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Comparative Analysis of 12 Indonesian Non-Timber Forest Products Cases

By Brian Belcher[1], Manuel Ruiz-Pérez[2], Dede Rohadi[1] and Ramadhani Achdiawan[1]

[1] Center for International Forestry Research (CIFOR), Bogor, Indonesia
[2] Dpmt. Ecology, Autonomous University of Madrid, Spain, and CIFOR Research Associate

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Summary

Non-timber forest products have been targeted as key entry points for both development and conservation initiatives. Significant investments have been made in a variety of project interventions, and new attention is being given to policy options to encourage NTFP development. And yet, understanding of the true role and potential of NTFP to contribute to development or conservation, based as it is on scattered and inconsistent case-based research, remains limited.

This work is part of an ongoing effort to develop and refine a methodology and to undertake comparative analyses of cases. The aim is to develop an analytical framework that will facilitate systematic NTFP policy and management decisions. This paper describes the rationale, the step-wise approach being taken, and the results and conclusions of the first stages of the work.

The analysis follows the method developed by Ruiz-Perez and Byron (1999). It was designed to help to find patterns among divergent cases, to develop typologies, to identify key contextual variables, and to analyze the relationships with observed development outcomes. In this study a set of 12 studies of NTFP cases from Indonesia was organized, with each case described using a standard set of variables. The products included benzoin resin, gaharu (incense wood), damar (resin), bamboo, tengkawang (nuts), wild gathered and cultivated rattan, wild honey hunting, butterfly ranching and farming, palm sugar, and sandalwood (fragrant wood). The cases were selected to represent a range of kinds of products (animals, plants, plant products), of production systems (from pure extractive to cultivated) and market systems (from local markets to export markets). The variables were organized into several categories, describing different aspects of the production-to-consumption system, including:

- *Geographic setting*
- *Socio-economic setting*
- *Biological and physical characteristics of the product*
- *Characteristics of the raw material production system*
- *Characteristics of the processing industry*
- *Characteristics of the trade and marketing system*
- *Characteristics of the final market.*

Expert judgement was used to assign ranks to each case, on a variable-by-variable basis. Cases were compared using these data in: 1) non-linear principal components analysis to identify key variables that account for dissimilarity between cases; and 2) cluster analysis, to classify and group similar cases.

Several interesting classes of "case" were identified, based on characteristics such as remoteness, management intensity, the role of the product in livelihood strategies, level and kind of state intervention, degree and kind of processing required, characteristics of trade and marketing, and degree of external intervention

This trial confirmed the feasibility and the utility of the method, and helped to identify areas for improvement. Some problems were encountered with the definition of variables. Important limitations were experienced due to use of mainly qualitative data and rank-ordering. Personal knowledge and expertise about the case by collaborators was found to be very important, at least during the methodology development phase. Work is still needed to facilitate linking development and conservation outcomes with case characteristics. These lessons have been taken into account in the design of a new international comparative analysis.

Introduction

World-wide interest in forest conservation and sustainable development has helped focus attention on the many economically-important products that are produced in forest environments. There appears to be potential to develop some of these "Non Timber Forest Products" (NTFP) to achieve development objectives (income and employment generation, especially in rural areas). Some also argue that NTFP can be used as tools to achieve conservation objectives. The hypothesis, often implicit, is that increasing the creation and capture of value from forests by the local people will increase incentives for the maintenance and protection of the forest. Arnold and Ruiz Perez (1998) have summarized the main underlying, and still untested, assumptions:

- As compared to timber, NTFP give more benefits to the community, particularly those who are living adjacent to the forest, because they provide food, medicines and other materials for the livelihood, as well as commercial products.
- As compared to logging activities, harvesting of NTFP causes less impact to the environment.
- Increasing benefits of NTFP for the people living near the forest will increase the forest value and stimulate people participation on sustaining the forest resources.

Whether or not these assumptions are true, there is a high level of interest in NTFP development among government and non-government institutions. Investments have been made in various research and development projects focused on NTFP. As a result, there is a rich body of information on aspects of commercial forest product development, including numerous case-based studies of different elements of forest products systems and results from development projects that have invested in forest product development. Many interventions have been tried at the project level, including various combinations of technical, institutional and financial support for forest product production, processing and marketing, with mixed success. As well, larger, cross-cutting interventions have been attempted, including green markets, "fair trade" initiatives, and efforts to promote NTFP certification.

However, it is difficult to build a theoretical framework from this basis. The information has been gathered using a range of methods, at different scales, and focusing on different elements of the forest product production, processing and marketing systems. It is therefore difficult to generalize. Work is needed to document and compare cases using consistent terms and definitions for an appropriate range of variables.

Ruiz-Perez and Byron (1999) developed a comparative methodology that uses multivariate analysis techniques to find patterns, to develop typologies, to identify key context variables and to analyze their relationship with observed development outcomes. The approach involves describing the selected cases according to a standard set of descriptors to build a case-study matrix. Exploratory data analysis is used to outline patterns, gradients of variability, clusters of cases and key variables associated with them.

The method was first tested in a desk-study that compared 9 NTFP cases from several countries (Ruiz Perez and Byron, 1999). The study showed a promising approach that need for further testing and development.

The next step was to undertake a comparative analysis using field-based data. This paper reports the results of a comparative study of 12 Indonesian NTFP cases. The study had two principal objectives: 1) to further test and develop the method; 2) to analyze a set of Indonesian NTFP cases to provide basic information for decision makers and scientists at regional or international level for the development of NTFP towards sustainable forest management in Indonesia.

Research Methodology

The study was conducted during 1998-1999, in collaboration with several research and development organizations.[1] Twelve NTFP cases were selected from various locations in Indonesia, based on three criteria:

1. significant commercial value of the products
2. sufficient data availability;
3. availability of experts familiar with the case and willing to collaborate in the comparative analysis.

Cases were selected to represented a range of kinds of products (animals, plants, plant products), production systems (from pure extractive to cultivated), market systems (from local markets to export markets) and geographical conditions. As well, several cases that have had exteranl support were included, to be able to compare with those

[1] Collaborators included: 1) Indonesian Forestry and Estate Crops Research and Development Agency (FERDA) 2) Indonesian Ministry of Forestry and Estate Crops; 3) Center for Social Forestry, the University of Mulawarman; 4) Leuser Development Programme; 5) Biodiversity Conservation Network; 6) The Nature Conservancy; 7) Yayasan Diantama.

that have developed spontaneously. A complete list of the cases is presented in Table 1.

Table 1. List of the compared NTFP cases.

No.	Cases	Location	Experts/Participants
1	Arenga sugar (*Arenga pinnata*)	District of Minahasa, North Sulawesi.	Henkie Luntungan (Center for Industrial Estate Crops Research and Development).
2	Bamboo handicrafts	District of Tasikmalaya, West Java.	Dede Rohadi (Forest Products and Forestry Socioeconomic Research and Development Center, Bogor).
3	Rattan (cultivation)	Village Besiq, District of Pasir, East Kalimantan.	Fadjar Pambudhi (Center for Social Forestry, University of Mulawarman, Samarinda).
4	Rattan (wild gathering)	District of Sanggau, West Kalimantan.	Rudijanta Utama (Yayasan Diantama, Samarinda).
5	Damar (resinous material from *Shorea spp.).*	Sub District Krui, Lampung	Azis Khan (Forest Products and Forestry Socioeconomic Research and Development Center, Bogor).
6	Benzoin (resinous material from *Styrax spp*).	District of North Tapanuli, North Sumatra.	Dede Rohadi (Forest Products and Forestry Socioeconomic Research and Development Center, Bogor).
7	Butterfly Ranching	BCN Development Project at Arfak Mountain Nature Reserve, Irian Jaya.	Bern Cordes (Biodiversity Conservation Network)
8	Butterfly Farming	BCN Development Project at Lore Lindu National Park, Central Sulawesi.	Duncan Neville (Biodiversity Conservation Network)
9	Honey hunting	BCN Development Project at Lore Lindu National Park, Central Sulawesi.	Duncan Neville (Biodiversity Conservation Network)
10	Gaharu (incense wood from *Aquillaria spp.*).	Nias Island, West Sumatra.	Retno Maryani (Forest Products and Forestry Socioeconomic Research and Development Center, Bogor).
11	Sandalwood (*Santalum album*).	District of South Central Timor, East Nusa Tenggara.	Bambang Wiyono and Retno Maryani (Forest Products and Forestry Socioeconomic Research and Development Center, Bogor).
12	Tengkawang (fruit from *Shorea spp.*)	West Kalimantan.	Sudiarto (Center for Research and development of Medicinal Plants and Spices, Bogor).

The authors developed a more detailed set of descriptors from the original set, and furhter refined these through a series of discussions with collaborators. A Production-to-Consumption System (PCS) approach[2] was followed to cover the full range of information on each case.

Collaborators were requested to collate available data on each case to complete a case description, using the standard set of descriptors. Some of the cases were already the subject of research and/or development activities. Good quality and comprehensive data were available for these cases. Others were less well studied. Collaborators collected secondary data as and where it was available, and conducted rapid field assessments to complete the required data (for bamboo, damar, benzoin, gaharu and sandalwood).

A workshop was held in Medan in February 1999[3] to prepare a case study matrix. The workshop provided an opportunity for each collaborating team to present an overview of their case, for the information of other collaborators. Then, each case was ranked, variable-by-variable, using a range of 1 to 5. The process involved identifying a high case (5) and a low case (1), and then ranking other cases relative to the established maximum and minimum. For example, we take the variable "intensity of raw material production". The workshop agreed that gaharu, which is collected wild from the forest if and when it is encountered by gaharu hunters, represented a low value, and assigned a "1". Aregna sugar is produced from cultivated palms, that are managed relatively intenesely, so a high value of "5" was assigned. Other products that are produced under intermediate management conditions were assigned intermediate values (e.g. rattan produced in extensive gardens in East Kalimantan = 3(??)).

Most of the data available were qualitative data, making ranking the most practical approach. Quantitative data were available for some variables. These were recorded in quantitative terms, but later converted to rank scores. Some variables were treated as categorical variables (e.g. plant or animal type; type of market (local, national, regional or international (check???).

Some of the variables were found to be unworkable, either because they could not be defined sufficiently or because the data were simply unavaible for some cases. These were modified or replaced accordingly. Some other variables proved to be redundant, offering no additional information (with the current data set). These were discarded. The final data set is presented in Annex 1.

Due to time constraints, some of the variables (about 30%) were not completed during the workshop. Scoring of these variables was completed during a subsequent meeting held at CIFOR Headquarters in Bogor that was attended by about half of the original participants. Follow-up communications with those that were not able to attend the second session allowed the completion of the data set.

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[2] A PCS approach is defined as "the entire set of actors, materials, activities and institutions involved in growing and harvesting a particular raw materials, transforming the raw material into higher-value products and marketing the final products. The system includes the technologies to grow and process the material, as well as the social, institutional and economic environments in which these processes operate" (Belcher, 1998).

[3] The workshop was co-hosted by CIFOR and the Leuser Development Programme.

The completed data (scores) were analyzed using multivariate analyses, using SPSS software (Release 9). Hierarchical clustering and Multidimensional scaling analyses were used to identify case typologies. Mann-Whitney Mean Test was used to determine the key variables separating clusters of cases. Clustering results were further analyzed by Non-Linear Principal Component Analysis to determine key factors of the compared cases.

These analyses yielded clusters of cases with more or less similarity. In combination with the identified "key factors", this provides a basis for classifying cases and for interpreting issues and implications of different strategies to develop those types of cases.

Results and Discussion

The first round of analyses was done category by category.

Geographic setting

Figure 2 shows a typical output from a cluster analysis. This one is based on the variables identified for "geographic setting" of the raw material production system. Two main clusters are shown. One cluster includes the Butterfly ranching (IJ), Rattan wild gathering (WK), Rattan cultivation (EK), Gaharu and Benzoin cases. The remaining cases fall into the second cluster. Mann-Whitney U test identified two out of the six tested variables that were significantly different between the two clusters. These are "transportation infrastructure" and "percentage of forest cover."

Cases in the first group tend to have relatively under-developed transportation infrastructure and retain a higher percentage of forest cover, characteristics typical of remote areas. More developed (less remote) areas, have more developed transportation infrastructure, more economically-attractive land-use options, and consequently higher rates of land conversion.

This raises important questions about whether the NTFP production activities in the remote areas are likely to remain competitive as development proceeds (infrastrucutre is improved). Are they likely to be abandoned in favour of more rewarding alternatives or "pushed aside" as forest conversion reduces the availability of wild products?

This classification indicates that the level of transportation infrastructure and the percentage of forest cover may be useful attributes for characterizing the development level of the area, and for classifying an NTFP system.

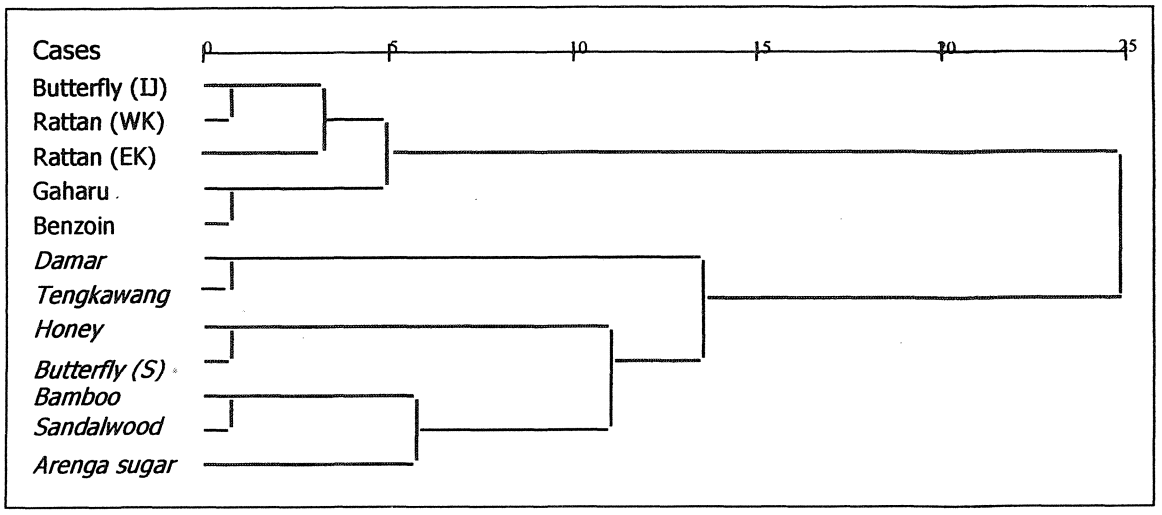

Figure 2. Cluster analyses of the cases based on geographical setting.

Production system and ecological implications

The variables in this category describe the biophysical aspects of the raw material production system. The cases divided into two primary clusters. The first group includes Honey, Gaharu, Sandalwood and Tengkawang cases, with the remaining cases falling into the second group. Mann-Whitney U-test shows that 7 out of 20 tested variables are significantly different between the two clusters . The first group of cases is characterized by:

- less intensive management
- lower trend towards domestication
- less biological availability
- shorter harvesting seasons
- less regularity of harvesting seasons
- harvesting causes more impact to the resource
- more important ecological interdependencies

These are the cases that depend primarily on wild gathering of the raw material. All of the other cases (group two) involve some degree of cultivation and/or management. The wild gathered products depend, to a greater degree, on the quality and availablity of natural forest than (most) of the cases in the second group. We can assume that increased harvesting could lead to over-exploition of the resource (as there is no management to increase productivity).

It is interesting to explore the reasons that the products in the first group have not been brought under more intensive management. They are traded commercially and it might be expected that people would have invested effort to increase productivity. In fact, some of these products can not be domesticated (e.g. it is not yet possible to induce gaharu production) and others present difficult technical (wild honey bees are difficult to

control) or economic (tengkawang has long time to first harvest and intermittent and unpredictable production) challenges.

The variable representing the degree of modification to the natural system did not emerge as a significant differentiating factor between the clusters. This seems to represent a problem in the definiton of the variable. That is, those products that are produced in intensively managed systems may not have a direct impact on the natural system. However, there has been an important impact in converting the land from forest to agricultural at some time in the past. This highlights the need to be clear about differntiating site-specific impacts and landscape-level impacts.

Multi-dimensional scaling (Figure ?? represents the level of similarity/difference between cases through the relative proximity of points on the plot. The Figure shows that the cases within Cluster II have relatively higher similarity to each other than the cases within Cluster I. The longer distances among the cases in the Cluster I (Tengkawang, Honey, Sandalwood and Gaharu) indicates a relatively higher variability among these cases in their production system and their ecological implications.

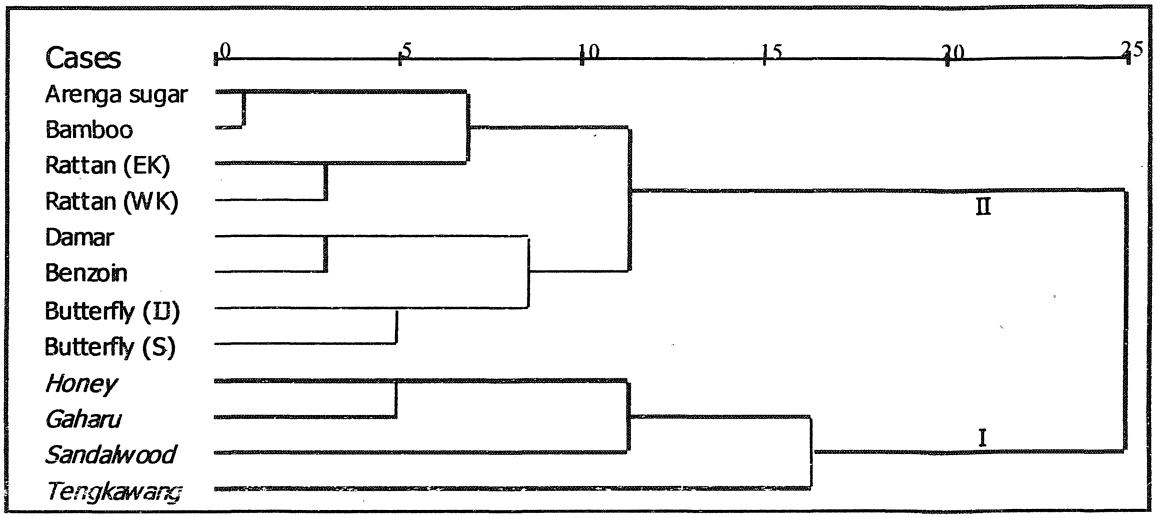

Figure 4. Cluster analyses of the cases based on production system and ecological implications.

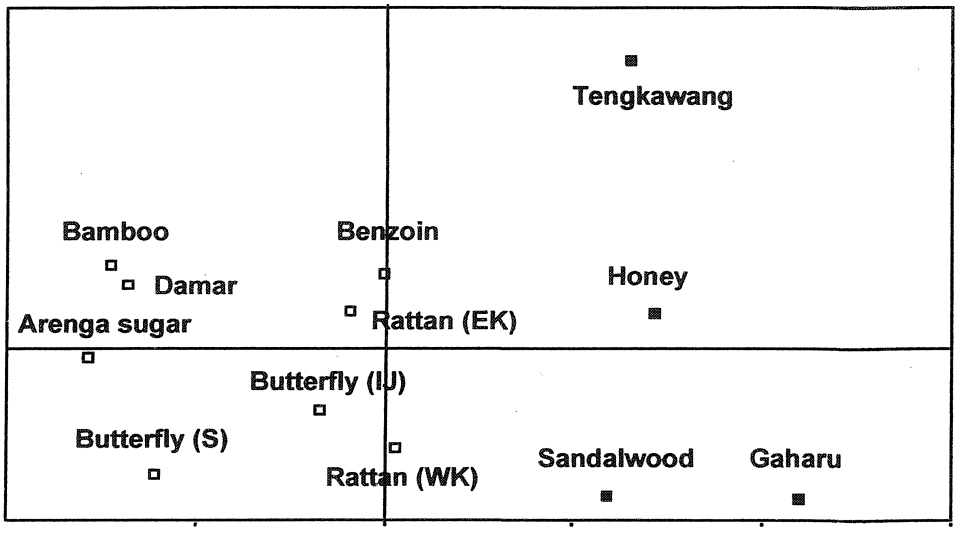

Figure 5. Multi dimensional scaling of the cases based on production system and ecological implications.

Socio-economic characteristics

This category of variables describes the social and economic characteristics of the communities where raw material producers live. Two primary clusters are evident in the cluser analysis. NLPCA supports this clustering, with an Eigen value (measuring the strenght of the model) of 73%. The first cluster includes Rattan (EK), Benzoin, Arenga sugar, Damar, and Bamboo cases, and the rest fall in the second group. Mann-Whitney U-test shows that 5 out of 10 tested variables are significantly different between the two clusters.

Cluster I is characterized by:

- higher average household yearly income
- higher proportion of household members involved in the production system
- higher percentage of household total consumption derived from forest products
- higher contribution of income derived from the specific products to the total forest products portfolio
- higher economic barriers keeping new entrants to the activity

The Cluster I cases have a more important role as main income generators for the community, as shown by significant contribution of the product to community total income. A higher proportion of households tends to be involved in the production to consumption system of these NTFP. These systems also have higher economic barriers constraining the entry into the business by newcomers. This is an interesting observation. The existence of such a barrier may be important in terms of limiting entry and maintaining an acceptable level of profitablity. The fact that large numbers of

households are involved shows that the barrier is not insurmountable. However, there may be opportunities for good returns on investments to realize economies of scale.

The Cluster II cases, in contrast, contribute relatively less to total community incomes. Production activities of these products seem to have a low opportunity cost, meaning that they may be treated as "fall-back" options. If better opportunities arise, these activities may be readily abandonned. This kind of infomatin should be taken nto account when evaluating potnetial investments. However, it is premature to draw conclusions about all of these products – several are currently receiving outside support which, if successful, will raise their socio-economic importance. Others play important roles as supplementary sources of income for the community.

It is important to note that the first cluster consists of each of the cultivated products. This raises important questions about the evolution of NTFP-based activities, and the degree to which domestication is driven by profitability (higher value products are managed more intensively).

Figure ?? shows a plot that relates gender and social status variables. The figure shows that Honey, Butterfly (IJ), Gaharu, Benzoin and Sandalwood are mainly associated with men. This may be due to the required skill or level of high risk involved with harvesting activities. The association of Rattan (WK) and Butterfly (S) with women may be related with processing activities, where women are more likely to engage the type of work required. Alternatively, it may reflect a deliberate effort on the part of development agencies (both are cases that have been targetted for external support) to involve women. The remaining cases showed no particular gender bias.

The Figure also shows the association of the cases to community social status (within the context of their own village). Tengkawang is associated with lower status. Arenga sugar is associated with higher status. Benzoin, Sandalwood, Rattan (WK) and Bamboo are associated with medium status. The remainder were not linked clearly with any particular social status grouping.

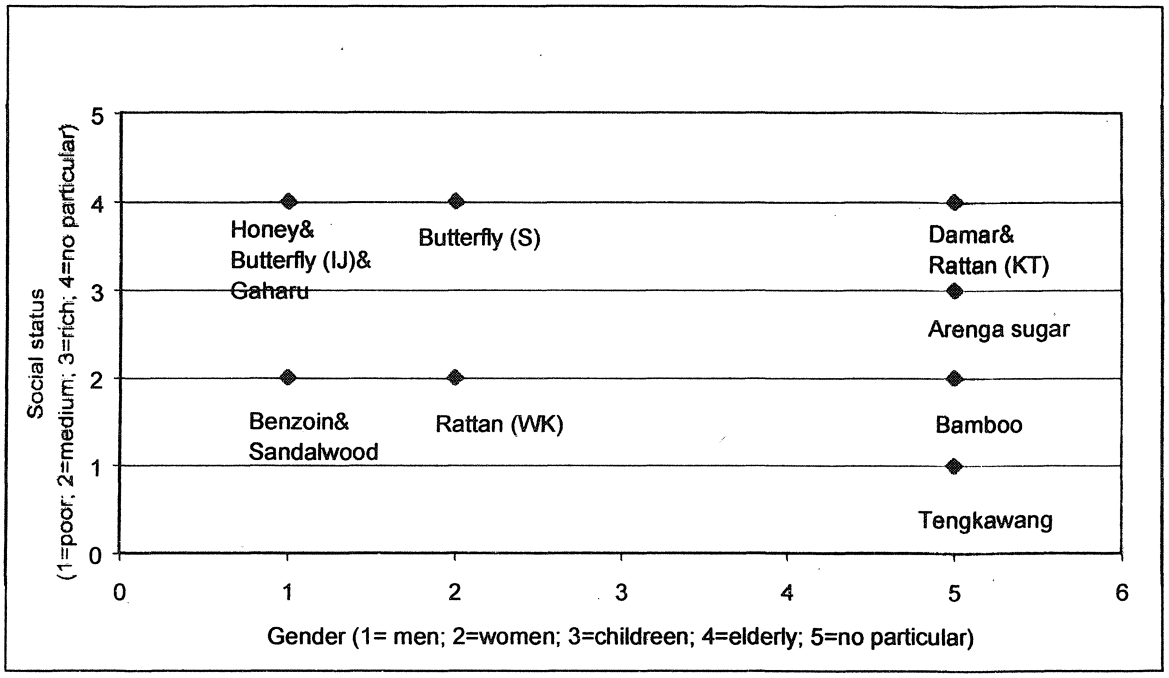

Figure ?? The association of the cases with gender and social status.

Institutional aspects

This category of variables deals with information about institutions and policies that affect the NTFP production and management. There are three main clusters (Figure ?) The first consists of Arenga sugar, Bamboo and Sandalwood cases. The second cluster includes Rattan (EK), Butterfly (IJ), Butterfly (S) and Gaharu. The last cluster contains the reamining cases of Honey, Rattan (WK), Damar, Tengkawang and Benzoin. Three of 17 tested variables are significantly different between the clusters. They are:

- intensity of state direct investment,
- the impact of state investment on production
- the degree of monitoring on state regulations

The Cluster I cases have received more intensive state involvement, mainly in research investment and regulation. The "monmitoring" of the regulations more than the existence of the regulations themselves emerges as a distinguishing variable. This reflects the fact that there are many blanket regulations that affect forest products, but the regulations tend to be enforced unequally, with more emphasis on more valuable products. The second cluster of cases are affected by regulations, or the monitoring of those regulations, but have benefitted less from state investment. The products in the third cluster of cases has been more or less ignored by government.

Evaluation of the variable scores indicates that the impact of state involvement will greatly depend on the type of intervention. When the involvement has been through regulation, the impacts tend to be negative, as illustrated in the extreme by the

Sandalwood case. In contrast, when state involvement has focused more on investment, the relationship tends to be positive, as illustrated by the cases of Bamboo and Arenga sugar (though no causality can be interpreted from these data).

Processing characteristics

This category of variables deals with the characteristics of the processing systems. Cluster analysis identified two clusters, with only Damar and Tengkawang in the first cluster. NLPCA, which places more emphasis on case charactersitics (as opposed to a pure measure of similarity) resulted in a different grouping 9with a very high Eigen value of 88,68%).

Cluster 1 includes Damar, Tengkawang, Benzoin, Rattan (EK), Cendana and Bamboo. Cluster 2 includes Gaharu, Honey, Butterfly (IJ), Butterfly (S), Arenga sugar and Rattan (WK).

The first group of products have:

1. a higher degree of transformation from raw material to finished product;
2. lower proportion of value of forest product in finished product for group;
3. higher processing technology, with more training/skill required for processing the product and higher capital requirement(equipment, chemicals, etc);
4. advantage of larger scale processing;
5. lower degree to which an enterprise can scale-up incrementally'
6. higher degree to which there are economic or technical barriers that impede new processors from entering.

These products require more complex processing to produce the final product. There are realtively large investment costs and a higher level technology that may prevent raw material producers from getting involved in the processing sub-sector. Instead, these forest products are marketed by the producers as raw materials.

The other group of products have lower requirements at the processing level. There are opportunites for raw material producers, or other people from rural communities, to get involved in processing and therebye create and capture more value added. Not surprisingly, all of the case that have had external interventions designed to increase local value addition, fall into this category.

Trade and marketing characteristics

Trade and marketing information describes the structure and function of the market and market channels for the product, from raw material producers to final consumer.

Cluster analysis revealed two clusters. The first cluster consists of Butterfly (IJ), Butterfly (S), Gaharu, Cnedana, Rattan (EK) and Benzoin. The second cluster includes Honey, Arenga sugar, Tengkawang, Damar, Bamboo and Rattan (WK). Seven of the

variables were significantly different between the groups. The first group is characterized by:

- Lower price elasticity of demand
- Higher income elasticity of demand,
- Lower market transparency,
- Higher barriers to entry,
- Higher intensity of state involvement – regulations
- Higher intensity of state involvement – taxes and subsidies
- Lower quality of state involvement.

The second cluster of products tend to have much more dispersed markets, with a large number of buyers relative to the number of producers. The market is open and competitive, with low barriers to entry and little state intervention. Consumers pay attention to prices, consuming less if prices increase, and prices tend to be determined by market mechanisms.

The other group of products (Cluster 1) all have much more limited markets, with more control exercised by buyers and more regulatory control. The butterfly markets, especially for live butterflies, are limited to a few butterfly houses and must pass through the hands a licensed exporters. Strict regulations further support this control. Damar resin and rattan pass thorugh restricted market channeis. As do sandal wood and gaharu, controlled, respecively, by rent-seeking government agents and traditional traders with connections to the main markets. Consumptinis less sensitive to price, and prices tend to be set by a variety of factors beyond demand.

Outside intervention

This set of variables describes whether and what kind of "outside intervention" (investments to assist the commercial or technical development of production, processing or marketing) has been made. NLPCA separates the cases into two groups, with 89% of data variablity explained by the model. The first group includes Butterfly (IJ), Butterfly (S), Rattan (WK), Honey, Bamboo and Damar, each of which have had some outside assistance, and the remaining cases that have not had outside interventions. The three signinficant distinguishing variables are:

1. strength of externai technical support
2. strength of exteranl organizational support
3. strength of political support.

While this classification is rather obvious with this set of cases, it has valuable application in this, and in a subsequent larger exercise. It is useful to see what other charactersitics might be associated with outside interventions. What sorts of issues seem to be important to donors and development agencies that leads them to select these cases?

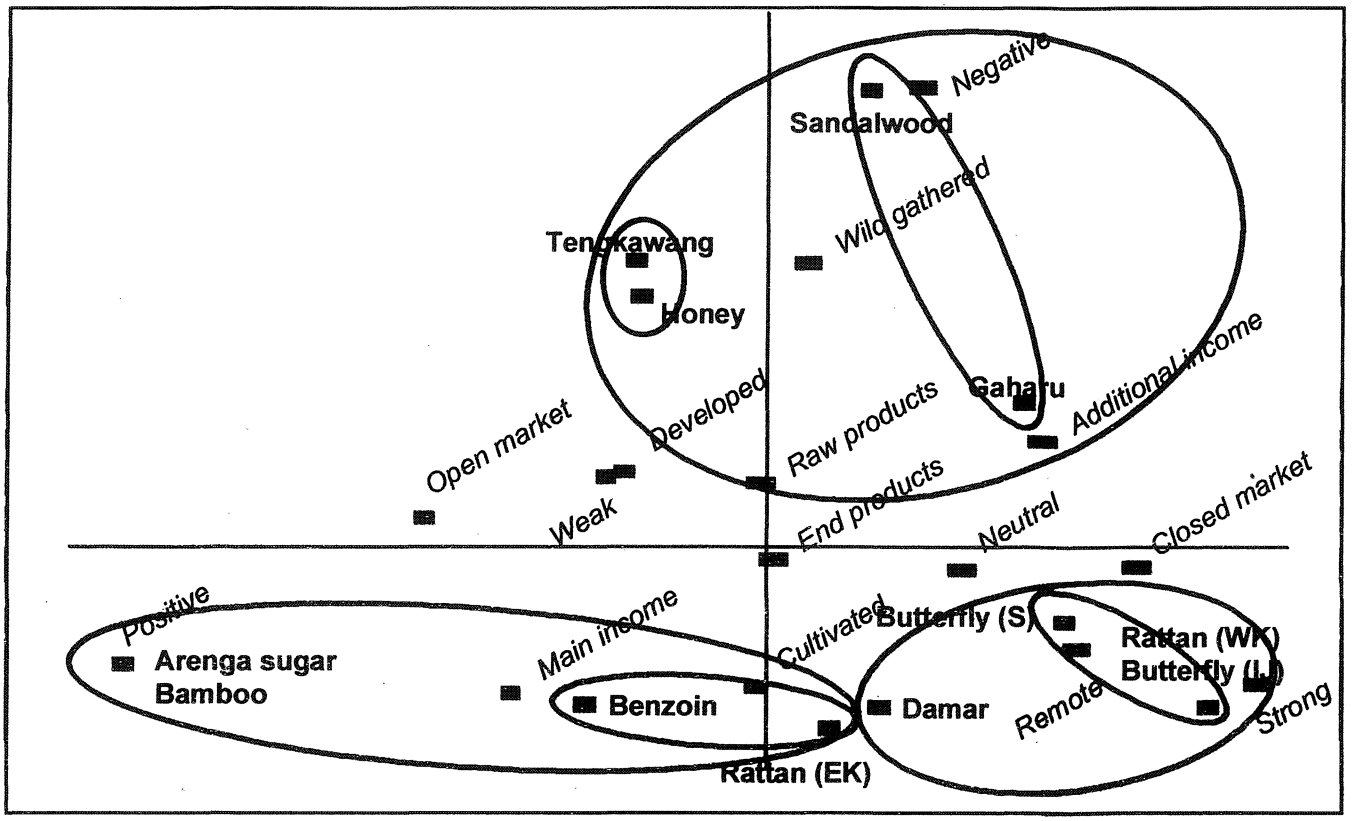

Figure 19. NTFP case typologies (summary).

2. Case typology based on all clustering aspects.

The previous cluster analyses focused on case typologies by category. The clusters are summarized on Table 2. All of the previous clustering results were then entered as new variables and were analyzed using cluster analyses combined with non linear principal component analyses. The results are presented on Figure 19.

Table 2. Summary of cluster analyses of the cases.

No	Cases	Geographical setting	Production system	Social economic	Institutions	Processing	Trade and marketing	Outside intervention
1	Honey	Developed	Wild gathered	Additional income	Neutral	End products	Open market	Weak
2	Arenga sugar	Developed	Cultivated	Main income	Positive	End products	Open market	Weak
3	Bamboo	Developed	Cultivated	M Main income	Positive	End products	Open market	Weak
4	Damar	Developed	Cultivated	Main income	Neutral	Raw products	Closed market	Strong
5	Gaharu	Remote	P Wild gathered	Additional income	Neutral	End products	Closed market	Weak
6	Rattan (EK)	Remote	Cultivated	Main income	Neutral	End products	Closed market	Weak
7	Butterfly (IJ)	Remote	Cultivated	Additional income	Neutral	End products	Closed market	Strong
8	Benzoin	Remote	Cultivated	Main income	Neutral	End products	Open market	Weak
9	Sandalwood	Developed	Wild gathered	Additional income	Negative	End products	Closed market	Weak
10	Tengkawang	Developed	Wild gathered	Additional income	Neutral	Raw products	Open market	Weak
11	Rattan (WK)	Remote	Cultivated	Additional income	Neutral	End products	Closed market	Strong
12	Butterfly (S)	Developed	Cultivated	Additional income	Neutral	End products	Closed market	Strong

Figure 19 shows three main clusters of the NTFP cases. The first cluster consists of Arenga sugar, Bamboo, Rattan (EK) and Benzoin cases. These cases are characterized by domesticated production, play important roles as main income source, have open market systems and receiving positive support from the government. The cases in this cluster are the most developed among the 12 compared NTFPs, despite have limited outside support.

The second cluster consists of Damar, Rattan (WK), Butterfly (IJ) and Butterfly (S) cases. These cases have had increased efforts to manage the resource, although the intensity remains low. These cases receive relatively low attention from the government, but have had significant support from non-government organizations. The market system tends to be closed and most of the cases are located at remote areas. The cases are considered as the developing NTFPs, tending towards more commercialization.

The third cluster consists of Gaharu, Sandalwood, Honey and Tengkawang cases. Production system of these cases depends on wild gathering. The economic role to the community is mainly as a supplementary source of income. The market system tends to be closed and relatively low attention has been given either by the government or other non-government institutions. One of the cases (i.e. Sandalwood) shows a strong negative impact of state involvement as a result of government regulations. The cases can be considered as under-developed NTFPs. Whether or not they are suitable for "development" requires further research.

Table 3 below presents the "eigen values" and "eigen vectors" [4] of the non linear principal component analyses of the Figure 19. For the first dimension, trade and marketing and institution show as the two dominant factors on determining case typologies with the eigen vectors 0.694 and 0.675 respectively. For the second dimension, production system shows the most dominant factor with eigen vector of 0.890. When both dimensions are considered, institution shows as the most dominant factor with the total eigen vectors of 1.121. The following dominant variables subsequently are production system, social economic, trade and marketing system, outside intervention and geographical conditions. Processing variables show the least effect to the model.

[4] Eigen value is a number representing the cumulative proportion of data distribution that can be explained by the model. In this case, eigen values for dimension 1 and 2 of the model are 0.348 and 0.299 respectively, giving the total proportion of 0.648 or 65% of data distribution that can be explained by the model (the two axis on Figure 19). The eigen vector is vector that correspond to eigen value. See for more detail in Anonymous (1998); Everitt (1992); Everitt and Dunn (1991).

Table 3. The eigen values and eigen vectors of the principal component analyses of the cases.

No.	Variables group	Dimension 1	Dimension 2	Total
A	Eigen values	0.348	0.299	0.648
B	Eigen vectors :			
B.1	Institution	0.675	0.446	1.121
B.2	Production system	0.003	0.890	0.893
B.3	Social economic	0.388	0.344	0.731
B.4	Trade and marketing	0.694	0.013	0.706
B.5	Outside supports	0.433	0.215	0.647
B.6	Geographical conditions	0.246	0.171	0.417
B.7	Processing	0.000	0.018	0.018

Methodology Lessons

One of the main purposes of this exercise was to test the approach, and to provide an empirical basis for improving the method. The trial confirmed the feasibility and the utility of the method, and helped to identify areas for improvement.

As described above, the analysis helped to identify useful categories of cases and useful distinguishing variables. It is possible, for example, to make useful classification of cases based on the percentage of forest cover and the level of infrastructure in the area where the product is grown. Likewise, knowing about the level of state investment in a PCS and the kind and degree of monitoring of regulations can be used to distinguish cases.

Some of the results in this analysis were obvious. For example, the multivariate analyses were not required to distinguish cases that have had outside interventions from those that have not. A knowledgeable observer will be able to distinguish intensively managed productions systems from extensively managed systemsw, without the need for sophisitcated statisitcal tools. However, this confirms the utility of the method. This analysis involved a small number of cases. In a larger comparison it becomes much more difficult to manage the large amounts of data, and the statistical methods come into their own. With a larger and more broadly representative set of cases, it will be possible through this approach to reduce the set of descriptors required for classification.

The method provided a structure and an analytical framework for collaorators to view their own cases. The approach places emphasis on understanding the whole system, from production to final market. The collaborators appreicated this and found value in the exercise independent of the analysis.

The workshop approach was valuable, and is probably indispensable at this stage in the development of the method. Many of the definitions could be interpreted several ways, and the discussion proved to be critical to develop a standard definition. In addition, it proved useful to have several particpants who were familiar with all of the cases. These people were able to bridge gaps and query supect data that resulted

from inconsistent definitions and misunderstandings. Moreover, the workshop provided an opportunity for all collaborators to become familiar with and to learn from a broad range of cases.

The participation of experts from each case was critical. In this exercise there was a wide range of "expertise", from people who have long-term, intimate involvement with "their" case, either as researchers or development practitioners. With their depth and breadth of knoweldge, the collaborators were able raise new questions and provide answers to new questions that arose. Other collaborators had done research to answer the original set of questions, but without the depth of long-term involvement in the case, they were unable to provide data to new and un-anticipated issues.

The quality of data could have been improved. Problems arose due to unclear definitions. There were also problems wth some cases that relied on highly suspect government statistiics. We attempted to overcome problems with data reliability and consistency by using mainly qualitiative data, either rank-ordered or nominal. The cost of this choice was to greatly reduce the precision of the analysis. In future it will be important to use quantitative data wherever possible.

Finally, we feel that it will be important to improve the link between development and environmental outcomes and the different classes of product/case

Conclusions and recommendations.

This comparative study of 12 NTFP cases in Indonesia showed the potential of the approach and highlighted a number of important issues in the Indonesian NTFP sector.

The products and the systems that are based on them are all important in the livelihoods of the people that are working on them. Some play a major role in generating income and employment. These products tend to be managed in more intensive systems, in more developed areas, and with a larger proportion of the community taking part. Many of these "more developed" products fall outside of the jurisdiction of the forest department. They are managed as agricultural commodities and are subject to policies that are designed for agriculture.

Other cases show relatively low potential as development tools due to their limitations on various aspects. There are strong technical or instituional barreirs that prevent more intensive managemnt. The products therefore tend to be treated more as "fall-back" commodities, managed by poor people who have low opprotunity costs. Others, such as Gaharu, have high value per unit, but because they can not be managed are treated as open access resources to be mined. They may have value in capital generation...

1. The typologies of NTFPs utilization and management in Indonesia vary considerably, however, they can be classified into three main categories, i.e.:

2. Government interventions to support NTFPs should not be too focussed on regulations to hinder counter productive effects. Supports should be directed on investments and promotions to stimulate community participation on sustaining the production.

3. Technology or processing is not a dominant factor on developing the NTFPs as long as the required sufficient condition is not available. These sufficient condition includes:
   - Conducive government interventions that should not be focussed on regulations, instead of investments and promotions.
   - More rational economical benefits to the community to stimulate people participation to domesticate the products for commercial purposes.
   - More fair and open market system (more transparent market information and eliminating trade barriers).
   - Better transportation infrastructure for better accessibility to potential markets.

4. Domestication of commercial NTFPs is necessary to sustain production. Dependence to forest resource for commercial production requires very careful production planning which in general is difficult to be implemented.

5. Research and development project supports for NTFPs should be directed to the needs. For this purpose, the understanding to the nature of NTFPs should be done at early stage. This typology study may contribute on selecting the appropriate government intervention alternatives.

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