ownership rights of the local residents, many of whom were indigenous people who had lived in the areas for generations (Fay and Michon 2005, Colchester et al. 2005).

International development agencies began to press for reforms of the Forest Law in 1989, achieving modest changes through the 1990s. In 1995 the Minister for Forests issued a decree that allowed farmers to apply for permits to harvest non-timber forest products from state forest lands. Another Ministerial decree was issued in 1998 that

permitted customary communities to have their lands designated as Special Purpose Areas (KDTI).

The fall of President Suharto in 1998 ushered in the era of *Reformasi* and the hope for much greater recognition of the rights of indigenous people and local communities. A new Forestry Act was passed in 1999 that included provisions for areas of forest domain to be designated as Special Purpose Areas and customary forests. Neither of these designations provided for community ownership of forest land, but rather were articulated as temporary leases or permits. The legal provisions and implementation arrangements for the Forest Act have periodically changed since 1999. The Government passed laws on regional autonomy in 1999 (Law 12/1999) and 2004 (32/2004) which granted local governments more authority over natural resource management (Colchester et al. 2005).

In 2001, the Minister of Forestry issued decree 31/2001, which provided operational guidelines for community forestry contracts, *Hutan Kemasyarakatan* (HKm). Farmer groups interested in securing HKm contracts are required to form recognized farmers' organizations and to follow management guidelines that local forestry officials approve as being protective of the watershed functions of the landscape. Five-year initial contracts can be extended to a maximum of 25 years. As of 2005, the area under HKm permits comprises 2100 square kilometers, less than 0.2% of the forest estate of the country (Colchester et al. 2005).

As defined by the Indonesia forestry law, therefore, HKm permits are community forestry contracts in which the Indonesia government grants limited duration rights to forest estate land provided that the communities abide by management requirements. Van Noordwijk et al. (2007) regard the HKm contracts in protection forest areas to be a type of reward for the provision of environmental services, which can be evaluated by the extent to which they are realistic, conditional, voluntary and propoor (Van Noodwijk et al. 2007).

2.2 Study site

The conjoint analysis study was conducted in the Way Besay sub-watershed in the sub-district of Sumber Jaya in West Lampung, Indonesia. As of the mid-1990s the Sumber Jaya area was known as an area of intense land-use conflicts. Between 1980 and 1990, the area was demarcated into a small area of private farm land, conservation forests for biodiversity conservation, and large areas of protection forests for watershed protection (Verbist et al. 2005). Although much of the protection forests had been deforested and converted to coffee farms as early as the 1950s, government officials periodically evicted

thousands of farmers who had settled in the area, with large evictions in 1990-1, 1995 and 1996. Government agencies were concerned about the impacts of coffee farms on the quality and quantity of water in the tributaries of the Way Besay River. A run-of-river hydro-power plant was built on the Way Besay River to increase energy supplies to southern Sumatra and surrounding areas. The state-owned power company used military power to remove people from the protected forest. As of the mid-1990s, there had been no serious attempt to resolve the land-use conflict through dialog or negotiation. The World Agroforestry Centre (ICRAF) and several local non-governmental organizations became active in the area in 1998.

At the time of this study, Sumber Jaya was part of the new district of West Lampung. In the year 2000, Sumber Jaya was divided into two subdistricts: Sumber Jaya to the east, covering 15 villages, and Way Tenong to the west, covering 14 villages. The new Sumber Jaya subdistrict has an area of 356 square kilometers and is home to about 50,000 people.

Forest cover and agroforestry are both very dynamic in the Sumber Jaya area. The amount of forest in the area declined from about 60% in 1970 to 32% in 1978 and to 10% in 1990 and 2000. Over the same period, the area covered by coffee-based agroforestry systems increased from about 8% in 1970 to 20% in 1978 to about 63% in 1990 to about 70% in 2000. Coffee is grown in three production systems in Sumber Jaya: monoculture coffee, shade coffee, and multi-strata agroforests. Shade coffee and multi-strata agroforests have been expanding since 1984 and now occupy about 36% of the study area (Verbist et al. 2005). The rate of deforestation peaked in the 1999-2000 period, when farmers took advantage of the fall of the Government of President Suharto and the relative freedom of the early days of *Reformasi* to expand coffee production in the protection forest and national park. Despite its higher conservation status under the Forestry Law, the rate of deforestation has been higher in the National Park than in the protection forest (Ekadinata et al., no date). Studies by Van Noordwijk et al. (2000) and Verbist et al. (2005) have shown that well-managed multi-strata agroforestry systems can be consistent with good soil management and watershed. A study by Suyanto et al. (2005) shows that farmers with secure property rights are more likely to establish multi-strata agroforestry systems than monoculture coffee systems.

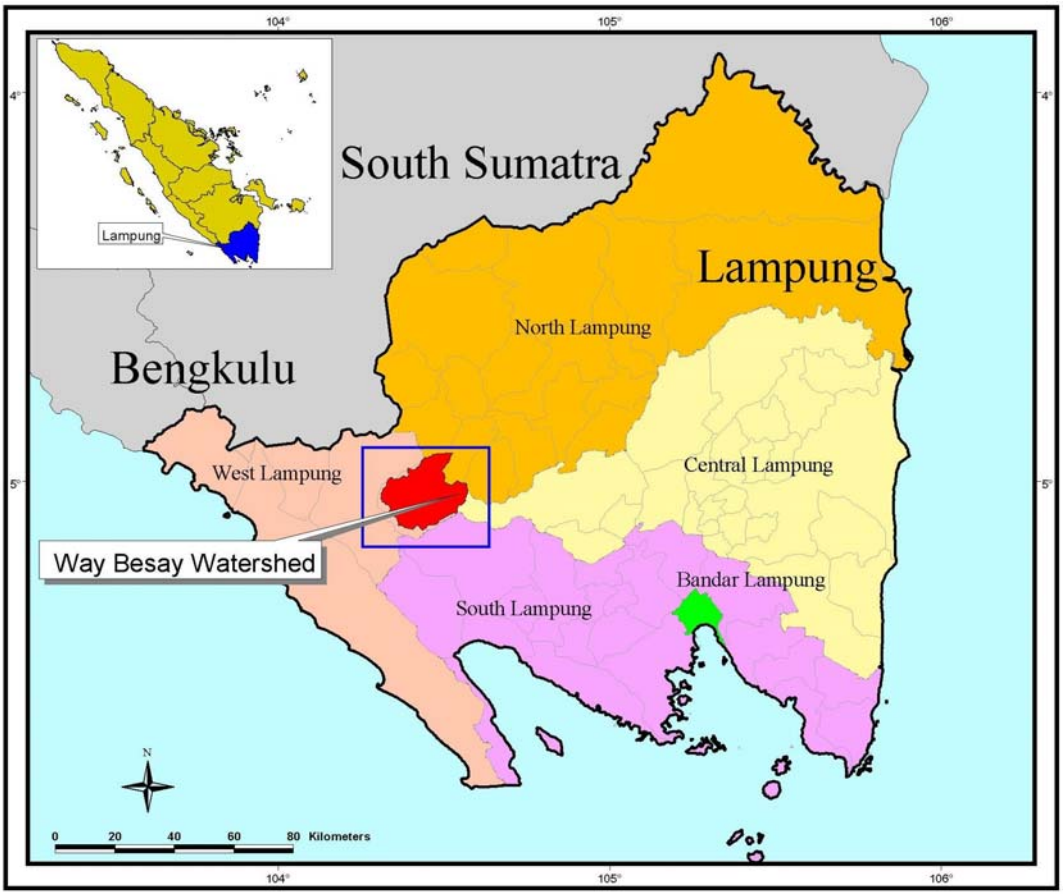

Figure 1. Way Besay Sub-watershed of Sumberjaya, Sumatra Indonesia.

The boundary of the Sumber Jaya subdistrict coincides with the watershed area of Way Besay, which also includes protected forests, including: (1) Register 39 Kota Agung Utara -- 500 km^2 hectares; (2) Register 44B Way Tenong Kenali -- 140 km^2; (3) Register 45B Bukit Rigis -- 83 km^2; and, (4) Register 46B Palakiah – 18 km^2. Register 45B Bukit Rigis is the most significant for watershed protection because it forms the headwaters of 11 rivers and streams.

Since the advent of *reformasi* in 1998, conflict and socio-economic tension between coffee growers and government officers has relaxed as processes became more open and government agencies have shown greater interest in participatory planning and involving stakeholders in managing forests and conserving resources. In the year 2000, the government of the Province of Lampung announced provincial decree 7/2000 on local tax and levies on non-timber forest products, including coffee. This arrangement has been seen as formally recognizing farmers who cultivate coffee in protection forests. The Forestry Law of 1999 and decentralization laws of 1999 and 2004 increased the scope

for local forestry officials to negotiate land use agreements with local residents. Research organizations and non-governmental organizations working in the area have supported negotiations between community groups and various government agencies.

2.3 Community forestry in the Sumber Jaya case study area

In the Sumber Jaya area, coffee agroforests have been established in areas designated as private farm land and areas designated as protected state forest land. Temporary 5-year *Hutan Kemasyarakatan* (HKm) contracts have been granted to coffee growers that form a farmers' organization and meet the criteria for community-based forestry management according to the Decree of Ministry of Forestry Number 31/2001. As of 2005, 28% of the protected forest area was under managed through HKm contracts, 56% of the area was in process of negotiation for HKm contracts, while the remaining 16% had no community forestry status.

Some elements of the HKm contracts are explicitly stated in the contracts that have been offered to farmers in the Sumber Jaya area:

1. Conditional tenure security to utilize forest land for a probationary period for five years. If the group of HKm farmers satisfies all criteria and indicators of HKm requirement, the tenure could be extended to a maximum of 25 years.
2. Farmers obtaining HKm permits are required to grow timber trees in the protection forest land. Different government programmes have required densities between 400 and 1000 trees per hectare. The current HKm contracts in Sumber Jaya require a minimum of 400 trees per hectare.
3. HKm holders can continue growing coffee and accompanying shade trees as long as at least 30 percent of the trees are of timber species.
4. Farmers have no right to sell and cut the timber trees that they plant.
5. HKm contracts in Sumber Jaya do not require the payment of any annual fee from the farmers, although farmers living in neighboring regions are required to pay an annual fee.

During open-ended interviews conducted in the preliminary stages of this research in Sumber Jaya, some farmer groups that had attained HKm contracts indicated that they had received benefits beyond the explicit elements of their contracts. It was suggested that by gaining the HKm status, farmers had become more eligible for participation in forestry extension programs, they had more rights to have public infrastructure constructed in the HKm areas, and their families had more legitimate claims on public services provided in nearby towns. The conjoint analysis study of farmers' preferences for the attributes of community forestry contracts therefore considered both the explicit and implicit elements of the contracts.

2.4 Conjoint Analysis

The main theoretical foundations of conjoint analysis are in consumer theory and its main applications have been in marketing. The fundamental assumption is that the utility derived from a good or service is derived from the properties or attributes of the good or service. In other words, overall utility for a good can be decomposed into separate utilities for its constituent attributes (Louviere 1994). In conjoint studies, respondents choose between alternative products or scenarios that display varying levels of selected attributes. Appropriately structured and repeated across a sample of respondents, these comparative evaluations can be used to calculate the part-worth utilities of each attribute. Part-worth utilities can be combined to estimate relative preference for any combination of attribute levels (Green and Srinivasan 1990).

The term 'conjoint analysis' refers to an overall approach and group of quantitative techniques that can be used to determine respondents' preferences for the attributes that make up a product or service. Key components of conjoint studies are: (1) the product may be defined using an aggregate of features or attributes that take certain levels or values, (2) different levels of the attributes define different versions of the product under consideration; (3) product appraisal by individuals is a function of the value which they assign to the product's attributes, and (4) during the decision-making process, individuals appraise the worth of each combination, and their choice demonstrates prioritization among the different combinations of attributes. The total worth of a particular product is then determined by the different part-worth of each attribute level (Sayadi, Roa and Requena, 2005).

Data for a conjoint study are generated through a survey in which respondents are asked to rate realistic but hypothetical products that have alternative levels of important attributes. Tradeoffs among attributes can be quantified and estimates developed for the marginal value of specified levels of the attributes. The survey data can also be analyzed to test whether there are significant differences in preferences among groups of respondents.

For the last few decades, conjoint analysis has been increasingly applied in the field of resource economics for valuation of ecosystem components and for ascertaining the preferences of stakeholders in environmental decisions involving tradeoffs not efficiently represented in market transactions. Asking respondents to make choices over a set of alternatives mimics the real choices that managers must make, and can provide feedback

to stakeholders with respect to the consequences of their choices. Choice experiments can be designed and analyzed in many ways. Respondents may be asked to reveal their preferences by choosing one of two or more options, ranking several options, or assigning numerical ratings to each option.

Conjoint analysis has also been used to support negotiations about the elements of contracts. Greenhalgh and Neslin (1981) tested and verified the applicability of conjoint analysis for ascertaining the preferences of management, unions and employees in a labour contract bargaining situation. Klosowski et al (2001) used conjoint analysis to assess the attitudes of U.S. farmers toward coordinated ecosystem management and economic policy tools for promoting ecosystem management. The Klosowski et al (2001) results showed that while farmers had generally positive attitudes toward ecosystem management, they were likely to have muted responses to tax incentives.

3. Applying Conjoint Analysis for Assessing Preferences for the Elements of Community forestry Contracts

In this study, conjoint analysis was used to evaluate farmers' preferences over the explicit and implicit attributes of community forestry contracts in the Sumber Jaya area of Indonesia. We begin with the assumption that farmers derive utility directly from the explicit and implicit attributes of the HKm contracts, with each attribute represented by a small number of levels.

The utility derived from HKm contracts is expressed as a quasi-concave, twice continuously differentiable utility function (equation 1):

$U_i(P_h) = U\{Z_h; X_i\}$ ..... (1)

where:

P_h is the h-th hypothetical package of HKm contract attributes;

$U_i(P_h)$ is the utility that the i-th farmer derives from the h-th HKm contract;

Z_h is a vector of levels making up the attributes of the HKm contract, P_h;

X_i is a vector of characteristics of the i-th farmer.

The corresponding indirect utility function $V_i(P)$ has a systematic component $v_i(P)$ and a random unobservable component, ε, that is unique to each farmer. The indirect utility for the h-th HKm contract is given by equation (2).

$V_i(P_h) = v(P_h) + \varepsilon_{ih}$ ..... (2)

Conjoint analysis uses field experiments in which a sample of farmers are asked to give ratings of hypothetical packages of HKm contracts with predetermined attributes and levels of attributes. A 1 to 5 scale was used for the rating, with 1 indicating least preferred and 5 indicating most preferred. In addition, farmers were asked to compare the hypothetic contracts with existing HKm contracts. In the same interview, farmers were also asked a series of questions to reveal information about their individual characteristics. Characteristics such as age, education, wealth and ethnicity were hypothesized to affect farmers' preferences to the different attributes of the contracts.

4. Study design and methods

This section explains the methodology used in the conjoint study, including the attributes of the HKm contracts, study sites, sampling, field survey procedures, and econometric technique to process the data collected from the field.

4.1 Design of Attributes and Levels of HKm Contracts

A preliminary list of explicit and implicit attributes of the HKm contracts and levels of those attributes was developed on the basis of the existing contracts (see Table 1), previous studies of HKm in the area (Arifin 2006, Suyanto et al., 2005), discussions with key informants, and group interviews at the site. The list of explicit attributes is mostly based on the Ministerial Decree No. 31/2001 that established the possibility of HKm contracts. In addition, the list of attributes includes the amount of labour required for group activities (in addition to attending meetings) such as forest guarding, tree planting etc. which has been built into some HKm contracts, although such requirements are not explicitly mentioned in the Ministerial Decree.

Implicit attributes are those that farmers in Sumber Jaya perceive to have been implied by the HKm contracts. From the key informant and group interviews, we hypothesized that farmers associated with HKm contracts with easier access to agroforestry extension services, access to better roads in the HKm areas, easier access to agricultural credit, easier access to agricultural marketing services, and easier access to public services. Interviews with forestry department officials revealed that they did deliberately select the HKm groups for inclusion in forestry extension programmes, in part because the HKm group structure made it easier for them to reach large number of farmers. Another government department did make major renovations on at least one road into the HKm area after contracts were signed. Some key informants postulated that easier access to credit and marketing services could be built into the contracts to make the contracts more popular with farmers.

The preliminary list of attributes was discussed with groups of interested researchers at the site and at the University of Lampung. A revised list of attributes and levels was then applied in a pre-test of the questionnaire in the study site. The pre-test suggested that farmers had trouble rating scenarios with too many attributes. The list of attributes and levels was further discussed by team members and at a seminar held at the offices of the Centre for International Forestry Research and World Agroforestry Centre in Bogor, Indonesia. Generally, we removed attributes that could not be clearly expressed to farmers and those that farmers did not expect to be explicitly included or influenced by HKm contracts. Table 1 lists the eight attributes that were ultimately included in the study design, including the level of that attribute as indicated in the current contract.

Table 1. Attributes of HKm Contracts

Attribute	**Requirements**
Explicit attribute of contract	
1. Length of main contract	25 years, after 5 year prob.
2. Minimum density of trees per hectare	400 trees (5x5 meter spacing)
3. Composition of trees allowed	At least 30% of timber trees
4. Right to harvest and sell timber trees that you plant on HKm land	No right to cut and sell
5. Fee to be paid to local government for HKm	Rp 0 per year
6. Required contribution of labor without pay for group activity (in addition to meeting) e.g.: forest guarding, tree planting etc	Not specified in HKm contract, but indicated in group constitutions
Implicit attribute of contract	
7. Easier access to agroforestry extension services and seedlings	Not specified
8. Better roads into the HKm area	Not specified

The levels of attributes are selected to simplistically capture the existing level and realistic alternative levels. For example, levels on the length of main contract are set to vary from the minimum of 15 years, to the default of 25 years, and to the maximum 35 years. The levels on the attribute of right to harvest and sell timber are set to binary options: "yes" (have the right) or and "no" (don't have the right). Implicit attributes related to government programs such as access to forestry and agroforestry extension and access on better roads into HKm areas also have only two levels, yes or no. Table 2 lists the attributes and levels included in the final conjoint survey design.

Table 2. Attributes and Levels of HKm Contracts in Sumber Jaya, Indonesia

Attribute	Level 1	Level 2	Level 3
Explicit attribute of contract			
1. Length of main contract	15 years	25 years	35 years
2. Required density of trees / ha	400 (5 meters)	600 (4 meters)	1000 (3 meters)
3. Composition of trees allowed	15% timber trees required	30% timber trees required	50% timber trees required
4. Right to cut and sell timber trees that you plant on HKm land	Have right to sell	Don't have right to sell	
5. Level of fee to be paid for HKm*	Rp 0 per hectare per year	Rp 36,000 per hectare per year	Rp 72,000 per hectare per year
6. Required contribution of labor without pay for group activity (in addition to meeting) such as forest guarding, tree planting etc	1 day per month	5 days per month	
Implicit attribute of contract			
7. Easier access to agroforestry /forestry extension services and seedlings	Yes	No	
8. Better roads into the HKm area	Yes	No	

* The average rate of exchange between the US$ and Indonesian Rupiah in 2005 was 9500 Rupiah / 1 US$.

4.2 Field Survey Design

The conjoint analysis study was conducted as component of a study of the potential for the HKm contracts to contribute to poverty alleviation. That broader study was conducted with eight strata of households in the Way Besay sub-watershed (see Figure 2). Strata 1 and 2 were selected to represent different levels of likely tenure security, including the least secure (strata 1 – farming in the national park) and the most secure (strata 2 – farming on private land). Three levels of HKm permit were distinguished for people farming in protection forest land: having an HKm permit (strata 3 and 4), having an HKm permit in process (strata 5 and 6) and having no HKm rights (strata 7 and 8). Each of these three groups was further distinguished by whether or not they had experienced evictions in the 1990s. Table 3 lists the full set of household strata and Figure 2 shows the geographic distribution of the 8 strata.

Table 3: Strata of households included in the study of poverty alleviation impacts of HKm

Strata number	Characteristics of households
1	Living in the Bukit Barison Selatan National Park
2	Cultivating own private land
3	Having a HKm permit, and experiencing eviction in the 1990s
4	Having a HKm permit, and no experience with eviction
5	Having HKm in the process of approval, and experiencing eviction in the 1990s
6	Having HKm in the process of approval, and no eviction experience
7	Having no HKm rights, and experiencing eviction in the 1990s
8	Having no HKm rights, and no eviction experience

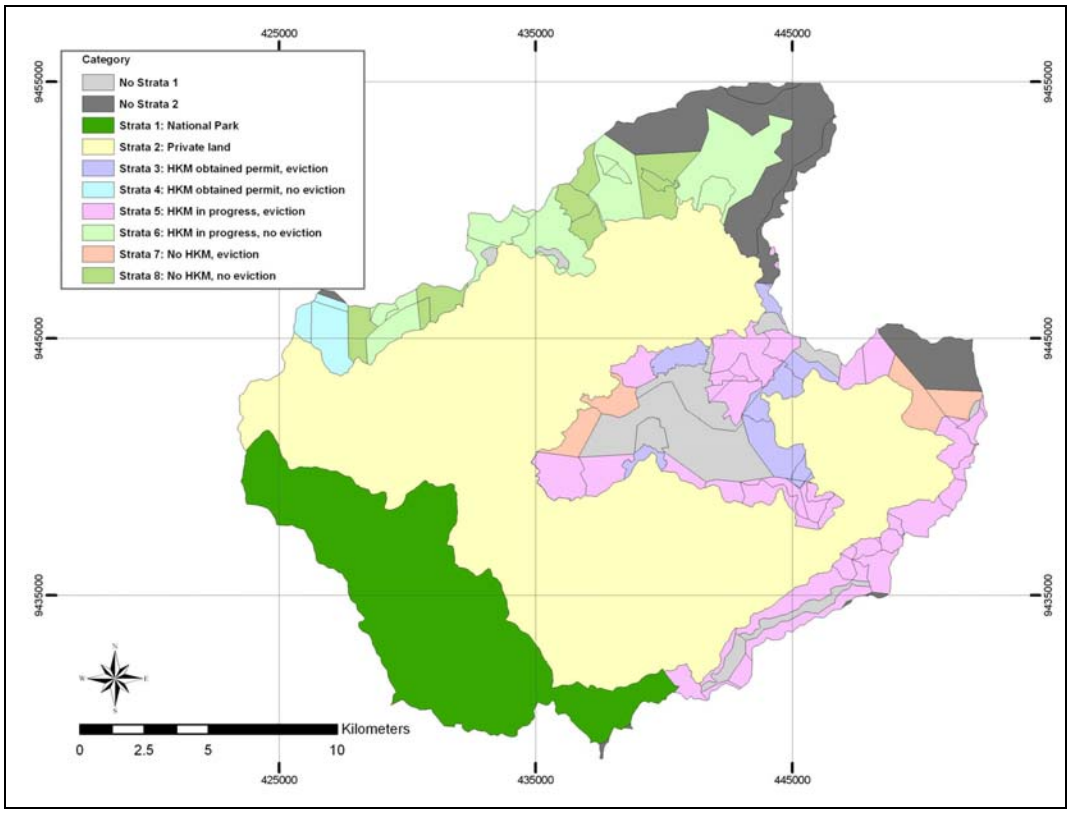

Figure 2. Distribution of Sample in Way Besay Sub-Watershed, in Sumberjaya.

This study of preferences for the attributes of community forestry contracts was conducted with households with some experience of the HKm contracts. For these purposes, strata 3 and 4 were combined into a stratum of households with HKm permits, while strata 5 and 6 were combined into a stratum of households who had applied for HKm permits, but not yet received the permits.

The sampling and interview methods were jointly designed to efficiently cover the range of contract design options described in Table 2. There are four attributes with three levels (length of contract, required tree density, composition of trees allowed, fee) and 4 attributes with 2 levels (right to cut and sell timber trees, required labour contribution, access to agroforestry / forestry extension services, access to improved roads). The total number of scenarios for the 8 attributes is $2^4 * 3^4 = 1296$. From pre-tests of the conjoint analysis method, we determined that 12 was an appropriate number of scenarios to ask each respondent to rate. We therefore ascertained that 108 respondents could handle the full set of scenarios, meaning that each respondent responded to a unique set of 12 scenarios (12 scenarios x 108 respondents = 1296 scenarios). Our sampling procedure therefore was to randomly select 108 respondents from the stratum of households who had HKm permits and 108 respondents from the stratum of households who had applied for HKm permits. Each respondent was asked to compare 12 scenarios, selected to give a near orthogonal design. A total of 216 interviews were therefore conducted.

The questionnaires were written in Bahasa Indonesia in order to ease the process of data collection and improve communication between enumerators and respondents. From the results of previous surveys conducted in the area, we understood that all respondents would be literate, with most having completed elementary school. An introduction of about 30 minutes was given by the enumerator to each respondent before the respondent was asked to provide ratings and preferences on the package of HKm contracts. The attributes and levels were summarized in the questionnaire in a simple table that could be easily understood by the respondents. As explained above, each respondent was asked to rate 12 scenarios or hypothetical contracts. Respondents were asked to providing ratings of between 1 and 5 for each hypothetical contract, with 1 representing a low desirability and 5 representing high desirability, as well as an indication of whether or not they preferred the hypothetical contract over the current contract. Respondents were also asked to provide information about household characteristics that we hypothesized to have important affects on preferences. These included age of household head, family size, ethnicity, years of education of the household head, knowledge of HKm, previous access to technical assistance, and whether the HKm contract had already been granted or was still being processed.

4.3 Bivariate Logit Analysis

Two statistical analyses was undertaken to evaluate farmers' preferences over the levels and attributes of the contracts. First, a bivariate logit analysis was undertaken to assess how the levels of the attributes affected whether they preferred the hypothetical contract over the current contract.

Expanding equation (2) from above for our case, we obtain equation (3):

$V_i(P_h)^* = b_1 Z_{1h} + \ldots\ b_8 Z_{8h} + c_1 X_1 + \ldots + c_j X_j + \varepsilon_{ih}$ ……(3)

Where: $V_i(P_h)^*$ is an unobserved measure of the utility that farmer i derives from the attributes of the h-th HKm contract

$Z_{1h} \ldots Z_{8h}$ is a vector of levels of the observed attributes of the HKm contract

$X_1 \ldots X_j$ is a vector of the respondent's characteristics

$b_1 \ldots b_8$ and $c_1 \ldots c_j$ are unknown parameters

ε_{ih} is a random error term.

While $V_i(P_h)^*$ cannot be observed, the binary choice experiment provides information about whether the farmer prefers or does not prefer the hypothetical contract to the existing contract. The rational farmer will choose the existing contract if the utility he or she expects to derive from the existing contract is equal to or greater than the utility he or she would expect to derive from the hypothetical contract. In other words:

$BC_i=0$ *if* $V_i^*(P_0) \geq V_i^*(P_h)$ …… *(4)*

$BC_i=1$ *if* $V_i^*(P_0) < V_i^*(P_h)$

Where: $BC_i=0$ if farmer i prefers the existing contract and BCi=1 if farmer i prefers the hypothetical alternative contract (BC represents binary choice).

$\Pr(BC_i=1) = \Pr(U_i^*(P_h) > U_i^*(P_0)$ ……(5)

$= \Pr[(\varepsilon_{i0} - \varepsilon_{ih}) < (\beta_1 Z_{1h} + \ldots + \beta_8 Z_{8h} + c_1 X_1 + \ldots + c_j X_j) - (\beta_1 Z_{10} + \ldots + \beta_8 Z_{80} + c_1 X_1 + \ldots + c_j X_j)]$

ZX is the vector of attributes of the HKm contracts and respondent characteristics

β is a vector of parameters to be estimated

Assuming that the εs are independently and identically distributed, the appropriate functional form of $(\varepsilon_{i0} - \varepsilon_{ih})$ defines the appropriate estimation technique for estimating the utility difference (equation 5). Here we assume that $(\varepsilon_{i0} - \varepsilon_{ih})$ is distributed according to the logistic function, making bivariate logit the most appropriate estimation technique. An advantage of the logit technique is that the parameter estimates are easily interpreted as the logarithm of the odds ratios. An odds ratio is the ratio of the odds of an event occurring in one group to the odds of it occurring in another group. For a given attribute, an odds ratio of one implies that the attribute has no effect on the odds that respondents will prefer the hypothetical contract to an existing contract. An odds ratio less than one indicate that higher levels of the attribute reduce the odds that

respondents prefer the hypothetical contract to the existing contract. An odds ratio greater than one implies that higher levels of the attribute increase the odds that respondents will prefer the hypothetical contract compared to the existing contract.

4.4 Ordered logit analysis

Another statistical procedure was appropriate for the analysis of the ratings data. The dependent variable is the rating between 1 (least preferred) and 5 (most preferred), while the independent variables are the levels of the 8 attributes and the characteristics of the respondents. We assume that any contract that the farmer rates with a higher number is preferred over any contract that he or she rates with a lower number, but do not assume that the intervals between the ratings are equal. For example, we cannot assume that the difference in preference between ratings 1 and 2 is the same as the difference in preference between ratings 4 and 5. The ratings therefore are characterized as discrete and ordered, but not ordered by equal interval. Again assuming that the error terms are distributed over the logistic function, ordered logit is an appropriate analytical approach for this analysis (Greene 1993).

As for the bivariate logit, the starting point for the ordered logit model is equation (3) above, where the indirect utility that is derived from an HKm contract is a function of the attributes of the contract and the respondent's characteristics. While the indirect utility derived from a particular contract cannot be observed, we observe the ratings (Rating) of between 1 to 5, where:

Rating = 1 if $P_h^* \leq \mu_1$

Rating = 2 if $\mu_1 < P_h^* < \mu_2$

Rating = 3 if $\mu_2 < P_h^* < \mu_3$

Rating = 4 if $\mu_3 < P_h^* < \mu_4$

Rating = 5 if $P_h^* \geq \mu_4$

Where $\mu_1 \ldots \mu_4$ are estimated cutoff points.

The probability that the farmer will give a rating of j to the h-th HKm contract is given as:

$$P_{hj} = Prob\ (Rating = j) = Prob\ \mu_{j-1} < \Gamma ZX + e_{ih} < \mu_j \ldots\ldots\ (6a)$$

$$= L\ (\mu_j - (\Gamma ZX)) - L\ (\mu_{j-1} - (\Gamma ZX)) \ldots.\ (6b)$$

Where: Γ is a vector of parameters to be estimated using a maximum likelihood estimator

ZX is the vector of attributes of the HKm contracts and respondent characteristics

L is the cumulative logistic density function.

5. Results

This section presents the research results, including descriptive statistics about the respondents and econometric analysis on the attributes of HKm contracts.

5.1 Respondent Characteristics

The average respondent of this survey was 43.7 years for households with HKm permits and 42.6 years for households with HKm permits in process. Respondents with the HKm permits had an average of 6.5 years of formal education, while those with the HKm in process had an average 5.9 years of education. Average family sizes were generally small, 4.0 in households with HKm permits and 3.6 in households with HKm permits in process.

The major ethnic groups of respondents with HKm permits were Javenese (45 percent) and Sundanese (43 percent), while those with HKm permits in process were Javanese (43 percent) and Sundanese (34 percent). The majority of respondents were migrants from Java or children of migrants. Indigneous Lampungese were a minority. The demographic characteristics of respondents are summarized in Table 4.

Table 4. Demographic Characteristics of Respondents

Important Variables	**HKm Permit**		**HKm Process**	
	Mean	**Std.dev**	**Mean**	**Std.dev**
1. Age (years)	43.7	0.4	42.6	0.3
2. Education (years)	6.5	0.1	5.9	0.1
3. Household size (number)	3.6	1.3	4.0	1.5
4. Ethnic Group				
- Javanese (%)	45.4	4.8	42.6	4.8
- Sundanese (%)	42.6	4.8	34.3	4.6
- Lampungese (%)	12.0	3.2	23.2	4.1
5. Migration Status				
- From Java	35.2	4.6	38.0	4.7
- From other districts in Lampung	19.4	3.8	17.6	3.7
- From other places in the country	8.3	2.7	7.4	2.5
6. Permanent migrant status (%)	98.2	1.3	99.1	0.9
7. Second generation migrant (%)	34.3	4.6	33.3	4.6
8. Third generation migrant (%)	2.8	1.6	3.7	1.8

Source: Calculated from field survey

Additional characteristics of the respondents are presented in Table 5. A large majority of the respondents listed agriculture as their primary occupation. The total value of the

assets owned or controlled by the households was Rp 57.5 million for households with HKm permits and 61.5 million for households with permits in process. This includes the value of their house, land parcels, animals, and transportation equipment. Respondents in households with HKm permits were generally aware of the permits (84 percent), while awareness was lower among households with permits in process (48 percent). Access to formal credit was similar with the two groups, while access to extension services was higher for households with HKm contracts (84 percent) compared to households with permits in process (59 percent). These differences in awareness of HKm and access to extension were the only notable differences between the two groups.

Table 5. Social-Economic Characteristics of Respondents

Important Variables	**HKM Permit**		**HKm Process**	
	Mean	**St.dev**	**Mean**	**St.dev**
Agriculture as primary occupation (%)	97.2	1.0	97.2	1.6
Total asset owned (Rp million) *	57.5	2.0	61.5	2.3
Awareness of HKm tenure (%)	84.3	3.5	48.2	4.8
Access on technical assistance (%)	81.4	3.8	59.3	4.8
Access on formal credits (%)	39.8	4.7	38.9	4.7

* The average rate of exchange between the US$ and Indonesian Rupiah in 2005 was 9500 Rupiah / 1 US$.

Source: Calculated from field survey

5.2 Preferences for hypothetical contracts compared to existing contracts

Table 6 presents the results of the bivariate logit analysis on preferences for hypothetical contracts compared to the existing HKm contracts. As shown in equation (5), the explanatory variables include the contract attributes and characteristics of the respondent households. In addition, we considered four variables that represent the interactions between contract attributes and household characteristics. That is, we hypothesized: (1) that preferences over length of contract would be affected by the household's HKm status; (2) that preferences over the HKm fee would be affected by their assets; (3) that preferences over the need to contribute to group activities would be affected by family size; and (4) that preferences over tree density requirements would be affected by previous access to technical assistance.

The results for the explicit attributes are generally consistent with expectation, with all attributes having statistically significant effects on preferences except for tree composition and labour contributions to collective activities. The odds ratios shown in

the rightmost column show that contracts that require higher tree density, higher fruit tree percentages, and impose higher fees would all be less preferred than the terms of the existing contract (those with odds ratios less than 1). Length of contract has a very large impact on the odds of a farmer preferring the hypothetical contract over the existing contract: a contract valid for 25 years would be 2.7 times more likely to be chosen than a contract valid for 15 years, while a contract valid for 35 years would be 9.2 times more likely to be chosen than a contract valid for 15 years. A contract that allowed farmers to harvest timber trees would be 2.2 times more likely to be chosen than a contract that did not allow harvesting of timber trees.

The two implicit attributes – better access to extension services and access to better roads in the HKm area -- have significant effects on preferences. Contracts that provided better access to forestry and agroforestry extension services would be 2.4 times more likely to be selected than contracts that did not provide such access, while contracts that provided better roads in HKm areas would be 1.5 times more likely to be selected than contracts that did not provide that acess. Even though the existing contracts do not explicitly indicate that members of HKm groups will obtain better access on extension services and seedlings, the norms found in the study site are that government extension providers have given priority to HKm groups.

Respondent characteristics have little effect on preferences. Age of household head, ethnicity, household assets, and years of education all had insignificant effects on preferences. Perhaps most surprising was that there were no significant differences in preferences between respondents who belonged to groups with HKm contracts and respondents who belonged to groups with HKm contracts in progress. Instead, the results indicate that respondents who were not aware of the HKm contracts had somewhat lower preferences for the hypothetical contracts than respondents who were aware of the HKm contracts. They had odds of 0.29 of preferring the hypothetical contract to the actual contract. Also respondents who had received technical assistance had lower preferences for the hypothetical contracts than respondents who had not received technical assistance. They had odds of 0.32 of preferring the hypothetical contract to the actual contract.

The results at the bottom of Table 6 show that two of the interaction terms had statistically significant effects on preferences. That is, households whose HKm contract was still be processed placed even greater importance on the length of contract than households whose HKm contracts had already been granted. While statistically significant, the odds ratio was only 1.04. Households that had access to technical

assistance placed even greater important on tree density than households whose HKm contracts had already been granted. The odds ratio on this interaction term was only 1.002.

Table 6. Bivariate Logit Results on Preferences for Hypothetical Compared to the existing HKm contract

Definition	Coefficient (log odds ratio)	z	P>z	Odds ratio
Constant	-1.704			
Attributes of the hypothetical contract:				
• HKm period 25 years (default 15 years)	0.997	4.37	0.000	2.710
• HKm period 35 years (default 15 years)	2.221	5.43	0.000	9.217
•Tree density 600 trees / ha (default 400 trees / ha)	-0.655	-4.29	0.000	0.519
• Tree density 800 trees / ha (default 400 trees / ha)	-1.047	-4.69	0.000	0.351
• Max fruit tree composition 30% (default 15%)	-0.162	-1.34	0.180	0.850
• Max fruit tree composition 50% (default 15%)	-0.155	-1.29	0.198	0.856
• Tree cutting rights (default no cutting)	0.802	7.98	0.000	2.230
• Pay fees of 36,000 Rp / year (default no fees)	-0.969	-7.57	0.000	0.379
• Pay fees of 72,000 Rp year (default no fees)	-1.159	-7.93	0.000	0.314
• Contribute 5 days per month to group activities (default 1 day)	-0.255	-0.91	0.363	0.775
• Access to extension services & inputs (default no access)	0.863	8.57	0.000	2.370
• Access to roads in HKm area (default no access)	0.382	3.85	0.000	1.465
Characteristics of respondent:				
• Age of household head	0.001	0.20	0.841	1.001
• Ethnicity of Javanese (default, Lampung, Sumendo)	-0.031	-0.21	0.830	0.969
• Ethnicity of Sundanese (default, Lampung, Sumendo)	0.059	0.39	0.694	1.061
• Years of education	-0.020	-1.11	0.266	0.980
• Aware of HKm (default no aware of HKm)	-0.024	-0.19	0.853	0.976
• Access to technical assistance (default no access)	-1.223	-2.95	0.003	0.294
• Assets in year 2000	0.002	1.55	0.121	1.002
• HKm status in progress (default HKm permit already issued)	-1.153	-3.15	0.003	0.315
• Family size in 2005	-0.070	-1.12	0.264	0.932
Interactions between attributes of contract and respondent characteristics:				
Length of contract x HKm status in process	0.040	3.00	0.003	1.041
Fee on HKm contract x Assets in year 2000	0.000	-0.24	0.811	1.000
Contribute to group activities x Family size in year 2005	0.015	0.88	0.379	1.015
Tree density x access to technical assistance	0.002	2.68	0.007	1.002
Pseudo R-squared	0.291			

5.3 Factors affecting farmers' ratings of HKm contracts

Results from the ordered logit analysis of farmer ratings of the hypothetical contracts are presented in Table 7. In qualitative terms, the results of the ordered logit model are very similar to those generated by the bivariate logit model of farmers' preferences of hypothetical contracts compared to the existing HKm contract. The ordered logit results also indicate strong preferences over the length of the contract period, the required density of timber trees, the right to cut the timber trees, and the level of the annual fee.

Rules on the composition of trees and required contributions to group activities had insignificant effects on farmer ratings. The two implicit attributes, access to extension services and roads in the HKm area, also had significant effects on preferences. The only respondent characteristics that had any effect on preferences were awareness of the contracts and previous access to technical services, both of which reduced farmers' ratings over the hypothetical contracts. The odds ratios confirm that length of contract is by far the most important variable affecting preferences. None of the interaction terms had significant effects on preferences.

Table 7. Ordered Logit Results on Ratings of Hypothetical HKm Contracts

Definition	Coefficient (log odds ratio)	z	P>z	Odds ratio
Attributes of the hypothetical contract:				
HKm period 25 year (default 15 year)	1.437	8.36	0.000	4.208
HKm period 35 year (default 15 year)	3.239	10.68	0.000	25.508
Trees density 600 trees/ ha (default 400 trees/ha)	-0.308	-2.69	0.007	0.735
Trees density 800 trees/ ha (default 400 trees/ha)	-0.553	-3.33	0.001	0.575
Trees composition 30% (default 15%)	-0.136	-1.49	0.136	0.873
Trees composition 50% (default 15%)	-0.222	-2.43	0.015	0.801
cutting rights (default no cutting)	0.609	8.07	0.000	1.839
pay fees 36000 Rp/year (default no pay fees)	-0.976	-10.00	0.000	0.377
pay fees 72000 Rp/year (default no pay fees)	-1.397	-12.38	0.000	0.247
contribute to activities group 5 day (default 1 day)	-0.285	-1.33	0.182	0.752
access to extension service and input (default no access)	0.922	12.04	0.000	2.514
access to roads in HKm area (default no access to roads)	0.496	6.59	0.000	1.642
Characteristics of respondent:				
age of HH	-0.002	-0.56	0.572	0.998
ethnic of Javanese (default lampung,sumendo ethnic)	0.144	1.33	0.183	1.155
ethnic of sundanese (default lampung,sumendo ethnic)	0.151	1.32	0.185	1.163
Education	-0.0153	-1.12	0.263	0.985
aware of HKm (default not aware of HKm)	0.169	1.76	0.078	1.184
access to technical assistance (default no access)	-0.271	-0.87	0.384	0.763
assets in 2000	0.002	1.81	0.070	1.002
HKm status in Process (default HKm permit)	-0.270	-1.08	0.281	0.763
family size in 2005	-0.068	-1.41	0.158	0.934
Interactions between attributes of contract and respondent characteristics:				
Interaction HKm status in Process and length of contract of HKm	0.009	0.95	0.344	1.009
Interaction assets in 2000 and Fee on HKm contract	0.000	-1.18	0.238	1.000
Interaction family size in 2005 and contribute to activities group	0.015	1.15	0.249	1.015
Interaction access to technical assistance and trees density	0.000	0.29	0.776	1.000
Cut-off points between the ranks:				
cut1	-1.910			
cut2	1.159			
cut3	2.799			
cut4	4.695			
Pseudo R2	0.197			

6. Discussion and Conclusions

This conjoint analysis study of farmers' preferences for the attributes of community forestry contracts in the Sumber Jaya watershed in Lampung Province applied bivariate logit to analyze farmers' comparisons of hypothetical contracts with existing contracts and ordered logit to analyze farmers' ratings over hypothetical contracts. Results from the two analyses were remarkably similar, suggesting that we can be very confident in the validity of the findings. This study therefore indicates that the conjoint analysis methods can be effective in the Indonesia context. In Indonesia and elsewhere in the developing world, conjoint analysis can be effective in eliciting farmers' preferences over the attributes of community forestry contracts. To our knowledge, this is the first application of conjoint analysis to elicit farmers' preferences for the attributes of community forestry contracts. Results such as those generated in this study can be used to support conflict resolution and negotiation between farmers and foresters.

Results from both the bivariate logit and ordered logit indicate that the length of the HKm contract is the attribute of greatest concern to farmers in the Sumber Jaya area. The results suggest that farmers in this area would be willing to accept contracts with many land use and tree planting restrictions, provided that they have certainty that they and their families will be able to stay on the land for a relatively long period. There are two likely reasons why land tenure security emerged as so important in this study. First, most of the survey respondents identify themselves as first or second generation migrants to the area; as migrants they are less able to claim customary rights and are particularly interested in being able to benefit from long-term investments in the area. Second, the Sumber Jaya area has a history of conflict over farmers' use of the protection forests for coffee production (Verbist et al. 2005).

The survey participants also responded very favourably to hypothetical contracts that gave them the right to harvest timber from their HKm plots. The existing rules and regulations on HKm do not allow any farmer to cut the timber in the state forests, except for some domestic or non-commercial uses. The Forest Department should carefully consider the implications of allowing farmers to harvest timber for commercial use on some of protected forest land. Results from the previous studies by Verbist et al. (2005) and Suyanto et al. (2005) suggest that farmers in the area are increasingly adopting multi-strata agroforestry systems and that land tenure security prompts greater investment in the multi-strata systems. Having the right to harvest timber might further strengthen these investment incentives.

The results also suggest that farmers are very concerned about the presence and level of any fee levied on the HKm contracts. This result was surprising for two reasons. First, preliminary interviews suggested that farmers might prefer to pay a fee for their contracts so that they would have clearer evidence of government endorsement of those contracts. Second, the fees of Rp 36.000 or Rp 72.000 appear to be very low ($US 4-8) compared to the potential returns that the farmers can earn from growing coffee in the HKm plots. A study in the same area by Arifin (2006) suggests that farmers feel that they have paid enough retribution and fees during the earlier stages of obtaining the HKm permit. Farmers also may feel that the imposition of a fee reduces their tenure security, giving them a status more akin to annual renting than long-term leasing.

An approximate analysis (results not shown) suggested that farmers concern about length of contract and rights to cut trees were the most variable between individuals in the sample. This variability between individuals could not be attributed to any of the social characteristics considered.

This study went beyond consideration of the explicit attributes of the community forestry contracts to also consider two implicit attributes that farmers seemed to associate with the HKm contracts. The descriptive results confirmed that farmers with HKm contracts were more likely to get access to forestry and agroforestry extension. Results from the conjoint analysis showed that farmers would indeed place higher value on contracts that ensured them better access to extension. As long as the norm is for farmers to associate better access to forestry extension with the HKm contracts, the government may not need to explicitly incorporate this into the contract.

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58. Assessing the Hydrological Situation of Talau Watershed, Belu Regency, East Nusa Tenggara.

59. Kajian Kondisi Hidrologis DAS Talau, Kabupaten Belu, Nusa Tenggara Timur.

60. Kajian Kondisi Hidrologis DAS Kapuas Hulu, Kabupaten Kapuas Hulu, Kalimantan Barat.

61. Lessons learned from community capacity building activities to support agroforest as sustainable economic alternatives in Batang Toru orang utan habitat conservation program (Martini, Endri et al.)

62. Mainstreaming Climate Change in the Philippines.

Who we are

The World Agroforestry Centre is the international leader in the science and practice of integrating 'working trees' on small farms and in rural landscapes. We have invigorated the ancient practice of growing trees on farms, using innovative science for development to transform lives and landscapes.

Our vision

Our Vision is an 'Agroforestry Transformation' in the developing world resulting in a massive increase in the use of working trees on working landscapes by smallholder rural households that helps ensure security in food, nutrition, income, health, shelter and energy and a regenerated environment.

Our mission

Our mission is to advance the science and practice of agroforestry to help realize an 'Agroforestry Transformation' throughout the developing world.

FUTURE HARVEST CGIAR

A Future Harvest Centre supported by the CGIAR

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