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Full Length Research Paper

Quantities and values of selected forest medicines harvested by eight villages adjacent to natural woodlands in the four ecological zones of rural Swaziland

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Harvesting patterns of non-timber forest products (NTFPs) normally vary within and between communities and villages adjacent to natural woodlands. The objective of this study was to undertake user surveys to determine the actual quantities of harvested and utilized medicinal NTFPs, and to do an economic valuation of their direct use values. Methods used included literature research, community consultations, household visits and interviews, household profiles and economic valuation. Findings of the study indicated that use of medicinal NTFPs was significantly different between sites in quantities harvested per household, in quantities harvested per household between communities, in quantities harvested per household between households within sites, between sites in value per household, and in value per household between communities. Harvesting is all year round or when necessary over 1 to 9 months. About 65 species were reported as preferred across the four study sites. The key factors determining the variability in harvested quantities and values per household are: the wealth status, variability of species per site, season and duration of harvesting, commercialization, number of accessible natural woodlands within a site, need and demand, the household profile with regard to gender and age, and farm gate price differences.

Key words: Natural woodland, sustainable, economic valuation, user surveys, non-use values, resource assessment, quantities, households.

INTRODUCTION

Generally, goods and services provided by the natural forests and woodlands fall into two broad categories that meet human needs, namely products and services. Products include fertilizer, foods, fibre, medicines, energy, browse (fodder), construction and craft material. Services comprise cultural and spiritual values, climate regulation, erosion control and hydrological control (Dlamini, 2007).

In Swaziland natural forests and woodlands are home to a broad diversity of medicinal plants. These various plants and plant parts play a significant role in traditional medical practice because they are the main ingredients used for preparing the remedies administered to patients who patronize the medical practice. In addition, plants and plant parts form a major component of ethnomedicines, and are major sources of drugs used in the orthodox medical practice. Consequently, a majority of the phytomedicines used in conventional medical practice today were discovered through the ethnobotanical surveys. Amusan et al. (2007) reported that about 74% of drugs developed from higher plants which are currently in the market were actually derived from the indigenous knowledge of traditional people on ethnomedicnes. Most of the plants used for preparing ethnomedicines in Swaziland have never been quantified and valuated.

It is essential to understand and recognize the role that environmental resources (such as medicinal plants) play in the provision of income to peoples' livelihoods

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(especially the poor and marginalized communities). The importance of this phenomenon of valuation of environmental goods is manifested in two ways. Firstly, it helps policymakers in designing and implementing effective poverty reduction strategies. Secondly, the size and nature of environmental values has implications for issues of conservation and sustainable resource use (Vedeld et al., 2004; Willis, 2004; Dlamini, 2007).

The methods used in evaluating tropical forests have the potential to influence how policy makers and others perceive forestland. Policy- 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, 2000a; Dovie et al., 2001; Hassan et al., 2002; Dlamini, 2007).

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, 2010a). The economic valuation of NTFPs 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; Dlamini, 2010a). 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. (1993a), Wong et al. *(*2001) and Dlamini (2007) present a summary of common failings of biometric rigour and reporting protocols in NWFPs assessments from the perspective of natural resource economists, and makes suggestions for how methods could be improved. In spite of the available information (DANCED, 2000b; Hassan et al., 2002), Swaziland still remains deficient of accurate and precise information on the economic value of the direct and indirect use benefits, and the intermediate use services of the non-timber forestry goods and services from the country's natural forests and woodlands (Braun and Dlamini, 1994; Dlamini, 1997; Dlamini, 1999; DANCED, 2000b; GOS, 2002; Dlamini and Geldenhuys, 2009). The specific objective of the study was:

To undertake user surveys to determine the actual quantities of harvested and utilized medicinal NTFP's, and to do an economic analysis of their direct use values.

The associated research question was:

What is the socio-economic contribution of the harvested medicinal NTFPs to the local people's health status, food security and rural household income?

The Hypothesis tested were:

(1) The quantities and values of medicinal NTFPs extracted and utilized, vary amongst households in response to a myriad of local and external contextual conditions (Shackleton and Shackleton, 2006).
(2) Medicinal NTFPs make a significant contribution to rural household income (Lawes et al., 2004; Chipeta and Kowero, 2004).

METHODS

Selection of the study area

The selection procedures for the study area, villages within each area and households within each village for user surveys were based on the following criteria:

Step one

The study area covered the four ecological zones of the country in order to fully capture variability in climatic and socio-economic conditions between these regions of the country. In addition, a wide range of the country's major forest and woodland types would be captured. This would in turn allow for a broad spectrum of study sites to allow calculation of variance and make it possible to use the data for comparison and generalization (modified from Godoy et al., 1993b; DANCED, 2000b; FAO, 2001; Hassan et al., 2002).

Box 1 presents a brief description of the ecological zones, while Figure 1 presents the detailed physiographic zones. A letter of request for permission to engage local communities was written and a human ethics permit was sought and granted by the local and traditional authorities in the various study sites.

Step two

The selection procedure was such that all the villages selected within study sites were those that harvest, extract or collect and utilize NTFPs from the neighbouring natural forests and woodlands as suggested by Appasamy (1993), Godoy and Bawa (1993b), Hall and Bawa (1993), Hedge et al. (1996), Shackleton (1996), Campbell et al. (1997), Crafter et al. (1997), Qureshi and Kumar (1998), Shackleton and Shackleton (2000b), Shackleton et al. (2002), Dovie (2003) and Dlamini (2007). Only rural villages were included in the study due to the low dependence of urban populations on direct harvesting of NTFPs from natural forests and

Box 1. Brief description of the four ecological zones of Swaziland.

Ecological zone and characteristics
Highveld The Swaziland Highveld (altitude: 900-1400 m) is the upper part of an overall escarpment, comprising complex steep slopes between low and high levels, dissected plateaux, plateau remnants, and associated hills, valleys and basins. Mean annual rainfall is 850-1400 mm. Characterized by short grassland with evergreen forest patches.
Middleveld The Upper Middleveld (altitude: 600-800 m) consists of strongly eroded plateau remnants and hills at intermediate level of the overall escarpment. It also has structurally defined basins in relatively protected positions, which are only weakly eroded. The Lower Middleveld (altitude: 400-600 m) is a piedmont zone of the escarpment, with generally strongly eroded foot slopes. The slopes are mostly moderate and the zone classifies at the first level as a plain. Mean annual rainfall is 650-1000 mm. Dominated by tall grassland with scattered trees and shrubs and broad-leaved savanna.
Lowveld The Lowveld plain comprises sedimentary and volcanic Karroo beds as opposed to the igneous and metamorphic rocks of the Highveld and Middleveld. The Lowveld is subdivided into the higher Western Lowveld (altitude: 250-400 m) on sandstone or claystone and the lower Eastern Lowveld (altitude: 200-400 m) on basalt. Mean annual rainfall is 550-725 mm. There is a combination of mixed savanna and Acacia savanna.
Lubombo The Lubombo range (altitude: 250-600 m) is a cuesta with a steep escarpment bordering the Eastern Lowveld and a gradual dip slope of about 5% descending east. As a major landform the Lubombo qualifies as a plateau. Mean annual rainfall is 700-825 mm. Usually has hillside bush and plateau savanna.

Source: Dlamini (2007).

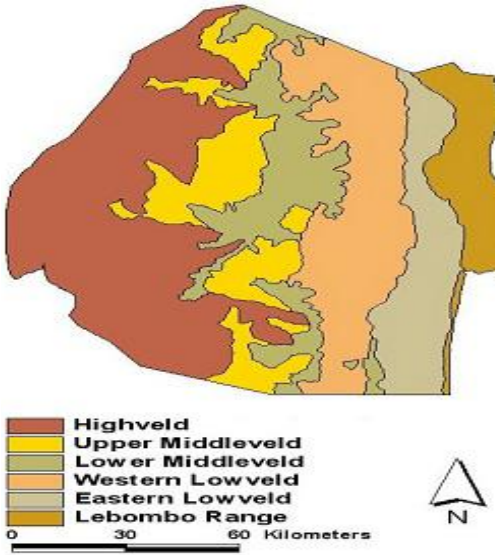

Figure 1. Major physiographic zones of Swaziland (Source: Masarirambi et al., 2010).

woodlands (Hassan et al., 2002; Dlamini and Geldenhuys, 2011b).

Step three

It was worthwhile to study at least two villages adjacent to a community forest reserve, where harvesting is monitored and under control. Over and above that it was important to have at least two villages surrounding a protection-worthy area, amongst those selected during a study on the identification of protection-worthy areas in Swaziland undertaken by DANCED (2000a); Dlamini (2010a); Dlamini and Geldenhuys (2011b). This was a means to

assess the degree of product flow from a protection-worthy area to confirm its protection worthiness.

Household profiles for the four sites across the four ecological zones

Within any given community there is significant socio-economic differentiation arising from a multitude of factors such as levels of employment, education, gender, age, human population, wealth status, farming opportunities, and other factors (Shackleton and Shackleton, 2006; Dlamini, 2007; Dlamini and Geldenhuys, 2011a). A profile of the households at the site level was therefore carried out through face to face interviews and literature review at the central statistics office (CSO).

DATA COLLECTION AND ANALYSIS

Step one: Literature search

Existing relevant documents, from the central statistics office (CSO) on the latest census on the number of homesteads and average individuals per household on study sites, were reviewed. This aided in determining the sample size (number of households to be selected for interviews per village for precision purposes).

Step two: Community meetings

Three community consultation meetings were held to brief the people about the relevance of the user surveys and economic analysis of the actual harvested quantities of their preferred medicinal products to the resources inventory and sustainability of NTFPs. The full cooperation of the people was sought following the same trend like during the national forest policy development process in 2001/2002 (Dlamini, 2007) and a slight modification of the work of Balick and Mendelson (1992), Hall and Bawa (1993), Peters (1996), Campbell et al. (1997), Gram (2001) and Dlamini and Geldenhuys (2011a).

Step three: Sampling design and procedure

According to previous studies (Godoy et al., 1993a, 2000; Wong et al., 2001; Dlamini and Geldenhuys, 2011b) the most accurate method of valuing NTFPs extracted is to identify, count, weigh and measure them as they enter the village daily. This study, in addition to the above method, also investigated the quantities of products harvested and consumed or traded either in the forest or along the way to the village but before the collectors enters the village. This is in view of the fact that a variety of products are consumed by villagers daily before reaching the village while doing other tasks.

The sampling approach omitted any on-farm harvesting of NTFPs and concentrated on those NTFPs collected from natural forests, other wooded land and trees outside forests. This means that the values per household per year of medicinal NTFPs calculated will be conservative considering the results in High and Shackleton (2000) where NTFPs made one third of the total value from home plots or home gardens.

A Nested Sampling approach was followed, where villages are nested on sites and in turn households are nested in villages (modified from Ott, 1998). Two villages adjacent to the study sites were selected based on the criterion that they do harvest medicinal NTFPs either for domestic or sale purposes on a full time basis. A maximum of seventeen households per village were selected in line with criteria outlined earlier on (modified from Campbell et al., 1997; Gram, 2001; Hassan et al., 2002; Shackleton et al., 2002).

Step four: Employment status of selected households

A brief analysis of the employment status of all the selected households in all the study sites was carried out through interviewing households for the number of employed versus unemployed members. This was to have an idea of the financial status of the households besides subsistence farming and its effects on NTFPs harvesting.

Step five: Data recording

Special recording sheets were printed for each household (maximum of thirty four) per study site (modified from Godoy et al., 1993a; Gram, 2001; Wong et al., 2001; Hassan et al., 2002; Shackeleton et al., 2002) to collect and record the following data, where possible:

1) Which specific products are extracted/collected/harvested?
2) Where are they collected (for example on trees, shrubs, herbs, under-story, on the ground, water courses, etc.);
3) Who collects the products (men, women, children etc.);
4) Quantities of products extracted (for consumption in forest/veld/along the way home);
5) Quantities of products collected for domestic use; quantities of products harvested for trade (bartering or sale);
6) Time spent going to the source/forest;
7) Time spent extracting product;
8) Distance between homestead and product source (km);
9) Processing and end-use of products; value of products (preferably at farm gate);
10) Tools for extraction;
11) Transport means to convey products to the village;
12) Marginal costs of extraction (in terms of time, labour, processing etc.);
13) Farming activities (yields and economic value);
14) Other income; and time used in different activities; and
15) Farm gate prices were being collected monthly over the entire survey period from local sources.

Based on the above data the annual direct use values per household were calculated. The user surveys were undertaken from November 2003 up to July 2004.

Step six: Economic valuation

Below is a generally ideal equation for calculating the value of NTFPs, under sustainable and unsustainable extraction (Godoy et al., 1993a, 2000):

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., 1993b, 2000).

However, the above equation was found to be inappropriate for calculating value of NTFPs extracted per household in rural Swaziland due to the following factors:

1) Extraction costs are largely very low, as none of the resources harvested require specialist tools, usually just an axe, sickle or a bush knife and such tools are used for a multitude of uses within the household. Transport used for conveying 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, 2000a). 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, 2000b).

Then the approach of Shackleton and Shackleton (2000a) 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 farm gate price.

Step seven: Data analysis

The data sets collected for household profiles, annual quantities of medicinal NTFPs harvested per household, and the annual value per household for harvested NTFPs were analyzed and results were interpreted. Analyses were carried out at the following levels:

1) Between sites
2) Between villages within sites
3) Between households within villages
4) Between species within sites
5) Between species within villages

Statistical analyses

This was not an experimental study, but a nested sampling design and procedure with continuous data. Therefore appropriate analyses of variance (Proc GLM with SAS version 8.2) were used to analyse the data (SAS, 1999). Student's t-Least Significant Difference was calculated at the 5% confidence level to compare treatment means (Ott, 1998).

Statistical model: Household profiles

$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$

Where:

μ =Population mean
α_i =Main effect (Employment)
ε_{ij} = Error
(Analysis of variance for a one-way classification)

Statistical model: Annual quantities and values

$Y_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + \varepsilon_{ijk}$

Where:

μ = Population mean
α_i = Main effect (site or species or village)
β_j = Duration effect
$\alpha\beta_{ij}$ = Interaction effect of duration with main effect (site or species or community)
ε_{ijk} = Error

The Shapiro-Wilk test was performed to test for non-normality (Shapiro and Wilk, 1965). In some cases where evidence of non-normality was found, it was due to high kurtosis and not skewness. A magnitude of similar values was responsible for the kurtosis. According to Glass et al. (1972) these analyses are valid.

RESULTS

Employment status of households

The data for employment status of households were log transformed during statistical analysis, hence the means look a bit unrealistic but the trend is correct for interpretation purposes. The village with the highest employment (as reflected in the raw data) remains as such and vice versa. There were highly significant differences ($p<0.0001$) in the number of unemployed members per household between sites. The t-test (LSD) shows that grand valley had the highest mean and Shewula had the lowest mean, this means that more members per household are unemployed in the grand valley and a few members are unemployed in the Shewula site. There were no significant differences in the number of employed members per household between villages ($p=0.7208$).

Medicinal species used

There was variation in the number of NTFPs medicinal species reported per household, per village and per ecological zone (study site), and in the harvesting periods between villages (Table 1).

Annual quantities and values harvested per household

The summary statistics for the mean quantities and values per year of medicinal goods harvested per household in the four study areas show large variations (Table 2).

The statistical significance of the quantities harvested, the duration of the harvests and the interaction between the quantities and duration are shown in Table 3. The differences in annual quantities of harvested medicinal NTFPs between sites are highly significant. The differences between sites in annual value per household are highly significant for medicinal NTFPs. These results support, in part, the hypothesis that there are variations in quantities of NTFPs harvested between sites.

Table 1. Medicinal NTFPs species used and harvesting duration according to the user surveys undertaken in the eight villages over the four ecological zones.

Village	No. of medicinal species	Harvesting duration (months)
Mlumati	12	5 durations (1, 2, 3, 4, 5)
Hhelehhele North	13	5 durations (1, 2, 3, 4, 5)
Emoti	20	5 durations (1, 2, 3, 4, 5)
Kundodemnyama	38	5 durations (1, 2, 3, 4, 5)
Jamehlungwini	17	3 durations (1, 2, 3)
Mangwenya	11	5 durations (1, 2, 3, 4, 5)
Hlutse	5	5 durations (1, 2, 3, 4, 5)
Madvuma	3	8 durations (1, 2, 3, 4, 5, 6, 7, 8)

Table 2. Summary statistics of mean annual quantities and mean annual values per household in the various study sites.

Item	Hhelehhele north		Grand valley		Shewula		Siphofaneni	
Annual quantities	N	Mean (kg)	N	Mean (kg)	N	Mean (kg)	N	Mean (kg)
Medicinal	99	2.8[b]	148	5.3[a]	103	1.6[c]	102	1.6[c]
Annual values	N	Mean (US$)	N	Mean (US$)	N	Mean (US$)	N	Mean (US$)
Medicinal	99	65.6[b]	148	122.1[a]	103	37.0[c]	102	37.4[c]

Means with same letters are not statistically significantly different, exchange rate: 1US$ is equivalent to R70.00 as at 2007 (Times of Swaziland, 2nd March 2004).

Table 3. Combined ANOVA for User Surveys and Economic valuation in the various study sites.

Item	Source of variation	Degrees of freedom	Mean squares	P-values
Annual quantities-medicinal				
	Sites	3	390.33	<0.0001
	Duration	8	605.50	<0.0001
	Sites*duration	12	275.81	<0.0001
Annual values-medicinal				
	Sites	3	8790066.3	<0.0001
	Duration	8	13624913.6	<0.0001
	Sites*Duration	12	6205148.8	<0.0001

The annual quantities harvested per household for medicinal NTFPs show significant differences between villages within sites, except for Hhelehhele North. The same applies for harvesting duration. The grand valley area harvests the highest quantities of medicinal NTFPs. This means that communities in the area rely heavily on the available natural medicines in the surrounding woodlands.

Similarly, there are significant differences in annual values per household between villages within sites in medicinal NTFPs (Table 4). The same trend as in high extraction rates (previous paragraph) is seen in annual values, most probably because prices are constant across the study sites.

As mentioned before there were 9 classes of harvesting duration (in months) for medicinal NTFPs (Table 5). The highest extraction rate was over 5 months. It was alluded to that there are species that are harvested any time of the year (for medicine), but it should be noted that these are not harvested continuously but fall within the given harvesting durations as well. The annual values for medicinal NTFPs followed the trend of the annual values since unit prices were constant.

The Emoti and Kundodemnyama villages in the grand valley area were highest in harvesting medicinal NTFPs, and this agrees with the earlier report that the grand valley site was highest in medicinal NTFPs extraction. The annual values followed the same trend.

Table 4. Combined ANOVA for user surveys and economic valuation in the various study sites.

Sources of variation	Hhelehhele north			Shewula			Siphofaneni			Grand valley		
	Degrees of freedom	Mean squares	P-values	Degrees of freedom	Mean squares	P-values	Degrees of freedom	Mean squares	P-values	Degrees of freedom	Mean squares	P-values
Annual quantities-medicinal												
Villages	1	0.2	0.873	1	44.8	0.005	1	12.7	<0.0001	1	551.9	<0.0001
Duration	4	18.2	0.070	4	24.8	0.002	8	10.0	<0.0001	4	1827.9	<0.0001
Villages*duration	4	4.3	0.720	2	7.6	0.250	3	2.8	<0.0001	4	0.4	0.9600
Annual values-medicinal												
Villages	1	4794.8	0.80	1	1000125.6	0.005	1	286166.7	<0.0001	1	12418691.4	<0.0001
Duration	4	410911.4	0.07	4	559886.7	0.002	8	225475.0	<0.0001	4	41127667.2	<0.0001
Villages*duration	4	97929.7	0.72	2	172095.1	0.250	3	65117.5	<0.0001	4	9768.3	0.9600

Table 5. Summary statistics of mean annual quantities and mean annual values per household over the respective harvesting durations.

Harvesting duration in months-medicinal	Annual quantities		Annual values	
	N	Mean (kg)	N	Mean (US$)
1	133	0.9	133	22.3
2	116	1.5	116	36.3
3	99	2.3	99	54
4	63	7.4	63	171.4
5	23	14.1	23	325.8
6	10	3.0	10	69.2
7	4	3.0	4	70.7
8	1	4.0	1	93.2
9	3	4.0	3	103.8

Exchange rate: 1US$ is equivalent to R70.00 as at 2011 (Times of Swaziland, 2nd March 2004).

Out of interest the twenty most harvested species of medicinal NTFPs were selected based on harvesting frequency and quantities over the entire spectrum of the study sites (Table 6). *Sclerocarya birrea* (A. Rich) Hochst. sub-species *caffra* (Sond). Kokwaro (ANACARDIACEAE) was the most highly ranked species in the user surveys. The matrix of common NTFPs in Swaziland also revealed that *Sclerocarya birrea* was the most multi-purpose species in Swaziland (Table 7).

Currently there is a national project initiative

Table 6. Summary statistics of mean annual quantities and mean annual values per household in the respective villages**.**

Item	Madvuma		Hlutse		Kundodemnyama		Emoti		Mangwenya		Jamehlungwini		Hhelehhele North		Mlumati	
Quantities	N	Mean(kg)	N	Mean (kg)	N	Mean (kg)	N	Mean (kg)	N	Mean (kg)	N	Mean (kg)	N	Mean (kg)	N	Mean (kg)
Medicinal	49	1.9d^{e}	53	1.2^{ef}	84	3.6^{b}	64	7.5^{a}	56	2.2^{cd}	47	0.8^{f}	50	2.7^{c}	49	2.8^{bc}
Values	N	Mean (US$)	N	Mean (US$)	N	Mean (US$)	N	Mean (US$)	N	Mean (US$)	N	Mean (US$)	N	Mean (US$)	N	Mean(US$)
Medicinal	49	45.9d^{e}	53	29.6^{ef}	84	83.2^{b}	64	173.2^{a}	56	50.8^{cd}	47	20.4^{f}	50	64.5^{c}	49	66.7^{bc}

Means with same letters are not statistically significant or different, exchange rate: 1US$ is equivalent to R70.00 as at 2007 (Times of Swaziland, 2nd March 2004).

Table 7. The top twenty most commonly harvested species across the study sites.

Species/product name	Mean annual quantities harvested (kg)
Medicinal	
Aloe saponaria	24.6
Momordica involucrata	12.0
Momordica claematidia	12.0
Tabernaemontana elegans	8.5
Schotia brachypetala	7.6
Kigelia Africana	6.5
Siphonochilus aethiopicus	5.6
Pittosporum viridiflorum	3.5
Rotheca hirsute	3.4
Peltophorum africanum	2.9
The prioritised multi-purpose species harvested for both edible and medicinal purposes	
Sclerocarya birrea	
Psidium guajava	
Momordica involucrata	
Momordica clematidea	
Aloe saponaria	
Berchemia zeyheri	

on the collection and processing of indigenous fruit and berries, where *Sclerocarya birrea* is the top priority species.

DISCUSSION

The results of this study confirm that natural forests and woodlands contribute to all aspects of rural life, in particular by providing foods and medicines to the rural communities.

There is, however a great variation within and between sites and within and between communities, as noted, in the annual quantities harvested per household per year and the annual value per household per year derived from various forest medicines. These results are in line with the findings of Falconer (1992), Shackleton et al. (2002), and Hassan et al. (2002).

In terms of traditional medicines this study shows about 65 harvested species of forest medicines over the eight villages sampled, while in South Africa 120 species were reported by traders and healers in Mpumalanga Province alone (Mander, 1997). The differences in figures could be attributed to the fact that this study was concerned with the general public and not specific to traditional healers and traders. Traditional practitioners may list more species.

The study shows that natural forests and woodlands remain a highly valued source of natural medicines, which are essential components of health treatments throughout Swaziland. They are the main medicines used by the vast majority of rural people (except in the Siphofaneni site) and despite many different healing practices and beliefs; they are still commonly used in conjunction with mystical and ritual practices and beliefs.

The possible factor that makes the Siphofaneni people to harvest few medicinal plants could be the availability of many and easily accessible health care centres in the area, which is not the case with the other study sites. In addition, the Siphofaneni site is close to a small town and the people normally prefer modern medicines to traditional medicines.

The survey found that knowledge and use of plant medicines is not confined to specialist healers but the local people practice self-administered treatments. Elderly women and men play a vital part in first aid treatments as they normally diagnose and treat the health related problems of their family members. Knowledge of plant medicine treatments is passed on from generation to generation, and even young children have some knowledge in plant medicine treatments. Similar facts were established in southern Ghana (Falconer, 1992). A medicinal plant survey in South Africa indicated that traditional medicine consumers come from across the age spectrum and tribal groups and include both sexes (Mander, 1997). Over and above that, some 58% of clinic patients indicated that they use both indigenous and conventional health care systems. They further indicated that 67% of plants used were obtained from traditional healers while 30% were collected from the veld and only 3% were purchased, thus confirming that self-medication takes place within the traditional healing system.

Generally the people use a wide range and combination of different health options depending on their particular ailment, financial situation, past experiences and access to and availability of conventional medicines or traditional healers. This is reflected in the variation in annual quantities harvested per household and annual values per household between households within villages studied. All households interviewed in all the eight villages use plant medicines, and the majority of them rely on wild plants as their main medicinal source. Dlamini (1999) and Dlamini and Geldenhuys (2011a, b) noted that traditional healers play a very important role in the health sector in Swaziland. The number of healers to the population is given as 1:100 indicating as many as 10 000 traditional healers in the country. Many medicinal plant families provide ingredients for traditional treatments (roots, stems, leaves, flowers, tubers and rhizomes are used) and are found in market stalls. Indigenous medicinal plants are widely used in most parts of eastern and Southern Africa (Crafter et al., 1997; Dlamini, 2007).

The top ten predominant indigenous medicinal species that are most preferred and harvested more frequently are: *Aloe saponaria*, *Momordica involucrata*, *Momordica clematidea*, *Tabernaemontana elegans*, *Schotia brachypetala*, *Kigelia africana*, *Siphonochilus aethiopicus*, *Pittosporum viridiflorum*, *Rotheca hirsuta* and *Peltophorum africanum*. This list of species is similar to that of Dlamini (1999, 2007) but differs from that compiled for the natural resource accounts for the state and economic contribution of forests and woodland resources in Swaziland by Hassan et al. (2002).

The indigenous and naturalized species that are harvested for both food and medicine are: *Sclerocarya birrea, Psidium guajava, Momordica involucrata, Momordica clematidea, Aloe saponaria, Berchemia zeyheri.* As a result these multi-purpose species are the most highly valued plant species in all the villages where they exist. The notable thing is that these species are almost always readily available within short distances from the village. Furthermore, *Sclerocarya birrea* occurs in all the eight villages sampled, but due to altitude it is relatively scarce or sparsely distributed in the Highveld region of the country.

The ten most valuable medicinal species are exactly the same species as those most preferred and most harvested species above. This is logical considering that the farm gate prices of medicinal products are at an average of US$23.10 and the prices only change, but drastically, when the products reach the town markets after some value adding processing. This processing could involve grinding, drying, sorting, etc., to produce semi or finished products. The farm gate prices of medicinal products ranged between US$15.40 per kg to US$23.10 per kg. These prices are expected to rise at the urban markets and also vary from species to species depending on the price elasticity of demand and supply. This means that the indicated values of the preferred medicinal NTFPs reflected in this study are conservative figures on the lower estimate. These prices are however in line with those in Mander (1997), DANCED (2000b) and Dlamini (2007).

The annual values per household for in medicinal

NTFPs ranged between US$20.4 and US$173.2. These figures are higher than the mean gross direct use value for utilization of plant resources of US$159 in the Eastern Cape Province of South Africa reported by Cocks and Wiersum, 2003). These figures are higher than those of Shackleton et al. (2002) of a mean total gross annual direct use value per household of between US$211 and US$324 found in Kat River Valley of South Africa. These figures are extremely high in view of the fact that this study only covered medicinal products and excluded other NTFPs such as fuelwood and bushmeat, which the South African study included. The range in this study is higher than a combination of wild and domestic plants that were valued at US$206.00 per household per year in a South African rural village by High and Shackleton (2000), considering that this study excluded domestic plants. The annual values per household in this study are higher than those of the annual value of woodland resources (mainly NTFPs), in all sectors in South Africa, of an annual value of US$41 per household for medicines (Dovie et al., 2001). The annual values in this study are comparable with those total direct use values of 11 secondary resources in the Bushbuckridge area in the Lowveld of South Africa where US$368 per household is for domestic use and US$767 is for trading (Shackleton and Shackleton, 2000a).

Based on the resource assessment and economic analysis of preferred NTFPs and other wild resources from communal lands, Shackleton (1996), in the Central Transvaal of South Africa, noted that the broad-scale harvesting and commercialization of such natural resources in such areas could be a vehicle towards meaningful development, rather than to simply support a subsistence livelihood. The same could be said about Swaziland in view of the economic values of the preferred NTFPs in the four ecological zones.

The ultimate concern of the user surveys is ecological rather than economic sustainability. This is in consideration of the fact that extraction of NTFPs may be economically sustainable if the value, adjusted for inflation, increases or remains constant, but economic sustainability is not always consistent with ecological sustainability (Hall and Bawa, 1993; Dlamini, 2010a). In this case over-harvesting of the preferred NTFPs may lead to continuing decline of populations while persistent demand keeps the market value constant.

The populations of the highly sought species of forest foods and forest medicines become depleted and the products become scarce, and there may be an increase in economic return if the demand remains the same while the resources are dwindling. Furthermore, scarcity may increase the marginal costs of extraction, pushing the prices upwards thus reducing the demand.

Consequently, with complete resource depletion, there will be neither economic nor ecological sustainability, but only local extinction of the economically viable species. In economic terms, the effects of unsustainable extraction take a long time to be detected, especially with long-lived trees (Hall and Bawa, 1993; Dlamini, 2007).

CONCLUSION AND RECOMMENDATIONS

The study has shown that the rural communities of the four ecological zones of rural Swaziland make good use of the NTFPs from the surrounding natural forests and woodlands, and that the financial value of such direct provisioning was significant. In addition, the input costs associated with harvesting of natural resources were extremely low, making it a viable strategy for poor households, both for domestic consumption and trade. It is worth noting that about 75% of the entire population resides in the rural areas where poverty is very high and the vast majority of these people depend on and derive many direct and indirect use and non-use benefits from natural forests and woodland resources (DANCED, 2000b; GOS, 2001; Hassan et al., 2002; Dlamini, 2007, 2010a, b; Dlamini and Geldenhuys, 2011b).

Hypothesis (the quantities and values of medicinal NTFPs extracted and utilized vary amongst households) and the (medicinal NTFPs make a significant contribution in rural household income) are accepted based on the results of this study.

The preferred species of medicinal NTFPs have been captured and they need immediate attention as they may be threatened with extinction if left unchecked. An immediate action programme for participatory research into the ecology of the affected species and the domestication and commercialization of all the priority species is recommended alongside other conservation strategies such as integrated local-level sustainable forest management approaches.

Harvesting and marketing commercial quantities of any NTFPs produces a measurable impact on the structure and dynamics of plant and animal populations, as well as the genetic composition of the harvested populations (Peters, 1996). In this case the most highly sought and extracted species may be in danger in the near future as long as there are no local-level strategies and practices towards sustainable use of the concerned NTFPs. It is clear that the harvesting rates of different species differ from ecological zone to ecological zone and between and within villages. Unfortunately both the flow of benefits and asset values of natural forests and woodland resources are not captured in the system of national accounts in Swaziland (Hassan et al., 2002; Dlamini, 2007). This may be due to one or all of the following factors:

1) Most of the direct benefits derived from natural forests and woodlands, such as indigenous edible vegetables, fruit and berries, are not commercially supplied and traded in the formal markets (Hassan et al., 2002). Lately indigenous medicines are flooding the modern town markets though.

2) Economic growth and development have taken place primarily through degradation of the natural environment as stock of renewable and non-renewable resources are depleted, and as such the national accounting system purposefully disguises this depreciation. While depreciation of man-made capital appears as a cost GDP, the exploitation of natural resources appears a positive entry in the form of high economic activity (GOS, 1997).

Governments are urged to reconsider the interdependence of environment, economy and society with special consideration of the following primary functions of the forest environment:

1) Providing raw materials;
2) Acting as a sink/dumping ground for waste generated by life supporting activities;
3) Providing life-sustaining services such as climate stability and soil and water supplies; and
4) Supporting human beings, their cultures and livelihoods along with animal and plant habitats.

Considering the array of benefits and functions of the forest environment the national accounting system should include or reflect these. This will be a milestone in the recognition of the contribution of the natural forests and woodlands to life on earth. Consequently, the sustainable development slogan will be practically realized.

A policy recommendation is that there is an urgent need to provide economic incentives for communities to become involved in sustainable forest management. There is need to develop and test economic incentive measures within the context of on-going attempts at community-based sustainable forest management, which generate tangible benefits in forms and at levels that are at least equal to compensate for the economic costs that accrue to communities.

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