A Methodology to Analyze Divergent Case Studies of Non-Timber Forest Products and Their Development Potential

Manuel Ruiz Perez and Neil Byron

ABSTRACT. Debate currently rages over the development potential of Non-Timber Forest Products (NTFP) in tropical forests. Proponents of particular "solutions" can refer to evidence (case studies, data) which tend to support their interpretation of events and relationships. Recommendations thus frequently depend on how data are classified and interpreted. Inaccurate or incomplete classification leads to defective subsequent theories, models, and recommendations. We present a method forclassifyingvery divergent case-study data, and some initial results as a basis for general understanding of key factors that influence a given result. Crucial issues determining outcomes of NTFP development include the nature of government involvement, distribution of property rights, the ability of local people to claim and enforce such rights, market transparency, and pressure on the resource. This paper concludes with suggestions for further testing and development of the methodology. FOR. SCI. 45(1):1-14.

Additional Key Words: NTFP, multivariate analysis, case characterization, development potential.

AFTER WORLD WAR II, forestry attention centered on theproductioncapabilitiesofforestsforcommercial timber, particularly in tropical forests. For 3 decades the actual and potential roles of the multiple products and environmental services offered by forests were virtually ignored. The technocratic approach to natural resource management overlooked and frequently even despised the traditional knowledge and customary rights of people who lived in and around the forests extracting different resources from them (Saxena 1997). The consolidation of old colonial rules or the establishment of new laws asserting state rule over "empty,free"forestlandsconsecrated thissituation(Dargavel et al. 1988, Bergeret 1995, Buchy 1995). Thus three themes now considered extremely important, namely people's livelihoods, environmental functions, and the broader economic roles of most tropical forests, were assigned very low priority, if they were considered at all.

However. by the late 1970s it became apparent that a forestry dissociated from people was producing major failures, thus giving birth to the first social and community forestry programs (Westoby 1975, FAO 1978). In this context, the role of "minor forest products" (we shall call them Non-Timber Forest Products, NTFP) attracted renewed attention (Arnold and Jongma 1978). The conservation community had started to recognize the need to address social issues if a conservation agenda was to be successfully implemented (IUCN 1980). This led to proposals to promote what was considered to be a less damaging use of the forest, based on NTFP (Myers 1988, Allegretti 1989, Fearnside 1989, Richards 1993). At the same time some forest dwellers' organizations became aware of the potential synergy that this could offer to their own agendas (COICA 1989, Mendes 1992, Conklin and Graham 1995. Redford and Mansour 1996).

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Formerly discrete and unconnected paths started to merge in the late 1980s. with initiatives coming from one sectoral perspective expanding their constituency and potential impacts by assimilating elements of other interest groups. Hence, human rights advocates and development assistance NGOs becamemoreenvironmentallyconsciousforexample, moving towards the recently established green marketing arena.' Meanwhile, conservationists attempted to bridge gaps with local communities' interests after realizing that, in the political debate, "to be pro-saving plants and animals but unmindful of the plight of poor rural communities" was an untenable position.* The somewhat flexible "sustainable development" concept emerging as an internationally accepted objective (Brundtland 1987, Poore et al. 1989) gave credibility to the growing consensus that conservation, development, and socio-political rights were all facets of the same global goal.

Numerous meetings, publications, and projects focused on NTFP burgeoned during the late 1980s and early 1990s (see for example Cultural Survival 1989, Nepstad and Schwartzman 1992, Plotkin and Famolare 1992. Redford and Padoch 1992. Hladik et al. 1993. Ruiz Pérez et al. 1993). A common proposition arising from them was the need to find ways to make tropical forests economically attractive to local populations. It was assumed that with added economic incentives, people would stop deforesting for alternative uses or would strengthen their resolve against other deforesting agents. NTFP were suggested as one of the best ways to raise the income that people derived from forests.

Nonetheless, consensus was far from complete in both philosophical and practical questions. People's participation was considered a sine yua non for the success of NTFP-based development activities (Westoby 1987). However, its implementation has ranged from complete devolution of land titles andmanagementrightstoindividualsorcommunities(Carter 1996, Hobley 1996. Wily 1997). to a shared responsibility between the state and community-based institutions (Gilmour and Fisher 1991, Poffenberger and McGean 1996). or a mere consultation process in which forestry departments or similar state institutions have the final management power (Saxena 1997).

Conservation and development objectives were seen by some authors as intrinsically linked and mutually reinforcing (IUCN et al. 1992, Wells and Brandon 1992, Clay and Clement 1993). While recognizing the potential, other authors (Browder 1992, Pendelton 1992, Salafsky et al. 1993, Freese 1996. Peters 1996) warned against the risks of over-harvesting, the limits of a long-term development based on NTFP. as well as possible failures due to inappropriate

extrapolation of local conditions to other places. Some authors (Redford IYY2, Redford and Stearman 1993) considered matching these objectives to be a mirage that would unavoidably lead to long-term conflicting goals.

Linked to this discussion, there has been an ongoing debate on different ways to attain a balance between conservation, socioeconomic development, and political rights. A key issue is to what extent economic improvements can lead to gaining further control of natural resources management bylocalpopulationsandto theultimate goalofsecuringlongterm economic and political rights.

A "market approach" maintains that improving prices to producers, adding value locally, and organizing people to achieve these aims, while increasing people's interest in conserving forests, can also lead to the long-term economic and political rights goal (Cultural Survival 1989, Clay 1992, Nepstadand Schwartzman 1992, PlotkinandFamolare 1992, Evans 1993, Stiles 1994). In contrast, a "political empowerment approach" tends to consider securing economic and political rights as the first and main step. For the proponents of the latter approach (Gray 1990, Carrie 1993, Dove, 1993, 1994, 1995). the NTFP market-based initiatives without a previousfirmpolitical frameare atbest marginalandat worst can be counterproductive, leading to appropriation of valuable resources by the already existing elite and therefore reinforcingtheactual dispossessionofforest-dwellingpeople.

Finally, from the point of view of activism and political action, the link between conservation and development has been perceivedasastrategicalliance(Allegretti 1989,COlCA 1989, Mendes 1992). as a short-term tactic in the context of independent (although not necessarily conflicting) objectives (González 1992, Conklin and Graham 1995) oreven as occasional neocolonial attempts (Cox and Elmqvist 1997).

Three main reasons underlie the different views in the debate. The first relates to the concrete, often locetion-specific, experience upon which a position is established or defended, The very large variety of situations encountered when studying the relationship of people with forests means that different observers will almost certainly find different results. A second reason relates to differing analytical perspectives. This could refer to professional backgrounds, political viewpoints, or action-oriented responses. A corollary of this is the frequent use of a partial set of criteria or variables to define and justify a given position. Finally, the time frame involved determines a focus on current status, short term-achievements, or long-term processes, each of which may suggest divergent conclusions.

This debate has far-reaching implications that transcend academic interest, because of the policy- and action-oriented agendas of government institutions and NGOs at both the national and international levels, with different perspectives on the potential for NTFP-based conservation and development. They range from the World Bank Pilot Project for Brazil to local NGO initiatives to promote new tree species of economic interest in northern Sumatra. and from setting up a village cooperative in Uttara Kannada in India to devolving land rights to communities in Zimbabwe.

This is the case of Cultural Survival, that created Cultural Survival Enterprises in 1989 (Clay 1992). Local development organizations like Appropriate Technology International incorporated conservation aspects into their development projects (Hyman 1996).
Several international environmental NGOs, like Conservation International, IUCN, and WWF, initiated projects (generally termed Integrated Conservation and Development Projects) aimed at supporting local communities engaged in activities assumed to be environmentally beneficial (see Conservation International, no date, Biodiversity Conservation Network 1997).

Table 1. Cases relected for the comparison

Country	Case	Product	Experts consulted
Indonesia	East Kalimantan	Rattan (*Calomus* spp.)	B. Nasendi
India	Bihar	Sal seeds (*Shorea robusta*)	*N.C. Saxena*
Sudan	Southern Belt	Gum arabic (Acacia sewgal)	M. Gasim Muss, C.T.S. Nair
Zimbabwe	CAMPFIRE	Large wildlife	B. Campbell
Botswana	Okavango Swamps	Palm fiber handicraft (*Hyphaene* spp.)	B. Campbell, A. Cunningham, F. Taylor
Brazil	ACE	Brazil nut (*Berrholleria excelsa*)	M. Almeida
Guatemala	Petén	Chicle (*Manilkara zapora*)	M.A. Palacios
Cameroon	Humid forest zone	Kola nut (Cola acuminotn)	O. Ndoye
China	Anji County	Bamboo (*Phyllostachys heterocyclo*)	Fu Maoyi, Zhong Maogong

There is thus an urgent need to throw light on this discussion. We believe that rather than offering categorical answers to some of the propositions mentioned above, a more fruitful approach is to analyze such questions as to *what extent, and under what conditions, can NTFP exfraction, use, and marketing help the development of forestrelatedpeople and rhe consrrvarion offorests?* The literature suggests four main types of conditions generally thought to favor development of forest-related people:

1 clear land titling and/or access to the resources that would promote people's direct involvement and long-term perspectives

2 good natural resources endowment (both qualitative and quantitative) that would allow a wide range of options for harvesting and use of different products

3 market demand that could be satisfied by sustainable harvesting of natural forests or plantations that would guarantee long-term supplies

4 suitable policy and legal environment for management, processing, and marketing NTFP

However, there is no accepted framework of interdependence and causal links among these conditions, nor any consensus on which ones have a key role and would warrant focused intervention in a given set of circumstances.

In this context, a possible way ahead is to develop typologies of cases based on a large number of variables. These could produce frameworks that would contain the divergentandspparentlycontradictorypositions, outlined above. as special cases depending on context. Such frameworks would be greatly enhanced by an understanding of key contextual variables that influence which of the possible outcomes will prevail in any specific instance.

We outline below a methodology based on multivariate analysis techniques that could he used to find patterns, to develop typologies, to propose key context variables, and to analyze their relationships with observed conservation and development outcomes. A number ofexamples ofcommercial extraction drawn from the universe of case studies, have been compared in order to explore their commonalities and differences, as well as the circumstances that contribute to their particular outcomes.

Methodology

A comparative study can be based on a number of cases that can be defined using the same variables measured with standard criteria and units. In so doing, a base of information will be produced that takes the form of a matrix of objects (cases) by attributes (variables). Exploratory data analysis can then be used to outline patterns, gradients of variability, clusters of cases, and key variables associated with them. Exploratory data analysis is also an excellent tool to formulate hypotheses to be tested in the field.

Comparison of cases of the commercial extraction of NTFP and the resulting typology requires preparation of a case-study matrix. A first issue that arises when preparing such a matrix is the definition of a case or, in other words, whatiseachoftheobjects tobecompared "acaseof?"Inthis study, each case is defined by the commercial harvesting of one forest product bypeoplein agivenarea within acommon set of socioeconomic, environmental, and political conditions. This common set of conditions plus the reference to a single product per case allows each of them to be treated as an internally homogeneous entity. The choice of a single, commercial productisaconsciouseffort toreduce variability so that the potential of the proposed methodology can be explored within a workable set of conditions."

It is obvious that focusing at a low hierarchical level of analysis (e.g., community or household) would show heterogeneity and potentially large differences within a given case. Therefore, it is important to fix the scale of analysis and to select the variables so as to define possible different states betweencases, butonesinglestateforeachcase.Casesin this study were selected to allow for a diversity of products and conditions while maintaining acompatible scale. As aresult, nine cases were selected for analysis (Table I).

Five criteria were used to select the cases:

● existence of ongoing commercial extraction of NTFP

● coverageofregional variability, withcasesfromthethree main tropical regions

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[3] In many cases people will obtain a variety of products from the forest, both for subsistence and commercial uses. A possible way to incorporate this is by considering a variable that records the degree of multiple extraction of forest products. This was actually suggested by one of the referees and we have added it to the original matrix, which already contained information related to the importance of the contribution of the product to the total household economy (see Table 3).

- contacts with experts who could rate the cases

- degreeofdirectfamiliarityoftheauthors witheachofthe cases

- accessibilityofkeyreferences thatcould beusedtocheck ratings and to resolve possible discrepancies

The cases correspond to relatively homogeneous geographical zones or to administrative units below the country level but above the village or district level. The range of variability in both the number of people engaged in the activity(10^3-10^4 [4] people) and the area in which it is carried out (10^5-10^6 [6] ha) is one order of magnitude. In the context of the huge variability in the scale of forest management units (from a few hectares run by one household to millions of hectares used under different arrangements by many clusters of communities or by large enterprises), the variability of the proposed cases could be considered acceptable for the purpose of this article.

The definitions of attributes were prepared progressively. First, the major factors that characterize a given situation were identified based on a literature review of theories and models related to harvesting and use of NTFP (Falconer and Arnold 1989, Gunatilake 1994, Arnold 1995, Ros-Tonen et al. 1995, Townson 1995, Ruiz Pérez and Arnold 1996, Wickramasinghe et al. 1996). This review suggested that the key factors influencing the relationships between people and forests relate to historical aspects (Dargavel et al. 1988, Hanson 1992. Coomes 1995. Potter 1996). community organization,recognitionoflegalrights, andstatepolicies(Peluso 1992a, Dove I993, 1994, Ostrom 1994), market features and technology (Padoch 1990, Anderson and Ioris 1992, Homma I992, Panayotou and Ashton 1992, lqbal 1993, Dufournaud et al. 1995). cultural aspects (Balée 1989, Garine et al. 1993, Grenand and Grenand 1996). as well as the nature of the product, its availability, environmental impacts of its extractionandthetypeofproductionsystembeingused(Godoyand Bawa 1993, Godoy et al. 1995. Peters 1996).

Having identified these key factors, the next step was to define them by an extended list of attributes. A total of 30 attributes were proposed by the authors based on a literature review (Table 2). In order to complete the matrix of cases by attributes we sought the cooperation of recognized experts for each of the cases. We benefited initially from the selected panel of experts that attended the FAO/Government of Indonesia consultative meeting on NTFP in Yogyakarta (Indonesia) in 1995 (FAO 1995). This was supplemented by discussions with colleagues from different tropical countries with whom we have collaborative research or other types of cooperation (these experts are also listed in Table I).

Ideally. a meeting of all experts involved in the scoring of attributes to harmonize criteria and to agree on the range of variability would have been desirable. However, this was only possible with a subset of the experts. The necessary standardization of criteria and ranges of values was therefore completed by the authors of this article, who discussed personally with each of the experts the objectives of the analysis, the criteria used to select the attributes and a detailed explanation of each attribute, as

well as the range of variability expected for the whole set of selected cases. Following the recommendations of a referee, two new variables were added during the review of the manuscript and scored by the authors based on our direct knowledge and bibliographical overview: an estimate of the importance of multiproduct harvesting and the presence of competing uses.

As a first approximation, experts were asked to rate each attribute for their particular case of expertise with three classes that took the general form of low, medium, and high. The expert was then asked for a possible qualification of two intermediate stages, low/medium and medium/high. This allowed for a revision of the criteria and a refinement of the rating, extending it to five classes. In order to carry out the numerical analysis, each class was subsequently converted into a value ranging from I (low) to 5 (high). The matrix of numerical values for the ordinal variables [4] is shown in Table 3.

Three cases (Sudan, Botswana, and China) were rated by more than one expert[5] The degree of coincidence between experts evaluating the same case can be used as a proxy for the reliability of the scoring and, thus, for the robustness of the methodology proposed. There were differences, or 21% of the total 90 scores for the 3 cases. These can be separated into II "marginal" divergences of only I rating-unit difference (e.g., from medium-low to medium), 1 "important" divergences of 2 rating-unit differences (e.g., between medium and low) and I "major" divergence, in this case of three rating-unit differences (between high and medium-low rating). The China case, with 8 divergences (6 of them marginal) showed no consistent bias in the direction of scoring variations by the two experts. For the other two cases, with fewer but more significant divergences, the experts were consistent in their direction of the scoring when they diverged.

If we discard the marginal divergences, we conclude that only 9% of the attributes show significant differences in rating criteria amongst the experts consulted. In case of divergence, experts tended to show a consistent tendency to rate higher or lower than other experts on the same case, what indicates an internal consistency in the relative values among variables for a given case. Moreover, no one attribute was rated with significant differences in all three cases. In the context of this article, we consider these divergences as indicating afairlyconsistent scoring approach. In the process of preparing the matrix, divergent scores were averaged and, when required, rounded up to the next highest.

The cases were later rated by the degree of success in meeting conservation and development objectives. This rating, suggested also by one referee, was based on a

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4 Different values of an ordinal variable indicate different ranks, but say nothing of the magnitude of this difference. An ordinal variable has more information than a qualitative assessment typical of nominal variables, but less than a fully quantitative (interval or ratio) variable. Some similarity indices and statistical tests can be used for ordinal, interval, and ratio variables (Belbin 1994).

5 The Botswana case was initially scored jointly by Campbell and Taylor (recorded as a single expert's scoring), and subsequently by Cunningham. For the discussion in the following paragraph we consider these to be two different scores.

Table 2. List of attributes used in the characterization of the eases

Key factor	Attribute	Description
People's organization	Level	Degree of organization of producers
	Age	Age of the organization
State involvement	Intensity	Degree of state involvement in NTFP managemeot, processing, and trade regulations
	Quality	Quality of state-sponsored NTFP regulations
Use/tenure rights	Legal recognition	Legal recognition by state of use/tenure rights of collectors
	Knowledge of legal rights	Collector's knowledge of their legal rights
	Barriers to entry	State or community barriers to control newcomers entering activity
	Enforcement by state	Degree of state enforcement of existing laws
	Existence of traditional laws	Existence of traditional laws to regulate the activity
	Relation state-traditional laws	Relationship (conflict, neutral, mutually supporting) between state laws and traditional laws
Social attitude	General	General attitude (hostile, apathetic, supportive) of society towards the collectors and their activities
	Specific interest groups	Degree of support by specific interest groups (e.g., NGOs, traders) other than collectors
Household economy	Total economy	Contribution of product gathering to total household economy
	Cash economy	Contribution ofproduct gathering to household cash generation
	Multiple NTFP	Degree of multiple NTFP harvesting
Technology	Intensity of labor	Intensity of labor required for collection/processing NTFP
	Training/skills	Required skills/training of collectors
	Group activity	Degree of collective gathering
Marker features	No. of buyers	Number of intermediariesiwholesale traders
	No. of sellers	Number of producers selling
	Transparency	Public access to information on the main steps in market chain
	Interlocked	Financing of collectors by traders through advancing resources
	Relevance international markets	Importance of international markets in total trade
	tncome elasticity	Income elasticity of demand (national or international depending on importance of exports)
Nature of the product	Perishability	Perishability of the product
	Transformation to end product	Degree of transformation from raw to end product
	Physical substitution	Degree of physical substitutability by other products or synthetics
Production system	Origin of the resource	Importance of wild gathering versus plantation/cultivation
	Seasonality	Length of the producing season
	Alternative uses	Existence of competing land uses
Environmental effects	On the resource used	Effects on the population of the resource being exploited
	On the rest of ecosystem	Effects of harvesting that product on the rest of the forest ecosystem

literature search and consultation with some of the above experts.[6] It followed a similar, but independent, approach to the one outlined above. Each case was rated from one to five for ecological sustainability, contribution to household economy. and political empowerment as described in the bibliographical sources consulted. An aggregate index was then calculated by adding the three scores. This index ranges from 3 in the case of the lowest score in each component, to 15 in the case of the highest score for each component. Table 4 presents the aggregate scores as well as the sources used in each case.

Analysis of Data

The matrix ofattributes was then studied with multivariate analysis techniques using the PATN (Pattern Analysis) pack-

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[6] An attempt was made to consult all the experts, but we only received comments for four of the nine cases.

Table 3. Matrix of attributes by cases.

	Indonesia	India	Sudan	Zimbabwe	Botswana	Brazil	Guatemala	Cameroon	China
Level of organization	I	I	2	5	3	5	5	I	5
Age of organization	I	5	5	3	3	2	5	5	4
Intensity state involvement	5	4	5	4	I	2	4	I	5
Quality state involvement	I	2	3	5	3	4	4	4	5
Legal recognition	I	3	5	5	2	4	4	4	4
Knowledge legal rights	I	I	5	5	2	5	5	5	5
Barriers to entry	3	3	4	I	I	I	2	3	3
Enforcement by state	I	2	4	5	I	4	5	I	5
Existence wad. laws	5	5	5	3	3	I	I	5	I
Relation state trad. law	I	3	4	5	2	3	2	4	4
General social attitude	I	2	5	5	3	4	3	4	5
Specific interest group	4	4	3	5	4	3	5	4	5
Total economy	2	I	3	I	3	3	2	I	3
Cash economy	4	3	5	I	5	4	4	2	4
Multiple NTFP	3	3	I	2	2	4	5	5	I
Intensity of labor	3	3	2	I	4	3	3	5	4
Training/skills	2	I	I	5	3	I	3	I	5
Group activity	3	I	I	5	4	2	I	2	2
Buyer	2	3	5	2	3	1	I	4	3
Seller	4	5	5	I	5	3	5	5	5
Transparency	I	3	5	5	3	4	5	3	4
Interlocking	4	5	5	I	I	2	5	I	I
Relevance intemat. market	4	I	4	5	3	4	5	3	3
income elasticity	4	I	2	5	4	3	2	4	4
Perishability	I	5	I	I	I	3	3	2	2
Transform. to end product	5	I	4	2	4	3	4	I	4
Physical substitution	3	4	3	I	3	4	5	2	4
Origin of resource	2	5	3	5	5	5	5	3	I
Seasonality	4	I	4	5	5	2	3	3	3
Competing uses	4	2	I	2	I	5	3	4	I
Effects on resource used	3	4	I	I	5	3	I	3	I
Effects on rest ecosystem	2	2	I	I	3	I	I	I	2

Table 4. Assessment of the outcomes of NTFP commercialization in the cases studied.

Case	Aggregate score	References
Indonesia	6	Peluso 1992b, Dove 1993, 1994, Safran and Godoy 1993, Sicbert 1993, Nasendi 1994. Stockdale 1994, Pumama and Prahasto 1996, Bennett 1996
India	4	Commander 1984, Government of India 1984, Levine et al. 1986, Nadkami et al. 1989, Arnold et al. 1990, Gadgil 1991, Saxena 1997
Sudan	8	Awouda 1988, Pearce et al. 1990, Gum Arabic Co. 1991, Larson and Bromley 1991, Barbier 1992, Hanson 1992, Anderson 1993. Jamal and Huntsinger 1993, Fagg and Stewart 1994
Zimbabwe	I2	Martin and Thomas 1991, WWF 1993, Gibson and Marks 1995, Mctcalfe et al 1995, B. Child 1996, G. Child 1996, Campbell et al. 1997
Botswana	7	Terry 1984, Cunningham and Milton 1987, Cunningham 1991, Cunningham 1992, Terry and Cunningham 1993
Brazil	I3	Mori and Prance 1990, Afsah 1992, LaFleur 1992, Mcndes 1992, Almeida 1996
Guatemala	12	Schwartz 1990. CATIE 1992, Reining and Heinzman 1992, Salafsky ct al. 1993, MAGA 1994, Palacios Mender 1995
Cameroon	8	Nkongmeneck 19X5, Ministére de l'Environnement et des For& 1995, Ndoye et al. 1997, Ndoyc and Ruiz Pérez 1991
China	I3	AFB 1993, Zhang 1995, Zhong et al. 1995, 1997, Ruiz Phez et al. 1996

age (Belbin 1994). Given the ordinal nature of the data, a Bray-Curtis index was used to calculate the similarity matrix. Its general expression is:

$$D = (\Sigma \mid d, \; djk \mid / \Sigma ((\; d_{ik} \; +$$

where d_{ik} = data value of the i case and k variable.

This index performs well with different types of data, having more robust monotonical and proportional relationships with distances in the multidimensional space defined by the variables than classical indices like Euclidean, Manhattan, or Chi-square distances, especially when dealing with large differences in similarity (Faith et al. 1987). This index is suitable for ordinal data like those contained in the attributes matrix (Belbin 1994).

Ordination techniques are aimed at finding a small number of variables that can account for a large proportion of the information contained in the data matrix. Two ordination techniques were used: Principal Co-ordinates Analysis and Multidimensional Scaling. Principal Co-ordinates Analysis (PCoA) allows for a linear combination of the variables for each axis accounting for decreasing proportions of variance. Itresembles thePrincipal Components Analysis (PCA) methodology, with the advantage that PCoA can handle any similarity matrix using a Cower transformation algorithm (Cower 1967). The PCoA therefore is suitable for a wider set of data, particularly where the standard correlation matrix used by the PCA is not suitable.

However. PCoA hassimilarproblems to PCA, namely the trend to overrepresent the larger values of dissimilarity, compacting the distribution of highly similar cases.' An option toovercome this problem is Multidimensional Scaling (MS). This ordination technique assumes an initial configuration of cases in a number of dimensions previously defined by the user. An iterative process of calculating the similarity between cases, formulating the regression, calculating the estimated similarity based on the regression values, and rearranging the initial configuration is followed until an acceptable"stress"(mismatch between actual andcalculated similarities) is reached (Kruskal and Wish 1978, Coxon 1982). The main disadvantage is that the number of dimensions has to be fixed in advance and there is no estimate of how much variability is represented by each of them, although the "stress" of the fitness is an indication of how well the analysis has performed overall.

Cluster analysis to classify cases was conducted using several similarity indices (Bray-Curtis, Euclidean Indices, Correlation, and Chi-square) and grouping algorithms. They show consistent results for the split in two main groups,[8] although there is some divergence about where to cluster the case of Sudan and. at lower-level groupings, with the cases of Chinaand Sudan. We have thereforeselectedone ofthe mast standard methods based on agglomerative hierarchical techniques with Euclidean distance matrix and Unweighted Pair

Group with Mathematical Average (UPCMA) grouping algorithm (Swath and Sokal, 1973, Everitt 1993). A Minimum Spanning Tree was used to reveal the interconnections and distances between cases. Regression models and ANOVA tests were conducted to study the relationship between assessment of outcomes and the results of the ordination and cluster analysis. The combination of these techniques offers a comprehensive exploration of the variability and relationships between cases, variables, and assessment of outcomes.

Discussion of Results

The PCoA and MS (for three dimensions) show very similar results.[9] Ten of the 12 variables that have more weight (positive or negative) in the definition of axes I and II are the same in both analyses. The ordering of cases is the same, and their coordinates show a very high correlation (0.97 for the first axis of PCoA and MS, and 0.9 I for the second axis). The third axis shows some departure, as expected, but there is still a high correlation (0.72: $P = 0.02$). With these results, and given the advantage of knowing the variance explained by each axis in the PCoA, we haveopted tofocuson thisanalysis in the following section.

The results are shown in Figures I and 2. The first three axes of the Principal Co-ordinates Analysis account for 71% of the total variance of the matrix. The nine cases are ordered along gradients characterized by the variables that contribute most to theirdefinition. Axis I (40% of variance) stresses theimportance of the political framework (represented by the quality of state involvement). It also shows the role of the collectors' knowledge of their legal rights, the existence of support groups, the level of people's organization, the transparency of the market, the intensity of labor, and the pressure on the resource and the whole forest ecosystem as key factors that contribute to case differentiation along this axis. It is worth noting that high-quality state interwntion seems not to be associated with (but *is almost* divorced from) the existence of strong traditional tights. An extreme case occurs when poor quality state interventions act to frustrate strong traditional culture and rights.

isdefinedby theageofpeople's organization, recognition of legal rights, and features of the products (scasonality and perishability), as well as income elasticity for their demand. Two of the variables with high contributions to the first axis, market transparency and pressure on the forest ecosystem, also appear in this second axis. In contrast. Axis 111 (12% of variance) emphasizes activities (intensity of labor and transformation to end product), interlocked markets, the role of gathering in the household cash economy, the intensity of state involvement, and the importance of multiple extraction of NTFP.

Linking the results of the ordination analysis with the assessment of the degree of success can help shed light on thequestionofwhichcontext variablesareassociatedwith success. This has been done with a multiple regression

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[7] This is partially offset by using the Bray-Curtis index.

[8] The nearest neighbor and Centroid algorithms based on Euclidean distances produced noninformative dendrograms where halfofthe cases were not linked to any group.

[9] The actual stress obtained with the MS was 0.08, which can be considered a satisfactory level of fitness.

[10] Ordinary Least Squares; since the coordinates of the axis are themselves estimated with error, we have used White's Robust Standard Error (Greene 1997) for the calculation of the T-Statistics as suggested by one referee.
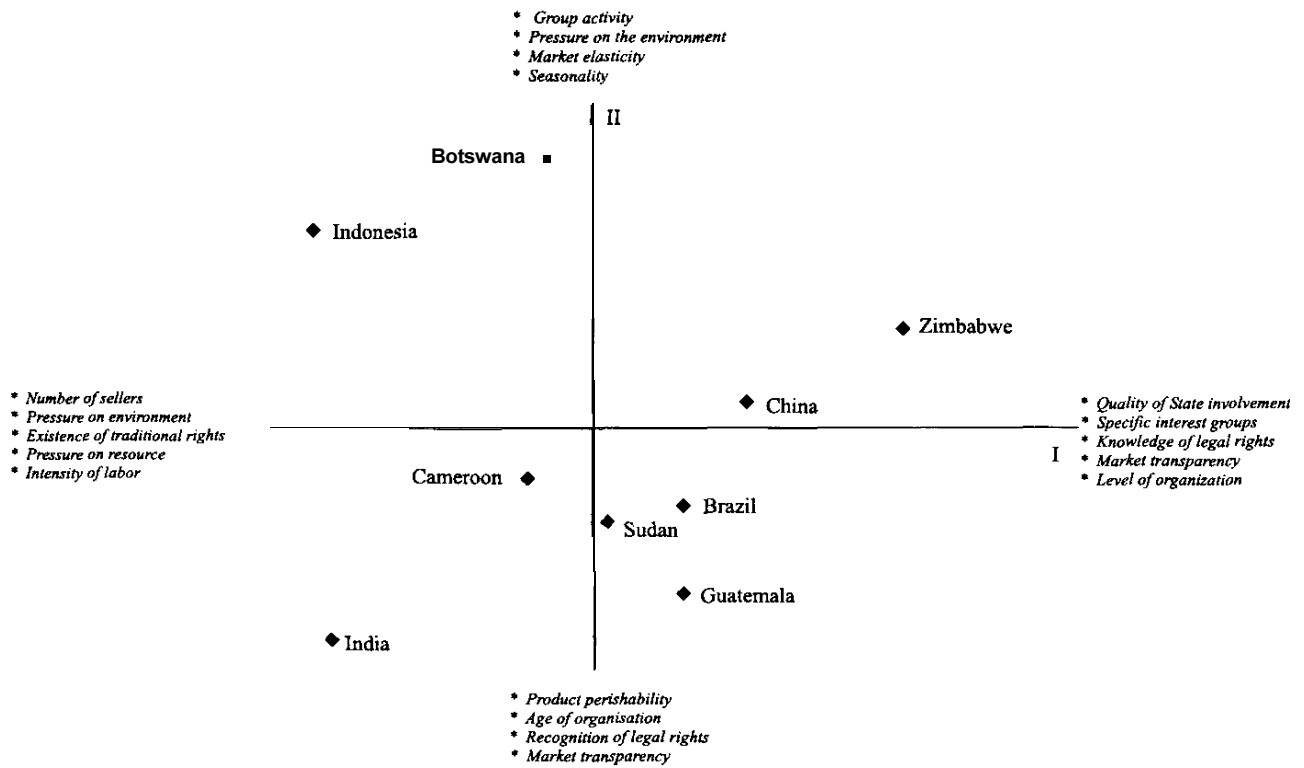
* Group activity
* Pressure on the environment
* Market elasticity
* Seasonality

II

Botswana ■

◆ Indonesia

◆ Zimbabwe

◆ China

* Number of sellers
* Pressure on environment
* Existence of traditional rights
* Pressure on resource
* Intensity of labor

Cameroon ◆

I

* Quality of State involvement
* Specific interest groups
* Knowledge of legal rights
* Market transparency
* Level of organization

◆ Brazil
◆ Sudan

◆ Guatemala

◆ India

* Product perishability
* Age of organisation
* Recognition of legal rights
* Market transparency

Figure 1. Projection of the nine cases in axes I and II of the Principal Co-ordinates Analysis.

* Intensity of labor
* Pressure on the environment
* Origin of the resource
* Importance of multiple NTFP

Cameroon ◢   III

◆ Brazil

Botswana ■

◆ India

* Number of sellers
* Pressure on environment
* Existence of traditional rights
* Pressure on resource
* Intensity of labor

◆ Zimbabwe

I

* Quality of State involvement
* Specific interest groups
* Knowledge of legal rights
* Market transparency
* Level of organization

◆ China
◆ Guatemala

◆ Indonesia

■ Sudan

* Intensity of State involvement
* Importance for cash economy
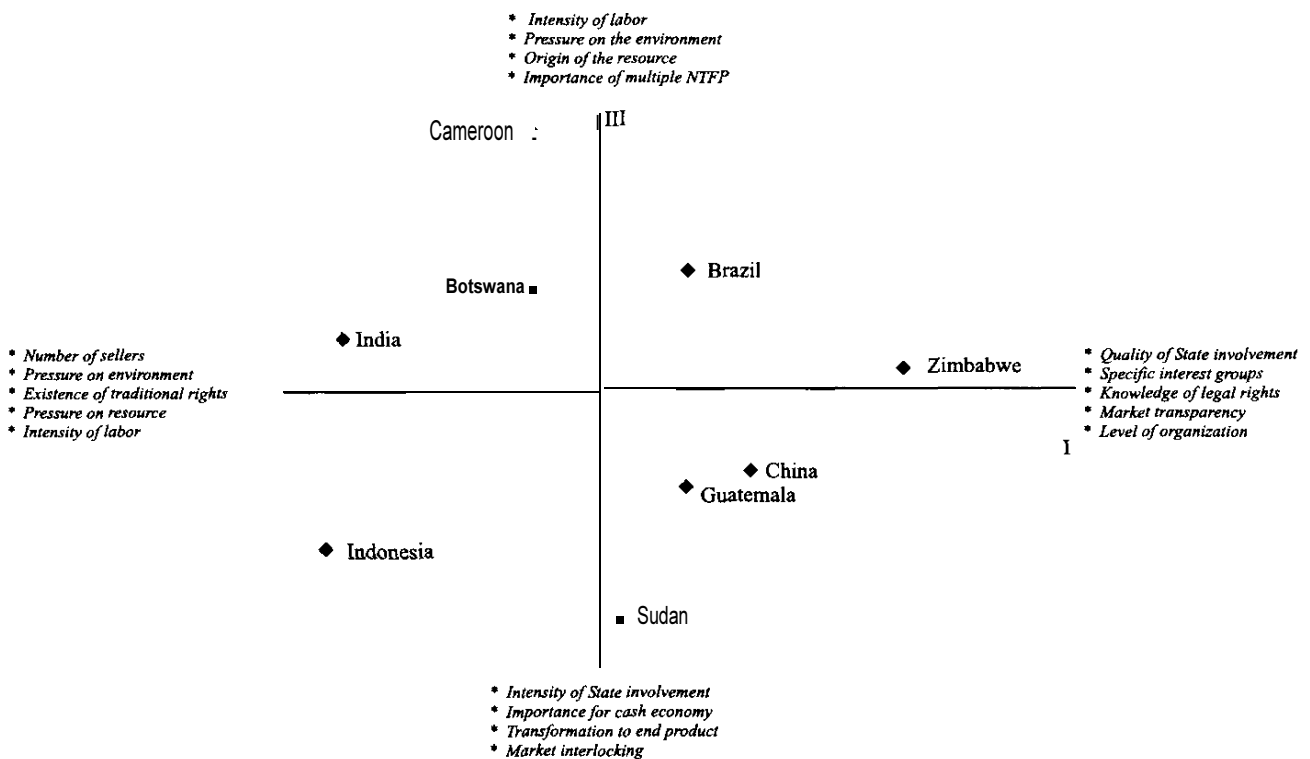* Transformation to end product
* Market interlocking

Figure 2. Projection of the nine cases in axes I and III of the Principal Co-ordinates Analysis.

Table 5. Multiple regression of assessment of outcomes on the first three axes of the PCoA.

Variable	B cocfiiciem	Beta coefficient	T-value	Significance
Axis I	24.941	0.8X0	5.325	0.003
Axis II	-3.281	-0.079	0.590	0.581
Am Ill	-1.526	4.030	0.220	0.835
Constant	9.222		18.770	0.000

Note: R square = 0.782
     Adjusted R square = 0.651
     Wald Chi square P = 0.0009

of the assessment on the positions of the cases along the first three axes of the PCoA (Table 5).

The regression shows that the first axis has the highest B and beta coefficients and T values; in fact this axis is the only one that has a statistically significant relationship with the assessment of outcomes. This can be emphasized with a simple linear regression of outcomes on the coordinates for axis I (Figure 3). [11] The high significance of the regression (R-square = 0.774; adjusted R square = 0.742; F = 24.036; significance F = 0.0017) suggests that the combination of variables that define the gradient represented by axis I should be considered as key context variables in relation to the assessment of outcomes in the nine cases studied. These are also the variables that show the highest absolute Tau Kendall correlation values (specially appropriate for ordinal data) with the assessment of performance, confirming the interpretation above.

Another important issue[12] is the identification of the less relevant variables that do not contribute to case differentiationandlor that show littlerelation with thedegreeofsuccess. We compare the variables that contribute least to the main

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[11] The coordinates of the cases in the second axis of the PCoA show a quadratic relation (although below the level of statistical significance) with the scores of the performance assessment matrix.
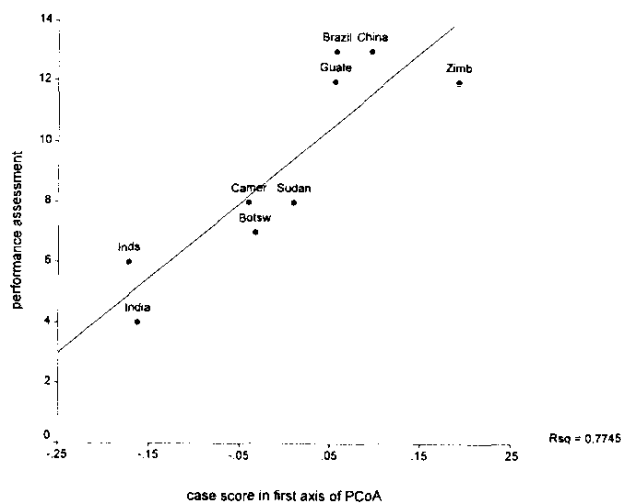[12] A question raised by one referee of this article.

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ordination axis with those that have the lowest absolute value of Tau Kendall correlation of performance. Three variables are among the five lowest for both values: intensity of state intervention, transformation to end product and origin of the resource.

The insignificance of the intensity of state intervention (Tau Kendall = 0.032, P = 0.912; contribution to axis I = 0.012) contrasts with the prominence of the quality of state intervention (contribution to axis 1 = 0.865, Tau Kendall = 0.750, P = 0.009). This seems to indicate that the delicate balance of people's relations with forests can be altered by relatively moderate interventions. A corollary of this is that, in order to promote NTFP-based development, vigorous state regulations are not required but any intervention must set up the right conditions.

A surprising result that contradicts the emphasis given to adding value in local development projects is the low importance ascribed to the degree of transformation needed from raw to end product (Tau Kendell = 0.000, *P* = 1.000; contribution to axis I = 0.002). One interpretation is that the potential for adding value locally might not be a sufficient or even necessary condition to promote NTFP-based development, and that its usefulness will depend very much on other factors(suchasnatureoftheproduct, technology,andmarket organization). Preliminary assessments of initiatives aimed at checking in practical terms the viability of this approach. like the already mentioned Biodiversity Conservation Network, seem to confirm the validity of the above result.

Finally, the low value placed on the origin of the resource (Tau Kendall = 0.000, *P* = 1.000; contribution to axis I = 0.133) seems to indicate that the key issue is to have a regular source of supply rather than whether it comes from natural forests, plantations or a mixed system.

The cluster analysis separates two main groups of cases (Figure 4), one represented by thosefromlndonesia,Botswana, India, and Cameroon, and another including the cases from Zimbabwe, China, Brazil, Guatemala, andSudan. This grouping represents a split of the three-dimensional space defined

Figure 3. Regression of the performance assessment on the coordinates of cases in the first axis of the Principal Co-ordinates Analysis.
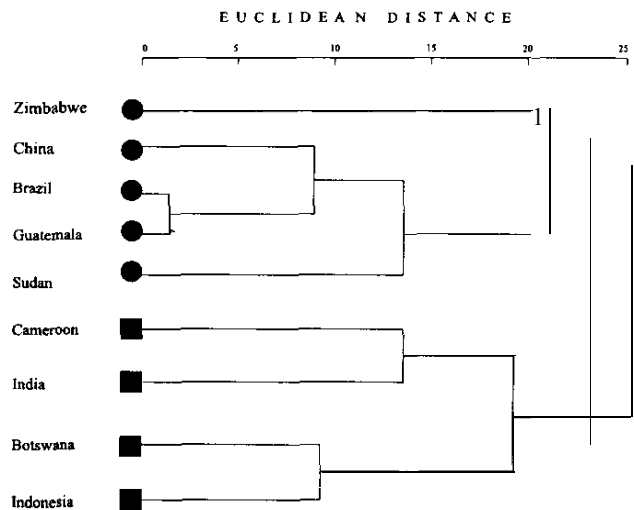

Figure 4. Cluster analysis based in distance matrix and UPGMA algorithm.

by the first three axes of the PCoA, especially by the gradient represented by axis I, as can be seen in Figure 5. Thus, the group formed by the cases of Indonesia, Botswana, India, and Cameroon occupier the space characterized by strong traditional rights that tend to be more opposed or confronted by the state, and a less transparent market with a relatively high number of sellers that exerts a greater pressure on the resource and the whole forest environment. Conversely, the group formed by the cases from Zimbabwe, China, Brazil, Guatemala, and Sudan occupies the space characterized by positive state intervention, farmers with greater knowledge of their rights. more transparent markets, and a wider interest in the society as well as the existence of specific interest groups supportive of their activities.

Group definition at lower levels in the dendrogram would result in additional subdivision of groups, thus differentiating two subgroups in each of the main groups (i.e., Indonesia-Botswana and India-Cameroon for the first group; Brazil-Guatemala, China-Sudan, and Zimbabwe for the second group). This indicates close similarities between the Brazil and Guatemala cases, the separation of Indonesia-Botswana from India-Cameroon based mainly on the features of the products (seasonality, perishability) related to axis II, and the distinctiveness of the Zimbabwe case. However, given the nature of the data and the purpose of the paper we do not elaborate on this level of clustering.

An important question is whether this grouping reflects degrees of performance as assessed in Table 4. This can be examined using an ANOVA test to compare the rating of outcomes between the two main groups. The test shows a highly significant difference ($F= 17.158$; $P= 0.004$) indicating again the existence of a strong relation between assessment of outcomes and the two main groups of the cluster analysis, that seem to separate lower from higher performance cases.

Finally, in order to visualize the relative position of the nine cases in a multidimensional space defined by all the attributes, a minimum spanning tree (MST) linking the cases has been added in Figure 5. The MST reinforces the relationships between cases as shown by the ordination and classification analysis. It clearly indicates the extreme positions of the CAMPFIRE in Zimbabwe versus rattan in Indonesia and
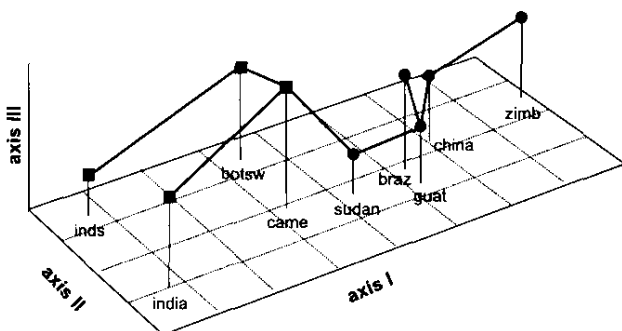

Figure 5. Three-dimensional scatterplot of the first three axes of the Principal Co-ordinates Analysis showing the Minimum Spanning Tree among cases. Symbols are used to separate the two main groups of the cluster analysis. The scale of each axis is proportional to the variance explained.

sal seeds in India. Beyond visualizing the range of spread of cases, the MST also helps to illustrate the problems of deriving general propositions and formulating broad recommendations based on particular cases.

Conclusions

The combined analysis shows that the set of cases chosen can be portrayed along a gradient of variability defined to a different degree by each of the attributes. Thus, the combination of the political/policy framework, traditions, level of organization, market features, and pressure on the resources permits a clear differentiation of cases. At the same time, hierarchical clustering techniques help to arrange groups of cases that share similar attributes, frequently resulting in polarizing dichotomies.

The comparison of the results of the multivariate analysis with the assessment of outcomes shows a significant link between both. The grouping produced by the cluster analysis relates clearly to the degree of performance of cases based on the literature review. At the same time, the rating of cases by its performance correlates highly with the first axis of the PCoA.

We conclude that, for the set of cases analyzed, the variables that contribute most to the definition of the first axis of the PCoA could also be considered key context variables that influence the nature of the outcome. Thus, positive state-sponsored regulations that offer clear and well-known rights to people, a harvesting intensity and/or technique that does not put excessive pressure on the resource, a transparent market, well-organized gatherers, and the existence of external support groups have a strong link with cases generally considered as successful. At the other end of the spectrum, state regulations that confront traditional rights and that are little understood by people, a nontransparent market being approached by many individual sellers with poor organization, and a high pressure on the resource are conditions associated with cases where commercial exploitation of NTFP is generally considered to have adverse consequences.

These results synthesize the different positions found in the current NTFP literature. They tend to support the importance of state intervention and the macro-policy framework as key case-differentiating factors, reinforcing the need to improve forest dwellers' rights (that is, confirming the Gray, Dove, and Carrie criticisms of the "market approach"). But it also suggests the potential for concrete actions (improvement in market transparency, knowledge of rights, people's organization, sustainable extraction, and other key differentiating factors), in line with many current initiatives, as a way to change the existing situation. Therefore, it should be possible to use concrete. seemingly incremental, improvements in livelihood conditions while aiming at larger, more strategic changes in the political and economic arena. In fact, they should not be viewed as contlicting objectives but as ally reinforcing aims.

An interesting result of the analysis is the low importance for case differentiation and successful outcomes of

the intensity of state intervention. degree of transformation to end products, and the origin of the resource. It
could indicate that these factors have less value in a
general framework of analysis than is commonly accepted
in the current debate.

Whatisimponanttostressfromthispaperisthatitseemsthat
in order to maximize the chances of positive outcomes both the
macro-policy-framework and the market, products, and management features have to match. Thus, in the absence of an appropriate market behavior and suitable management practices,
empowering people withpolitical and tenurerightsmightnotbe
enough to promote a NTFP-based development. Similarly,
sound management practices and a performing market in the
absence of appropriate political and policy frameworks might
not lead to pedpldevelopment. Giving emphasis to selected
positive or negative conditions associated with outcomes seems
to be at the root of the polarizing debate.

However, there is more common ground between conflicting positions than the argument might suggest. Additionally, the analysis indicates that sometimes these positions
may also he grounded in extreme cases that are extrapolated
to the whole range of possibilities. We believe these conclusions have important implications when dealing with policy
proposals and development actions aimed at improving forest dwellèr livelihoods based on multiple use of forests.

We concede that, although appealing as an analytical tool
to spell out some reasons behind the disparity of criteria and
to propose possible key factors associated with success, the
paper currently lacks the ability to undertake a fine-grain
analysis which might maximize the chances of situation
improvement. It would he necessary torefine the analysis, to
define attributes at a more detailed level (each could he
subdivided into several locally relevant variables) and to
measure them in a more consistent and, whenever possible,
quantitative way. A larger set of cases would he needed to
capture a higher proportion of the variability of situations
encountered. A substantial potential improvement could he
achieved by incorporating a time element in the data collected in order to assess apparently different trends, since
these data are only cross-sectional. Finally, the key issue of
the desirability or degree of proximity to a commonly agreed
goal will need to be faced in future research using tools that
go beyond literature reviews.

Nevertheless, we are confident of the potential of these
methods to typify cases, as a basis for the development of
theories, preparation of models, assessment of current initiatives, andeventually as a useful guide to policy interventions.
The consistency between the analysis of attributes and the
assessmentofoutcomes, together with the fairly high level of
agreement in ratings by different experts, are promising
indications of this potential.

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