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ANALYZING INTERVIEW DATA FROM NATIONAL FOREST ASSESSMENTS

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Forests are crucial for the well being of humanity. They provide foundations for life on earth through ecological functions, by regulating the climate and water resources and by serving as habitats for plants and animals. Forests also furnish a wide range of essential goods such as wood, food, fodder and medicines, in addition to opportunities for recreation, spiritual renewal and other services.

Today, forests are under pressure from increasing demands of land-based products and services, which frequently leads to the conversion or degradation of forests into unsustainable forms of land use. When forests are lost or severely degraded, their capacity to function as regulators of the environment is also lost, increasing flood and erosion hazards, reducing soil fertility and contributing to the loss of plant and animal life. As a result, the sustainable provision of goods and services from forests is jeopardized.

In response to the growing demand for reliable information on forest and tree resources at both country and global levels, FAO initiated an activity to provide support to national forest monitoring (NFM). The support to NFM includes developing a harmonized approach to national forest assessments (NFAs), information management, reporting and support to policy impact analysis for national level decision-making.

The purpose of the NFM initiative is to introduce countries to an alternative approach designed to generate cost-effective information on forests and trees outside forests, including all benefits, uses and users of the resources and their management. Special attention is placed on monitoring the state and changes of forests, and on their social, economic and environmental functions. Another main objective is to build national capacities and harmonize methods, forest related definitions and classification systems among countries.

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TABLE OF CONTENTS

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INTRODUCTION

At the 2005 FAO Committee on Forestry (COFO), member government representatives committed themselves to step up their efforts to promote sustainable forest management (SFM) in their respective countries (FAO, 2005). One of their main vehicles for doing so is to adjust current national policies so that these become more conducive to the long term goals of SFM. To make informed decisions about how current policies may be modified, however, policy makers need accurate and precise information on how these policies influence the condition of forests and trees outside forests. The problem is that few countries generate systematic data on the changing characteristics of their forest resources and trees outside forests (TOF), and even fewer countries collect and analyze information on the factors that help determine the effectiveness of public policy in supporting SFM. The 2005 COFO recognized this limitation and consequently asked the FAO to "strengthen its activities in the area of monitoring, assessment and reporting on forests and intensify assistance to countries for activities in this area" (ibid: 9-59). FAO was also asked to "assist countries to better incorporate forestry in poverty reduction strategies, to enhance forest law enforcement…and to strengthen capacity for conducting national forest assessments and building forest information systems" (ibid: 9-58).

FAO's support to national forest inventories and assessments aims to "contribute to the sustainable management of forests and TOF by providing decision makers and stakeholders with the best possible, most relevant and cost-effective information for their purpose at local, national and international levels" (FAO, 2002) In this program, FAO assists countries that have requested support in developing baseline information from statistically verifiable data on the state of the country's forestry resources, their uses and management. More specifically, countries that collaborate with FAO in implementing this approach generate policy-relevant information based on a broad set of variables ranging from biophysical characteristics of the resource to socioeconomic aspects of resource usage.

This study is concerned with the analysis of socio-economic data derived from the interviews conducted under FAO's approach to National Forest Assessment programs (NFA). It is this interview component of the NFA that sets it apart from many conventional forest inventories. This component makes use of innovative methods to measure the extent to which specific forest products and services are accessed and used, how they are used, and by whom they are used throughout the country under study. It also makes the data generated by the NFAs potentially more useful for policy makers, who can use the reported NFA data to assess the role of forest resources in supplying a wide variety of goods and services to the population at large. In the five countries where FAO's NFA approach has been carried out so far, the publication of the socioeconomic NFA data marks the first time such information has been available at the national level in any country. Over time, as the NFA is repeated periodically, the NFA data will serve to monitor the effectiveness of specific policy instruments to influence human practices related to a country's tree and forest resources.

There is no doubt that the NFA interview component shows great potential in terms of generating useful information. At the same time, it is a challenging component when it comes to the analysis and presentation of data. The types of variables gathered through interviews are different from those variables that are directly measured in the biophysical components of the NFA (such as the diameter at breast height of trees, and the slope of a given sampling plot). It therefore requires a different analytical approach to make good sense of the interview data. The fact that the interview variables are generally categorical in nature--rather than continuous--poses several challenges to the NFA analysts.

The purpose of this report is to help the NFA teams to make the best possible use of the data that they worked so hard to gather. Good use of the interview data will improve the likelihood that the NFA reports will be effective in informing policy decisions.

Based on an in-depth review of four of the first FAO-supported NFAs (Cameroon, Guatemala, Lebanon, and the Philippines), this report starts by identifying some of the most important characteristics that any given the NFA report should include. I argue that these characteristics will affect the effectiveness of the communication of findings to the principal NFA end users: forestry policy makers. One of the most important of these characteristics is the way in which the different sources of uncertainty are addressed in the analysis and presentation of the NFA interview data. The second section unpacks and discusses these different sources and offers examples of how the existing NFA reports deal with uncertainty. In the section that follows, I develop a series of hypotheses that stipulate specific relationships between different NFA variables. I then propose and illustrate a series of simple quantitative methods that the NFA teams may use to test similar hypotheses in each of their countries. I argue that such an approach will improve the quality and credibility of the NFA interview data analysis. I conclude by recommending a variety of plausible improvements to the NFA interview component, including the actual field protocol as well as the preferred analytical methods that the teams should employ in the future.

ELEMENTS OF GOOD POLICY ANALYSIS IN NFA REPORTING

For the NFAs to get their findings across to policy makers there are several things that need to fall into place. Policy makers are continuously inundated with information and the NFA representatives need to compete with lobbyist, citizen groups, technical agencies, and NGOs for their attention. The impact that the findings will eventually have depend on a variety of factors, such as the political importance of forestry issues in the country, the timing of the NFA report, the extent to which the findings coincide with the interests of a critical mass of politicians, as well as the overall quality of the report. This report discusses two key aspects of the quality of NFA reports: the ways in which the teams analyze and present the NFA interview data. In doing so pay particular attention to the teams' treatment of uncertainty and the extent to which the reports discuss the implications of limited accuracy and precision of the data. [1]

Analysis of Uncertainty

One of the fundamental rules in the analysis of interview or survey data is the explicit calculation and discussion of the level of uncertainty generated in the data collection process and in the presentation of results. There are two major sources of uncertainty that should be addressed in any analysis of informant based on interviews: namely sampling error and measurement error. Sampling error is a measure of the precision of the data while measurement error is more related to the accuracy of the data (for more on the distinction between precision and accuracy of empirical data see http://www.answers.com/topic/accuracy-and-precision). It is important that these issues are addressed in an explicit manner. By including estimations of different types of error—based on the number of interviewees, the way they were selected, their respective interests in relation to forest use, and the informants' social and economic positions—a more robust interpretation of the interview data should be possible. Similarly, the inclusion of such information would enhance the credibility of the results presented and allow for more complete replication of this study by other researchers and for comparison with future assessments.

<u>Sampling error</u>

Given the nature of the forest mensuration data collected, it is possible to calculate valid measurements of variance, standard deviations, and thereby confidence intervals for these continuous variables. Inclusion of such calculations would provide future researchers and policy makers with a more complete picture of the variables measured and their validity. When addressing the interview data, some unique problems arise in estimating sampling error. This is due to the nature of the data collected, which is either binary (values are either 0 or 1) or ordinal (values represent order of importance or rank, i.e. a five point scale in which a score of 1 is the least important and a score of 5 represents the most important). Binary and ordinal variables are both examples of categorical variables and one of the distinguishing features of this type of variables is that they contain less variance, because such measurements are fit into predetermined categories. Because of the non-continuous nature of such variables, special statistical techniques need to be employed when analyzing categorical data, including estimates of sampling error.

Simply put, sampling error is the difference between the sample measure and the corresponding population measure. This difference is due to the fact that the sample is an imperfect representation of the population. Using conventional statistical techniques to calculate the sampling error for any given measure requires that the sample is randomly selected. If the sample is not random, measures may not be normally distributed (bell-shaped distribution curve) and conventional statistics will, in that case, produce biased

[1] The NFA program has produced a series of useful reference documents that address other aspects of the overall quality of the NFAs, such as field manuals to guide the fieldwork in sample sites, methods for gathering data through interviews, how to use remote sensing to inform the NFAs, etc. For more see **www.fao.org/forestry/site/fra-knowledgeref/en**

estimators. FAO's NFA approach follows a systematic sample strategy which has shown to be equivalent to a pure random sample in terms of distribution normality (Fowler, 1993). The randomness of the sample is a bit more difficult to assess when it comes to the selection of interviewees in each of the systematically selected sample sites. To maintain normality of the sample, it is important to follow an identical procedure for identifying interviewees in each site. The chapter on Data Collection through Interviews in FAO-IUFRO Knowledge Reference for the NFA provides detailed guidelines for how this should be done so as to avoid biased selections. If the different field crews apply varying criteria for selecting interviewees in each of their sites, the measures will not be adequate for statistical analysis. It is therefore of utmost importance that all field crews thoroughly understand how they should select interviewees and conduct the interviews in the field. The crew members' performance with regards to interview data gathering will largely determine how meaningful it is to undertake statistical analysis with the results. The examples of statistical calculations and tests that are provided in this paper make the assumption that the NFA interview data sets have been derived from reliable field methods.

Assuming a random sample, it is possible to calculate the precision of particular measures and estimates of the interview data. Consider the following example: For a 95-percent confidence interval and for questions where the sampled interviewees' answers were split down the middle (50 % answering "yes" and the other 50% answering "no", which is the most conservative estimate for calculating interview sampling error) the sampling error for a sample of 260 interviews produces an estimated sampling error of 6.8%. For questions where a smaller or larger proportion responded affirmatively the sampling error will be even smaller. Illustration 1 below offers an example of how sampling error may be calculated for NFA interview data. Reporting on such errors in relation to particular estimates in the results should be standard procedure for all NFA reports.

Illustration 1: Calculating Sampling Error for Binary Interview Variables

Because a proportion is the same thing as the mean of a two-value distribution (if yes=1 and no=0, then the mean and the proportion of yes-sayers is the same thing) it is possible to calculate the standard errors of the proportions by estimating the variance of the proportion: $\rho * (1-\rho)$ (assuming a normally distributed sample). The standard error of that proportion will depend on the value of that proportion itself but for a conservative calculation let us assume it to be exactly 50%. Let us also assume that we interviewed a total of 260 individuals: Standard error

$$= \sqrt{\frac{\rho(1-\rho)}{n}} = \sqrt{\frac{.50 * .50}{260}} = 0.034.$$

The correct interpretation of this result is that at the 67% confidence level, the true proportion will be in the range from 46.6% to 53.4% ($\pm$ 1 standard error). At the 95% confidence level, the true proportion of the population lies within a band of two standard errors from the estimated mean, in this case $\pm 6.8\%$. At the 99% level, the confidence interval is three standard errors wide, in this case just over $\pm$ 10%.

It is considered good practice to account for the degree of precision when presenting any analytical results derived from a sample. All NFA reports should therefore make it a habit to present sampling errors for all quantitative variables reported, regardless of whether these measure socio-economic or biophysical phenomena. That said, sampling error is only one component of the total measure of uncertainty in a given result. There are other types of errors that are important sources of uncertainty in the NFA. Measurement error is of particular concern for the NFA interview component and the next section discusses how this type of error may be accounted for when reporting results.

Measurement error

All research designs relying on interviews need to take into consideration the potential influence of *measurement error* on the reported results. This type of error refers to participants' limitations related to "memory, understanding, and willingness to respond truthfully to questions, and as a consequence distort the quality of results" (Niemi, 1993). Measurement errors in the NFA interviews refer to difficulties to obtain valid and truthful information about people's relationships to trees and forest resources. Consider the following example: If local users do not enjoy undisputed and officially recognized property rights they are likely to be reluctant to reveal the full array of products and services that they derive from these resources. But even if users are perfectly legitimate and legal users of the resources, they may also be reluctant to provide accurate information to strangers. After all, even legal users don't have anything to gain—only lose—from revealing information about their use. It is therefore a good idea to expect that forest use reported by users themselves is systematically underestimated. This would be an example of a biased result. Bias occurs when measurement repeatedly tends toward one direction or another or, in the worst case, the direction is unknown.

When the direction of the bias is known it is possible to make a post-facto correction—albeit qualitative—for the bias in the reported results. It is more problematic when the direction of the bias is unknown. Such a bias could occur if the variability in forest use is very high but the interviewees do not reflect this variability. For example, relying on a particular local actor—such as a local government employee or a farmer association leader—as the *only* key informant for the interviews in all sites will produce a one-sided view of forest use although such use may in reality be multi-faceted and complex. Under such an approach, a skewed and inaccurate view of the actual forest use will emerge.

Non-responses in surveys represent another type of measurement problem that is very difficult to deal with. This may be the most difficult source of measurement error to deal with since it is hard to learn much about those individuals who did not participate in interviews (Fowler, 1993). In the NFA interviews, field crews are under a great deal of pressure to finish their fieldwork on time. If one of the pre-selected interviewees is not available or refuses to be interviewed, field personnel will select an alternate interviewee without necessarily recording that the person who was pre-selected could not participate. Consequently, the NFA interview sample is likely to be systematically biased towards those individuals who have more time to talk, and who have less to lose from divulging information about their forest use. I strongly advise the NFA to incorporate non-responses in the field protocols so that NFA teams may estimate its influence on total uncertainty of sample estimates.

Another potential source of inaccuracy is the respondent's hidden agenda with regards to local forest use. Interviewees may deliberately conceal or distort information even if they do not have an apparent reason to do so. Without proper triangulation of responses such inaccuracies are virtually impossible to detect.

All these measurement problems affect the accuracy of the sample estimates. The crux of it is that unlike sampling error, it is not possible to calculate the precise size of the measurement error. That does not mean that it should not be addressed in the reports. What it does mean is that reports need to discuss the influence measurement error in more qualitative terms by addressing a series of key issues. Some of these issues include how interviewees were selected, how many individual interviews were carried out, if and how interviewers were trained, if and how interview instruments were pre-tested and validated, among other.

The FAO-IUFRO Knowledge Reference for National Forest Assessments describes a basic approach for how interviewees should be identified. According to the FAO-IUFRO-recommended approach, measurement error may be partly mitigated by selecting interviewees according to their *interests* in the tree-related products and services. By interviewing the widest variety of local actors possible—with respect to their different interests in products and services—the sample estimates will be less biased. Since it is not possible to calculate this bias in any mathematically exact way, the NFA teams should describe the detailed measures taken to address measurement error. Doing so will enhance the transparency of the research, as well as adding to the credibility of the results presented. Illustration 2 below outlines a series of steps that the NFA teams are advised to follow when analyzing and presenting the NFA interview results. This is information that the readers need for proper interpretation of the results.

Illustration 2: Addressing Measurement Error for Interview Variables

<u>Questions related to measurement error that NFA reports should address:</u>

1. How was the interview instrument developed?
2. How many field tests were carried out?
3. What was the result of the field test?
4. Who carried out the interviews?
5. What training did the interviewers go through?
6. How were interviewees identified and selected?
7. How many interviewees were interviewed in total?
8. Did the number of interviewees vary form one tract to another? Why?

Finally, it seems possible to come up with an *indicator for interview sample accuracy* for the NFA interview component. It could be developed by considering the total number of interviewees carried out in each sample tract and the relative complexity of forest use in each tract. Such an indicator might be calculated for each tract to determine whether an appropriate number of interviews have been conducted before concluding data collection and moving on to the next tract. One way of calculating such an indicator would be to define it as:

$$I = \frac{n_i}{(3 * x_{mLUS}) + y_{LUS} + 1}$$

where,

I = Interview sample accuracy indicator for a given tract

n_i = number of people interviewed in a given tract

n_{mLUS}= number of land use sections (LUS) in that tract that host multiple harvesters (>1) and multiple products (>1)

n_{LUS}= number of single-use land use sections in the tract

The logic behind constructing a sampling accuracy indicator is for field crews and their supervisors to be able to gauge whether the data gathering process manages to capture the variance in forest use in each site. This would potentially enable crews to reduce measurement errors by interviewing more individuals in more complex sites. The number of LUS with multiple individuals harvesting multiple products in each tract gives an indication of the complexity of forest use in the tract.

Consider the following example of how to calculate I: In a given tract there may be seven different LUS. Let us say that in four of these areas two or more individuals are harvesting at least two different products. In the other three LUS there is only one or zero individuals harvesting in each LUS. Let us further assume that a total of 18 individuals were interviewed in the tract. This would mean that

I = 18 / ((4*3) + 3 + 1) = 18/16 = 1.125.

With this result at hand, the question is what this score means. Following the instructions in FAO-IUFRO knowledge reference (Andersson, 2004) in which NFA teams are encouraged to interview at least three individuals that represent different interests in each complex site, a score for greater than 1 (*I*>1) seems appropriate for this indicator. However, the NFA program is advised to experiment with different indicators of interview measurement accuracy—as well as varying values of the constants in the equation—and to test these empirically in the countries where the program is assisting governments with NFAs.

Testing Explanations and Policy Implications

For NFA results to be of use to policy makers, they need to spell out the results' most important policy implications in a very explicit manner. Unless there is a clear link between a given country's existing policy framework and the NFA results, policy makers will consider the NFA "interesting" at best. The Guatemalan report serves as an excellent example for how the NFA reports can provide valuable information for policy makers (see http://www.inab.gob.gt/espanol/inab/estadisticas/IFN%20Final%20PDF.pdf).

In their special report for policy makers (see ftp://ftp.fao.org/docrep/fao/008/ae577s/ae577s00.pdf) the Guatemalan team derives a series of policy-specific indicators from the NFA that can be used to evaluate the effectiveness of public policy instruments that aim to support forest governance. The Guatemala report uses the existing NFA data to explore relationships that seek to *explain* the observed outcomes in the NFA. For example, under section 5.1.1 the authors use data on ethnic origins and the prevalence of forests to see whether there is any difference between the proportions of forestlands that are inhabited by indigenous vs. ladino groups. This is very promising analysis as it starts to suggests *patterns in the relationships between variables* measured in the NFA. These relationships are what policy makers need to understand to be able to improve public policies.

It would be good practice to use the NFA data to test some of the conclusions drawn from the analysis of policy implications. The second part of this report presents a number of examples of quantitative explorations of such policy implications derived from the NFA interview data.

Presentation

In general the NFA reports should contain a discussion of the processes that may have caused the observed outcomes, a detailed description of the methods used for carrying out interviews, and the implications of the different dimensions of uncertainty, outlined above. For instance, if there is an average sampling error of 6.8 percent at the 95-percent confidence level for some interview variables, it means that changes in these variables when comparing to future NFA results will not be statistically significant unless the percent change is greater than 6.8 %. This would be useful information for any reader. It is important to be up-front about the limitations in the data. Otherwise, the users of the report may read too much into the results and draw inappropriate conclusions.

The Guatemala report also serves as a good example when it comes to selecting the most relevant information rather than reporting every single variable for which data was collected. If a report tries to cover all variables, the most significant pieces of information are likely to disappear in the sea of data. It is the NFA team's job to highlight the most relevant information through a selective presentation technique. Another technique that will increase the effectiveness of the communication with the NFA readers is the use of visual aids. It would be important to use the narrative text to discuss the implications of the findings presented graphically so that the text and figures complement each other, rather than simply duplicating information.

A good way of increasing the usefulness of the NFA data analysis for policy makers would be to analyze relationships between variables that are of particular policy concern. In the NFA Knowledge Reference, Persson and Janz (2004) identify seven areas of concern for policy makers: Forest use; the present state of forests; change; plantations; trees outside forests; the role of forests for local communities, and other issues such as ownership and environmental benefits.[2] For instance, a national government involved in creating policies that are supportive of sustainable forest management, will be interested in learning about such things as the prevalence of conflicts in relation to specific products and varying external conditions, the level of awareness about forestry legislation among forest users, as well as the relationship between land tenure and forest health just to mention a few. Creative use of the NFA interview component in combination with the other components of the NFA can help provide such analytical results. The next section describes how a careful analysis of the NFA interview data can help to shed light on several policy-relevant issues related to the socio-economic aspects of forest use.

EXPLORING SOCIECONOMIC RELATIONSHIPS IN THE NFA

The purpose of this section is to illustrate the types of simple relational analyses using interview data that the NFA teams may draw on for their country reports. As a point of departure, I construct a series of hypotheses on the themes that policy makers involved in forestry are likely to be interested in. Many of these hypotheses have their origin in the emerging literature on the role of public policy in supporting sustainable forestry (i.e. Gibson et al., 2000; Ostrom, 1999; Thomson, 1992; Arnold, 1998; White and Martin, 2002; Repetto and Gillis, 1988).

There are several functions of governmental authorities that can support the achievement of sustainable forest management. Ostrom (1999) suggests that governmental organizations may have a particularly important role to play in backing up local efforts to monitor and enforce property rights, providing forest users with forums for conflict resolution as well as developing and disseminating information about the condition of the

[2] (See section 4.3 Types of information normally needed; What information is needed? http://www.fao.org/forestry/foris/webview/nfa-ref/index.jsp?siteId=2621&sitetreeId=7287&langId=1&geoId=0)

resource beyond the local domains. This larger scale information is often crucial as a first step towards avoiding negative spill-over effects between local units of governance. With these critical public policy functions in mind, I have developed a series of hypotheses that stipulate specific relationships between selected NFA variables—interview variables in particular. The purpose of the section is to illustrate how hypothesis-testing using NFA interview data may generate useful knowledge for actors interested in supporting sustainable forest management. The hypotheses are organized according to six broad themes:

(1) Tree and forest-related conflicts
(2) Policy interventions
(3) Gender issues
(4) Tree and land tenure
(5) Protected areas, and
(6) Biophysical attributes

Hypothesis Testing

Since practically all of the NFA interview variables are binary in nature, there is a limited set of statistical tools that may be used for the hypotheses testing. For all subsequent tests, I use a simple, quantitative approach to analyze possible correlations between variables. This technique is commonly referred to as cross-tabulation analysis.

Cross Tabulation Analysis —A Brief Introduction

A cross tabulation (often abbreviated as cross tab) displays the *joint distribution* of two or more variables. They are usually presented as a contingency table in a matrix format. Whereas a frequency distribution provides the distribution of one variable, a contingency table describes the distribution of two or more variables simultaneously. Each cell shows the number of observations that correspond to a specific combination of variable values. Let us consider an example of how a frequency table may be converted to a cross tabulation.

Table A. below has 11 observations of binary variables X and Y. These observations have then been organized into the Frequency Table B and Cross Tabulation Table C.

Table A. Data Table

Table A

Obs. #	X	Y
1	1	1
2	0	0
3	0	0
4	0	1
5	1	1
6	0	0
7	0	1
8	1	0
9	1	1
10	0	0
11	1	1

Table B. Frequency Table

Table B

Variable	x	y
Proportion	0.4545	0.5455
St dev	0.5222	0.5222
min	0	0
max	1	1

Table C. Cross Tabulation

Actual		Y		
		1	0	Total
X	1	4	2	6
	0	1	4	5
Total		5	6	11

To assess whether X and Y are correlated with each other, one compares the values of the cells in Table C with that of the values in a hypothetical cross tabulation that represents what the distribution of X and Y *would have been* if there were no systematic correlation or association between the two variables at all. In such a hypothetical table, the distribution of the values of X and Y is perfectly proportional to the total proportions. We have created such a hypothetical table in Table D below.

The only information we need in order to create Table D is the proportions from Table B. We use these total proportions to create the cell values in the cross tab of expected values in Table D. When looking at the distribution of values in the four cells in Table D it is obvious that these are perfectly proportionate to the totals, and there is therefore no correlation between X and Y in this case.

Table D. Expected values for zero correlation

		Y		
		0	1	Total
X	0	(100%-45.45%)*5	(100%-45.45%)*6	6
	1	45.45%*5	45.45%*6	5
Total		5	6	11

		Y		
		0	1	Total
X	0	2.73	3.27	6
	1	2.27	2.73	5
Total		5	6	11

To assess the correlation between X and Y, we compare the cell values between the zero-correlation table in Table D with the actual cell values in Table C. The larger the differences are between the cell values in the two tables the higher the likelihood of having a statistically significant correlation between X and Y.

There are several statistics that may be used to evaluate whether the differences in cell values are statistically significant. Here we use the most common one: the Pearson chi-square statistic (often abbreviated "chi-square"). Most statistical packages, such as Megastats, SPSS, and Stata, generate this statistic. For the zero-correlation expected values table, the Pearson chi-square score is always zero. But depending on how many cases are included in the analysis—and the desired level of statistical significance of the hypothesis test—there is a critical threshold value of the Pearson chi-square score for when there is a systematic association between variables in the observed values table (Table C). For a 95 percent confidence level, the critical Pearson chi-square value in our example is equal to about 4.1. All scores greater than 4.1 would indicate that there *is* a systematic correlation between X and Y. In our example, however there seems to be no statistically significant relationship between the two variables as the generated Pearson chi-square score equals 2.40. Our statistical software produced the following output:

Crosstabulation

		Y		
		Y	Y	Total
X	X	**4**	**1**	5
	X	**2**	**4**	6
	Total	6	5	11

2.40 chi-square
1 df
.1217 p-value

The way to interpret this result is that, at a 95% confidence level, X and Y are independent of each other and hence not correlated. Had there been a significant correlation, and the chi-square greater than the critical threshold level, the p-value would have been smaller than 0.05. Next we apply these techniques to the analysis of correlations involving NFA interview variables. Table 1 lists 16 examples of possible hypotheses that we will test, each of which uses a different combination of NFA variables.

Table 1. Examples of Hypotheses Exploring Policy-Relevant Relationships in the NFA

Topics	Hypotheses
Conflicts	1. Conflicts related to the use of forest products and services are more likely to occur when users perceive a shortage of these products/services. 2. Conflicts over scarce forest products/services are more likely when such products are related to the food security of users—such as firewood for cooking, fruits for household consumption—than for products and services related to other areas such as commercial extraction or recreation. 3. For products that are perceived as relatively scarce, the likelihood that conflicts occur is higher when harvesters share the rights to those products than when there are property rights that are exclusive to the harvesting individual, community, or organization.
Policy Interventions	4. Areas from which products and services are harvested by users comply with forestry legislation are in better condition than areas in which users do not. 5. People who harvest products for commercial purposes are more likely to be aware of forestry incentives than those who harvest the same products for domestic purposes
Gender	6. There is no difference between the proportion products harvested by men and women 7. Products that are harvested daily for domestic use are more likely to be harvested by women and children than by men
Tenure	8. Products and services extracted from Government forest lands are perceived as more abundant that than the products and services from other tenure regimes (communal and private) 9. The proportion of forestland that is used for wood-related products is greater for privately owned land than for communal and public lands 10. Forest products and services for which there are shared user rights do not exist on private lands and products/services for which there are exclusive rights do not exist on public or community lands
Protected Areas	11. The proportion of forest land where products are harvested is significantly smaller inside government protected areas than outside of such areas. 12. There is a significantly larger proportion forest land producing highly valued services inside government protected areas than outside of such areas

Biophysical Attributes	13. Areas that have good infrastructure but face population increases are more likely to face a shortage of services and products 14. Harvesters of products from forests and TOF who have greater access to markets will perceive greater demands for forest products. 15. A larger number of both products and services are derived from trees in forest lands than from trees outside forests 16. There are less non-timber products harvested per hectare from plantations than from other forestlands.

Note that these hypotheses make use of the vast majority of all interview variables included in the NFA. In the actual NFA reports, however, it would be wise for each country to select the most important relationship so that the results become more accessible to the readers. Note also that the purpose of this section is to *illustrate* the type of relational analysis that is possible to carry out with existing NFA interview data. The purpose of this section is *not* to provide substantive conclusions about the results or policy implications for any particular country's NFA. The latter requires more intimate knowledge about the policy process in each country—something the NFA teams are best suited to do.

Tree and Forest-Related Conflicts

Starting with the importance of conflict resolution forums, it would be of interest to policy makers to be able to identify the conditions that are associated with a high likelihood of forest-related conflicts occurring in their countries. The first three hypotheses analyze this topic.

Hypothesis 1

***Conflicts** related to the use of forest products and services are more likely to occur when users perceive a **shortage** of these products/services.*

The logic behind this hypothesis is that when products are perceived as scarce people value them more and therefore are prepared to dispute the control over these resources (Homer-Dixon, 1999). If a local group enjoys recognized property rights to their products, such scarcity-related conflicts may actually serve as catalysts for mobilizing the community to self-organization for greater monitoring and enforcement of such property rights (Gibson, 1999). On the other hand, if products are abundant, users are less likely to put up a fight to gain control over the products, and conflicts are therefore less likely to materialize.

We use the NFA data from the Philippines to test whether the hypothetical relationship holds in this country. The variable "perceived shortage" is defined as a simultaneously perceived increase in demand *and* decrease in supply of a given product/service). The variable "User Conflicts" was set to equal 1 when harvesters noted that conflicts existed in relation with other harvesters over the control of a given product and 0 when no such conflicts were reported. Consequently, the unit of analysis for this hypothesis is the harvested product/service (n=4306). Table 2 shows the proportions and sampling error for of each of these variables. For 24.9 % of the products harvested (± 0.66%), harvesters perceive a shortage of these products. Out of all products harvested, users perceive conflicts associated with 18.3 % of these products (± 0.59%).

Table 2: Descriptive Statistics of "Perceived Shortage" and "Conflicts".

Proportion estimation of "perceived shortage" and "conflicts"			
n = 4306			
Variable Name	**Proportion**	**St. Err.**	**95% Conf. Interval**
Perceived shortage	0.2489549	0.0065903	.2360345 .2618754
User Conflicts	0.1832327	0.0058961	.1716733 .1947921

All 4306 observations were then classified into one of four different categories: (1) No perceived shortage and no user conflicts observed; (2) No perceived shortage but user conflicts observed; (3) Perceived shortage but no user conflicts, and (4) Perceived shortage and observed conflicts. Table 3 displays the distribution of the observations in the four categories, which is indicative of the relationship between user-perceptions of scarcity and the prevalence of conflicts.

Table 3: Conflicts-Scarcity Relationship

	No User Conflicts	User Conflicts	Total
No Perceived Shortage	(1): 2783	(2): 451	3234
Perceived Shortage	(3): 734	(4): 338	1072
Total	3517	789	4306

Pearson chi2(1) = 166.3444 Pr = 0.000

The results of this cross-tabulation analysis suggest that there is a systematic relationship between the two binary variables. The bivariate association is statistically significant (Pearson chi-square (χ^2)=166.34; df=1; p<0.001)[3], which would suggest that we found some support for our hypothesis that conflicts are more likely to occur when users perceived shortages and less likely to occur when no such perception exists.

To further help policy makers understand more about when conflicts over scarce resources are most likely to occur we proceed to look at which scarce products are most commonly fought over in the Philippines. Table 4 shows the break-down of the 338 products that were classified as both scarce and associated with conflicts. The specific products and services are ranked in order from largest to smallest proportions.

[3] The Pearson chi-square score is a statistical measure of association between the variables under analysis. If the reported p-value of the test is smaller than 0.05 it means that there is a systematic relationship between the two variables that is statistically significant (assuming that the pre-defined level of statistical confidence is 95 percent).

This result would suggest that more than half of all reported conflicts over scarce products (53.6% ±9.4%) are related to the harvesting of timber and firewood. Hunting is in third place with 11.2% ±3.4% and food-related products in fourth place with 8.3 % ±2.9% of all conflicts over scarce products in the country. The next hypothesis dwells further into the relationship between scarcity and conflicts for different types of products.

Table 4: Proportion of Products/Services where Conflicts & Perceived Shortages Exist				
n = 338				
Product/Service ID	**Proportion**	**Std. Error**	**95% Conf. Interval**	
101- Timber	0.320	0.025	0.270	0.369
102- Firewood	0.216	0.224	0.172	0.260
402- Hunting (sport)	0.112	0.017	0.079	0.146
201- Food	0.083	0.015	0.053	0.112
209- Non-wood	0.083	0.015	0.053	0.112
403- Grazing	0.071	0.014	0.043	0.099
409- Soil and water	0.050	0.012	0.027	0.074
208- Handicraft	0.018	0.007	0.004	0.032
202- Fodder	0.015	0.007	0.002	0.028
301- Wild animals	0.012	0.006	0.000	0.023
303- Honey, wax	0.006	0.004	-0.002	0.014
411- Wind breaking curtains	0.006	0.004	-0.002	0.014
299- Other Non-wood forest	0.003	0.003	-0.003	0.009
401- Source for employment	0.003	0.003	-0.003	0.009
406- Conservation	0.003	0.003	-0.003	0.009

Hypothesis 2

***Conflicts** over scarce forest products/services are more likely when such products are related to the **food security** of users—such as firewood for cooking, fruits for household consumption—than for products and services related to other areas such as commercial extraction or recreation.*

This hypothesis considers the relationship between three variables. The hypothesis introduces the idea that forest-related conflicts are motivated not only by scarcity but rather by a combination of scarcity and **salience** of the product. Products related to the food security of the users are likely to be viewed as the most salient products by the users themselves. If a product was simply scarce but not very important to the users, we would expect that conflicts would not arise as frequently as when both conditions are met. We test this idea by analyzing how the relationship between scarcity and user conflicts change depending on the type of product considered.

First we need to define the variable called **salience**. In this case, salience is defined as the degree to which any product is related to food security. If a product is directly related to food security we assign a value of 1, and if not the variable takes on a value of 0. Food security-related products were defined as: firewood, medicinal plants, fodder, and food items. We then separate the entire sample (n=4306) according to whether the product is salient or not and end up with one dataset of 2264 observations (less salient) and another with 2042 observations (salient). The descriptive statistics for this variable are displayed in table 5 below. Note that with the existing definition salience, 37.2% (± 0.75%) of all products in the sample are salient for food security.

Table 5: Descriptive Statistics for "Salience"

Proportion estimation for "Salience"				
Food Security Product	**Proportion**	**Std. Err**	**95% Conf. Interval**	
Yes	0.372	0.007	.358	.387

We then repeat the cross-tabulation analysis that we did under hypothesis 1 to estimate the degree of association between scarcity and conflicts for products with different levels of salience. Given our hypothesis, we would expect the degree of association, as indicated by the chi-square statistic, to be stronger for the products that are salient than for the products that are not. Table 6 lists the results. We would also expect that the proportion of observations in category (4) relative to the other categories in the table to be larger when products are salient than when they are not.

Table 6 Conflicts and scarcity under different levels of salience

		User Conflicts		
Food products (salient)	**Scarcity**	**No**	**Yes**	Total
	Low	1345	240	1,585
	High	345	112	457
	Total	1690	352	2,042
Pearson chi2(1) = 21.8098 Pr = 0.000				
		User Conflicts		
Non-Food Products & Services (less salient)	**Scarcity**	**No**	**Yes**	Total
	Low	1438	211	1,649
	High	389	226	615
	Total	1827	437	2,264
Pearson chi2(1) = 164.9863 Pr = 0.000				

The results in table 6 suggest that there is a systematic relationship between perceptions of scarcity and conflicts regardless of levels of salience (links to food products). Comparing the proportion of products that are associated with conflicts for both the two kinds of products and services, one can observe that there is actually a higher likelihood of conflicts occurring when products and services are not food related than when they are. This result may have to do with the fact that many of the conflicts are related to the products with the highest commercial value of all: timber (which in this example is a product that is classified as "less salient").

For policy makers interested in facilitating the prevention or peaceful resolution of resource user conflicts this finding would suggest that such prevention efforts may fare better if they target areas where products from forests and TOF are both scarce and salient to the population at large. How to design such a policy intervention, however, can be very challenging. One of the confounding factors that is likely to complicate any policy intervention is the current allocation of property rights. The next hypothesis introduces this variable into the analysis of the preponderance of conflicts.

Hypothesis 3

For products that are perceived as relatively scarce, the likelihood that conflicts occur is higher when harvesters share the rights to those products than when there are property rights that are exclusive to the harvesting individual, community, or organization.

The first step in setting up the testing of this hypothesis is to select all observations that represent scarcity (defined as a perception of simultaneous decrease in supply and increase in demand). Using NFA data from the Philippines, we end up with 1072 observations. Next we define the "user right" variable as a binary variable for which a value of 0 means that there are no exclusive rights associated with the harvesting of a particular product and a value of 1 means that there are exclusive rights for the product. Table 6 presents the breakdown of the occurrence of conflicts for the two types of rights.

Table 6: Conflicts over Scarce Resources under Different Property Right Regimes

User Right	Conflict	No Conflict	Total
No exclusive rights	322	222	544
Exclusive rights	21	507	528
Total	343	729	1072

For scarce products, more than 93.9 % (322) of all conflicts (343) happen when harvesters do not have exclusive rights. The results of the cross-tab analysis suggest that there is a strong systematic relationship between the degree of exclusivity of property rights and the occurrence of conflicts. Hence, conflicts seem to occur much more frequently when the resource is an open-access resource rather than under the control of a particular group or individual. This relationship is statistically significant (χ^2=416.10; df=1; p<0.01).

One caveat in this analysis, however, is that "rights" are not necessarily formal property rights issued by the government but actually represents the interviewees' de facto perception of mutually recognized property rights. As such the finding does not say much about the effectiveness of formal property rights in regulating access to resources or their ability to prevent natural resource-related conflicts. Hence, subsequent studies would need to appreciate more fully the relationship between formal property rights, de facto rights and the occurrence of conflicts. It is also worth noting that the exclusive rights are not necessarily individual ownership rights but can also be private group property as is the case of corporations or communities, which constitute groups of individuals who hold a private property rights to a resource. Hypothesis 10 below looks further into this issue.

Policy Interventions

Hypothesis 4

Areas from which products and services are harvested by users who comply with forestry legislation, are in better condition than areas in which users do not.

To test this hypothesis we use data from Lebanon. We prepare the data set for the quantitative analysis by first coding observations as 1 for all products/services harvested by users who are observed as aware of and compliant to the exiting forestry legislation. All others are coded as 0. Taking the tract level as the basic unit of analysis for this question, we found that in 71 out of the 226 tracts, forest users were aware of and complied with forestry legislation (31.4 %).

Next we looked at the tracts in which all products had been harvested. We classified all tracts (n=226) into two equally-sized groups: One representing "better tree health condition" and the other "poorer tree health condition". This variable was defined by first calculating the proportion of trees in each tract that was considered to be perfectly healthy and then ordering all tracts according to this information. Tracts with a proportion greater than the median proportion of perfectly health trees (99%) was classified as "better tree health condition". The rest of the tracts were put into the category called "poorer tree health condition".

To test the proposed relationship between legal compliance and proportional tree health in each tract, we create a cross tabulation that organizes our observations into four main categories: (1) tracts that have relatively poor forest conditions and in which users have low compliance with forestry legislation; (2) tracts that have relatively good forest conditions but in which users have low compliance with forestry legislation; (3) tracts with poor conditions but legally compliant harvesters; and (4) tracts with good conditions but with users who are not complying with the government forestry regulations and laws.

Table 7. Legal compliance and tree health in Lebanon

		Compliance		Total
		Low (0)	High (1)	
Tree health	Low (0)	(1) 68	(3) 34	102
	High (1)	(2) 87	(4) 37	124
Total		155	71	226

Pearson Chi-Square 0.277, df=1, p=0.599

As our analysis fails to find a significant association between forest health and compliance with formal forestry laws, we must reject the hypothesis. The results may be related to the fact that the forestry legislation in Lebanon has recently changed and these changes may not have been widely disseminated among small-scale rural users. It would therefore make sense for the NFA in Lebanon to keep this question for the next NFA so as to be able to monitor the effect of information dissemination programs and their eventual effect on forest conditions.

Hypothesis 5

People who harvest products for commercial purposes are more likely to be aware of forestry incentives than those who harvest the same products for domestic purposes

The rationale for this hypothesis is that knowledge about the existence of government-provided economic incentives is likely to be greater among those actors who harvest products for commercial purposes. It would sense that people who seek to profit economically from harvesting seek out opportunities to improve the economic performance of their harvesting activities. Participating in incentive programs might be a way to do so, depending on the design of the program.

Again we use data from Lebanon since Lebanon is the only country that has incorporated questions about forestry incentive programs in their NFA. A query into their database found that there were there were a total 1712 records of different consumptive products[4] being harvested from the sampled tracts. We also found that out of the 1712 records, 486 (28.4%) were harvested for commercial end use but only four of these cases (0.23%) represented products that were harvested by individuals who were aware of forestry incentives. Table 8 below shows this data organized into a 2two-by-two cross tabulation.

Table 8: Cross-Tab Analysis for Incentive Awareness and Commercial End Use

		101g Forest Incentives Awareness		
		awareness	no awareness	Total
Commercial use	Observed		**486**	486
	% of total	0.0%	28.4%	28.4%
Subsistence use	Observed	**4**	**1222**	1226
	% of total	0.2%	71.4%	71.6%
Total	Observed	4	1708	1712
	% of total	0.2%	99.8%	100.0%

1.59	chi-square
1	df
.2074	p-value

It is evident from table 8 that there is no significant positive relationship between commercial end use and incentive awareness among harvesters in Lebanon. In fact, out of

[4] Not including services.

the four products harvested by users aware of forestry incentives, none of the users used their products for commercial purposes. Moreover, none of the 486 products and services harvested for commercial purposes were harvested by individuals who reported to be aware of forestry incentive programs in Lebanon.

There may be a very natural explanation for this result. It may be that the design of the incentive program excludes forestry lands used for commercial extraction (i.e. conservation easements). Context-sensitive policy analysis by NFA team members who are experts in forestry policy will be able to interpret these results in a more adequate manner.

Gender Aspects of Tree and Forest Use

Hypothesis 6

There is no difference between the proportion products harvested by men and women

Several studies on socioeconomic aspects of forest use suggest that men and women relate to forests differently (i.e. Agarwal, 1997; Moser, 1989; Rojas, 1989). Women may value different sets of products than men and may be restricted by local rules and norms to harvest only specific products. Being aware of such potential differences, we analyze the NFA data from the Philippines to test whether men and women harvest different kinds of products.

First, the data set was reduced to include only products [PSID 101-303], thereby eliminating all services [PSID 401-499]. Question 101 addresses the end use of harvesting and whether women, children, or men did the harvesting. The original check boxes from the Access files were converted from checks to 1's; absence of check to 0's. For all end uses of harvesting if men participated more than women for each product harvested. In cases where there were equal proportions of participation of men and women, they were classified as "not harvested mainly by men". The proportion of men doing the majority of harvesting was then compared to the proportion of them not doing a majority of the harvesting.

Several interesting results emerge from this analysis. First, there seems to be some evidence that there are fundamental differences between men and women in their harvesting and use patterns of products and services. Considering the entire set of 4550 observations related to the use of 28 different products and services throughout the country, men were reported to account for more than two-thirds of all harvesting and use activities (67.7%). This difference between men and women was statistically significant ($p<0.001$). The proportion of women harvesting a product was greater than men harvesting for only three out of the 19 consumptive products (Herbs and spices, Ornamentals, and Fertilizers, biological pesticides). The difference between men and women was most striking for timber harvesting. In 90 percent of all reported cases of timber extractions in the country, men were the primary harvesters. When it comes to the use of services, however, women are more frequent users than men for seven out of the nine services included in the NFA interviews. For example, mainly women are reported to use the tree and forest resources for religious and spiritual purposes and mainly men are reported as hunting for bush meat. These results taken together, we must reject the hypothesis, at least for the case of the Philippines.

Table 9: Descriptive statistics for products harvested by men or women

Products harvested mainly by men				
PS_ID	**Products & Services**	**No**	**Yes**	**Total**
101	**Timber**	59	531	590
102	**Firewood***	285	413	698
201	**Food***	606	626	1,232
202	**Fodder***	93	33	126
203	**Medical products***	30	12	42
204	**Oils, soap, cosmetics**	11	89	100
205	**Tannins**	1	3	4
206	**Herbs and spices***	6	0	6
207	**Resin**	3	18	21
208	**Handicraft**	20	44	64
209	**Non-wood constructions**	44	187	231
210	**Ornamentals**	12	6	18
211	**Seeds**	0	1	1
212	**Fertilizers, biological pesticides***	5	0	5
299	**Other Non-Wood forest products**	24	58	82
301	**Wild animals**	5	18	23
302	**Bush meat***	0	7	7
303	**Honey, wax***	1	19	20
401	**Source for employment (paid)**	65	115	180
402	**Hunting (sport)**	14	86	100
403	**Grazing**	145	103	248
405	**Scientific studies**	5	1	6
406	**Conservation**	22	3	25
407	**Recreation and tourism**	28	3	31
408	**Religious, spiritual**	5	0	5
409	**Soil and water conservation**	458	30	488
411	**Windbreaking curtains**	150	47	197
	Total	2097	2453	4550
		32.3%	67.7%	100%
*Considered food security products				
Pearson chi2(27) = 1.2e+03 Pr = 0.000				

Hypothesis 7

Products that are harvested daily for domestic use are more likely to be harvested by women and children than by men.

Women are often assumed to hold the main responsibility for tending to the daily subsistence needs of the household while men are assumed to be responsible for earning income through the trading of crops or off-farm employment. We put these assumptions to the test, using data from the Philippines.

Based on the data set, all products were identified and then the data set was trimmed to include only those cases where the product was harvested for daily use, as indicated by question (108) "Last Activity". Next, the products and services harvested by women and children were combined into a separate variable and compared against the frequency of harvesting only by men.

Table 10: Products harvested for daily use mainly by women and children

Women and children	Proportion	SE	Confidence interval	
No	.7319588	.0452073	.642223	.8216945
Yes	.2680412	.0452073	.1783055	.357777

The hypothesis must be rejected as the proportion of women and children is significantly smaller than for men, even when considering the daily harvesting of products for domestic end use.

Tree and Land Tenure

Hypothesis 8

Products and services extracted from Government forest lands are perceived as more abundant that than the products and services from other tenure regimes (communal and private)

The debate over the most appropriate tenure regime for sustainable forest management is divided into two dominating views: one that advocates government ownership of the resources in order to exert command and control over forest use, and another that maintains that forests are better cared for when owned and managed by private individuals or communities. To this date, very little systematic evidence has been gathered at the national level. The NFA represents an effort to do just that. To test the hypothetical relationship, we used the NFA data from the Philippines. In the first step of the analysis we grouped the observations on products (n=4281) into the four categories in Table 11.

Table 11: Perceived abundance of forest products on government vs. nongovernment-owned lands

	Perceived Shortage			
Ownership	**No**	**Yes**	**Total**	**% of Perceived Shortage**
Non-governmental ownership	1869	471	2340	0.199651
Governmental ownership	1342	599	1941	0.306729
Total	3211	1070	4281	

Pearson chi2(4) = 71.5319 Pr = 0.000

The results show that about 20 percent of all products harvested on land owned by private individuals, organizations or communities are perceived as scarce while almost 31 percent of the products harvested on governmental land are perceived as scarce. The difference is statistically significant at the 99 percent confidence level. These results provide evidence to reject the stated hypothesis as it appears that for the Philippines a greater proportion of the products harvested on *government-owned* land are perceived as scarce compared to products harvested on land owned by nongovernmental individuals, organizations and communities. This result may have several potential reasons, including limited monitoring and enforcement of access and management rules by government on these lands as well as a different set of products that are harvested from the two tenure regimes. A closer look at the data, however, reveals that the types of products harvested from the two types of lands are quite similar, effectively ruling out this as a plausible alternative explanation to the result. Future research should dwell deeper into this topic to establish with more certainty what factors have caused this result.

In a second stage of the analysis, we investigate whether the apparent differences between land tenure for the perceived abundance of resources also holds for the actual health of individual trees. Using data from NFA in the Philippines, which comprises a total of 27216 measured trees, we test whether there is a systematic relationship between land tenure and tree health. The results of the analysis are presented in Table 12 below.

Table 12: Relationship between tree health and land tenure

	Land Tenure				
	Private	**State**	**Municipality**	**Community**	**Total**
Health State					
Not Healthy	471	2,888	64	30	3,453
Healthy	3,614	19,630	183	336	23,763
Total	4,085	22,518	247	366	27,216
Pearson chi2(3) = 50.9783 Pr = 0.000					

Less than 2% of all measured trees were considered to be more than slightly affected and therefore in less than perfect health condition. But the proportion of unhealthy trees varies a great deal from one tenure category to the next. Although the numbers are very small for municipal and community lands, the proportions of unhealthy trees seems to be the smallest for community owned trees (8.20%) and the largest for trees on municipal lands (25.91%). The proportion of unhealthy trees on private and state property is 11.53% and 12.83 % respectively. All differences are statistically significant at the 0.05 level. These results would suggest that future studies need to look at the possible malfunctioning of municipal forest lands in the Philippines and analyze why these differences exist.

Hypothesis 9

The proportion of forestland that is used for wood-related products is greater for privately owned land than for communal and public lands

To test this hypothesis, the products and services identifications were recoded to reflect commercially harvested products as identified in question 101. Then a new variable was created that identified wood-related products and non-wood products. This variable was then related to the land tenure on the land where the product was harvested.

Table 13: LUS tenure and commercial harvesting of wood products

	Public	**Private**	**Total**
Timber	90	67	157
Firewood	44	63	107
Total	134	130	264

According to our chi-square test there is no statistically significant association between the kinds of wood products harvested and the type of land tenure. We must therefore reject our initial hypothesis.

Hypothesis 10

Forest products and services for which there are shared user rights do not exist on private lands and products/services for which there are exclusive rights do not exist on public or community lands

As noted in the third hypothesis, there is a common confusion about the differences between property rights to a particular product—such as firewood, medicinal plants, or timber—and land tenure regimes. Private land is often erroneously equated with exclusive rights to products from that land. Shared user rights, on the other hand, are often associated with public lands owned by the government. In the NFA each measurement area is classified into one of six possible land tenure categories, as listed in Table 14 below. For each product that is harvested from a particular area, the NFA interview team codes the observed type of user right associated with each product. The five alternative categories of property rights are also listed in Table 13.

Table 14: The relationship between user rights to products and land tenure regimes

	Land Tenure						
User Right	*Private*	*State*	*Municipality*	*Community*	*Not Known*	*Other*	*Total*
Not Applicable	14	15	0	0	0	0	29
No Right	6	153	0	0	0	1	160
Exclusive Rights	1890	506	6	31	31	9	2442
No Exclusive Right	**374**	**1224**	**18**	**16**	**16**	**1**	**1633**
Not Known	10	19	0	0	0	1	30
Total	2294	1917	24	47	47	12	4294

The results indicate that our rather naïve hypothesis must be rejected. There are several cases of de facto exclusive rights on government and community owned land. In fact, for community owned land, there are twice as many products with exclusive rights than there are products without exclusive rights. On private lands, 16.3% of all products harvested are not associated with any exclusive rights to harvest. This finding suggests that more nuance is needed in the debate about property rights. It is necessary to distinguish between property rights to particular products and to the land on which these products grow.

Protected Areas and Forest Use

Hypothesis 11

The proportion of forest land where products are harvested is significantly smaller inside government protected areas than outside of such areas.

Based on the subplot area created previously, a new variable was constructed to reflect government protected areas instead of protected areas. In the NFA classification conservation areas, national parks, national monuments, and managed protected areas were recoded as 1, and production areas were coded as 0. This variable was then compared to those products which were considered for consumptive use/ food security. These products include: firewood, food, fodder, medical products, herbs and spices, seeds, wild animals, bush meat, and honey wax.

Table 15: Harvesting inside and outside protected areas

	Sample Area	Proportion of Total	Land Use Area m^2 products	Area Proportions of area where products are harvested
Not government protected area	7,694,440 m^2	.9245	4,647,440	.60399
Government protected area	628,340 m^2	.0755	249,640	.39730
Total	8,322,780 m^2		4,897,080	

Data shows that the proportion of forest lands where products are harvested is significantly smaller ($p<0.05$) for government protected areas than for areas outside protected areas. This means that our hypothesis seems to hold for the situation in the Philippines.

Hypothesis 12

There is a significantly larger proportion forest land producing highly valued services inside government protected areas than outside of such areas

Based on the previously created variable identifying government protected areas and not protected areas, a comparison was made to those services that were valued as 1 in the NFA coding. Table 16 displays the results of the analysis.

Table 16: Highly valued services inside and outside protected areas

	Sample Area	Percentage of Total	Land Use Area m^2 for highly valued services	Proportion of area where highly valued services are present
Not government protected area	7,694,440 m^2	92.45%	245,180	0.466903
Government protected area	628,340 m^2	7.55%	279,940	0.533097
Total	8,322,780 m^2		525,120	

The evidence would suggest that the hypothesis holds for the Philippines as the proportion of highly valued services is about seven percent higher for government protected areas than for non-protected areas. This difference is significant at the $p=0.05$ level.

Biophysical Attributes

Hypothesis 13

Areas that have good infrastructure but face population increases are more likely to face a shortage of services and products

After examining the relationships and distributions among the distance to roads, schools, and hospitals variables, it was determined that the distance to all-weather roads would be used as a proxy for good infrastructure. The distribution indicated that the median value of this variable was approximately 1.0km. Therefore the data set was divided along this median line and compared to the perceptions of shortage, as previously defined as increasing demand and decreasing supply for each product.

Table 17: Shortages, Population Increases and infrastructure

	Perceived Shortage		
Proximity to all weather road	No	Yes	Total
>1.0 km	524	130	654
≤ 1.0 km	995	281	1,276
Total	1,519	411	1,930
Pearson chi2(1) = 1.1862 Pr = 0.276			

The hypothesis must be rejected as the analysis fails to detect any systematic relationship between the two variables, at least for the Philippines.

Hypothesis 14

Harvesters of products from forests and TOF who have greater access to markets will perceive greater demands for forest products.

If perceived changes in the demand for products is a function of the distance between where the products are harvested and markets, then these areas are likely to be most vulnerable to over-harvesting. To test the hypothesis we start by sorting all products into four categories: (1) products for which there is decreasing or stable demand and that are harvested relatively close to markets; (2) products for which there is decreasing or stable demand and that are harvested relatively far away from markets; (3) products for which there is increasing demand and that are harvested relatively close to markets; and (4) products for which there is increasing demand and that are harvested relatively far away from markets. Proximity to markets is a binary variable that is assigned a value of 1 if the distance is smaller or equal to the median distance for the entire sample, and 0 if it is larger than the median value.

The distribution of distance to market was examined and the median was determined to be 6.55km. This benchmark was used to create a new variable, distance to market. This was then compared to the perceptions of demand, which were categorized as either decreasing or stable or increasing.

Table 18: Relationship between proximity to markets and perceptions of increasing demand trends

Demand Trends for Forest Products			
Proximity to Market	**Decreasing or Stable**	**Increasing**	**Total**
Closer (< 6.55 km)	582	1382	1964
Farther (> 6.55 km)	522	1386	1908
Total	1104	2768	3872
Pearson chi2(1) = 2.4572 Pr = 0.117			

The cross-tab analysis in Table 18 reveals that there is no statistically significant relationship between the distance to markets and the perception of demand trends among harvesters. Those who are harvesting close to markets are not necessarily more likely to perceive an increasing demand trend than are those users who harvest far away from markets. We reject the hypothesis for the case of the Philippines.

Hypothesis 15

A larger number of both products and services are derived from trees in forest lands than from trees outside forests

Since most traditional forest inventories account for vegetation inside forests, it is often unclear what the importance of trees outside forests is for the population at large. Conventional wisdom would suggest that the harvesting and use of products and services related to trees would be greater in forestlands than in other land use classes, such as meadows, agricultural lands, or urban areas. We test this hypothesis with data from the Philippines.

We start our inquiry by classifying all products and services recorded (4,306) into two categories: (1) those harvested from forestlands; and (2) those harvested from non-forestlands. Second, we tabulated all products and services separately for both land use categories. This produced table 19 below.

Table 19: Use of Products and Services from forests vs. trees outside forests

Land Use	**Services**	**%**	**Products**	**%**	**Total**	**%**
Forest	1039	38.4%	117	7.3%	1156	26.8%
Non-forest	1664	61.6%	1486	92.7%	3150	73.2%
Total	2703	100.0%	1603	100.0%	4306	100.0%

The results in table 19 are clear: Much greater quantities of both services and products are derived from trees outside forests than from forests, at least in the case of the

Philippines. A total of 73.2% of all products and services are harvested from outside forests. In the case of consumptive products, such as firewood timber, over 90 % come from outside forests. In light of this evidence, we must reject the hypothesis.

There are several plausible explanations to this result. As previously noted, much of the forestland in the Philippines is owned by the government and it may be difficult to access the government-owned land for harvesting. Because of these possible legal restrictions to harvest from government forests, it is likely that forest users interviewed under the NFA under-reported the harvesting activities from such forests. These are hypothetical explanations that the NFA team may want to pursue in future, more in-depth policy analyses.

Hypothesis 16

There are less non-timber products harvested per hectare from plantations than from other forestlands

The LUS categories of 121,000 and 122,000 were identified and used to create new variable called 'plantations'. This was then compared to the newly created variable non-timber products. This was simply created by using the PSID codes to identify all non-timber products.

Table 20: Proportion of area where highly valued services are present

	Sample Area	Proportion of Total	Land Use Area m^2 for non-timber products	Proportion of area where highly valued services are present
Plantations	263,480	.021639	124,060	0.47085
Other forestlands	11,912,520	.978361	10,572,580	0.98840
Total	12,176,000		10,696,640	

Given these results, we fail to reject the hypothesis since the proportional area used for high-value non-timber harvesting on plantations is less than half as large as the proportion of natural forestlands. The difference is statistically significant ($p<0.05$).

CONCLUSIONS AND RECOMMENDATIONS

The NFA interview component aspires to achieve what no other program has managed to do: to collect valid and reliable data on the use of tree-related products and services at the national level. To be successful, the component will have to continue to evolve and adjust itself to lessons learned from previous experiences. The purpose of this section is to guide this learning process of the NFA program. My recommendations to the program will focus on, but not be limited to, the analysis of interview data as discussed throughout this report.

1. **Analyze and report level of uncertainty**

The credibility of the interview component depends on how well the NFA teams account for the various sources of uncertainty in the sample estimates. The precision of interview results are related to the sampling error. Although most interview variables are dichotomous in nature, it is still possible to calculate sampling error for these. This paper describes a method for how this may be done and it is recommended that this statistic is reported for all interview results.

Measurement errors refer to the limitations of the interview process—the interviewers' limited capacity to communicate the true meaning of the questions, inadequate selection of interviewees, memory lapses, untruthful responses, and other factors that distort the quality of the interview data. These errors are always present in research based on interviews. What separates sloppy studies from rigorous research relying on interviews is the extent to which these errors are addressed in the design and implementation of the interviews.

In this paper, I have outlined several issues related to measurement error that each country report should address in their analysis and reporting. I also proposed that a quantitative sampling accuracy indicator is developed at the tract level of each NFA. Such an indicator would gauge the approximate level of accuracy in the interview data for each tract. Reporting such an indicator would not only give team leaders an idea of whether additional interviews are needed to reflect the complexity in the use of products and services in each tract but it will also assist readers of the national reports to draw appropriate conclusions from the reported results.

2. **Involve national policy makers to identify the most relevant policy questions for each NFA**

For the NFA to inform national policy decisions, it is important that it can deliver the information that the country's key policy actors demand. This would require certain flexibility in the definition of the variables to be measured in the field. The NFA report from Guatemala provides a useful illustration. In their report, they identified a number of public policies and programs that were somehow related to the use of tree and forest resources in the country. Taking as a point of departure the goals of these policies, our colleagues identified plausible indicators for the monitoring of these policies and tried to match these with variables collected in the NFA. They found that several NFA variables, if measured overtime, may be used to monitor several key policies in Guatemala. Ideally, however, the identification of policy indicators should be carried out before the data collection starts. I would recommend each national team to carry out several consultations with key policy actors in each country as part of the prioritizing of variables to be measures in the field. Policy makers who have been consulted and have demanded information related to certain NFA variables *before* the NFA starts, are more likely to be interested in the reported results.

Another way of increasing the policy impact of the NFA reports is to adapt the presentation format to the policy audience and to present the results in an accessible and convincing manner. In this paper, I propose that NFA reports should (1) select the most important results rather than presenting all results; (2) acknowledge limitations of data and implications for causal inference; (3) explore relationships between variables that may inform national and international policy debates; (4) suggest future areas of more in-depth research; and (5) spell out the implications of the findings for national policies.

3. Analyze policy-relevant relationships between variables

The main objective of this paper was help NFA teams in the analysis of the interview data that they have worked so hard to collect. For merely illustrative purposes, I developed a series of hypotheses that included two or more variables from the NFA—out of which at least one was an interview variable. I then used actual NFA data from different countries to test the relationships between variables as stipulated in each hypothesis. I described how the variables included in the hypotheses were constructed and then used simple, non-parametric statistical techniques to analyze the 16 sample hypotheses.

Hypothesis testing can be a useful exercise for detecting patterns in the data as well as for identifying empirical puzzles that need further study. Despite the simplicity of the illustrative hypothesis tests, I would recommend each NFA to follow this approach in the NFA reports. This type of relational analysis takes the reports beyond the rather mundane accounting of descriptive results, such as frequencies and means for one variable at a time. Presenting more analytical reflections based on the hypothesis tests, readers are likely to learn more policy-relevant lessons from the reports.

4. Explore causal inferences through complementary, in-depth studies

The NFA reports provides an excellent snapshot of what the state of a country’s tree and forest resources are and what the most prominent products and services are for the forest users at large. This is a vast improvement over conventional inventories, which often were so expensive that few countries could afford carrying them out. One of the most fundamental strengths of the NFA is that they are much more economical than conventional forest inventories, making them more viable to less-developed countries.

In its current format, however, it is not possible to make causal inferences on the factors that are driving the observed state of the country’s resources, products and services. If policy makers were to rely on NFA data only, such causality could not be established until the NFA is repeated in the distant future. By then the policy interests in the country may have shifted, or even worse, the state of the resource may have degraded to a point where it is more costly to mitigate the problem. For policy making, the *timing* of the feedback from studies is of the essence.

One way to generate more immediate policy lessons from the NFA would be to carry out qualitative, in-depth studies in those tracts in which the relational analyses suggest that plausible casual factors may be studied in more detail. Such in-depth policy studies at carefully selected sites would be an enormously valuable complement to the national assessment data. Through such studies, policy-related influences on the resource and its usage could be identified and described with a timeliness and level of accuracy and precision that is not possible to accomplish by relying on NFA data alone. This way, a set of qualitative studies in carefully selected tracts (6-7 sites) would add rich descriptions of how particular policy-related factors affect the outcomes that the NFA documents at the national level.

The case study approach developed by the International Forest Resources and Institutions (IFRI) research program would be an excellent complement to the national assessments. The IFRI approach is similar to the NFA in that it combines biophysical measures of forest resource characteristics with social assessments of harvesting decisions and practices among rural communities. After 13 years, IFRI scholars in 12 countries have completed in-depth studies in 250 sites. Over 200 scholars in 20 different countries have now been trained in the IFRI methods. This group of interdisciplinary scholars represents an important human resource base for the NFAs worldwide. IFRI scholars could be consulted for assisting the NFA during fieldwork—in particular for the preparation and implementation of the interview component.

5. Train NFA teams in interview procedures

To carry out most of the recommended actions, it will be necessary for the NFA teams to be trained in how to carry out data gathering through personal interviews. I would recommend that the central NFA team at FAO headquarters are trained in specific topics related to interview procedures, including sampling, instrument validation, interview techniques, accuracy tests, and analytical approaches for categorical data. Trained FAO personnel would then be in position to train NFA team members in countries that are preparing for implementing their own National Forest Assessments. Several IFRI partner organizations—including the University of Michigan, Indiana University, and the Asian Institute of Technology in Bangkok offer annual training courses in data gathering through personal interviews, as an integral part of the IFRI methodology. I recommend that the NFA and IFRI programs create a special NFA interview component course—a “training of trainers” course that selected NFA staff could attend.

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