Unveiling Regional Preferences for Biological Diversity in Central Sulawesi: A Choice Experiment Approach

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Summary:

Knowledge on preferences for ecosystem services at the rainforest margin can facilitate the development of economically sound conservation strategies as claimed by the Convention on Biological Diversity. Applying an ecosystem service approach, a choice experiment was employed in Central Sulawesi/Indonesia around the Lore Lindu National Park to elicitate values for rattan availability, water supply for irrigation, population size of anoa as well as types of cocoa cultivation along a shade tree gradient. While on average a willingness to contribute to the maintenance of the resource base was found for the first three attributes, respondents had preferences for more intensive ways of cocoa cultivation. Interactions with socio-demographic variables help to obtain a more distinct view on the choice behaviour of respondents.

Keywords: ecosystem services, choice experiment, valuation, biodiversity, heterogeneous preferences, willingness to pay

1. Introduction

An important issue for the biodiversity debate is the loss of species, for which land use change is an important driving force (e.g. Pearce and Moran 1994). Land use change alters ecosystems and thus influences the provision of ecosystem goods and services. The Central Sulawesi rainforests are part of the global Wallacea biodiversity hotspot (Myers et al. 2000), and Sulawesi's moist forests were found to be among the world's most biologically valuable eco-regions (Olson and Dinerstein 1998). The Lore Lindu National Park in Central Sulawesi is one of few large forest areas left on the island of Sulawesi (Waltert et al. 2004). Therefore, ensuring its integrity is an important contribution to global biodiversity conservation efforts as demanded by the Convention on Biological Diversity. The CBD recognizes that any conservation effort needs to consider the livelihood of people that depend on the use of natural resources. Consequently, it is acknowledged that economic and social development targeting poverty eradication are priority issues in developing countries. Central Sulawesi is one of the poorest provinces in Indonesia (Suryahadi and Sumarto 2001). Thus, residents are situated between (global) conservation objectives and (local) development goals. By elicitating preferences for biodiversity held by inhabitants around the Lore Lindu National Park in Central Sulawesi, this study aims at (i) improving the knowledge base of decision makers for the development of economically informed conservation strategies, and at (ii) providing information regarding the economic behaviour of agents – mainly smallhold farmers (Schwarze 2004).

Methodologically, the purpose of this study is to improve the *choice experiment* approach for an estimation of locally perceived values of biodiversity. We make explicit use of an ecosystem service approach to assess functional biodiversity benefits. In particular, combining design attributes of ecosystem services with socio-demographic characteristics of individuals provides further insights into the choice behaviour of the respondents.

2. The research area

The research region is located in the humid tropics about 1 degree south of the equator. It comprises 7 administrative districts (*kecamatan*) in the province of Central Sulawesi/Indonesia. The districts of the research region mainly follow distinct valleys and their bordering mountain ranges. In more than 115 villages, it holds a population of about

130.000 – mainly smallholder farmers - on 7.220 km^2. The Lore Lindu National Park is centered within the study region and covers some 2.200 km^2 of mountainous rainforest. Although already founded in 1982, the National Park was not officially recognized until 1993, and its permanent border was not established until 1999 (Maertens 2004). A large number of species endemic to Sulawesi, including e.g. the mammals anoa (*Bubalus sp*.) or babirusa (*Babyrousa babirussa*) as well as many endemic bird species, can be found in the National Park area (Waltert et al. 2004).

The geophysical conditions of the research region vary to a large extend. The altitude ranges from just above sea level up to 2500 meters, and rainfall varies from 500 to 2500 mm per year (Maertens 2004). In combination with other heterogeneous physical features such as relief and soil conditions, the prerequisites for agricultural activity are diverse among the 7 districts.

Demographics and land use are characterized by strong dynamics, providing an interesting background in the potential area of conflict between development and conservation goals. In the period from 1980 – 2001, the population increased by 60%. Approximating this is an annual rate of 2.4% on average. The spatial distribution of the growth is unequal. In one of the districts (Palolo), population size doubled, and in Lore Utara it almost tripled (Maertens 2004). A large share of population growth results from migration – mainly from within the research region or other parts of Sulawesi[1]. There are also migrants from other islands of the Indonesian archipelago. A main driving force for this migration processes was the availability of land for agricultural use (Maertens 2004). The complex demographic history led to a high ethnical diversity (Faust et al 2003).

A large variation of land use patterns can be found (Schwarze 2004). In the course of the 'cocoa boom' in Indonesia (Akiyama and Nishio 1996), cocoa became the dominant 'cash' crop in the research region being often cultivated in the upland. Wetland rice remained the dominant 'food' crop being cultivated in the lowland, resulting in a lowland-upland dichotomy throughout the research region. Based on data from household surveys, cocoa and wetland rice together account for 57% of the net crop income (Schwarze 2004). Factors that facilitated the increasing cultivation of cocoa included, among others, the availability of suitable land, low production cost and the entrepreneurship of smallholders (Akiyama and Nishio 1996). Thus, the agricultural areas in the Lore Lindu region itself increased to a large extend over the past two decades (Maertens 2004). The related land use change (LUC) is

closely related to the increasing production of (cash) crops (e.g. cocoa) (ibid 2004). LUC can be divided into conversion of (primary or secondary) forest into arable land, and conversion within land previously used for agriculture (e.g. wet rice fields to cocoa plantations, coffee to cocoa). Concerning forest products, collection of fuel wood is widespread for private consumption, while rattan is the most important marketed forest product (Schwarze 2004). A broad array of factors can be identified as driving forces for LUC, ranging from market forces over changes in the natural environment (e.g. lack of water for irrigation) to social processes within local communities related to in-migration (e.g. Burkard 2002b).

3. Valuation of functional benefits of biological diversity - the Ecosystem service approach

The CBD regards ecosystems as functional units made up of a dynamic complex of plant, animal and micro-organism communities and their non-living environment. The ecosystem concept is an appropriate approach to compartmentalize nature into units that can be examined by researchers of both ecological and economic disciplines. Biodiversity is defined as the diversity within and between living organisms as well as between ecosystems. It provides flows of products and benefits to humans. Thus, biological diversity can be regarded as 'natural assets'. There are manifold links between biodiversity and ecosystems. "Diversity is a structural feature of ecosystems, and the variability among ecosystems is an element of biodiversity." (Millennium Ecosystem Assessment 2003: 9). Thus, changes in biodiversity and the related changes of ecosystems can affect the generation of ecosystem functions beneficial to humans.

In order to show in what way these benefits influence human activity, environmental economics makes use of the *Total Economic Value* (TEV, Randall and Stoll 1983, Pearce and Moran 1994). On a first level, use and non-use values are distinguished. *Non-use values* are those parts of the TEV that are most difficult to be assessed and have been subject to extensive discussion (e.g. Kahnemann 1992; Sagoff 1996), particularly concerning the so-called "existence value"[2] (Krutilla 1967). *Use values* are further divided in direct (active) and indirect (passive) use values. It is mainly the indirect/ passive use values that capture functional benefits of ecosystems, such as flood control or the benefits from nutrient cycling. The TEV is based on an *economic* concept of value, and was introduced for improving *economic* valuation. The TEV does not pretend to be the only possible way of conceptualizing

the values generated by nature. However, the TEV does not explain which components or 'effects' of ecosystems beneficial to humankind belong to which value category. Particular difficulties arise when functional attributes of ecosystems are concerned. In particular, it is difficult to assign an economic value directly to ecosystem functions, such as nutrient cycling. 'Ecosystem function' itself is an analytic scientific term that has no direct economic meaning: neither do ecosystem functions directly enter economic production functions, nor are consumers sufficiently aware of their economic implications. Therefore, a concept that mediates between ecological processes and their impact on humans is required. What may be called ecosystem service approach is a promising complement to the TEV to fill this conceptual gap (Barkmann et al. *subm. a*). As de Groot et al. (2002: 395) put it: "...observed ecosystem functions are reconceptualized as `ecosystem goods and services'[3] when human values are implied. The primary insight here is that the concept of ecosystem goods and services is inherently anthropocentric: it is the presence of human beings as valuing agents that enables the translation of basic ecological structures and processes into value-laden entities."

The 'translation' process clarifies that the *effects* of ecosystem structures, functions and processes on human activity are the objects of valuation, not the ecosystem structure, function or process *themselves*. For economic valuation of ecosystem services, a large variety of valuation techniques have been developed during the past decades. They are commonly divided into *revealed* and *stated preference* methods, the first using actual market data, the second being a survey-based technique and assessing values from hypothetical markets (Adamowicz 1998a). As the effects that are investigated by revealed preference (RP) methods are already captured in existing markets, an ecosystem service approach might be particularly beneficial for stated preference (SP) methods. A prerequisite to perceive a benefit in the first place is the awareness of the interrelation between humans and nature. Awareness in turn is initiated by recognition, which needs prior identification. A number of implications are known through experience and tradition, especially those concerning the production of (material) goods. However, although „the science of ecology has matured, mankind's knowledge about the interconnectedness of ecosystem processes and structures has grown" leading to "...increasing concern about the effects of human actions on ecosystems" (Bingham et al. 1995:76), much more remains unknown both for ecologists and laymen or simply not understood for the latter. This lack of scientific data on ecological relationships and functioning due to the complexity of nature, which can be termed "ignorance" (Fromm 2000),

and, similarly, the lack of people's awareness of existing knowledge affect environmental and ecosystem valuation by limiting the *array* of services that are potentially valuable. Furthermore, it limits people's *ability* to express their preferences for services of ecosystems already identified and recognized. Consequently, it can be doubted, whether people are able to express meaningful preferences if they had to make decisions concerning complex ecosystem functioning (Nunes and v.d. Bergh 2001). The major conceptual improvement of the ecosystem service approach is to 'translate' complex aspects of ecological functions into concepts that non-experts recognize as important for their lives. In this form, they are potentially valuable by people. By using the ecosystem service approach in this case study for an assessment of functional benefits of ecosystems, its applicability and limitations can be evaluated. A more detailed account of the ecosystem service approach can be found in Barkmann et al. (*subm. a*).

4. The Choice Experiment

4.1 Introduction to the method

A "Choice Experiment" (CE) is a stated preference (SP) method that was first developed in transport and marketing research (Louviere et al. 2001). In recent years, the CE became increasingly popular in environmental valuation (Bennet and Blamey 2001). Due to the advantage of CE to allow for simultaneous elicitation of multi-attribute benefits (use *and* non-use, e.g. in a policy scenario), CE was preferred over the other popular stated preference technique (contingent valuation) for the purpose of this study. Further advantages include the possibility to explicitly incorporate substitute goods and some evidence that CE is less susceptible to bias (Morrison et al. 1996). However, CVM "…may be better suited to situations where changes in the total economic value of a non-market good are at issue or where environmental resources are hard to describe using attributes" (Colombo et al 2005: 82). Recent applications of the CE in environmental valuation investigated, e.g., moose management in Finland (Horne and Petäjistö 2003) and off-farm effects of soil erosion in Spain (Colombo et al. 2005). Studies using CE or similar techniques for the valuation of functional benefits of biodiversity in rural areas of so-called developing countries are rare. An exception are, e.g., Pattanayak and Kramer (2001) using contingent valuation method for pricing drought mitigation benefits to local farmers in eastern Indonesia.

In a CE, consumers state their preference by (repeated) choice among different alternatives or goods following an experimental plan. Having foundations in Lancastarian consumer theory (Lancaster 1966, 1991), the goods are being transformed into objective characteristics (attributes) from which the consumer is assumed to derive utility ('well-being' or 'satisfaction'). In environmental choice modelling, the alternatives are often described as different development or policy scenarios (Bennett 1999). The decision context including the description and specification of the options or alternatives constitute the *stimuli*. The decision itself (which is a choice in choice experiments) is the *elicited response* (Adamowicz et al. 1998a). The decision-maker is assumed to be an individual (Louviere et al. 2001). The term 'individual' reflects that CE is based on disaggregate data collected in surveys. The 'individual' decision-making entity can be a single person, but can also be defined as a group, e.g. a household. In this case, it is important to note that the internal decision-making process within a group is not captured. Choice modelling is based on random utility theory (RUT) (e.g. Thurstone 1927, McFadden 1973, Manski 1977). Before characterising RUT and the random utility model, assumptions about the process used by the decision-maker to evaluate alternatives of a choice set and to make a choice, the *decision rule*, are briefly outlined. The common decision rule used in the random utility approach is *utility maximisation*. It is based on neoclassical economic theory, namely utility theory, which assumes that the decision-maker's preference for an alternative is captured by a value, called utility. The decision-maker selects the alternative in the choice set with the highest utility (Ben Akiva and Bierlaire 1999). This rule is widely adopted within (micro-) economics. There are some assumptions associated with the application of this concept: it is assumed that individuals "... have full information, use all information and are compensatory in their decisions (i.e. they are willing to trade-off any one attribute for others)" (Louviere et al. 2001: 254), or in short, that individuals have a perfect discrimination capability. However, the researcher has incomplete information and faces uncertainty[4]. Uncertainty may arise due to: (i) unobserved alternative attributes, (ii) unobserved individual characteristics (unobserved taste variations), (iii) measurement errors and finally (iv) proxy or instrumental variables rather than the actual variables that appear in the utility function (Manski 1977). Due to this uncertainty, it is appropriate from the analyst's point of view to incorporate a probabilistic dimension in the model of the decision-making process. Some models assume intrinsically probabilistic decision rules. The model applied here, however, assumes a deterministic utility and a probabilistic decision-making process, reflecting the randomness arising from uncertainty. Based on the findings of Thurstone (1927), a consumer "... may not choose what seems to the

analyst to be the preferred alternative [when choosing between pairs of offerings consumers like best]. Such variations in choice can be explained by proposing a random component of consumer's utility function" (Adamowicz et al. 1998a: 9).

Utility can therefore be partionated into a deterministic, systematic component or 'representative utility' and a random, stochastic part of utility "... reflecting [the] unobserved individual idiosyncrasies of taste" (Louviere et al. 2001: 38):

$$U_{ij} = V_{ij}(X_{ij}, S_i) + \varepsilon_{ij} \; \forall \; j \in C_i \tag{1}$$

where U_{ij} is the utility an individual i is assumed to obtain from of alternative j in choice set C_i, all $j,k \in C_i$. V_{ij} is the deterministic (systematic) part that is held to be a function of the attributes of alternatives (X_{ij}, which is a vector of attributes as perceived by individual i for alternative j) and characteristics of the individual (S_i). ε_{ij} is the random term. As the analyst is unable to measure ε_{ij}[5], s/he cannot determine exactly why an individual chooses an alternative j out of a set of competing options $C_i \; \forall \; j,k \in C_i$ and i = 1,...I. However, the systematic component V_{ij} still allows making probabilistic statements about the outcome of such a choice. This leads to equation (2) and is called a *Random Utility Model*. The probability that individual i prefers to choose alternative j over any alternative k out of a choice set C_n with n = 1,2,...N and all $j,k \in C_n$ can be expressed as:

$$P(j|C_i) = P\,(U_{ij}>U_{ik}) = P\,[(V_{ij}+ \varepsilon_{ij}) > (V_{ik} + \varepsilon_{ik})] \;\; \forall \;\; j,k \in C_i \text{ and } j \neq k \neq 0 \tag{2a}$$

$$= P\,[(V_{ij} - V_{ik}) > (\varepsilon_{ij} - \varepsilon_{ik})] \;\; \forall \;\; j,k \in C_i \text{ and } j \neq k \neq 0 \tag{2b}$$

The model differs from the traditional economic model of consumer demand in the way that it is a "... more complex but realistic assumption about individual behaviour to account for the analyst's inability to fully represent all variables that explain preferences in the utility function" (Louviere et al. 2001: 40).

In order to be able to estimate the probabilities of equation (2a/b), assumptions have to be made about the nature of the random error term. The majority of discrete choice models assumes that the random term is independently and identically distributed (IID), and related to the choice probability with a Type I extreme-value (Gumbel, Weibull, double-exponential)

distribution (with zero mean and a variance of μ^2). As a consequence of the IID assumption, the alternatives have to be independent from irrelevant alternatives (IIA). I.e., the ratio of probabilities of choosing alternative j over k out of a choice set C_i remains unaffected by the presence or absence of any other alternative. All assumptions are given now for the conditional or multinomial logit model (MNL, McFadden 1973):

$$P(j \mid C_i) = \frac{\exp^{\mu V_{ji}}}{\sum_{k \in C_i} \exp^{\mu V_{ki}}} \quad (3)$$

where μ is the scale parameter usually set to 1 (constant error variances) and inversely proportional to the standard deviation of the error terms (Louviere et al. 2001). V_{ij} is assumed to be linear and additive in parameters:

$$V_{ij} = \alpha ASC_j + \beta_1 f(X_1) + \beta_2 f(X_2) + \cdots + \beta_N f(X_N) \quad (4)$$

where X_n is the attribute level of attribute n (n = 1,2,…N) of the j^{th} alternative and β_n is the parameter value associated with attribute n. ASC_j is short for alternative specific constants that equal 1 for alternative j (otherwise: 0), and can be included for j-1 alternatives. If the alternatives are generic (unspecific, i.e. unlabelled), the ASCs are equal. "It is the role of the ASCs to take up any variation in choices that cannot be explained by either the attributes or the socio-economic variables" (Bennett 1999: 16). By using a statistical estimation technique such as 'maximum likelihood estimation' (MLE) available in statistical software packages, e.g. LIMDEP (Green 2003), estimates for the coefficients associated with the attributes can be obtained.

Socio-economic, attitudinal or survey-related variables can be interacted either with the ASC and/or the attributes. This is a way to incorporate heterogeneity in tastes into the model. By doing so, the analyst is able to better understand (i) why respondents preferred certain alternatives relative to others and (ii) what factors may influence the importance of attributes on the probability of an alternative to be chosen (i.e. the main effects). Accounting for heterogeneity of tastes may also improve predictive model capabilities.

If the variance of unobserved components of the utility function or scale is different among (subsets of) alternatives, e.g. due to heterogeneous preferences, the IID and IIA assumptions

do not hold. One test frequently applied in literature is a Hausman type test (Hausman and McFadden 1984). If IIA is violated, the MNL should not be used and models such as the Nested Logit (NL) (Louviere et al. 2001) or Random Parameters Logit (RPL) (Train 1998) should be considered that relax these assumptions (Louviere et al. 2001). Accounting for preference heterogeneity by interacting socioeconomic and/or attitudinal attributes may help to mitigate IIA violations (Train 1986).

As the parameters β_n in V_j are confounded with μ and thus are not separable, they cannot be interpreted in *absolute* terms. "In other words, the extent of the variance of the statistical error involved in the estimation process has an impact on the absolute magnitude of the β coefficients" (Bennett 1999: 18). The estimated probabilities using equation (3) can, consequently, merely serve as an indication for the *relative* utility an individual obtains from choosing a particular alternative from a choice set. However, the scale parameters are cancelled out if marginal rates of substitution between any pair of attributes a and b is estimated. If one of the attributes reflects 'cost', the trade-offs are 'part-worths' or 'implicit prices'. For any attribute n, they can be calculated by:

$$Part-worth(n) \quad = \quad -\left(\frac{\mu\beta_n}{\mu\beta_{cost}}\right) \quad = \quad -\left(\frac{\beta_n}{\beta_{cost}}\right) \tag{5}$$

where β_n is the coefficient of attribute n, and β_{cost} is the coefficient of the 'cost' attribute (Bennett and Blamey 2001). A positive coefficient β_n indicates that more of an attribute is associated with positive utility, a negative coefficient that more of an attribute is associated with disutility. `Cost' in *this* context is understood as 'the amount given up in a voluntary exchange'. The implicit prices reflect the marginal willingness to pay (MWTP) for a marginal change in a single attribute on a "ceteris paribus" basis (Bennett and Blamey 2001).

4.2 Choice experiment - a short summary

In a choice experiment, respondents choose between alternatives or 'goods' that alternative with the highest (expected) utility. In the environmental context, the choice offered usually consists of a number of "proposed changes" and a "status quo option", for example between different management alternatives for a certain area and the present situation. These goods are characterized by a number of attributes that ideally comprise all relevant aspects a respondent

ascribes to a certain 'good' at stake. The attributes – being quantitative or qualitative dimensions of characteristics - in turn, consist of a number of levels. Within and between the choice sets presented to the respondent, the attribute levels and thus the goods or commodities presented vary, usually according to an experimental design. Coefficients for the attributes in a linear and additive expression of the utility function can be calculated by maximum likelihood estimation (MLE) procedures. If one attribute reflects 'cost', these parameters allow for a calculation of implicit prices, or part-worth utilities, preference ratios and elasticities. It is worth noting that it is also possible to infer the amount people are willing to pay for a shift from a 'status quo' bundle of attribute levels to an alternative bundle. Thus, willingness to pay for a specific alternative outcome can be calculated. "These estimates of compensating surpluses are consistent with the principles of welfare economics and are therefore suited for inclusion as value estimates in benefit cost analyses of policy alternatives" (Bennett 1999: 3). Benefit cost analysis, however, is not the aim of this study. Interacting socio-demographic or attitudinal variables allows for better understanding the choice behaviour of respondents.

5. The Choice Experiment Design

"[...] the characteristics model of consumer behaviour is designed to simplify reality. Fitting it into any given situation ultimately involves some art as well as some science" (Lancaster 1991: 67).

The design of choice experiments includes decisions about the nature of the stimuli of choice. These decisions are concerned with (i) the attributes of an alternative and their levels, (ii) the nature of the 'cost' attribute, (iii) the situation in which the alternatives are presented to the respondent ('framing'), (iv) the definition of a base (reference) option and (v) the experimental plan that allows for statistical estimation of the attributes' coefficients.

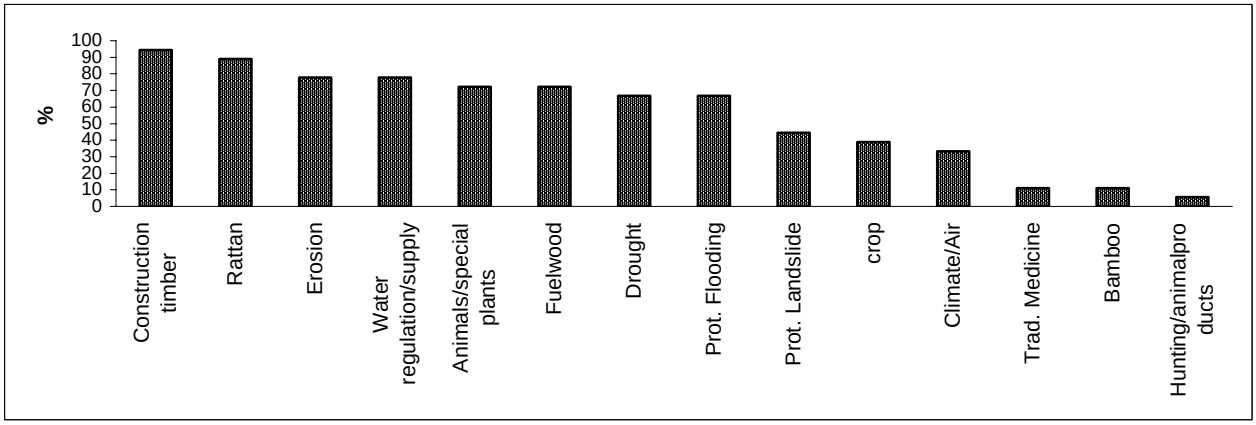
5.1 Attribute selection

Out of the universe of potential "characteristics" of biological diversity and ecosystem services, which are to be selected? As a way to guide the decisions, a (multidimensional) space can be created, which is demarcated by (i) the objectives of the analyst and the research question, (ii) constraints imposed by the respondents (relevance, cognitive burden/ task

complexity), (iii) the social context (e.g. problems concerning strategic behaviour) as well as (iv) the 'natural' environment in which the survey is being conducted.

Generally, only relevant characteristics should be considered in a choice experiment. According to Lancaster (1991: 56), a characteristic is "relevant to the situation if ignoring its existence would change our conclusions about choice or ordering of the goods by the consumers". Blamey et al. (1997) distinguishes between demand-relevance and policy- or context-relevance. Demand relevance refers to the relative importance people assign to an attribute (demand-driven), whilst policy relevance refers to what the government or researchers perceive to be important (supply-driven). In order to be sure that people make sense out of an attribute offered, any "… supply-driven attribute should always be screened from a demand-perspective" (Blamey et al. 1997: 7). Task complexity rises with the number of attributes offered. Alpizar et al. (2001) note that more than 4 to 5 attributes may have an unwarranted effect on the quality of the data collected. Louviere (2001), however, reports that there is no evidence that the number of attributes or alternatives would have significant impact on the estimated parameter values but that there is some evidence that it can have impact on the random error term. For details concerning attributes in CE and the related task complexity see also e.g. Blamey et al. (1998), Swait and Adamowicz (1996).

Figure 1. Results of the pre-study. Benefits derived by the forest (% mentioned by n=18 respondents).



Source: own calculations

For the attributes used in this study, selection followed aspects of relevance, and the maximum number of attributes was limited to 5. As well as the choice of appropriate levels, attribute selection was based on information gathered in individual and peer-group interviews[6] in various villages of the research region. Furthermore, information and data obtained by experts as well as from literature (e.g. Belsky and Siebert 2003; Siebert 2002; Keil 2004) were

incorporated. There was high awareness of functional (indirect) benefits, particularly concerning water-related issues such as water supply or flood protection/erosion (Figure 1). The attributes chosen and the respective levels are listed in Table 1 and are described in detail below.

Table 1. Attributes and levels

	Attribute label	Levels	Ecosystem service category	Value type (TEV)
Rattan	availability of rattan (*Calamus spp.*) as expressed in distance from village	[*km*] 5, 10, 15, 20	provisioning service	Direct use/ Option value
Water	availability of irrigation water for wet rice cultivation as expressed in number of months with water scarcity	[*No of months*] 0, 1, 2, 3	regulating service	Indirect use value
Cocoa	preponderance of cocoa plantations differing along a shade tree gradient	[*% under shade*] 5, 35, 65, 95	regulating services	Indirect use / Option value
Anoa	populations of different sizes of the endemic dwarf buffalo anoa (*Bubalus sp.)*	[*No of animals*] 10, 180, 350[§], 520	cultural/ provisioning service	Existence/ direct use value
'Cost' attribute	extra taxes or donation to village fund	[*1 000 IDR per year*] 0, 18, 36, 54, 72	-	-

[§] present state; 1 US$ ~ 8 500 IDR at the time of the survey

Cocoa (*Theobroma sp.*) is the dominant cash crop in the research region. Increasingly, production is intensified, resulting in monocultures with no or merely low levels of (planted) shade trees (e.g. *Gliricidia sepium*). Despite the generation of higher yields on average, intensification to sun-grown cocoa leads to higher agronomic and socioeconomic risks, e.g. soil degradation and negative impacts on local food security (Belsky and Siebert 2003). Shade-grown cocoa farming can provide habitat for a wide range of native species, thus contributing to biodiversity conservation, while soil productivity may be retained to a certain degree (Siebert 2002). Thus, this attribute implies trade-offs between (short-term) economic goals and (long-term) biodiversity conservation objectives. The trade-offs are mapped by shade tree gradient (5-35-65-95% under shade) for preponderance of cocoa plantations ranging from full-sun grown cocoa on one side, and cocoa cultivated beneath primary or secondary forest vegetation on the other side.

Sufficient water for irrigation is essential for the production of wetland rice, the region's main food crop. There is indication that deforestation on the hillsides leads to water shortages in the dry months of the year, particularly when the water originates from small watersheds in combination with prevailing simple irrigation techniques (own data[7], Burkard 2002b). Keil (2004) showed that perceptional data on irrigation water fits quite well to the related measured precipitation. Thus, an attribute was created relating effects of land conversion on slopes to the provision of irrigation water. The levels were described as the perceived months with water shortage for irrigation purposes[8].

Rattan (*Calamus spp.*) is the most important marketed forest product and serves as a secondary income source for locals, particularly at the poorer margin of the population (Maertens 2004, Schwarze 2004). If harvests fail, e.g., as a cause of natural disasters (droughts, flooding), rattan can serve an additional income alternative, and thus has an 'option' or insurance value component. In accordance with results from our pre-study investigations, previous research of Zeller and Birner (2003) showed that the encounter distance from the forest edge to harvesting locations increased from 4.4 km on average in 1990 to 14.5 km in 2001, indicating an overuse of rattan resources. Rattan supplies are in decline, while market demand remains strong. This suggests that rattan resources will become increasingly scarce, particularly affecting large-diameter canes (Siebert 2001). The rattan attribute was operationalized by the encounter distance to the nearest extracting location (5, 10, 15, 20 km).

An important issue for the biodiversity debate is the loss of species. The Sulawesi region is an important centre for species endemism, and the Lore Lindu National Park harbours many of Sulawesi's endemic mammals and birds (Waltert et al. 2004, Whitten et al. 1987). Thus, conservation of the park's species is in line with global conservation objectives. However, large forest clearings inside the National Park show that the forest frontier in the research region is by no means secured (Weber 2005). To find out how conservation objectives are supported by the local population around the National Park, different population sizes of the dwarf-buffalo anoa (*Bupalus depressicornis, B. quarlesi)* were included as an attribute exemplarily for an endemic species. Population sizes in the research region are in decline (Zeller and Birner 2003, Burton et al. 2005). Burton et al. (2005) identified the Lore Lindu National Park as one of the areas on which to focus conservation efforts of this animal.

Individual interviews showed that anoa was a widely known forest species. As a result of discussions with locals and experts, the present state was estimated as 350 individuals living in the forests of the Lore Lindu region. Anoa populations provide a mixture of different TEV value categories. One is 'existence' value, e.g. the "… concern to protect […] although he or she has never seen one and is never likely to …" (Pearce and Moran 1994: 12). However, interactions between the living environment and the population are common, implying that other value components such as direct use value (e.g. hunting) or existence value (e.g. intergenerational aspects) have to be considered as well. The latter ones might even be of greater importance (see Burton et al. 2005). It was found in pre-tests and numerous conversations with the locals that the relationship towards anoa is ambiguous: although most people value anoa for the different reasons listed above, many also perceive anoa as a ferocious and wild animal, and thus as a threat if encountered[9]. If the latter aspect dominates the attitude of individuals, it may also happen that those may prefer smaller over larger populations.

A negative sign of the utility coefficient was expected for 'water', 'rattan' and 'cocoa'. A positive one for 'anoa', assuming that value aspects are more important on average.[10]

The 'cost' attribute was split-sampled as (i) a rise in "house- and land" tax (*Pajak Bumi Bangunan* (*PBB*)) or a donation to a village fund (*Iuran dana pembangunan desa*) affecting every household of the research region as well as (ii) a monthly or yearly payment scheme[11]. According to Whittington (1998), the highest price should be rejected by 90 % - 95 % of the respondents in CVM studies. The levels were derived following this rule of thumb by using different 'prices' in pre-tests additional to information obtained by a payment-ladder approach for the subjectively *'best'* option (e.g. Bateman et al. 2002). The income distribution in the study region is highly skewed: Some people live in concrete houses, have satellite television and sometimes even own a car. Others share a wooden hut without electricity. Some of the first group didn't hesitate to express a willingness to pay exceeding double the highest amount finally offered in the choice experiment (12.000 IDR per month, about 1,4 US$), whereas some members of the second group were virtually struck by the same amount. Offering the highest price to the poor could embarrass them, and could make "... the interviewers look insensitive and/or uninformed" (Whittington 1998:8). Hence, the range of 'price' levels was cut at the high end, accepting an underestimation of WTP and other welfare-theoretic measures by ignoring the higher WTP of a low percentage of rather well-situated people. As

no specific or unique time period could be defined to achieve a proposed improvement (and time-preferences respectively interest rates for continuous payment are unknown), WTP values are calculated on a one years' basis.

It is suggesting to use *monetary* 'cost' terms, as it is the 'universal' medium for exchange. However, it might be useful in so-called developing countries and semi-subsistence economies to employ other forms of payment. Shyamsundar and Kramer (1996), for example, use rice quantities in a case study on Madagascar, Mekonen (2000) offers payment in cash *or kind* for management of community woodland in rural Ethiopia, both using CV methods. Although rice is a staple food in the study region, it does not seem appropriate to use it for the 'cost' attribute. People may value a specific quantity of rice differently due to the following reasons: (i) varying breeds of rice are planted and sold with differing prices. (ii) There is a disparity between people owning rice fields and others, who do not own but work on rice fields as seasonal farm hands and finally those, who are not engaged in rice cultivation at all. This – in addition to fluctuating market prices - would result in a wide range of uncertainties for an ex post translation of rice quantities into monetary units. Another alternative payment method especially addressing the poorer parts of the population could be 'wage labour' (compare to Adamowicz et al. 1997a). However, it seems to be (i) morally questionable to 'let the poor work', and (ii) hard to find a specific and appropriate purpose for the work. Exploratory studies have shown that all people are familiar with monetary issues, though some were hardly able to pay some of the offered amounts. Therefore, following Whittington (1998), the use and interpretation of stated preference values will be bounded by respondents' *ability* to pay and by their *willingness* to pay. Before making their choices, respondents were reminded emphatically of their budget constraints in order to reduce bias resulting from strategic behaviour or interviewer compliance.

Bias may also arise from the order in which the attributes appear on the choice cards. In order to minimize such effects, a second version of choice sets has been created with an inverting order of the attributes. The two versions were randomly assigned to respondents in a way that approximately each half of the respondents received one of the versions.

All attributes entered the analysis as continuous attributes 'anoa', 'water', 'cocoa' and 'rattan' using actual values. It is assumed that attribute levels reflect an individual's utility in a linear fashion. For the amount of shade in cocoa, a quadratic utility surface was included in the

analysis because an (inverted) unimodal preference curve appeared likely (i.e. we assumed a threshold for intensification).

5.2 Framing

"The questionaire must strive to establish the frame in respondents' minds which is appropriate to the circumstances of the [...] decision being made" (Bennett 1999: 9). This step is called 'framing'. An appropriate context must be developed, in which the hypothetical scenarios are presented to the respondent. If the context is misleading or not credible, there is little incentive for respondents to take the choice task seriously. At the beginning of the questionaire, respondents were sensitized to potential changes in the future by letting them recall past changes in the fields of agriculture, infrastructure and living conditions. Thereafter, they were supposed to choose those 3 out of 6 competing development issues, which they thought should have priority for spending public money. Besides contributing to establish "a frame of reference for respondents", this question also served as a "'warm-up' exercise" for the choice task (Bennett & Adamowicz 2001: 52).

In the study, the 5 attributes were defined as results a government development program on a village scale. Multi-level development programs that address many different aspects are not unfamiliar to the locals. One example is the CSIADP (Central Sulawesi Integrated Area and Development Program, ANZDEC 1997). Intentions to link such a program to an actual policy process taking place in the Lore Lindu region in order to enhance credibility were abandoned. Rather than concentrating on impacts of attribute changes on their life, respondents tended to exhaustively discuss issues of e.g. property rights, or the management of the National Park area in pre-tests. Hence, it was not the question whether people took the informational context and therefore the choice task seriously. Instead, it was a problem that people took it *too* serious. Under such circumstances, choices could be increasingly biased by strategic behaviour (e.g. with respect to property rights) or be perceived as some kind of 'referendum' about policy measures described. A referendum-type frame can be desirable in a different context. In our case, however, we primarily focus on preferences for ecosystem services. In order to minimize strategic behaviour and accentuate neutrality, the program was not specified in detail. Respondents were repeatedly reminded that this research is not part of any NGO or governmental activity, and that there are no pre-defined interests regarding the future of the National Park and its surroundings. Further, people were sensitized to changes that

occurred in the past and the desired direction of changes for the future by several questions addressing these issues prior to the choice experiment.

Presented orally only, the provision of the information regarding the attributes caused some fatigue and confusion among the respondents, indicating a high cognitive demand. The education of 53 % of the respondents did not transcend elementary school, indicating a rather low level of literacy. Jae and Delvecchio (2004) found that the presence of a visual decision aid can improve choice by reducing task complexity and facilitating the mediation of information for low-literacy consumers. Thus, pictures containing the main information were painted in discussion with the local farmers in order to meet their perception. Painting was preferred to photographs as people's interest in the latter mainly consisted of the specific location shown on the picture, and in what differed from the conditions in their village. The paintings allowed for a more generalized visualization of the issues (attributes) in which village-specific details are less important. The pictures were collected in a picture book[12]. The pictures and their respective informational background were simultaneously presented to the respondent during the explanation of the attributes. Visualizations were also included in the choice cards (see appendix 1).

Often, the first language of the respondents was not Indonesian (*Bahasa Indonesia*), but their local language. Every ethnicity again has its own language. Additionally, English is a secondary language for both the first author and his assistant. Furthermore, there are differences in the urban and rural use of *Bahasa Indonesia*. Understandably, special attention had to be paid on the wording during several pre-tests to avoid misunderstandings. For final refinement of the questionaire, a pilot study was conducted (n = 96).

5.3 Experimental design and status quo

Out of the 4^5 possible combinations of attribute levels, an orthogonal fraction of 16 was selected by means of experimental design techniques (Louviere et al. 2001) and combined into choice scenarios that consisted of two (generic) alternatives A and B and a *status-quo* option presented on choice cards. The computed design was further improved following the design principles mentioned by Huber and Zwerina (1996), particularly with respect to level balance and minimal overlap. The sets of the main-effects experimental design were blocked into 4 versions, so that each respondent faced 4 choices.

Inclusion of a status quo option allows for economic welfare measures (e.g. Louviere et al. 2001). The status quo ('do-nothing') option is the reference point from which the scenarios the researcher offers to the respondents diverge (Bennett 1999). "Selection of a base may have an important influence on CM results by affecting the utility of the base option relative to others, and by influencing the framing of outcomes, for example, as gains or losses" (Blamey et al. 1997: 14). The status-quo was described as the present situation, because future attribute level changes could not easily be predicted and may differ in discrete villages. Particularly due to the heterogeneity concerning the environmental and socio-economic conditions of the villages, it would have been plainly unrealistic to define *one* common base for all villages. Therefore, the respondents were directly asked which attribute level was most similar to their perception of the present situation (cocoa, water, rattan)[13]. By this means, respondents created their 'individual' status-quo or "…'self-explicated' alternative" (Bennet and Blamey 2001: 138). This approach is consistent with choice theory (Louviere et al. 2001). It is expected that such an approach improves the predictive properties of the model for the following reasons. (i) It addresses local heterogeneity better than a 'constant base reference'. (ii) Prior to the choice task, the respondents had to intensively engage themselves with the present state regarding the attributes. As a result, respondents are expected to be more certain about their choices. (iii) Involving respondents in the preparation for the choice experiment could suspend some 'disbelief' about the choice task and the survey. However, there might be some implications for welfare analysis if actual and perceived values diverge (Adamowicz et al. 1997b). A typical choice set is shown in appendix 1.

5.4 Data Collection

In order to maximise the benefits of data exchange with other projects in STORMA and to enable aggregation of the (perceived) values for ecosystem services by a sampled population on a regional level in congruency with the STORMA research region, the common sampling frame of STORMA was adopted (for details, see Zeller et al. 2002). The choice experiment survey was administered to 301 randomly selected households in 12 villages of the research region. In-person interviews were conducted by 6 well-trained and graduated (B.Sc. UNTAD/Palu) local enumerators. To minimize potential interviewer effects, enumerators were randomly assigned to the households.

Additional data was collected including data related to the choice task (e.g. difficulty, confusion), background data concerning the attributes (e.g. past experience, present use) as well as several socio-economic characteristics (e.g. age, education, wealth status). The socio-demographic variables listed in table 2 are used in the succeeding analysis. Additionally, attitude items on value, risk and coping issues were included (for analysis see Barkmann et al. *subm. a/b*)

Table 2. Socio-demographic Variables

Variable	Description	Mean	Interaction
edu	Years in school (respondent)	7.68	ASC,Cost
imppay	5 point Likert score for importance ascribed to paying tax / village fund on household well-being [1: not important; 5: very important]	3.03	ASC
KL	Dummy variable showing whether respondent is from Lore or Kulawi districts	0.52	ASC
colrat	Dummy variable showing if a respondent is collecting rattan	0.13	Rattan
invwat	Dummy variable showing if a household is involved in wet rice cultivation	0.60	Water
agecoc	Maximum age of cocoa plantations owned by respondent	4.46	Cocoa
povind	Relative poverty index comprising a set of welfare indicators[§]	0.02	Cocoa
anohappy	5 point score (pictures) to express general attitude towards Anoa [1 complies with "unhappy", 5 with "very happy"]	3.05	Anoa
anosurv	5 point Likert score to express impacts expected when Anoa population is reduced to 10 individuals [1: surely will survive; 5: surely become extinct]	2.99	Anoa
prisec	Indicator for perceived discretionary income: share of total household income spend on primary needs (rather than secondary) [1: 3/4 to everything; 3: 1/4 up to ½]	2.05	Cost
depch	Dependency rate adults vs. children[§]	0.54	Cost

[§] Data from subproject A4 (see Schwarze 2004); missing values replaced by the mean

All 301 households completed the choice task, and 235 made choices which included either option A or B at least once. 66 respondents always chose the status quo. 80 % of them reported that they (i) could not afford the payment (3 respondents) or (ii) they perceived the present situation to be "better" than the offered alternatives (36 respondents), or a combination of both (27 respondents). The first aspect underlines that WTP measures have to be interpreted as a combination of people's *willingness* and their *ability* to pay. The remaining 13 respondents (20%) were classified as "…essentially not responding to the CE task." (Adamowicz et al. 1998b: 68) and were omitted[14], leaving 288 responses for further analysis.

6. Results and Discussion

6.1 Overall model results

We report the results from two multinomial logit models here: attributes only (model 1) and attributes and interactions with socioeconomic variables (model 2). Overall, models 1 and 2 were highly significant at the 99 % level. As expected, we find a significant improvement of the interaction model 2 as compared to the base model 1 (LR test: $\chi^2 = 211.10$; 14 d.f.). The overall model fit increases from the base model 1 (Adjusted ρ^2 (Pseudo-R^2) = 0.258) to the interaction model 2 ($\rho^2 = 0.345$). These pseudo-R^2 values can be compared with values of R^2 as in OLS regression models. A ρ^2 between 0.2 and 0.4 corresponds to R^2 values of 0.7 to 0.9, indicating very good fit (Hensher et al. 2005).

In order to test whether the MNL model is the appropriate model, Hausman-McFadden tests (Hausman and McFadden 1974) were performed to test for violations of the Independence of Irrelevant Alternatives (IIA) assumption that is implicit in MNL models. The results for the basic model were somehow inconclusive, i.e. violations were found for dropping one alternative, and the assumption could not be rejected when dropping the other two alternatives. No violations were found in the interaction model, however. This result is in line with Morrison et al. (1998), where the inclusion of SDCs helped to minimise IIA violations.

All attribute coefficients are significant and have the expected sign. I.e., disutility was observed for more months with water scarcity, with a greater distance to rattan harvesting locations and with paying tax or donating to a village fund. A utility gain is observed for bigger population sizes of the endemic dwarf buffalo Anoa. Concerning cocoa, the results indicate on average higher preferences for less shade in cocoa, implicitly having lower species diversity. Model results are listed in table 3.

6.2 ASC and interactions

The ASC is positive and significant in model 1. It is not significant; however, in model 2, indicating that much of the variation in choice is already explained by the attributes or interactions. This suggests that there is no particular propensity to choose the status quo option relative to the alternatives as more commonly reported in literature (e.g. Adamowicz 1998a). One exception are Mogas et al. (2002), who report a positive ASC in a study on

afforestation in Catalonia. A preference for the status quo, all else equal, was often related to what is referred to as 'status-quo bias' (Samuelson and Zeckhauser 1988). One reason for status quo bias can be that the status quo is used as an 'easy way out', e.g., in case of decision difficulty and/or limited cognitive capability (e.g. Luce 1998, Kontoleon and Yabe 2003). The positive ASC gives some evidence that this strategy was not particularly important in our study. People receive on average – everything else held constant – more utility from departing from the present situation than from keeping it. This could be due to a number of reasons such as, inter alia, that respondents include unobserved attributes associated with a governmental programme or task compliance. According to the high rate of status quo choices among all choices (53.2 %) it is unlikely, however, that the respondents felt 'forced' to choose among the alternatives of change as a consequence of a falsely perceived compliance with the intentions of this research.

The interactions of the ASC with SDC can shed some light on potential reasons and their heterogeneous distribution among the sample population (model 2 in table 3). The tendency to choose the management alternatives rather than the status quo decreases with increasing years in school (ASC***edu*), and if the respondent is from Kulawi or Lore districts (ASC***KL*). The education variable is positively correlated with the relative poverty index and with a dummy variable taking 1 if the respondent is involved in non-farm income activities (Pearsons R^2: 0.256 respectively 0.362, both significant at the 99 % level). Thus, respondents that are less poor and respondents that derive non-farm related income might be more satisfied with the current situation or may perceive to obtain less benefit from changes in mainly farming related attributes. On the other hand, better educated respondents may make less use of unobserved attributes when making their decision, which results in lower values for the ASC.

Finding an interpretation for the negative coefficient for the interaction ASC***KL* is far from straightforward. This dummy was created as Kulawi and Lore (comprising the districts Lore Utara and Lore Tengah) are – on the whole - still less intensively used agriculturally compared to Palolo and Sigi Biromaru districts, and farther from the urban capital Palu. Environmental degradation is more obvious here, resulting, e.g., in water shortages for irrigation as well as household usage. In Palolo district, deforestation of a large forest area named Dongi-Dongi was followed by a devastating flood event in December 2003. Hence, the threat imposed by environmental degradation could be felt more directly than in the Kulawi or Lore districts. This could increase the likelihood that respondents include unobserved

attributes of environmental change for their choice. The positive and significant interaction ASC*_imppay_ shows that respondents who give higher scores for the importance of paying tax on household well-being have higher preferences for a change away from the status quo. This could be due to the fact that these respondents expect higher utility from governmental programs.

Making sense intuitively, disutility for an impairment of rattan provision and water availability increases significantly if respondents are involved in either collecting rattan or cultivating wet rice. Large parts of a utility gain from an improved provision of rattan and water services can be explained by the involvement of respondents in these activities. However, involvement is not the only source that can explain people's preferences regarding the rattan and water attributes. This may lead to the assumption that these two activities are not easily substitutable for other income generating activities because they fulfil purposes other than related to the actual generation of income in cash or kind (i.e. for subsistence). In this context, rattan e.g. provides security as an alternative income source in the case of economic failure for vulnerable households. During our field work it became clear that in the perception of locals who were not involved in wet rice cultivation, the most important benefit from sustained wet rice cultivation in their region is to maintain a local market for the most important staple food which can be obtained at rather low prices. Due to improved access in most parts of the research region to the urban market of Palu, this aspect may actually be less important than perceived. Besides, there may be an array of social and cultural factors associated with wet rice cultivation that have influence on the life within local village communities. Some aspects are pointed out in Burkard (2002a), who also vividly shows the complexity and heterogeneity of such factors in the research region.

The quadratic term for cocoa is negative and significant, indicating that there is some threshold for intensification which would not have been detected in the basic linear model. At mean level for the socio-demographic characteristics and cocoa age interacted with cocoa, utility peaks at a level of shading of approximately 28 %. As the interactions with cocoa show, the likelihood is higher that the peak is reached at lower levels of shading if the maximum age of cocoa plantations increases and the respondent is less poor according to a relative poverty index measure.

Table 3. MNL model results

Variable	Base model 1		Interaction Model 2	
Rattan availability	-0.0404	***	-0.0307	***
	(-5.179)		(-3.455)	
Water for irrigation of paddy rice	-0.8943	***	-0.5118	***
	(-18.772)		(-7.268)	
Cocoa Shade	0.0126	*	0.0260	***
	(2.067)		(3.712)	
Cocoa Shade² (quadratic)	-0.0247	***	-0.0251	***
	(-3.913)		(-3.545)	
Anoa Population Size	0.0009	**	-0.0030	*
	(2.688)		(-2.202)	
Cost (Tax rise/village fund donation)	-0.0254	***	-0.0635	***
	(-9.146)		(-6.845)	
ASC (non-status quo choice)	0.4892	***	0.7189	
	(3.486)		(1.677)	
ASC*_KL_			-0.3327	*
			(-2.183)	
ASC*_edu_ (years in school)			-0.1716	***
			(-4.000)	
ASC*_imppay_ (importance of payment)			0.4023	***
			(4.494)	
Rattan*_colrat_ (dummy rattan collector)			-0.1172	***
			(4.034)	
Water*_invwat_ (dummy wet rice activity)			-0.7548	***
			(7.520)	
Cocoa(linear)*_povind_ (poverty index)			-0.0050	*
			(-2.138)	
Cocoa(linear)*_KL_ (Kulawi/ Lore)			-0.0146	***
			(-3.980)	
Cocoa (quadr.)*_agecoc_ (max. age of cocoa)			-0.0018	***
			(-3.642)	
Anoa*_anohappy_ (gen. attitude anoa)			0.0007	*
			(1.939)	
Anoa*_anosurv_ (extinction probability)			0.0006	*
			(2.541)	
Cost*_edu_ (years in school)			0.0036	***
			(4.000)	
Cost*_prisec_ (discretionary income)			0.0064	**
			(2.761)	
Cost*_depch_ (child dependency rate)			-0.0093	**
			(-2.663)	
Log-likelihood	-857.34		-759.55	
Number of observations	1152		1152	
Adjusted ρ^2 (Pseudo-R^2)	0.2646		0.3448	

t-statistics in parentheses (coefficient/standard error) *** = significant at $p \leq 0.001$;
** = significant at $p \leq 0.01$; * = significant at $p \leq 0.05$; Source: own calculations

Cocoa is usually planted under shade. The older it gets, the less shade is needed generally. Thus, people owning older plantations might be more confident in cultivation success under

less shade as a result of longer experience. The less poor people are, the more agronomic risk they may be willing to take, and the more disposable capital they may have to invest in fertilizer or pesticides. Additionally, respondents living in Lore or Kulawi districts have higher preferences for more intensive cocoa cultivation compared to those living in Sigi-Biromaru and Palolo. This may at least partially be explained by a longer establishment of cocoa cultivation in these districts.

The results of the interactions show that it is likely that further intensification will take place in the future. Thus, biodiversity conservation measures aiming at more sustainable ways of cocoa cultivation (measured here by a shade tree gradient) will be unlikely to be successful without creating incentives for the cocoa farmers such as, e.g., price premiums. However, cocoa intensification can be very beneficial from a development economics standpoint: Keil (2004) has shown that there is still much potential for increasing the technical efficiency and therefore the benefits obtained from cocoa cultivation. Despite the risks, the spread of cocoa and its intensification has improved welfare not only for migrants from South Sulawesi, who have a longer tradition in cocoa cultivation, but also for many "locals". For an example that cocoa cultivation does not necessarily lead to an improvement of the living conditions for locals see Sitorus (2002). Weber (2005) has discussed the risks associated with the rising dependency on (world market) prices for cocoa. He concluded that a severe price crash would mean the end of cocoa as a driving force for improved welfare, but that it is likely that welfare would not drop below the state before the beginning of the cocoa boom. It is a matter of dispute whether intensification can help to mitigate encroachment in the forest or whether it may actually enhance it (see Keil 2004), while it can generally be assumed that the emergence of cocoa in the Lore Lindu region in the course of the cocoa boom has promoted forest encroachment (e.g. Maertens 2004).

In general, not much is known about specific ecological and economic short and long term implications resulting from cocoa cultivation. Hence, it is in the realm of speculation to judge whether the (private) net benefits of cocoa cultivation and its intensification exceed the (social) cost, particularly in the long run. Still, the demand of people for further intensification should seriously be considered by decision makers. As an aside, we could not find any significant differences of preferences regarding the cocoa attribute between "locals" and migrants[15] as well as between households with an indigenous or non-indigenous head of household (data not shown). This finding gives rise to the hypothesis that (i) there are no

differences in the preferred way of cocoa cultivation between these groups and (ii) that the key factor influencing the cultivation decision is profit maximization. This does not mean that there are no actual differences between cocoa plots. However, these differences could be the result of e.g. different general cropping strategies, which are outlined in e.g. Burkard (2002a) and Weber (2005), different knowledge about cultivation practices or the access to the latter (Weber 2005).

Surprisingly, the sign of the coefficient (significant at the 5 % level) for the anoa attribute changes in model 2 and is negative contrarily to prior expectation. The two interactions included are both positive and significant at 5 % or lower. The more positive people felt about anoa, and the more likely they find it that a population of 10 remaining individuals will become extinct, the higher the utility they get from maintaining larger population sizes in the Lore Lindu area. If an individual's attitude is rather negative and/or it thinks that it is more likely that a population of 10 will survive, however, it will receive disutility from anoa conservation efforts. By calculating individual utilities based on model estimates and SDC, about one fifth of the respondents prefer *smaller* population sizes of anoa. When asked about negative and positive aspects associated with anoa, about one third (32 %) of the respondents could not mention any positive aspects, while more than half of the respondents (53 %) reported potential or actual problems. 51 % stated to obtain benefits mostly related to the protection of a species which is 'special' (*khas*) to Sulawesi (including bequest motives). On the other hand, about 14 % can name benefits from the direct use of anoa (meat, horns, skin etc.).

Results from population models reported by Manansang et al. (1996) indicate that anoa populations may only be able to survive a hunting rate of 2-3 % of the total population number each year. Despite the fact that not every respondent of the 14 % mentioning hunting-related benefits might actually hunt anoa[16], it is not unlikely, on the other hand, that hunting rates may actually exceed 2-3 % of the total anoa population. Burton et al. (2005: 42) suggest education and training of people as a measure for an anoa conservation programme: "It is necessary to explain to people living around protected areas why their activities need to be controlled and why wildlife, which they might otherwise utilize, should be conserved. The fact that anoas, along with many other species, do not occur outside Sulawesi should be stressed because many people on the island are unaware of their heritage […]".

The model results suggest that educational efforts can contribute to anoa conservation by altering people's attitude and their knowledge about anoa: further decline of the population would very likely lead to anoa becoming extinct in the National Park area. Thus, Burton et al. (2005: 40) conclude that "Law enforcement should be combined with an environmental education campaign that stresses that the anoas are unique to Sulawesi and in danger of being lost forever".

All included interactions of socioeconomic variables with the cost attribute were significant, and marginal WTP is a function of these variables. Individuals with higher education and a higher perceived discretionary (short-term) income are less responsive to increases of the cost attribute (thus having positive effect on WTP), whereas individuals with higher child dependency rates are more concerned about tax rise or village donation (thus having negative impact on WTP). As an aside, we did not find a significant influence of relative poverty on the cost attribute (data not shown). In addition to the documented linear influence on cocoa shading, relative poverty may have a systematically non-linear influence on preferences for anoa, rattan and water (Glenk et al. *accepted*). However, as relative poverty is a composite mid-term welfare measure, it does not directly reflect the current buying power or cash availability of respondents. These aspects are more likely to be determinants of sensitivity for changes in the cost attribute as indicated by the interaction with the perceived discretionary income mentioned above.

6.3 Part Worths

Marginal WTP values or implicit prices for the ecosystem services included in the choice experiment can be calculated by dividing the attribute coefficient with the coefficient of the cost attribute. For the interactions with SDC, mean values were used. Implicit prices "… can be used by policy makers to assign more resources to improving those attributes that have higher prices…" (Colombo et al. 2005:89). However, care must be taken when comparing the implicit prices as the attribute units differ. Results are listed in table 4. Most impressively, median MWTP to avoid 1 month of water scarcity for irrigation is about 35 000 IDR (4.1 US$) per year, 100 individuals more of anoa are still worth about 3 300 IDR (0.39 US$) per year. Confidence intervals were calculated by using a Krinsky and Robb (1986) procedure with 1000 random draws[17].

Table 4. Part Worths in IDR/year/household (US$)

		Rattan	Water	Cocoa[§]	Anoa
Median Part Worths		-1 662 (-0.2)	-35 106 (-4.13)	-530 (-0.06)	33 (0.004)
95%	**Lower bound**	-2 461 (-0.29)	-45 806 (-5.39)	-733 (-0.09)	12 (0.001)
	Upper bound	-1 066 (-0.13)	-28 715 (-3.38)	-386 (-0.05)	62 (0.007)

[§] Calculated as mean slope between 5 % and 95 %; Source: own calculations

What can be said about the absolute magnitude of the MWTP values? Are they in a reasonable range or particularly low or high? We collected some background data related to attributes, allowing a vague assessment of the plausibility of the magnitude of MWTP values, particularly for rattan and water availability. The following comparisons should not be conceived as a formal proof of external validity. Still they are helpful in anchoring the MWTP values within a broader context. First, the average direct tax (*PBB: pajak bumi bangunan*) paid by households in the research region is about 15 000 IDR per year. Thus, MWTP for one month less with water scarcity for irrigation equals up to 200 % of the "house and land" tax people have to pay on average per year. A number of households in some villages have to pay irrigation fees of about 19 200 IDR per ha and year on average[18]. Therefore, WTP for improved water availability expressed by the respondents can be considered to reflect a substantial amount for the inhabitants of the Lore Lindu region. Concerning rattan, we conducted a linear regression of the time needed to reach the rattan harvesting locations (h) on the distance (km) (see appendix 2).

One km less is associated with a time saving of about 0.4 hours (n = 37, significant at the 99 % level). To derive a monetary value of time savings, they may either be related to the (local) wage labour market or calculated as the income forgone from collecting more of a (priced) resource (Köhlin and Anmacher 2005). This is a very simplified assumption of economic activity in the project area, as we do know next to nothing about the potential utilisation of time savings[19]. Average income from wage labour is about 15 000 IDR per day. On average, people collected rattan 18 times per year. One km less is therefore associated with 14.4 h ((18 x 2) x 0,4 h) saved per year. Assuming perfect substitutability of time and labour, one km less would equal income forgone from wage labour of about 22 000 IDR per year, while the fraction of the sample selling rattan is 12.8 %. Median MWTP for 1km less is about 1 600 IDR/year.

Comparisons like that are more difficult for cocoa and particularly anoa due to the complexity of the benefits associated with those attributes on one hand, and to a lack of data available on those benefits on the other hand. For the water and rattan attributes, however, there is indication that the MWTP values are in a reasonable range. Furthermore, Pattanayak and Kramer (2001) report a WTP of 2-3 US$ for drought mitigation services by watershed protection on Flores/ Indonesia derived by contingent valuation method. Although not directly comparable, their result for a similarly framed ecosystem service can provide some weak evidence that MWTP for water as calculated in this study seems to be neither completely over- or underestimated.

7. Conclusion

With a carefully adjusted instrument, the choice experiment could be conducted successfully on one of Indonesia's outer islands. Model performance was quite good. The MNL model results provide some evidence that the choice experiment can be applied to complex ecological services in an ecologically and socially diverse rural area and in a developing country setting. The design strategies to adjust the status-quo scenario to the individual respondents and the translation of biodiversity values into ecosystem *services* contributed essentially to this result. Concerning the first, one of the major advantages of using individual-specific perceived levels for the status-quo is the availability to account for heterogeneous environmental conditions in an on-site study, therefore enhancing credibility among respondents as well as framing choices properly as gains and losses.

Using the ecosystem service approach and translating ecosystem functions into concepts that correspond to and interact with peoples life may contribute to reduce potential problems arising from the divergence of perceived and actual values for welfare analysis. The ecosystem approach proved to be a successful instrument to be used for the valuation of ecosystem services in general and for ecosystem services provided by complex ecosystem functions in particular. However, the link between ecosystem services as described in this study and the underlying ecosystem structures, functions and processes is not well established (also see Barkmann et al. *subm. a*). It is for instance neither known, what management practices would be necessary to reduce the encounter distance to the harvesting locations for rattan by 5 km, nor is it clear, what kind of quantitative and qualitative land use change would result in a water shortage for irrigation of one month more. Thus, one of the major challenges

for future applications of the ecosystem service approach is to improve the 'tuning' with ecological sciences to achieve that data is produced in a form that is translatable into ecosystem services for the assessment of (welfare) implications of human-induced changes. The task for economists, on the other hand, is to identify the values of ecosystem services for consideration in decision-making processes. By combining the impacts on human-wellbeing with ecological background data and other societal aspects, a useful policy/management tool could arise. Hence, further efforts are needed to improve the communication between the two disciplines.

Measures of MWTP for an improved provision of ecosystem services ('water', 'rattan', 'anoa') were documented. We outlined that the magnitude of MWTP is quite substantial considering the living conditions of the inhabitants of the Lore Lindu region. Furthermore, we provided some indication that MWTP values calculated in this study are neither completely over- nor underestimated. There is a willingness of local respondents to contribute actively to the maintenance of their resource base concerning water availability and rattan provision. This could also be beneficial from a biodiversity conservation standpoint. On average, residents even have small MWTP for maintaining viable population sizes of the local endemic dwarf buffalo anoa. By taking a closer look, we found a substantial amount of respondents who either don't care or even have preferences for smaller populations, which is of concern for the conservation of that species. This shows the importance of accounting for heterogeneity of tastes by interactions. In the fast growing sector of cocoa agroforestry systems, the respondents indicated an unexpectedly clear preference for more intensively managed plantations with fewer shade trees. Benefits due to increased welfare are opposed by negative impacts on biodiversity. However, the relationship between private net benefits and social costs is not clear for neither short nor longer terms.

Overall, the conflict between locally predominant objectives of economic development and more globally defined conservation objectives is clearly reflected in people's preferences for the range of ecosystem services observed. MWTP figures reflecting net benefits can serve as a benchmark for future research and may be utilized as measures of Hicksian compensating variation (e.g. Bennett and Blamey 2001) in a cost-benefit framework, which addresses all relevant costs and benefits, associated with a development program. It is the results from interactions with socio-demographic variables, however, which contribute to a more distinguished understanding of people's preferences.

8. References

Adamowicz, W., Luckert, M. and M. Veeman, 1997a. Issues in using valuation techniques cross-culturally: three cases in Zimbabwe using contingent valuation, observed behaviour and derived demand techniques. Commonwealth Forestry Review, 76(3):194-97.

Adamowicz, W., Swait, J., Boxall, P., Louviere, J. and M. Williams, 1997b. Perceptions versus Objective Measures of Environmental Quality in Combined Revealed and Stated Preference Models of Environmental Valuation. Journal of Environmental Economics and Management, 32: 65-84.

Adamowicz, W., Louviere, J. and J. Swait, 1998a. Introduction to Attribute-Based Stated Choice Methods. Prepared by Advanis Inc. for the National Oceanic and Atmospheric Administration, US Departement of Commerce.

Adamowicz, W., Boxall, P., Williams, M. and J. Louviere, 1998b. Stated preference approaches to measuring passive use values. American Journal of Agricultural Economics, 80: 64-75.

Akiyama, T. and A. Nishio, 1996. Indonesia's Cocoa Boom. Hands-off Policy Encourages Smallholder Dynamism. Policy Research Working Paper 1580. Washington, D.C.: World Bank.

Alpizar, F., Carlsson, F. and P. Martinsson, 2001. Using Choice Experiments for Non-Market Valuation. Economic Issues, 8: 83-110.

ANZDEC, 1997. Central Sulawesi Integrated Area Development and Conservation Project. TA NO 2518 - INO. Draft Final Report - Annex (Working Papers). Indonesia.

Barkmann, J., Dietrich, N., de Vries, K., Gerold, G., Glenk, K., Keil, A., Faust, H., Leemhuis, C. and R. Marggraf, (*submitted a*). Confronting unfamiliarity with ecosystem functions: The case for an ecosystem service approach to environmental valuation with stated preference methods. *Submitted to Ecological Economics.*

Barkmann, J., Glenk, K., Marggraf, R. (*submitted b*): Assessing economic preferences for biological diversity and ecosystem services at the Central Sulawesi Rainforest Margin – a choice experiment approach. Guhardja, Leuschner and Tscharntke (Eds): The stability of rainforest margins: linking ecological, economic and social constraints of land use and conservation.

Bateman, I.J., Carson, R.T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Monrato, S., Ozdemiroglu, E., Pearce, D., Sugden, R. and J. Swanson,

2002. Economic Valuation with Stated Preference Techniques – A Manual. Cheltenham, UK: Edward Elgar.

Belsky, J.M. and F.S. Siebert, 2003. Cultivating Cocoa: Implications of sun-grown cocoa on local food security and environmental sustainability. Agriculture and Human Values, 20: 277-85.

Ben-Akiva, M. and M. Bierlaire, 1999. Discrete Choice Methods and Their Applications to Short Term Travel Decisions, in R.W. Hall (Ed.): Handbook of Transportation Science: 5-33. USA: Kluwer Academic Publishers.

Bennett, J., 1999. Some Fundamentals of Environmental Choice Modelling. Research Report No.11. Canberra, Australia: School of Economics and Management, The University of New South Wales.

Bennett, J. and W. Adamowicz (2001), 'Some Fundamentals of Environmental Choice Modelling', in J. Bennett and R. Blamey, (Eds), *The Choice Modelling Approach to Environmental Valuation*. Cheltenham, UK: Edward Elgar.

Bennett, J. and R. Blamey (Eds), 2001. The Choice Modelling Approach to Environmental Valuation. Edward Elgar, Cheltenham, UK.

Bingham, G., Bishop, R., Brody, M., Bromley, D., Clark, E., Cooper, W., Constanza, R., Hale, T., Hayden, G., Kellert, S., Norgaard, R., Norton, B., Payne, J., Russell, C. and G. Suter, 1995. Issues in ecosystem valuation: improving information for decision making. Ecological Economics, 14: 73-90.

Blamey, R., Rolfe, J., Bennett, J. and M. Morrison, 1997. Environmental Choice Modelling: Issues and Qualitative Insights. Research Report No. 4. Canberra, Australia: School of Economics and Management, The University of New South Wales.

Blamey, R., J. Bennett, M. Morrison, J. Louviere and J. Rolfe, 1998. Attribute Selection in Environmental Choice Modelling Studies: The Effect of Causally Prior Attributes. Research Report No. 7. Canberra, Australia: School of Economics and Management, The University of New South Wales.

Burkard, G., 2002a. Stability or Sustainability? Dimensions of Socio-economic Security in a Rainforest Margin. STORMA Discussion Paper Series No. 7, Universities of Göttingen and Kassel, Germany and the Institut Pertanian Bogor and Universitas Tadulako, Indonesia.

Burkard, G. 2002b. Natural Resource Management in Central Sulawesi: Past Experience and

Future Prospects. STORMA Discussion Paper Series No. 8, Universities of Göttingen and Kassel, Germany and the Institut Pertanian Bogor and Universitas Tadulako, Indonesia.

Burton, J.A., Hedges, S. and A.H. Mustari, 2005. The taxonomic status, distribution and conservation of the lowland anoa *Bubalus depressicornis* and mountain anoa *Bubalus quarlesi*. Mammal Review, 35(1): 25-50.

Colombo, S., Calatrava-Requena, J. and N. Hanley, 2005. Designing Policy for Reducing the Off-farm Effects of Soil Erosion Using Choice Experiments. Journal of Agricultural Economics, 56(1): 81-95.

De Groot, R., Wilson, M. and R. Boumans, 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics, 41: 393-408.

Faust, H., Maertens, M., Weber, R., Nuryartono, N., van Rheenen, T. and R. Birner, 2003. Does Migration lead to Destabilization of Forest Margins? Evidence from an interdisciplinary field study in Central Sulawesi. STORMA Discussion Paper Series No. 11, Universities of Göttingen and Kassel, Germany and the Institut Pertanian Bogor and Universitas Tadulako, Indonesia.

Glenk, K., Barkmann, J., Schwarze, S., Zeller, M. and R. Marggraf, (*accepted*). Differential influence of relative poverty on preferences for ecosystem services: Evidence from rural Indonesia. Brisbane Conference on Environment and Development, 2006.

Greene, W.H., 2003. LIMDEP Version 8.0 NLogit Version 3.0. Plainview, N.Y.: Econometric Software, Inc.

Hausman, J. and D. McFadden, 1984. Specification Tests for the Multinomial Logit Model. Econometrica, 52(5): 1219-40.

Hensher, D.A., Rose, J.M., and W.H. Greene 2005. Applied choice analysis: a primer. Cambridge University Press, Cambridge, U.K.

Horne, P. and L. Petäjistö, 2003. Preferences for Alternative Moose Management Regimes among Finnish Landowners: A Choice Experiment Approach. Land Economics, 79(4): 472-82.

Huber, J. and K. Zwerina, 1996. The Importance of Utility Balance in Efficient Choice Designs. Journal of Marketing Research, 33: 307-17.

Jae, H. and D. del Vecchio, 2004. Decision Making by Low-Literacy Consumers in the Presence of Point-of-Purchase Information. The Journal of Consumer Affairs, 38(2): 342-54.

Kahneman, D. and J.L. Knetsch, 1992. Valuing Public Goods. The Purchase of Moral Satisfaction. Journal of Environmental Economics and Management, 22: 57-70.

Keil, A., 2004. The socio-economic impact of ENSO-related drought on farm households in Central Sulawesi, Indonesia. Ph.D. thesis, Institute of Rural Development, University of Goettingen.

Kemper, D. 2005. Die Bedeutung von „Wissen“ für Landnutzungsentscheidungen - eine kulturgeographische Untersuchung in zwei Dörfern am Rande des Lore Lindu Nationalpark, Indonesien. M.Sc. Thesis, Institute of Geography, University of Goettingen.

Köhlin, G. and G.S. Amacher, 2005. Welfare Implications of Community Forest Plantations in Developing Countries: The Orissa Social Forestry Project. American Journal of Agricultural Economics, 87(4): 823-1096.

Kontoleon, A. and M. Yabe, 2004. Assessing the Impacts of Alternative ‘Opt-out’ Formats in Choice Experiment Studies. Journal of Agricultural Policy Research, 5: 1-32.

Krinsky, I., and A. L. Robb, 1986. On approximating the statistical properties of elasticities. Review of Economics and Statistics, 68: 715–719.

Krutilla, J. V., 1967. Conservation Reconsidered. American Economic Review, 57(4): 777-786.

Lancaster, K., 1966. A New Approach to Consumer Theory. Journal of Political Economy, 74: 132-157.

Lancaster, K., 1991. Modern Consumer Theory. Brookfield VT: Edward Elgar.

Louviere, J., Hensher, D. and J. Swait 2001. Stated Choice Methods – Analysis and Application. Cambridge, UK: Cambridge University Press.

Luce, R.D., 1959. Individual choice behaviour. New York: Wiley.

Luce, M.F., 1998. Choosing to Avoid: Coping with Negatively Emotion-Laden Consumer Decisions. Journal of Consumer Research, 24: 409-33.

Maertens, M., 2004. Economic Modelling of Agricultural Land-Use Patterns in Forest Frontier Areas. Ph.D. thesis, Institute of Rural Development, University of Goettingen.

Manski, C., 1977. The Structure of Random Utility Models. Theory and Decision, 8: 229-54.

Marggraf, R. and R. Birner, 1998. The Conservation of Biological Diversity from an Economic Point of View. Theory in Biosciences, 117: 238-55.

McFadden, D., 1973. Conditional Logit Analysis of Qualitative Choice Behavior. In P. Zarembka (Ed.): Frontiers in Econometrics. New York: Academic Press.105-42.

Mekonnen, A., 2000.Valuation of Community Forestry in Ethiopia: a Contingent valuation Study of Rural Households. Environment and Development Economics, 5: 289-308.

Millennium Ecosystem Assessment, 2003. Ecosystems and human well-being: A framework for assessment. Washington, District of Columbia: Island Press.

Mogas, J., Riera, P. and J. Bennett, 2002. A comparison of contingent valuation and choice modelling: Estimating the environmental values of Catalonian forests. Occasional paper no. 1, National Centre for Development Studies, Australian National University.

Morrison M., Blamey, R. Bennett, J. and J. Louviere, 1996. A Comparism of Stated Preference Techniques for Estimating Environmental Values. Research Report No.1. Canberra, Australia: School of Economics and Management. The University of New South Wales.

Morrison, M., Bennett, J., and R. Blamey, 1998. Valuing improved wetland quality using choice modelling. Research Report No.6. Canberra, Australia: School of Economics and Management, The University of New South Wales.

Myers, N., Russel, A., Mittermeier, R., Mittermeier, C., da Fonseca, G. and J. Kent, 2000. Biodiversity hotspots for conservation priorities. Nature, 403:853-58.

Nunes, P. and J. v.d. Bergh, 2001. Economic valuation of biodiversity: sense or nonsense?. Ecological Economics, 39: 203-22.

Olson, D.M. and E. Dinerstein, 1998. The Global 200: a representation approach to conserving the Earth's most biologically valuable ecoregions. Conservation Biology, 12: 502.

Pattanayak, K. and R. Kramer, 2001. Pricing ecological services: Willingness to pay for drought mitigation from watershed protection in eastern Indonesia. Water Resources Research, 37(3): 771-78.

Pearce, D.W. and D. Moran, 1994. The economic Value of Biodiversity. IUCN – The World Conservation Union. London: Earthscan Publications.

Randall, A. and J. Stoll, 1983. Existence Values in a Total Valuation Framework. In: Row, R. D. and L.G. Chestnut: Managing Air Quality and Scenic Resources at National Parks and Wilderness Areas. Boulder, Colorado: Westview Press.

Sagoff, M., 1996. On the Value of Endangered and Other Species. Environmental Management, 20(6): 897-911.

Samuelson, W. and R. Zeckhauser, 1988. Status Quo Bias in Decision Making. Journal of Risk and Uncertainty, 1: 7-59.

Schwarze, S., 2004. Determinants of Income Generating Activities of Rural Households, A

Quantitative Study in the Vicinity of the Lore-Lindu National Park in Central Sulawesi/Indonesia. Ph.D. thesis, Institute of rural Development, University of Goettingen.

Shyamsundar, P. and R. Kramer, 1996. Tropical Forest Protection: An empirical analysis of the costs borne by local people. Journal of Environmental Economics and Management, 31: 129-44.

Siebert, F.S., 2001. Sustainable harvesting of wild rattan: viable concept or ecological oxymoron? Unasylva, 52: 36-45.

Siebert, F.S., 2002. From shade to sun-grown perennial crops in Sulawesi, Indonesia: implications for biodiversity conservation and soil fertility. Biodiversity and Conservation, 11: 1889-1902.

Sitorus, F. 2002. Land, ethnicity and the competing power. Agrarian dynamics in forest margin communities in Central Celebes, Indonesia. STORMA Discussion Paper Series No. 6, Universities of Göttingen and Kassel, Germany and the Institut Pertanian Bogor and Universitas Tadulako, Indonesia.

Slovic, P. and S. Lichtenstein, 1971. Comparison of Bayesian and Regression Approaches to the Study of Information Processing in Judgment. Organizational behavior and Human Performance, 6: 649-744.

Suryahadi, A. and S. Sumarto, 2001. The chronic poor, the transient poor, and the vulnerable in Indonesia before and after the crisis. SMERU working paper. Jakarta: SMERU Research Institute.

Swait, J. and W. Adamowicz, 1996. The Effect of Choice Experiments and Task Demands on Consumer Behavior: Discriminating Between Contribution and Confusion. Staff Paper 96-09. Edmonton, Canada: Departement of rural Economy, University of Alberta.

Thurstone, L.L., 1927. A Law of Comparative Judgment. Psychological Review, 4: 273-86.

Train, K., 1986. Qualitative Choice Analysis, Theory, Econometrics and an Application to Automobile Demand, MIT Press, London.

Train, K., 1998. Recreation demand models with taste differences over people. Land Economics, 74(2): 230 – 40.

Turner, R., Paavola, J., Cooper, P., Faber, S., Jessamy, V. and S. Georgiou, 2002. Valuing Nature: Lessons Learned and Future Research Directions. CSERGE Working Paper EDM 02-05. Norwich, UK: University of East Anglia.

Waltert, M., Mardiastuti, A. and M. Mühlenberg, 2004. Effects of land use on bird species richness in Sulawesi, Indonesia. Conservation Biology, 18: 1339-46.

Weber, R., 2005. Kulturlandschaftswandel während des 20. Jh. in Zentralsulawesi – eine historisch-geographische Analyse der Lore-Lindu-Bergregenwaldregion. Ph.D. thesis, Institute of Geography, University of Goettingen.

Whitten, A.J., Henderson, G.S. and M. Mustafa, 1987. The Ecology of Sulawesi. Yogyakarta, Indonesia: Gadjah Mada University Press.

Whittington, D., 1998. Administering contingent valuation surveys in developing countries. Environmental Economics Program for Southern and Eastern Asia Working Paper.

Zeller, M., Schwarze, S. and T. van Rheenen, 2002. Statistical Sampling Frame and Methods Used for the Selection of Villages and Households in the Scope of the Research Programme on Stability of Rainforest Margins in Indonesia (STORMA). STORMA Discussion Paper Series No. 1, Universities of Göttingen and Kassel, Germany and the Institut Pertanian Bogor and Universitas Tadulako, Indonesia.

Zeller, M. and R. Birner, 2003. Teilprojekt A3. Der Einfluss von Märkten und Politikmaßnahmen auf die Ressourcennutzung. in: Sonderforschungsbereich 552 "Stability of Rainforest Margins in Indonesia" der Deutschen Froschungsgemeinschaft. Ergebnisbericht über die 1. Förderungsphase 2000/2-2003/1. Georg-August-University Goettingen and University of Kassel.

Notes:

[1] Particularly from South Sulawesi many ‚cocoa migrants' were attracted by the availability of land (Faust et al 2003).

[2] "Existence value" can be defined to be the value arising merely from the information that a resource exists regardless of whether this asset now or in the future generates a productive, recreational or aesthetic use for the person holding the preferences (e.g. Bingham et al. 1995, Fromm 2000). In this sense, there is a notion that the resource or asset has a value of its own, which is of anthropocentric intrinsic nature. Intrinsic values, however, are not consistent with *conventional* economic thought (Turner et al. 2002).

[3] There is no need to distinguish between ecosystem goods and services if the provision of goods within an ecosystem is being classified as an ecosystem service itself. The distinction between production and consumption values (Marggraf and Birner 1998) as well as direct and indirect values within the TEV concept suggests that it may be appropriate to separate goods (production value, often direct use) and services (consumption value, often indirect use) conceptually from an economic point of view.

[4] We do not subscribe to extreme interpretations of this way to model actual human decision-making. Namely, we do not assume that actual individuals have perfect information. Our analytic paradigm models individuals 'as if' they have perfect information, however.

[5] According to the standard model, ε_{ij} remains perfectly deterministic from an individuals' point of view.

[6] Many CE case studies use "focus groups" for that purpose. It was hardly possible to conduct focus groups without the attendance of the most influential inhabitants of a village. The opinion of those people (e.g. village head) often dominated the sessions. Understandably, they wanted to shed the village into a favourable light. Therefore, it seemed appropriate to focus on individual interviews and use the peer-groups to obtain further information mainly about prevailing policy issues.

[7] E.g. in one village, one of the streams providing water for irrigation dried up, in another the water declined to such an extend that irrigation is hardly possible any more.
[8] This description implicitly entails that perceived effects of irrigation technology on irrigation water supply cannot be separated from the effects of land use.
[9] According to Kemper (2005) one inhabitant stated: "If I encounter anoa in the forest, either I kill it, or it will kill me".
[10] I.e. more months with water scarcity and more km to the rattan harvesting locations are expected to be associated with disutility.
[11] The split-samples are not analysed in this paper.
[12] The Indonesian version of the picture book, the text book and the questionaire can be seen at www.storma.de/DPS/pdf/SDP16b.pdf
[13] Present population sizes of anoa cannot possibly be known. Hence, a common reference point was defined (see table 1).
[14] Reasons for choosing always the status quo were 'protest' answers, payment aversion, and exceeding the cognitive capability to complete the choice task (one respondent).
[15] In this case, migrants were defined as households where the head of household or his/her father has moved to the village.
[16] On the other hand, not all respondents might have reported benefits from hunting as it is an illegal activity.
[17] A large number of random draws from a multivariate normal distribution with mean and variance of parameter estimates and a variance-covariance matrix from the estimated model.
[18] Mean value over four planting seasons from 2003 - 2004 for households that paid irrigation fees in 6 of the sample villages. Data from Alwin Keil (IMPENSO/ University of Hohenheim).
[19] The income from rattan per day is invariant on the distance of the rattan harvesting locations. Rattan collectors always look for locations where there are still enough large diameter canes, as they are far better priced than smaller diameters. Hence, it is justified to use time savings rather than changes in income in order to derive an estimate of the marginal economic impact of the distance of rattan harvesting locations.