Journal of Horticulture and Forestry Vol. 4(12), pp. 181-189, December 2012
Available online at http://www.academicjournals.org/JHF
DOI: 10.5897/JHF12.011
ISSN 2006-9782 ©2012 Academic Journals

Review

Types of values and valuation methods for environmental resources: Highlights of key aspects, concepts and approaches in the economic valuation of forest goods and services

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Accepted 31 October, 2012

It is essential to understand and recognize the role that environmental resources such as forest goods and services play in the provision of income to peoples' livelihoods (especially the poor and marginalized communities). The purpose of this paper is to give a concise account and scientific basis of the importance of the phenomenon of valuation of environmental goods and services which is manifested in two ways. Firstly, it helps policymakers in designing and implementing effective sustainable livelihoods and poverty reduction strategies. Secondly, the size and nature of environmental values have implications for issues of conservation and sustainable resource use. This paper outlines the contemporary models and approaches of valuing the direct use benefits, indirect use benefits and intermediate use services of the forest as an ecosystem and not a mechanical body to produce goods and services for income generation, overlooking the fundamental principles of sustainable forest management and sustainable development. Shortcomings and remedial measures of valuation methods are also summarized. Through appreciating the total value of the forest resources, national governments and local communities would be able to promote sustainable forest resource use across all strata of society and incorporate the value of natural forests and woodlands in their System of National Accounts to avoid unnecessary conversion of forests into other development projects.

Key words: Forest goods and services, natural woodland, sustainable, economic valuation, user surveys, non-use values.

INTRODUCTION

It is estimated that 80% of the population of "developing" countries relies on forest goods and services for their primary health and nutritional needs (FAO, 1995, 2001). In 1993, the world trade in NTFPs was estimated at US$ 11-billion. In addition to their economic value, NTFPs can play a vital role in restoration and maintenance of important cultural traditions and improve the quality of life for millions of people (Falconer, 1992; Crafter et al., 1997; Bishop, 1999; Harshaw, 2000; Dovie et al., 2001; Chamberlain et al., 1998; Hassan et al., 2002). It is further generally assumed that the sustained extraction and processing of NTFPs by local people can enhance their cash income and provide an alternative to tropical deforestation (Hedge et al., 1996; Dlamini, 2007). However, the degree to which such products may potentially contribute to rural incomes is poorly documented (Hedge et al., 1996; Campbell et al., 1997; High and Shackleton, 2000; Dlamini and Geldenhuys, 2009, 2011a).

There is still no indication that the deforestation rate of natural forests and woodlands is decreasing (Crafter et al., 1997; Gram, 2001). Destructive mining operations,

non-sustainable logging and conversion of forestland to large-scale agriculture are the most economically favourable options for investment compared to such activities as sustainable extraction of forest goods and services and in particular non-timber forest products (NTFPs) that have a great potential of natural forest preservation and environmental protection and conservation (Crafter et al., 1997; Gram, 2001; Hassan et al., 2002; Dlamini, 2011). The main attributes to that are: firstly, several services provided by the forest, such as carbon dioxide storage, conservation of biological diversity and maintenance of regional climate, represent externalities for companies investing in large-scale economic operations. Secondly, a wide range of products from natural forests and woodlands, rivers and lakes is extracted by adjacent communities and mainly used for subsistence purposes or exchanged at local markets; therefore, they are less attractive for commercial investments and non-local decision makers (Peters et al., 1989; Godoy et al., 1993, 2000; Temu, 1995; Robles-Diaz-De-Leon and Kangas, 1999; Gram, 2001; Hassan et al., 2002).

Despite their widespread use and importance, NTFPs are generally considered as minor products and not included in regional or national forest planning strategies. For a long time, NTFPs have been perceived as quaint substance products, that do not really add to the balance sheets of national economies, that is to the System of National Accounts (Godoy and Bawa, 1993; Crafter et al., 1997; Harshaw, 2000; Dovie et al., 2001; Hassan et al., 2002; Clarke and Grundy, 2004).

Resource surveys and resource accounting for forest goods and services in Swaziland is a relatively new field. A desk-top review of the forest goods and services focusing on NTFPs in Swaziland revealed an annual consumer value of selected NTFPs of between US$16.125 million and US$64.25 million with a median value of US$40.125 million at 1999 prices (DANCED, 2000). Medicinal and pharmaceutical products and fuel wood were on the top two positions in this analysis. This value is conservative in respect of the other non-timber goods and services of the natural forests and woodlands of Swaziland, such as environmental protection. Natural resource accounts for the state and economic contribution of forest and woodland resources in Swaziland reveal that the contribution of natural forest and woodlands in flow benefits was equivalent to 2.2% of total GDP, 20% of agriculture GDP and 449% of the contribution of forestry reported in the formal national accounts for 2000 (Hassan et al., 2002; Dlamini, 2007, 2011). This provides another evidence of the massive value of natural forest and woodland resources missing from the System of National Accounts (SNA) in Swaziland.

Consequently, the methods used to value tropical forests have the potential to influence how policy makers and others perceive forestland. Policy-makers and decision makers often assume that tropical and sub-tropical forests have no economic value, and through participatory natural resources and environmental accounting, these people will change their attitudes (Peters et al., 1989; Chopra, 1993; Campbell et al., 1997; Shackleton and Shacketon, 2000; Dovie et al., 2001; Hassan et al., 2002).

Types of value

The term value is used in many ways in studies on the economic valuation of forest goods and services, including use values and non-use values (Harshaw, 2000; Dlamini, 2007). It is important to clarify the meanings of the different types of values, as the term can have distinct meanings. The working definitions and discussions of non-market values offered here were adopted from Bishop (1999), Sarker and McKenney (1992), McKenney and Sarker (1994), Klemperer (1996) and Dlamini (2007).

Use values

Use value refers to the benefit a user obtains, either directly or indirectly, from participating in an activity. *Consumptive use* can be described as participation in activities that utilize and possibly deplete the forest resources (e.g. hunting, fishing and tree cutting); while *non-consumptive uses* are those uses or activities that do not affect the resource (e.g. bird-watching in a national park, appreciating a view at a look-out) (McKenney and Sarker, 1994; Dlamini, 2007).

Non-use values

Non-use values do not involve any actual physical consumption of the forest goods and services. Examples of non-use values include increases in productivity, well-being, health, longevity, and feelings of peace and tranquility and a decrease in stress levels (Sarker and McKenney, 1992; McKenney and Sarker, 1994; Klemperer, 1996; Dlamini, 2007). They are further classified as existence, option, quasi-option, bequest and vicarious values (Sarker and Mckenney, 1992; McKenney and Sarker, 1994; Dlamini, 2011). *Existence values* are those benefits that are derived from the knowledge that non-timber amenities and resources will continue to exist regardless of the fact that the amenity or the resource may never be used, seen or visited. *Option value* relates to the willingness to pay for an option to have the resources or services available in future when there is uncertainty attached to its supply (Bishop, 1999). In simple terms, the option value has been defined as “the value of the opportunity for obtaining better information

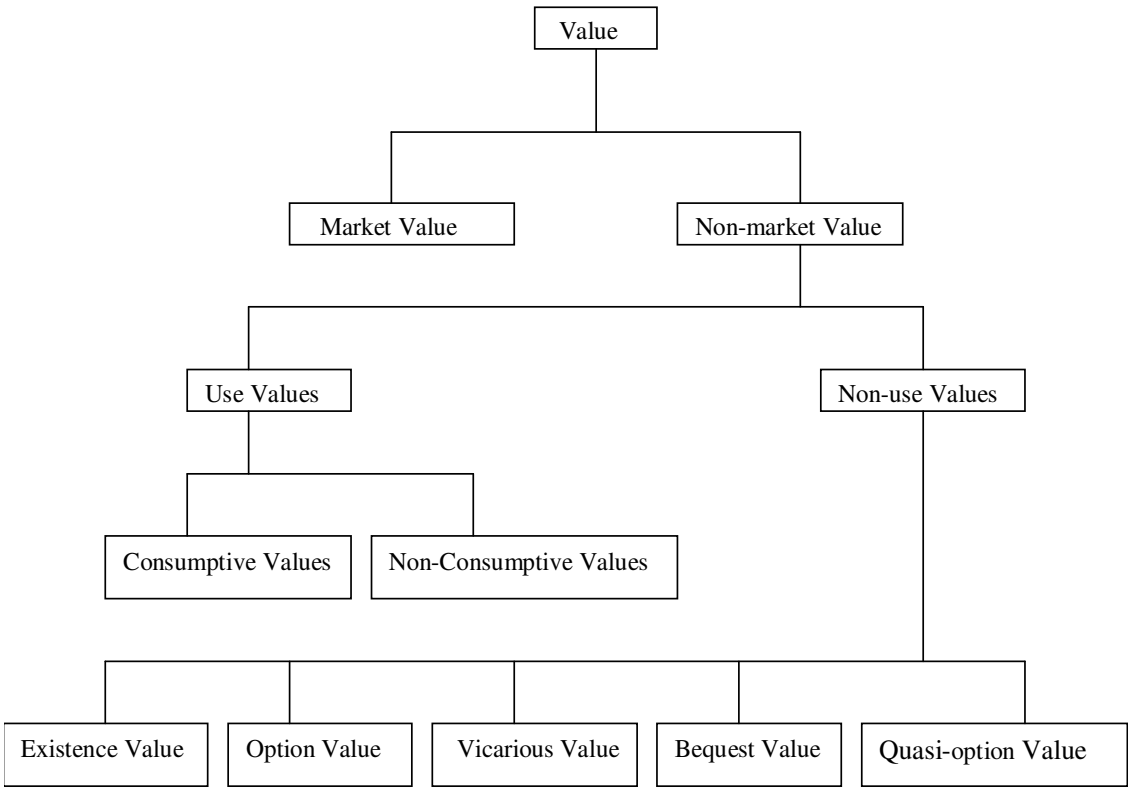

Figure 1. The relationship between different total economic values for NTFPs (Source: adapted from Sarker and Mckenny, 1992, p. 6; While this figure classifies use value and consumptive value as non-market values, they may also be considered as market values).

by delaying a decision that may cause irreversible changes" (Sarker and McKenney, 1992). *Quasi option* value is slightly complicated, it relates to the willingness to pay to avoid an irreversible development given an expectation that knowledge about the impact is in the offing (Bishop, 1999; Dlamini, 2007). *Bequest value* is the value assigned to preserving a resource for use by future generations.

In a forestry context, a bequest value could occur if an individual is willing and able to pay for the preservation of a forest resource so that his children and grandchildren find the resource in an intact state (McKenney and Sarker, 1994; Dlamini, 2007). *Vicarious value* deals with the value placed on a resource that may have never been used or planned to be used, but benefit may be derived from mere pictures, descriptions and other representtations of the resource. Vicarious values may include the information that certain rare species of animals like spotted owls, pine martens, peregrine falcons, etc. still exist. In addition to that, in the case of a vicarious value there may be no motive other than mere knowledge of existence or preservation of a natural environment, and this makes vicarious values a variant of the existence value (McKenney and Sarker, 1994; Dlamini, 2007, 2011). A schematic representation of these values is presented in Figure 1.

VALUATION METHODS

The methods adopted for the economic valuation of forest goods and services generally include direct methods, which determine the value a person is willing to pay for the products or goods through a resource survey instrument. Indirect methods are also used to determine the value of forest goods and services. A schematic representation of non-market valuation methods was developed by Sarker and McKenney (1992) and subsequently presented by McKenney and Sarker (1994) (Figure 2). Methods for valuing forest goods and services, adapted from Bishop (1999), are presented in Table 1.

Indirect valuation techniques

The travel cost method is an indirect valuation technique that was designed to model recreation behaviour. This method calculates a value based on the fact that the price paid to travel to the site is the ultimate value of that site. It should be considered that no fees may be imposed on the use of the resource. The costs associated with travelling to the resource (fuel, mechanical maintenance of vehicle, time spent travelling there)

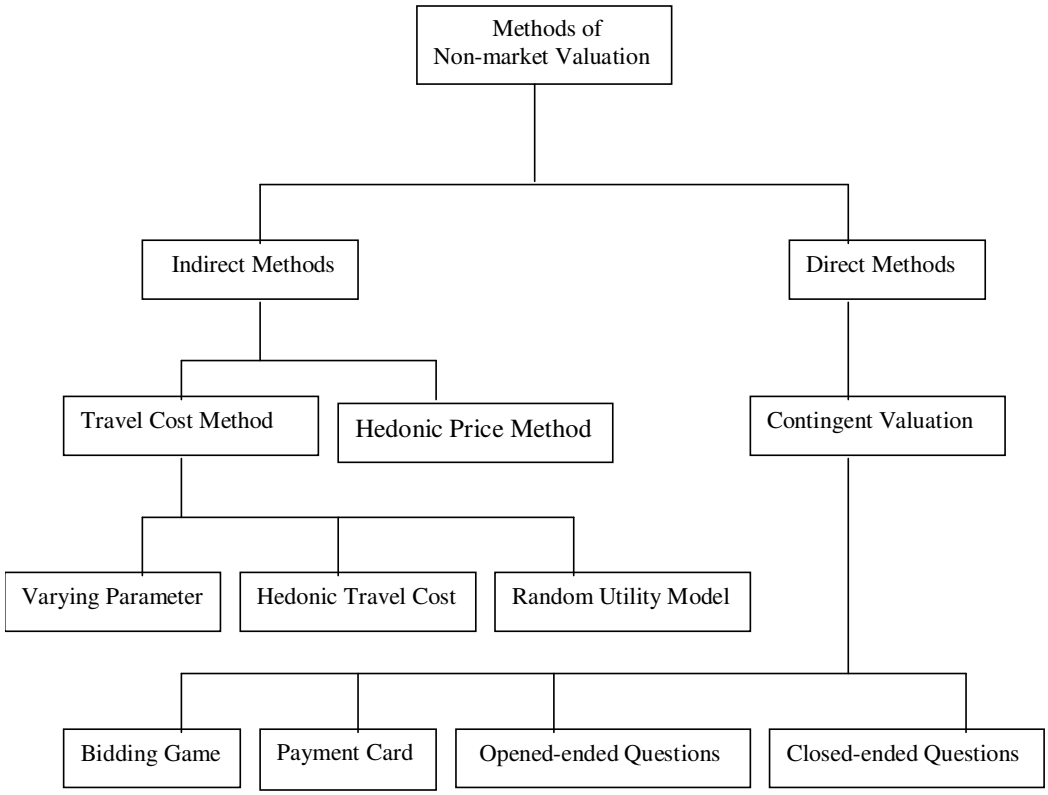

Figure 2. The relationship between different specific non-market valuation techniques for NTFPs (Source: adapted from Sarker and Mckenney, 1992).

become the variables to be used to determine the value of a resource. The weakness of this method is that, it only deals with single destination trips and assumes that travel is a means, rather than an end in itself (Sarker and Mckenney, 1992; McKenney and Sarker, 1994; Klemperer, 1996; Bishop, 1999; Dlamini, 2007, 2011). Under the Travel Cost Method there are three methods: the Varying Parameter, the Hedonic Travel Cost and the Random Utility Model methods. These variants of the travel cost method can be used to analyse the effect of the quality of the site characteristics rather than the gross value. They work with significantly more sophisticated econometric models than the basic travel cost method (Sarker and McKenney, 1992; McKenney and Sarker, 1994; Bishop, 1999; Dlamini, 2007). The origin of the travel cost methods is attributed to an economist named Harold Hotelling, but its operational development and current popularity are due to work done by Clawson (1959), Knetsch (1963) and Clawson and Knetsch (1966). A detailed description of the Travel Cost Method and its subsidiaries is well articulated in Table 1.

The Hedonic price models are based on a hypothesis that goods are aggregations of characteristics and that the demand for these goods is interrelated to these characteristics (Sarker and Mckenney, 1992; McKenney and Sarker, 1994; Bishop, 1999). The characteristics are true arguments of utility functions and any transaction is tied to a group of characteristics, thus the demand for certain characteristics is embedded in the prices and consumption levels of market goods. A good example would be to consider that the price of a house in a city includes the contribution of certain market goods (e.g., size, and design of the house, number of rooms, etc.) and the neighbourhood environmental conditions (e.g. air quality when near a sewage, noise pollution if near an airport, etc). Overall hedonic price models is a means to quantify the contributions of the market and non-market aspects of a particular good to its equilibrium market price through sound statistical analysis (Sarker and Mckenney, 1992; McKenney and Sarker, 1994; Bishop, 1999; Dlamini, 2007, 2011). The hedonic price model was first used by Griliches (1971) and further developed and refined by Rosen (1974) and Palmquist (1991).

The household production function model involves situations where individuals purchase private inputs at market prices and combine them with their time and natural resources and environmental attributes to produce out-door recreation experiences. This model has two stages. Firstly, the household reduces the cost of producing a given level of experiences. Secondly, the recreationist maximizes their utility subject to their budget constraint to determine the level of recreation experiences to consume. The household production theory was developed by Becker (1965) and was subsequently refined to

Table 1. Methods for valuing forest goods and services.

Valuation method	Relevant forest benefits	Strengths and weaknesses
Market prices: Use data from surveys of producers and consumers, adjusted if necessary to account for seasonal variation, value added processing and/or public policy distortion.	Price-based valuation is commonly applied to NTFPs which are partly or informally traded, in order to estimate subsistence and/or unrecorded consumption.	Market prices clearly reflect consumer preferences, but often need adjustment to account for public policy distortions or market failures. Aggregation or extrapolation of values based on potential production is not valid unless account is taken of likely price effects (elasticity of demand).
Surrogate markets: 1) Travel cost-use survey data on direct costs (e.g. fares, accommodation) and, in some cases, opportunity costs of time spent travelling to and from a site, evaluated at some fraction of the average wage rate. 2) Hedonic pricing-use statistical methods to correlate variation in the price of a marketed good to changes in the level of a related, non-marketed environmental amenity 3) Substitute goods-use market prices of substitutes for non-marketed benefits and level (or quality) of output of a marketed good/service	1) Travel cost is often used to estimate demand for forest recreation at specific locations. Related methods used mainly in developing countries estimate the value non-marketed, NTFPs in terms of the opportunity cost of time spent collecting and/or processing them. 2) Hedonic pricing is used to estimate the impact of proximity to forested land and/or logging on the prices of residential and commercial property 3) Substitute goods approaches may be used wherever close market substitutes for non-timber benefits exist. The effect of logging on hunting, downstream water users, fisheries and climate.	1) Provided the relation between the benefit being valued and the surrogate market is correctly specified, and prices in the surrogate market are not very distorted (e.g. by policy intervention), such methods are generally reliable. 2) Travel cost estimates may need to account for various objectives (benefits) in a single trip. 3) Hedonic pricing requires large data sets, in order to isolate the influence of a non-market benefit on market price, relative to other factors.
Stated preference: 1) Contingent valuation method-use consumer surveys to elicit hypothetical individual willingness-to-pay for a benefit, or willingness-to-accept compensation for the loss of that benefit 2) Contingent ranking/focus groups-use participatory techniques in group setting to elicit preferences for non-market benefits, either in relative terms (ranking) or in monetary terms.	1) Recreation values are often estimated using contingent valuation. 2) Stated preference methods such as Contingent Valuation Method (CVM) are the only generally accepted way to estimate non-use values, e.g. landscape or biodiversity values, for which price data do not exist and/or links to marketed goods cannot easily be established. Contingent ranking may be used where target groups are unfamiliar with cash valuation.	1) Contingent valuation estimates are generally considered reliable if strict procedural rules are followed. 2) Participatory valuation techniques are more experimental and not widely used to estimate non-market forest benefits. They are good at eliciting qualitative or "contextual" information, but there are doubts about their reliability for estimating willingness to pay.
Cost-based approaches: Uses data on the costs of measures taken to secure, maintain and/or replace forest goods and services.	Cost-based approaches include replacement/relocation cost, defensive expenditure and opportunity cost analysis; may be used (with caution) to value any type of forest benefit.	Cost-based approaches are usually considered less reliable than other methods. One test of validity is evidence that people are prepared to incur costs to secure relevant benefits

Source: Adapted from Bishop (1999).

its present form by Muellbauer (1974).

Direct valuation techniques

Contingent valuation is a direct way of capturing consumer surplus by means of eliciting the willingness to pay value for the preservation of a resource or opportunity in a simulated market. This method comprises a number of techniques to elicit valuation responses including a bidding game, the payment card, open-ended Questions and close-ended questions (Sarker and Mckenney, 1992; McKenney and Sarker, 1994; Bishop, 1999; Harshaw, 2000; Dlamini, 2007, 2011). Another value that can be elicited through contingent valuation is a willingness to accept value. A willingness to accept provides an estimate of the amount of money an individual would like to be compensated for to forgo an opportunity. This value is estimated based on the fact that the payment is equal to the benefits that an individual would enjoy through salvaging that opportunity (Sarker and Mckenney, 1992, McKenney and Sarker, 1994; Bishop, 1999; Harshaw, 2000; Dlamini, 2011).

In economic theory, the willingness to pay and willingness to accept values are similar, but in reality it has been demonstrated beyond doubt that willingness to

accept values can be four times higher than willingness to pay (Klemperer, 1996). Experimental economics approach is another direct method of deriving un-priced values of environmental goods and services. High profile experiments can be put in place to elicit individuals' valuation for environmental amenities. However, conducting such meaningful experiments is generally difficult and expensive (McKenney and Sarker, 1994).

USER SURVEYS AND ECONOMIC VALUATION

The ultimate aim of natural resource surveys and accounting is to promote sustainable use of the resources and prevent degradation (Hedge et al., 1996; Dovie et al., 2001; Sheil and Wunder, 2002; Geldenhuys, 2002; Dlamini, 2007, 2011). The economic valuation of the NTFPs aspect of forest goods and services is faced with numerous challenges like the inventory of NTFPs. The underlying reasons for the difficulty in the valuation of NTFPs are attributed to the complex nature of the products leading to most having non-wood values. Non-wood values have been described as those goods and services produced by the forestland which enter an individual's preference (or utility) function and for which individuals are willing to sacrifice their scarce resources (McKenney and Sarker, 1994: Dlamini, 2007) and these products may not have a defined market price. The local factors that influence land-use priorities, such as lack of secure land tenure, the low level of price stability for NTFPs, the non-economic preferences, and the traditional taboos and norms regarding extraction of these products need to be integrated into the economic valuation (Gram, 2001). Present-day knowledge about the economic value of NTFPs is based on a doubtful foundation because the different methods used by scholars have led to different results.

Consequently, widely different conclusions are made regarding the value of the various NTFPs (High and Shackeleton, 2000; Dovie et al., 2001; Gram, 2001; Godoy et al., 2000; Sheil and Wunder, 2002). Godoy et al. (1993) present a detailed summary of common failings of biometric rigour and reporting protocols in assessments of forest goods and services particularly non-wood forest products (NWFPs), which are basically NTFPs, from the perspective of natural resource economists, and makes suggestions for how methods could be improved. Refer to Table 2 for a summary of shortcomings of NWFPs resource assessments for valuation studies, and this is inconclusive as more and more scholars are coming up with more and more efficient resource assessment and valuations methods.

SIMPLISTIC APPROACH FOR VALUATION OF NTFPs EXTRACTED FROM AFRICAN FORESTS

Below is a generally ideal equation for calculating the value of NTFPs, under sustainable and unsustainable extraction (Godoy et al., 1993, 2000; Dlamini, 2007, 2011). The following equation would be the most ideal method to calculate the value of NTFPs under sustainable extraction:

$$\sum_{i-0}^{n} Qi(Pi - Ci)$$

where: Qi = quantity of goods extracted; Pi = forest/farm gate price of the goods; Ci = cost of extraction (marginal costs of extraction); i = set of non-timber forest products.

If the extraction rates are non-sustainable, adjustment should be made for the eventual depletion of the products by adding to Ci, a depletion premium based on the expected date of extraction (Godoy et al., 1993, 2000). However, the aforestated equation was found to be inappropriate for calculating the value of NTFPs extracted per household in rural Swaziland due to the following factors (Dlamini, 2007, 2011):

1. Extraction costs are largely very low, as none of the resources harvested require specialist tools, usually just an axe, sickle or a bushknife and such tools are used for a multitude of uses within the household. Transport used for conveying edible and medicinal NTFPs was mainly 'walking'. Thus, once the capital cost is spread over a number of different uses and then subject to a discount factor over the life of such a tool, then the annual cost or cost per unit harvested is negligible (Shackleton and Shackleton, 2000). Furthermore, the collecting containers for the NTFPs were old sacks and used plastic bags.
2. The impact of opportunity cost of labour were also very small, firstly because the daily rates paid for labour collecting NTFPs does not exist within the rural areas, as these products are collected by women and children as well as unemployed men, and there is a large surplus of unskilled labour. So the application of opportunity cost of labour under such circumstances would be unrealistic (Shackleton and Shackleton, 2000). Then the approach of Shackleton and Shackleton (2000) and Shackleton et al. (2002) was modified and adopted where the following equation is fitted:

Annual value extracted per household = Annual quantity extracted (either for domestic use or trade) × Mean farmgate price.

The value of NTFPs gives a clear indication of their socio-economic contribution to sustainable livelihoods in rural communities where the majority of the population are poor. This would bring a strong motivation for national governments to allocate financial resources and capacity building for sustainable forest resource use and management towards enhanced sustainable development. Furthermore, national governments will see the urgent need to include and give a true reflect of the value

Table 2. Summary of shortcomings of NWFP's resource assessments for valuation studies.

Information	Main failing	Suggested methodology
Data representative of forest	Many studies only use one site and reasons for choice not given so not possible to use data for comparison or generalization	Ideally a sample of study sites (allow calculation of variance) or failing this presentation of reasons for site choice
Population profiles suitable for generalization	Information in anthropological studies not randomized and sample sizes small	Identification of main attributes of extractors (e.g. age, technology, income). Stratified random sampling of people in identified strata
Data representative of seasonal pattern of NWFP's use	Few studies include more than 1 years data	Random selection of same number of weeks and days from each month through at least one year. Careful examination of climate and other variable, e.g. larger economy to understand representativeness of study period
Quantification of product flows (quantities used by people)	Some studies value the stock (inventory) which relates to neither present nor sustainable flows	Identify, count, weigh and measure products as they enter village each day. Assess random sample of villages and households and ask extractors or randomly observe and record their consumption
Product weight	Weights may not be measured	If products too difficult to weigh in bulk, take seasonal sub-samples for mean weights
Product identification	Irregular use of scientific names or use of local names hinders comparison between studies	Collect specimens (vouchers, skulls, photographs) for definitive scientific identification
Catchment area for product extraction	Many studies do not record catchment area so not possible to determine yields per hectare	Direct observation, participatory mapping, travel time assessment, aerial photographs Global Positioning Systems (GPS), etc.
Sufficient observations	Insufficient if reliant on single researcher undertaking all observations	Train and use extractors to collect information or keep personal diaries (be aware of possible biases)
Value of product	Some researcher use expenditure of labour or energy as a measure of value which is not consistent with modern valuation theory	Use prices that exist for the commodity concerned or that prevail in related markets, e.g. use marketed good bartered for non-marketed product, use value of close substitute. Use contingent (willingness to pay) methods
Share of harvest going to the household and to the market	Few studies have done this but it is important as households and market goods are priced differently	Random sample of households asked to keep log books of daily income, expenses and amounts of NWFP's consumed or sold
Shadow prices	Important in providing an economic rationale for NWFP's that may not be financially profitable. Require estimate valuation from a national viewpoint	Adjust for taxes and subsidies that cause price to deviate from opportunity cost of resource
Environmental externalities	No study has done this which means that conventional valuations underestimate economic benefits of NWFP's	No suggestions made
Marginal costs of extraction	No assessment of search times, cost of tools, etc., made for plant collection (has been made for animals in studies based on optimal-foraging theory)	Interviews, direct observation (instantaneous sampling, focal subject sampling), extractors diaries/records, log movements out of and into village
Wage rates	Some researchers have used country's official wage rate but this should not be done uncritically	Determine whether people actually pay each other. Note that rural wages vary by season, age, gender, and type of work
Cost of capital	Not often measured-use of market rate inappropriate	Use social discount rate-may be calculated locally otherwise use 4-5%
Sustainability	Three views: 1) Indigenous people manage forest sustainability 2) Indigenous people do not manage sustainability	Indirect: Comparison of distance, frequency and duration of collection forays, recall of yields over time etc. Direct: Comparisons of extraction and rates of reproduction/growth in the forest

Table 2. Contd.

Sustainability	3) Sustainability is result of special conditions that must be identified in each case	
Use of plant and animal extraction in single valuation	Not possible as botanists use returns per hectare while zoologist use returns per unit of labour	Multidisciplinary team comprising natural resource economist/economic anthropologist, botanist, zoologist; as well as indigenous people and local scholars

Source: Adapted from Wong et al. (2001).

of non-timber forest products in the SNA.

ACKNOWLEDGEMENTS

All authors cited in the text are highly appreciated for their invaluable contribution to valuing forests and forest resources.

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