CHAPTER 9

Volume and Value the Herbal Medicine Trade

Volume and financial value of species traded in the medicinal plant markets of Gauteng, South Africa

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SUMMARY
The demand for traditional medicinal plants and products in South Africa has created an extensive cross-border industry involving thousands of harvesters and traders. The market values of individual taxa vary considerably. Pricing structures fluctuate between markets and over time as the cost of harvesting species varies depending on a gatherer's access to the resources and the proximity of markets to the harvesting sites. This paper estimates trade values, describes the prices paid for 22 plant resources, investigates pricing structures relative to the mass/volume sold and the factors that influence the market price for plants. There is an inverse and disproportionate relationship between the price per kilogram (R/kg) and mass of the product sold. The smaller the quantity sold, the higher the R/kg sale values are relative to sales of larger quantities. This relationship is evident in different plant part types (e.g. bark and bulbs), species and markets (shops and street markets). Given the high mass sold relative to the price, bulbs, like bark, have the lowest R/kg values compared to other products like roots, fruits and leaves. The prices paid for heavier/denser species is thus disproportionate to the mass sold. If the relative values are used as an indicator of plant vulnerability (assuming high values indicate greater vulnerability), then bias is created in favour of 'lighter' and less dense plant parts typically sold in small quantities because of the nature of the plant part and the manner in which it is marketed and required by customers.

Keywords: ethnobotany, market value, medicinal plant trade, price structures

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INTRODUCTION

Medicinal plants represent one of the largest human uses of the natural world in terms of the number of species, and this value to livelihoods is essentially infinite (Hamilton 2004). These values concern its contributions to healthcare, financial income, cultural identity and livelihood security (Hamilton 2004). But, what is the value to the economy? The trade in medicinal plants has been appropriately labelled in South Africa as a "multi-million rand hidden-economy" (Cunningham 1989). This is, in part, because the demand for indigenous plant-based medicines has created a trade that was estimated to be worth more than R270 million a year and over 20 000 tonnes in 1998 (Mander 1998; Dold and Cocks 2002). The trade is essentially subsistence-based and, like other informal sector activities involving natural resources, employs a disproportionately large number of women with low education levels who are clustered in a poorly paid, narrow income range (Friedman and Hambridge 1991). The economy is also partly hidden because it is difficult to quantify subsistence economic activities in general, and in agriculture and resource use in particular (Friedman and Hambridge 1991).

There is debate over the use of the terms 'informal economy' or 'informal sector'. It has been suggested that these terms underestimate the relationship with the wider economy and trivialise the importance of these activities to many households across the social and economic spectrum (Rogerson and Preston-Whyte 1991). However, the distinction between the 'informal' and 'formal' trading sectors can partly be based on the manner in which the product or resource is produced and exchanged rather than on the final product (Rogerson and Preston-Whyte 1991). Hence, a characteristic of the medicinal plant trade is the flexibility in the nature of the transactions, that is, the selling of 'handfuls' of plants at negotiable prices and the absence of any contractual relationships of production.

Price negotiation is a common feature in local markets for indigenous resources. The process of price setting between harvester and buyer, for example, involves bargaining in order to reach an equilibrium price somewhere between the lowest price the seller is willing to accept and the highest price the buyer is willing to pay (Sunderland *et al.* 2004). In the KwaZulu-Natal markets, Mander (1998) noted that the wholesale purchasing of large volumes of medicinal plants is usually associated with aggressive bargaining, and as a result, it was impossible to ascertain realistic selling prices resulting from bulk purchases.

The price paid for a resource and the quantities sold inform the demand. When the demand for a species increases and the value and quantity sold rises, then it is an indication that the resource might be overexploited and could thus face threats to its persistence in the wild. However, information on the prices paid for medicinal plants and the quantities harvested and sold annually are sparse, partly because of absent or incomplete records and the often illicit nature of the trade (Cunningham 1990; Botha *et al.* 2004). A few quantitative studies on aspects of the volume and financial value of the medicinal plant trade have, however, been undertaken in the South African provinces of KwaZulu-Natal, Eastern Cape, Mpumalanga and Gauteng (Cunningham 1988; Mander 1998; Botha 2001; Dold and Cocks 2002; Williams 2003; Botha *et al.* 2004). In KwaZulu-Natal and the Eastern Cape, for example, the annual trade was valued at R60 million and R27 million respectively for 4 000 tonnes and 525 tonnes of plant material (Mander 1998; Dold and Cocks 2002).

The present study describes the volume and financial value of medicinal plants traded within the province of Gauteng, South Africa, and more specifically within a region called the Witwatersrand – an extensively urbanised axis of more than 100 x 40 km. Johannesburg is at the centre of this axis and home to approximately 3.23 million people, 36.5% of the total population of Gauteng (Statistics SA 2004). The region is also central to the trade in traditional medicines in the province. Two semi-quantitative surveys of the medicinal plants traded in the region were undertaken between 1994 and 2001. One aim of these studies was to obtain quantitative trade data that would inform assessments of risk levels and threats to species harvested for the medicinal plant trade, as well as to help prioritise plant conservation action (Williams n.d.). This paper estimates the trade values, describes the prices paid for plant resources, investigates pricing structures relative to the mass/volume sold and the factors that influence the market price for plants.

METHODS

Study area, market surveys and quantitative resource inventories

The Witwatersrand is probably South Africa's second largest market for medicinal plants after the markets in KwaZulu-Natal. The trade in the region is differentiated into two sectors, the more formalised businesses and the informal street markets and sellers (Williams *et al.* 1997). Traders, including traditional healers, selling traditional medicines from premises called *'muti'* shops (herbal chemists), represent the formal sector of the trade. In 1994, there were estimated to be 240 shops in the region (Williams *et al.* 1997). Commercial gatherers and traders selling plants from the pavements and street markets represent the informal sector. Located in Johannesburg, the Faraday Street market is the Witwatersrand's largest informal wholesale and retail street market for traditional medicine. At the time of the survey in 2001 there were approximately 164 sellers in the precinct.

Between February 1994 and January 2001, two semi-quantitative surveys of plants traded for traditional medicine were conducted within the Witwatersrand region. The first survey in 1994, based on a stratified random sample of research participants from 50 *muti* shops, appraised the characteristics of the trade in the formal sector (Williams *et al.* 2000). The second survey in 2001, a stratified random survey of 100 street traders in the informal Faraday market, was conducted on behalf of the Gauteng Directorate for Nature Conservation within the Department of Agriculture, Conservation and Environment (Williams 2003). In both surveys, an inventory of all common names of plants ('ethnospecies') sold by each trader was documented, and the frequency with which the corresponding species occurred in each shop or at each trader's stall was determined (Williams *et al.* 2000; Williams 2003; Williams *et al.* 2005).

Following the *muti* shop survey in 1994, 29 ethnospecies representative of various risk categories for over-exploitation were selected in order to obtain trade data that would be used in the subsequent design of a risk assessment model (Williams n.d.). Between April and October 1995, single visits were made to 27 shops to obtain the following information for each of the 29 ethnospecies: 1) the mass and retail price of a typical sale of the product to a customer; 2) an estimate of the price and number of 50 kg-size bags, or other functional quantity, bought wholesale annually; and 3) the frequency of daily, weekly or monthly sales of the product. In a related study to investigate similar trade variables in the informal markets, samples of the 29 ethnospecies were purchased during ten visits to the Faraday market between July and September 1995. The samples were weighed to obtain the relative values of a typical sale to a customer, but no data on the annual volumes sold by the traders in the market were collected. All plants were weighed using a portable digital scale accurate to 5 g to obtain the mass of an individual sale and derive the price per kilogram of that sale.

In addition to recording the frequency of occurrence of ethnospecies sold by the Faraday traders in 2001, the quantity of each plant product present at each trader's stall was estimated. Given time constraints and the number of species in the market (>470 species), it was not practical to weigh the quantity of each product on sale. Instead, the quantity was visually estimated and recorded as the volume equivalent to that of a 24 litre plastic shopping bag given out at most retail outlets (sometimes called a 'checkers' after a supermarket chain) and/or a 50 kg-size maize bag or fraction thereof – for example, 1½ 'checkers' or ¼ bag. The total quantity of plant material present in the market for each ethnospecies was then calculated based on a conversion factor derived for converting the total number of 'checkers' packets into the total number of 50 kg-size bags. A few months after the original survey, data were also collected on the price, quantity and frequency of sales and purchases of 26 ethnospecies of different plant part types (e.g. roots, bark, bulbs etc.) (Williams 2003, 2004), some of which included species selected in 1994 for further study.

Species investigated

Between the *muti* shops and the Faraday market, approximately 456 common names (ethnospecies) were recorded that corresponded with about 595 species (Williams *et al.* 2005). Three hundred and forty nine of these ethnospecies (≈475 species) were inventoried in Faraday, and the total volume on sale at the stalls of 100 traders was recorded for each of these species. Of the 29 ethnospecies for which more detailed trade information was collected, seven were excluded from the final analyses because of ambiguity over the actual identity of the species used. The remaining 22 ethnospecies are listed in Table 1, and include eight trees, five bulbous geophytes, and a range of perennial herbs with or without woody rootstocks and tubers.

Table 1 The 22 species investigated in this study.

Species	*Family*	*Common name*	*Growth form*
Bark			
Acacia xanthophloea Benth.	Mimosaceae	umKhanyakude	Tree
Albizia adianthifolia (Schumach.) W.F.Wight	Mimosaceae	umGadankawu	Tree
Balanites maughamii Sprague	Balanitaceae	umGobandlovu	Tree
Cinnamomum camphora Nees & Eberm. [1]	Lauraceae	uRoselina	Tree
Elaeodendron transvaalense (Burtt Davy) R.H.Archer	Celastraceae	iNgwavuma	Tree
Warburgia salutaris (Bertol.f.) Chiov.	Canellaceae	isiBhaha	Tree
Bulbs/roots/tubers			
Alepidea amatymbica Eckl. & Zeyh.	Apiaceae	iKhatazo	Perennial herb: rhizomatous root
Dioscorea sylvatica (Kunth) Eckl.	Dioscoreaceae	uFudu / iNgwevu	Tuberous climber
Diospyros galpinii (Hiern) De Winter	Ebenaceae	inDodemnyama	Dwarf shrub
Drimia spp. (*D. elata, D. altissima*)	Hyacinthaceae	Skanama / isiKlenama	Perennial herb; bulbous geophyte
Eucomis autumnalis (Mill.) Chitt.	Hyacinthaceae	uMathunga	Perennial herb; bulbous geophyte
Gunnera perpensa L.	Gunneraceae	uGhobho	Perennial herb; rhizomatous root
Hypoxis spp. (*H. colchicifolia*, *H. hemerocallidea*)	Hypoxidaceae	iLabatheka / iNkomfe	Perennial herb; cormous geophyte
Pappea capensis Eckl. & Zeyh.	Sapindaceae	uVuma-ebomvu	Tree
Merwilla plumbea (Lindl.) Speta (formerly *Scilla natalensis*)	Hyacinthaceae	inGuduza	Perennial herb; bulbous geophyte
Siphonochilus aethiopicus (Schweinf.) B.L.Burtt	Zingiberaceae	isiPhephetho	Aromatic herb; rhizomatous geophyte
Stangeria eriopus (Kunze) Baill.	Stangeriaceae	imFingo	Perennial cone-bearing plant; lignotubers
Whole plants			
Dianthus mooiensis Williams	Caryophyllaceae	Tjanibeswe	woody rootstock
Scabiosa columbaria L.	Dipsacaceae	iBheka	woody rootstock
Leaves and Stems			
Helichrysum spp. (incl. *H. odoratissimum*)	Asteraceae	iMphepho	Herb
Myrothamnus flabellifolia Welw.	Myrothamnaceae	uVukakwabafile	Small shrub
Fruit			
Kigelia africana (Lam.) Benth.	Bignoniaceae	umVongothi	Tree

[1] exotic species

Estimating the annual quantity of plant products traded

Medicinal plants were frequently transported to the markets in 50 kg-size maize bags. The actual mass of the contents of a bag depends on the plant part (e.g. bark, bulbs or leaves) and their density and dimensions. The annual quantity of plants purchased by the *muti* shops for the 22 species was estimated by determining the mean number of bags purchased per trader per annum (bags a^{-1}), and then multiplying this by the proportion of shops selling the species. The annual quantity of the 22 species purchased by the street traders in Faraday was calculated slightly differently. The frequency with which the traders purchased one bag of the species was determined, and then the number of bags that would have been bought per annum was calculated depending on the proportion of traders who sold the species.

Unlike the 2001 Faraday survey, the purpose of the 1994/95 *muti* shop study had not been to estimate the total annual volume and financial value of all species sold by traders within the region. Hence, there was a shortage of appropriate data for calculating similar values for the shops. The quantity sold annually in the Faraday market was calculated from the proportion of traders selling the species and the total number of traders in the market (n = 164). The methods for estimating the wholesale and retail value of sales for Faraday in 2001 are described in Williams (2003, 2004) and were based on factors such as the frequency and potential value of purchases and sales, as well as taking into account the likelihood of high volume and value sales to other retailers.

Statistical analyses

Regression analyses were used to describe the relationships between the mass of a product sold to a customer versus the price per kilogram in Rands (R/kg) value of that product. These analyses were conducted on various species and plant part types. Two-tailed student t-tests for independent samples were used to test the significance of the differences in the mean R/kg and kg/sale values of products sold in the *muti* shops in 1995 and the Faraday market in 1995. Excel 2000 and Statistica 6 were used for the analyses.

RESULTS

The quantities traded

Helichrysum spp. followed by *Drimia* spp. and *Eucomis autumnalis*, were the most frequently purchased species (16.2, 11.3 and 11.5 bags $shop^{-1}$ a^{-1} respectively) (Table 2). In general, bulbs were purchased more often than bark. In 1995, the bark of *Warburgia salutaris* was purchased more often than the other six species harvested for bark (6.7 ± 10.6 bags $shop^{-1}$ a^{-1}), followed by *Elaeodendron transvaalense* (4.2 ± 3.7 bags $shop^{-1}$ a^{-1}) and *Acacia xanthophloea* (3.9 ± 3.5 bags $shop^{-1}$ a^{-1}) (Table 2). The most infrequently purchased species was the fruit of *Kigelia africana* (0.2 ± 0.1 bags $shop^{-1}$ a^{-1}), a species kept by the least number of shops (24%) and clearly not a highly traded commodity in the *muti* shops. There was also a highly positive correlation between the mean number of bags bought annually per species per shop and the percentage of traders that sold the species (r^2 = 0.879) (Figure 1a). In other words, the more popular a particular species was, the more shops were likely to sell the species, and hence the greater the annual quantity likely to be purchased by a shop.

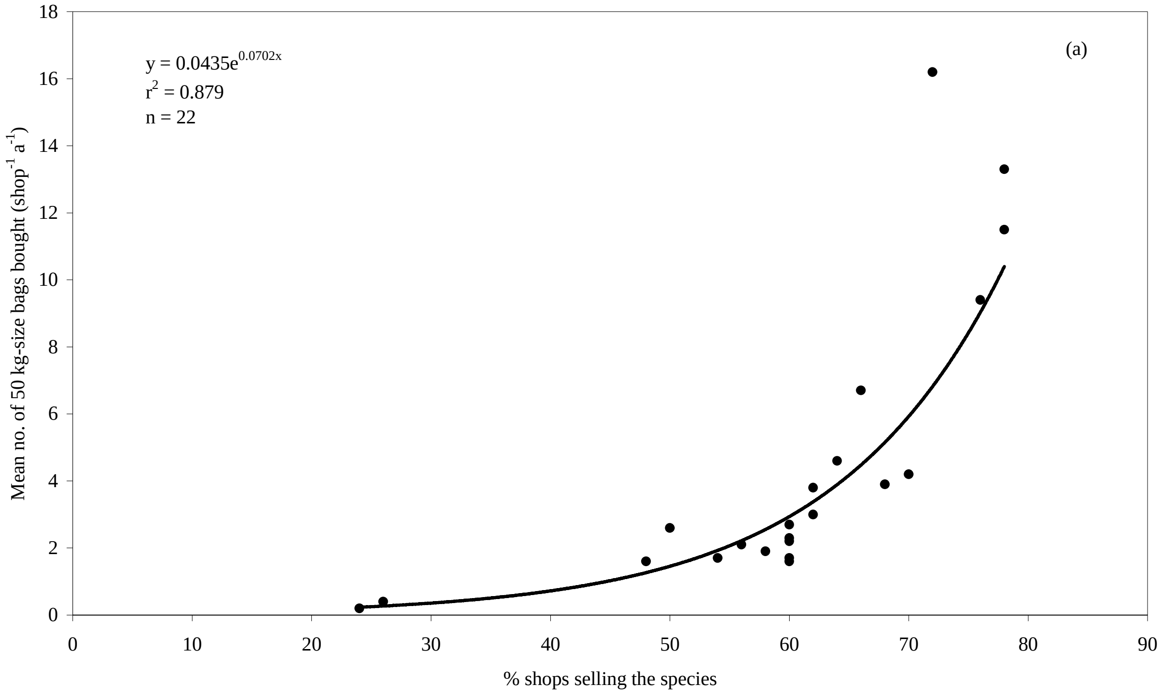
By comparison, the total number of bags present in the market for the 22 selected species in the Faraday market during the quantitative inventory ranged from 0.1 bags (the roots of *Pappea capensis*) to 24.9 bags (the bulbs of *Drimia* spp.) (Table 2). *Drimia* spp. was clearly the most popular and prevalent bulb in the market, followed by *Albizia adianthifolia* (18.1 bags), *Hypoxis* spp. (17.5 bags) and *E. transvaalense* (16.1 bags) (Table 2). There was also a highly positive correlation between the quantity of plant material present in the market per species and the percentage of traders that sold the species (Figure 1b).

The total quantity of plants present between the 349 ethnospecies and the 100 traders in Faraday in January 2001 was ≈755 bags. This value does not, however, include the quantity of plant material in storage and not visible during the inventory. The actual total quantity present in the market would therefore be much higher. Fourteen of the top 20 species present in the largest volumes in Faraday were woodland and forest species, with the roots of *Hydnora africana* being the most prevalent (19 bags) (Table 3). Bulb and bark species were clearly the most highly traded resources, especially *Drimia* spp., *Hypoxis* spp., *A. adianthifolia* and *E. transvaalense*. Other species present in large quantities include the bark of *Sclerocarya birrea* subsp. *caffra* and the whole plants of *Clivia* spp.

Table 2 Estimated quantities bought wholesale, per annum, by *muti* shops on the Witwatersrand in 1995 and street traders in the Faraday market in 2001 for 22 selected species.

		Muti shops 1995			*Faraday market 2001*		
Species	*Plant part sold*	*Mean number bags[1] bought (shops^{-1} a^{-1}) (± SD)*	*% shops selling species (n = 50)*	*Est. no. bags bought by 189 shops (bags a^{-1})*	*Total no. bags[1] present during survey 11-24 Jan.[2]*	*% traders selling species (n = 100)*	*Est. no. bags[1] bought by 164 traders (bags a^{-1})*
Acacia xanthophloea	Bark	3.9 ± 3.5	68	386	12.1	37	152
Albizia adianthifolia	Bark	1.6 ± 0.9	60	181	18.1	41	208
Balanites maughamii	Bark	1.7 ± 1.1	54	172	6.9	17	59
Cinnamomum camphora	Bark	1.7 ± 1.2	60	193	1.5	6	20
Elaeodendron transvaalense	Bark	4.2 ± 3.7	70	557	16.1	44	188
Warburgia salutaris	Bark	6.7 ± 10.6	66	830	4.9	22	76
Drimia spp.[3]	Bulb	13.3 ± 21.6	78	1961	24.9	60	443
Eucomis autumnalis[3]	Bulb	11.5 ± 21.6	78	1695	6.5	21	121
Hypoxis spp.	Bulb	3.8 ± 3.2	62	445	17.5	39	422
Merwilla plumbea[3]	Bulb	9.4 ± 20.9	76	1350	10.1	25	135
Kigelia africana	Fruit	0.2 ± 0.1	24	9	1.2	11	14
Helichrysum spp.	Leaves/stems	16.2 ± 21.3	72	2205	10.6	17	170
Myrothamnus flabellifolia	Leaves/stems	2.6 ± 2.6	50	246	1.6	6	30
Siphonochilus aethiopicus	Rhizome	0.4 ± 0.3	26	20	0.3	8	1
Alepidea amatymbica	Root	4.6 ± 4.2	64	556	1.3	9	3
Diospyros galpinii	Root	1.6 ± 1.3	48	145	1.3	4	3
Gunnera perpensa	Root	3.0 ± 2.8	62	352	8.6	17	103
Pappea capensis	Root	2.3 ± 1.3	60	261	0.1	3	11
Dioscorea sylvatica	Tuber	2.2 ± 1.2	60	249	7.5	28	514
Stangeria eriopus	Tuber	2.1 ± 1.3	56	243	2.9	9	38
Dianthus mooiensis	Whole plant	2.7 ± 2.5	60	306	0.7	8	45
Scabiosa columbaria	Whole plant	1.9 ± 1.6	58	208	0.9	6	26

[1] Bag = the volume of one 50 kg-size maize bag
[2] The quantity present in the market during the survey, excluding the quantity in storage
[3] Min = 1 bag a^{-1}, max = 100 bags a^{-1}



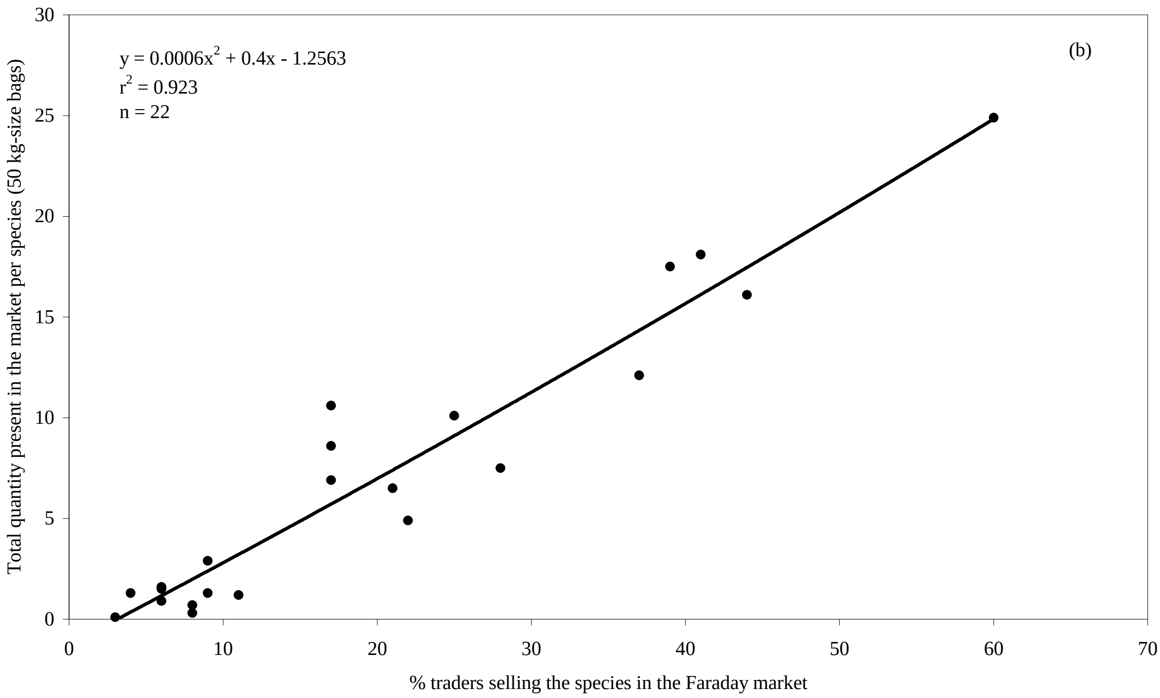


Figure 1 The relationship for 22 species between (a) the percentage of shops selling a species and the mean number of 50 kg-size bags purchased annually per shop per species in 1995, and (b) the percentage of traders selling the species in the Faraday market and the total volume (in 50 kg-size bags) per species present in the market in 2001

Table 3 Species present in the largest volumes in the Faraday market in January 2001. The species listed occurred in the market in quantities > 7 bags.

Species	*Common name*	*Plant part*	*% traders (n = 100)*	*No. bags*[1]
Drimia sp. *(D. elata, D. robusta)*	Skanama	Bulb	60	24.9
Hydnora africana	uMavumbuka	Root	49	19.0
Albizia adianthifolia	umGadankawu	Bark	41	18.1
Hypoxis spp.	iLabateka, iNkomfe	Bulb	39	17.5
Elaeodendron transvaalense	iNgwavuma	Bark	44	16.1
Sclerocarya birrea ssp. *caffra*	umGanu	Bark	33	13.2
Acacia xanthophloea	umKhanyakude	Bark	37	12.1
Clivia spp. *(C. miniata, C. nobilis)*	uMayime	Whole	26	11.2
Schotia brachypetala	iHuze, iGxamu	Bark	32	11.2
Rapanea melanophloeos	uMaphipha	Bark	26	10.2
Merwilla plumbea	inGuduza	Bulb	25	10.1
Trichilia spp. *(T. dregeana, T. emetica)*	umKhuhlu	Bark	23	9.8
Urginea spp.	umHlabelo	Bulb	25	9.3
Curtisia dentata	umLahleni	Bark	25	9.2
Adenia gummifera var. gummifera	imPindamshaye	Stem	28	8.9
Gunnera perpensa	uGobho	Root	17	8.6
Dombeya rotundifolia var. rotundifolia	inHliziyonkulu	Bark	23	8.5
Ekebergia capensis	umNyamathi	Bark	20	7.8
Ornithogalum longibracteatum	uMababaza	Bulb	22	7.6
Dioscorea sylvatica	iNgwevu, uFudu	Tuber	28	7.5

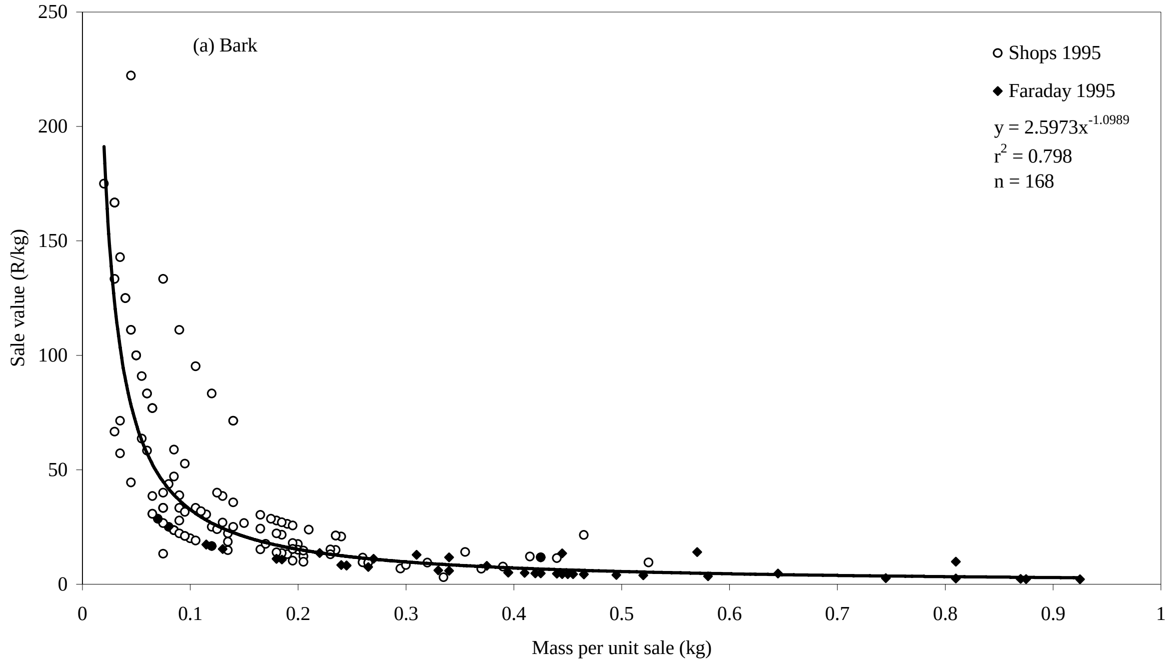
[1] Bag = the volume of one 50 kg-size maize bag

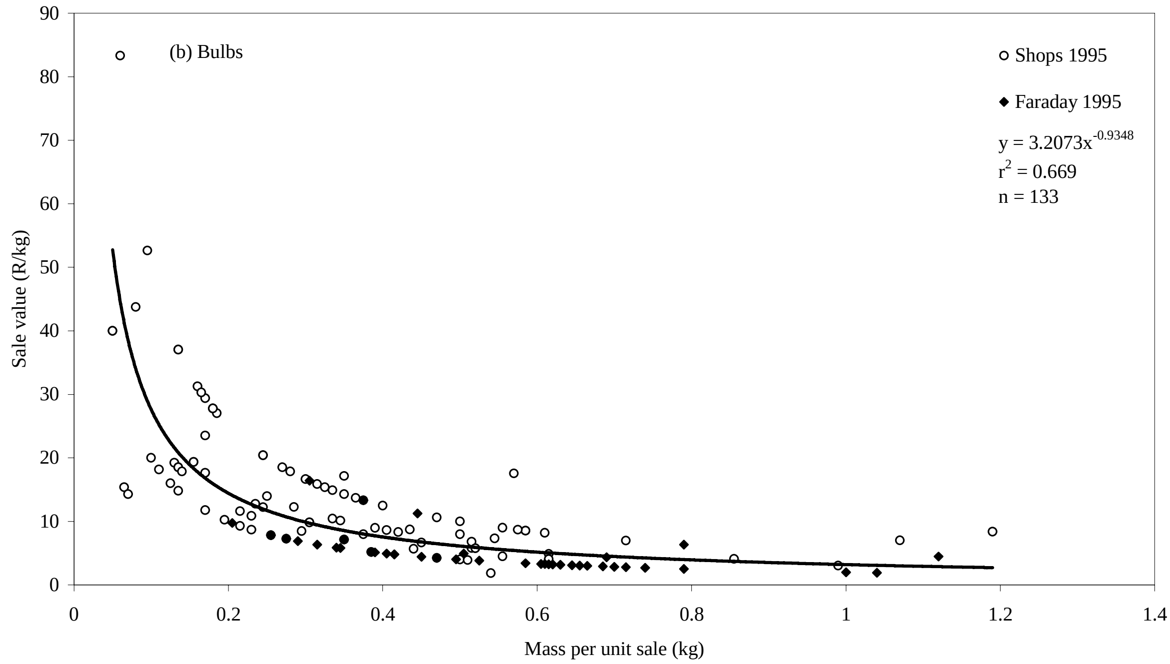
The minimum mass of plants estimated to be sold annually in Faraday in 2001 was 491 ± 851 tonnes a^{-1} (between 164 traders). For every tonne bought or sold, ≈630 kg were harvested from the woodland and forest biomes, ≈320 kg from grassland and ≈50 kg were common to both woodland and grassland (Williams 2003, 2004). The estimated annual retail value of the plants sold in Faraday is R2.22–R4.72 million (Williams 2003, 2004). For every R100 spent by customers or earned by traders, approximately R67 was derived from woodland/forest taxa, R26 from grassland taxa and R6 from taxa that are both woodland and grassland. No volume and financial retail values were estimated or obtained from the *muti* shops.

The annual quantities estimated to be purchased by the shops and street traders in 1995 and 2001 respectively mainly indicate the relative order of magnitude of purchases for the 22 species and the potential demand for one species versus another (Table 2). The differences in the quantities estimated to be purchased by traders in 1995 and 2001 does not imply that the amount harvested and the demand has dropped, but rather reflects differences within the supply and demand chain of each sector. In 1995, Faraday supplied ≈31% of the stock to *muti* shops (Williams *et al.* 2000). The largest quantities purchased annually between all the shops in the region were *Helichrysum* spp. (2 205 bags a^{-1}), *Drimia* spp. (1 961 bags a^{-1}), *E. autumnalis* (1 695 bags a^{-1}) and *Merwilla plumbea* (formerly *Scilla natalensis*) (1 350 bags a^{-1}) (Table 2). The largest quantities estimated to be purchased annually between the Faraday market traders were *Dioscorea sylvatica* tubers (514 bags a^{-1}), *Drimia* spp. (443 bags a^{-1}), *Hypoxis* spp. (422 bags a^{-1}) and *A. adianthifolia* (208 bags a^{-1}) (Table 2).

Pricing structures relative to mass

There is an inverse and disproportionate relationship between the price per kilogram (R/kg) and mass of the product sold (Figures 2 and 3). The smaller the quantity sold, the higher the R/kg sale values are relative to sales of larger quantities. This relationship is evident in different plant part types (e.g. bark and bulbs), species and markets (shops and street markets). Overall, products sold in the *muti* shops in 1995 had higher R/kg values compared with products sold in the Faraday market in 1995 (Figure 2a-e). However, the r^2 values and equations for the curvilinear relationship between mass and R/kg were not markedly different for the shop and Faraday data, and hence a single regression line was fitted to the data to show the relationships. The main reasons why plants sold in the *muti* shops have higher R/kg values is because of the higher prices charged for the same product, and because the mass per unit sale to customers tends to be less than the mass of the sales by street traders to their customers (as results later show).





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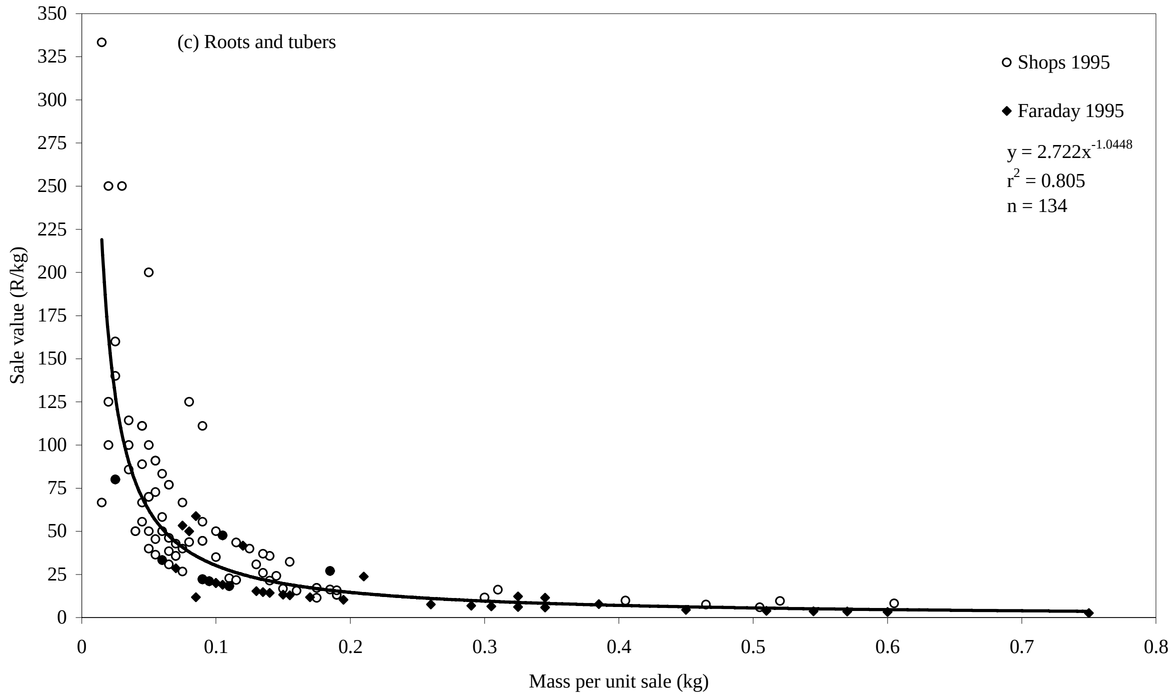

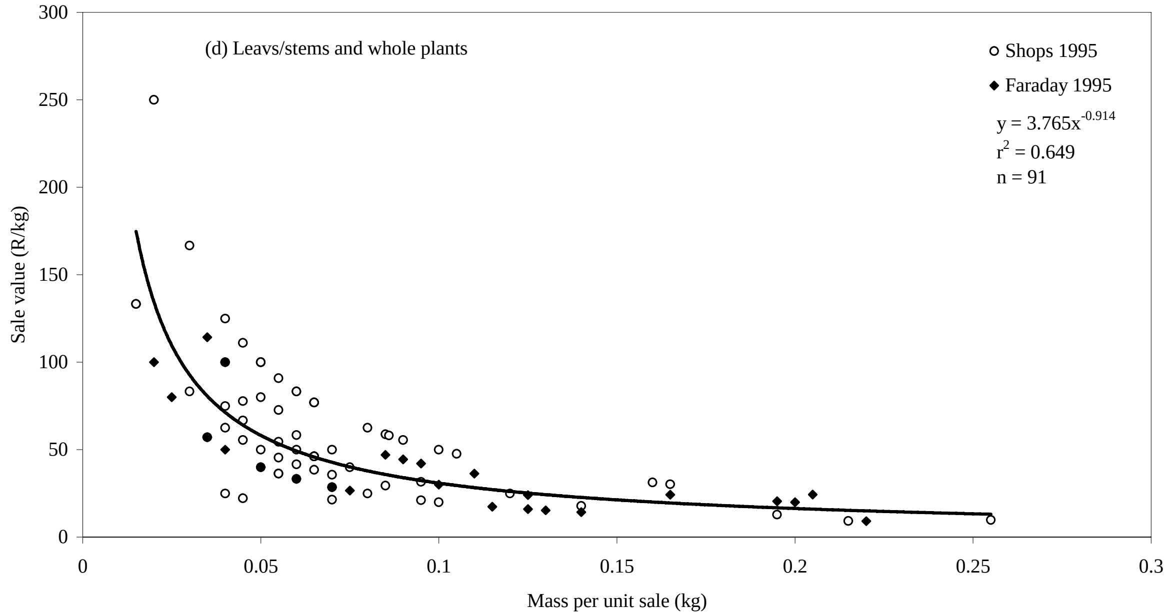

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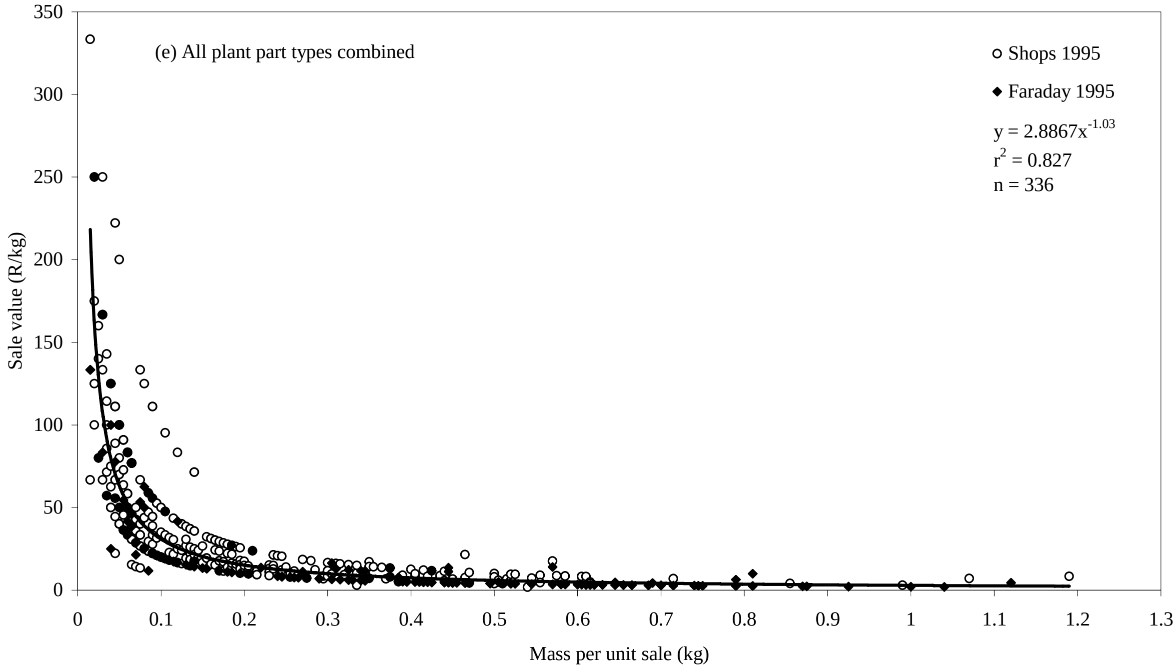
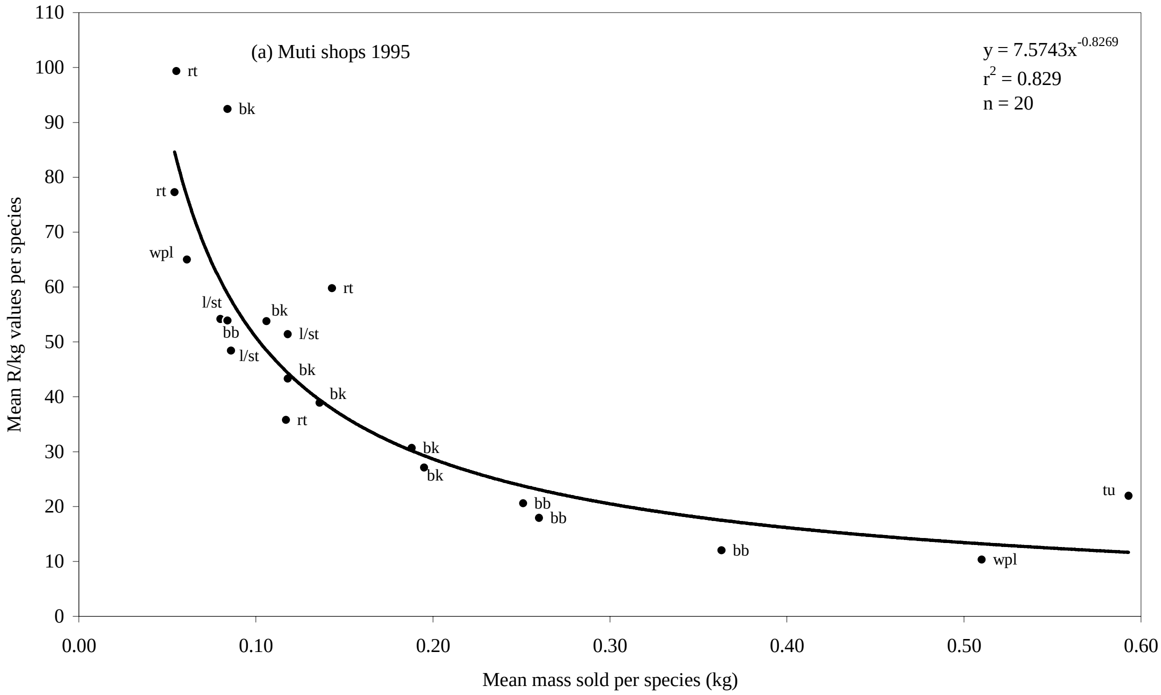


Figure 2 The relationship between mass and R/kg per unit sale for the following plant part types: (a) bark (7 species), (b) bulbs (4 species), (c) roots and tubers (6 species), (d) leaves/stems and whole plants (4 species), and (e) total combined for all plant part types traded in the *muti* shops in 1995 (open circles) and the Faraday market in 1995 (solid diamonds). Note the differences in scales for the different plant part types



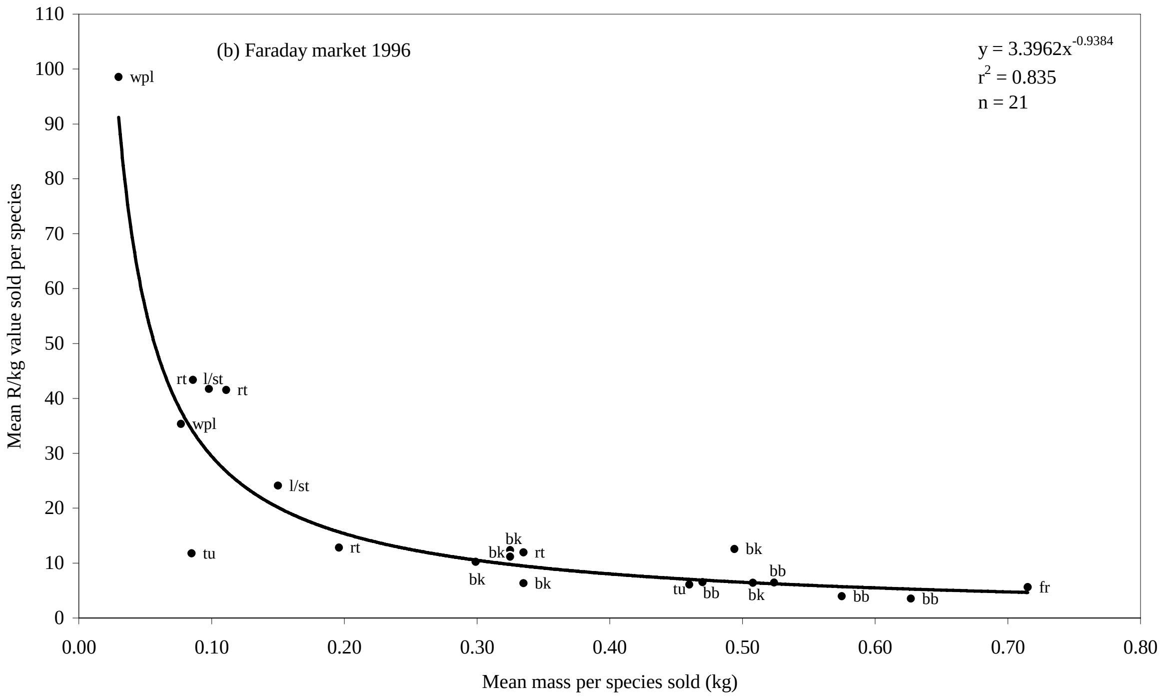


Figure 3 Mean R/kg vs mean mass per species, differentiated by plant part, for (a) *muti* shops in 1995 and (b) Faraday market in 1995. Excluded from the figure are *Kigelia africana* and *Siphonochilus aethiopicus* because values are > R100/kg and obscure the other data points. (bk = bark; bb = bulb; wpl = whole plant; rt = root; tu = tuber; l/st = leaves/stems) (See Table 4 for the species)

It is apparent from the graphs that the different plant part types can be grouped together: leaves/stems, whole plants and roots can be differentiated from bark, tuber and bulb species by the comparatively lower relative R/kg values of the latter (Figure 3). The bark and bulb species tended to lie parallel to the x-axis, while values for leaves/stems, whole plants and roots tended to be close to, or nearly parallel with, the y-axis. In many cases, the more expensive products for a plant part type were species that are, or at least perceived to be, scarce (hence, the smaller the mass sold relative to price and/or the higher the price relative to mass) and/or 'popular'.

Mean market statistics
The mean mass of species sold by Faraday traders to customers is significantly heavier and almost twice the mean mass sold by *muti* shops (Table 4). The average mass dispensed by the shops was 0.172 ± 0.170 kg (SD) (n = 380), compared to 0.336 ± 0.248 kg (n = 155) sold by the Faraday market traders (in 1995). In the *muti* shops, the heaviest products sold were pieces of *D. sylvatica* tubers (0.59 ± 0.69 kg), followed by the bulbs of *M. plumbea*, *Drimia* spp., *E. autumnalis* and *Hypoxis* spp. (0.51, 0.36, 0.26 and 0.25 kg respectively) (Table 4). The heaviest of the 22 products sold in the Faraday market was the fruit of *Kigelia africana* (0.72 ± 0.51 kg) (Table 4). Unlike in the *muti* shops, this species tends to be sold as a whole fruit rather than as chopped up pieces. The caudices of *Stangeria eriopus* are similarly mostly sold whole in Faraday compared to smaller pieces in the *muti* shops. The species sold in the smallest mass include the bundles of whole plants of *Scabiosa columbaria* and *Dianthus mooiensis*, as well as the rhizomes of the very scarce species *Siphonochilus aethiopicus* (Table 4). There were no significant differences in the mean mass of the bundles of *S. columbaria* and *D. mooiensis*, which is to be expected considering that harvesters usually supply these species in standard size bundles of ≈ 25 individual plants per bundle throughout the region.

Rand per kg values were significantly higher for species sold in *muti* shops than Faraday (Table 4). In terms of individual species R/kg values sold in *muti* shops in 1995, *S. aethiopicus* was the most expensive at R759.7 ± R502.4 kg^{-1}, followed by *K. africana*, *A. amatymbica, C. camphora* and the whole plants of *S. columbaria* and *D. mooiensis* (R116.3 kg^{-1}, R99.3 kg^{-1}, R92.4 kg^{-1}, R77.3 kg^{-1} and R64.9 kg^{-1} respectively) (Table 4). The leaves and stems of *Helichrysum* spp. and *Myrothamnus flabellifolia* have intermediate values, with the remaining plants (mostly bark and bulbs) on the low end of the range, the least expensive being *M. plumbea* (R10.3 kg^{-1}). The R/kg values of species sold by the Faraday traders show similar trends, however the highest value was recorded for *S. columbaria* (R98.6 kg^{-1}), followed by *Pappea capensis* (R43.4 kg^{-1}), *M. flabellifolia* (R41.7 kg^{-1}) and *A. amatymbica* (R41.5 kg^{-1}) (Table 4). Bark species values ranged between R10.2–R12.6 kg^{-1}, whereas bulbs ranged from R3.5–R6.5 kg^{-1}. Comparing the rank order of the species in terms of their R/kg values in the *muti* shops and Faraday market, Spearman's rank correlation was significant (r = 0.722, $P < 0.05$), thereby showing that species have a similar order of relative values in the different market sectors.

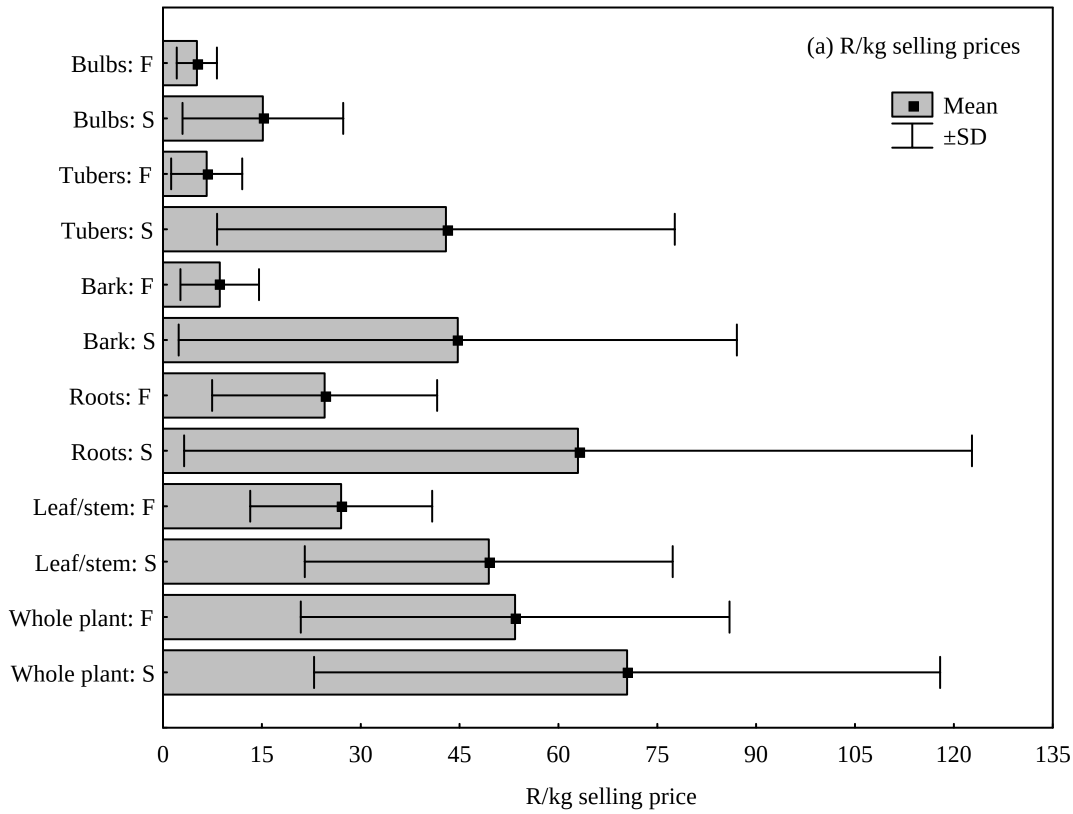
Bulb species were the heaviest plant products sold, but they are not necessarily sold as frequently as were other species. Of the 22 selected species, *Helichrysum* spp. was the most popular and the mean number of sales per annum per *muti* shop was 2 224 ± 1 979 (SD) (Table 4). *Eucomis autumnalis* was the second most frequently sold species, followed by *Drimia* spp., *Alepidea amatymbica*, *M. plumbea* and *Gunnera perpensa* (Table 4). The species sold least often were the fruits of *K. africana* and the roots of *Diospyros galpinii*. In several cases, the frequency of annual sales (and purchases) is related to availability. For example, traders in the shops indicated that they would have sold *W. salutaris* bark and *S. aethiopicus* rhizomes more often if they had been available.

The higher mean R/kg values and lower mean kg/S values of individual species sold in *muti* shops compared to the Faraday market also extends to plant part types (Figure 4). The differences in the mean R/kg and kg/S are significant for all plant part types ($P < 0.01$) sold in the shops and Faraday except whole plants ($P \geq 0.228$). Species sold as leaves and stems are relatively more expensive than bulbs and tubers in both the shops and Faraday (Figure 4a), and the quantity sold to customers is heavier for bulbs, tubers and bark (Figure 4b).

Table 4 Mean market statistics and trade figures for 22 species measured in the *muti* shops and the Faraday market in 1995. Two-tailed Student t-tests for independent samples compared the differences in the observed means. Significant *P* values are in **bold**. The sample size (n) for kg/S is the same as for R/kg.

Species	*Part sold*	*Mean mass per sale (kg/S) (± SD)*			*Mean price (R/kg) (± SD)*			*Mean individual sales*
		Muti shops 1995	*Faraday 1995*	*T-test (P)*	*Muti shops 1995*	*Faraday 1995*	*T-test (P)*	[1] *shop*$^{-1}$ *a*$^{-1}$ *(± SD) 1995*
Acacia xanthophloea	Bark	0.11 ± 0.11 (n = 10)	0.33 ± 0.02 (n = 2)	**0.020**	53.8 ± 36.0	12.3 ± 0.8	**0.654**	443 ± 663
Albizia adianthifolia	Bark	0.14 ± 0.09 (n = 20)	0.30 ± 0.15 (n = 7)	**0.002**	38.9 ± 28.7	10.2 ± 8.9	**0.016**	449 ± 310
Balanites maughamii	Bark	0.19 ± 0.13 (n = 15)	0.34 ± 0.91 (n = 5)	**0.031**	30.7 ± 35.1	6.3 ± 1.7	0.146	319 ± 402
Cinnamomum camphora	Bark	0.08 ± 0.10 (n = 18)	0.49 ± 0.22 (n = 5)	**<0.001**	92.4 ± 62.1	12.6 ± 1.7	**0.010**	415 ± 525
Elaeodendron transvaalense	Bark	0.19 ± 0.10 (n = 26)	0.51 ± 0.25 (n = 10)	**<0.001**	27.1 ± 25.0	6.4 ± 5.8	**0.015**	557 ± 709
Warburgia salutaris	Bark	0.12 ± 0.06 (n = 25)	0.33 ± 0.14 (n = 8)	**<0.001**	43.3 ± 41.0	11.2 ± 6.8	**0.037**	581 ± 778
Drimia spp.	Bulb	0.36 ± 0.17 (n = 25)	0.47 ± 0.22 (n = 12)	0.114	12.0 ± 4.8	6.5 ± 2.9	**0.0008**	1129 ± 1455
Eucomis autumnalis	Bulb	0.26 ± 0.16 (n = 23)	0.52 ± 0.26 (n = 10)	**0.001**	17.9 ±12.0	6.4 ± 4.3	**0.006**	1025 ± 1575
Hypoxis spp.	Bulb	0.25 ± 0.18 (n = 22)	0.58 ± 0.18 (n = 10)	**<0.001**	20.6 ± 18.3	4.0 ± 1.7	**0.008**	450 ± 666
Merwilla plumbea	Bulb	0.51 ± 0.27 (n = 22)	0.63 ± 0.17 (n = 10)	0.215	10.3 ± 7.4	3.5 ± 0.8	**0.007**	777 ± 1238
Kigelia africana	Fruit	0.05 ± 0.02 (n = 4)	0.72 ± 0.51 (n = 2)	**0.040**	116.3 ± 61.8	5.6 ± 4.0	**0.080**	87 ± 117
Helichrysum spp.	Leaves/stems	0.09 ± 0.06 (n = 24)	0.15 ± 0.06 (n = 10)	**0.009**	48.4 ± 26.9	24.1 ± 13.0	**0.011**	2224 ± 1979
Myrothamnus flabellifolia	Leaves/stems	0.12 ± 0.07 (n = 8)	0.10 ± 0.02 (n = 2)	0.918	51.4 ± 30.9	41.7 ± 7.6	0.683	330 ± 488
Siphonochilus aethiopicus	Rhizome	0.02 ± 0.03 (n = 6)	No data	**-**	759.7 ± 502.4	No data	-	No data
Alepidea amatymbica	Root	0.06 ± 0.03 (n = 24)	0.11 ± 0.06 (n = 8)	**0.002**	99.3 ± 85.2	41.5 ± 20.3	0.071	909 ± 1101
Diospyros galpinii	Root	0.14 ± 0.15 (n = 11)	0.34 ± 0.01 (n = 2)	0.107	59.8 ± 56.1	11.9 ± 0.5	0.269	140 ± 114
Gunnera perpensa	Root	0.12 ± 0.05 (n = 21)	0.20 ± 0.10 (n = 10)	**0.006**	35.8 ± 23.6	12.8 ± 5.1	**0.005**	773 ± 877
Pappea capensis	Root	0.08 ± 0.05 (n = 18)	0.09 ± 0.02 (n = 4)	0.831	54.2 ± 32.2	43.4 ± 11.1	0.523	542 ± 685
Dioscorea sylvatica	Tuber	0.59 ± 0.69 (n = 8)	0.085 (n = 1)	-	21.9 ± 28.4	11.8 [2]	-	369 ± 539
Stangeria eriopus	Tuber	0.08 ± 0.03 (n = 12)	0.46 ± 0.19 (n = 9)	**<0.001**	53.9 ± 33.6	6.1 ± 5.4	**0.0005**	375 ± 514
Dianthus mooiensis	Whole plant	0.06 ± 0.03 (n = 19)	0.08 ± 0.03 (n = 10)	0.152	64.9 ± 37.7	35.4 ± 13.9	**0.024**	730 ± 1019
Scabiosa columbaria	Whole plant	0.05 ± 0.02 (n = 15)	0.03 ± 0.01 (n = 4)	0.085	77.3 ± 58.3	98.6 ± 14.1	0.632	477 ± 658

[1] sales to customers



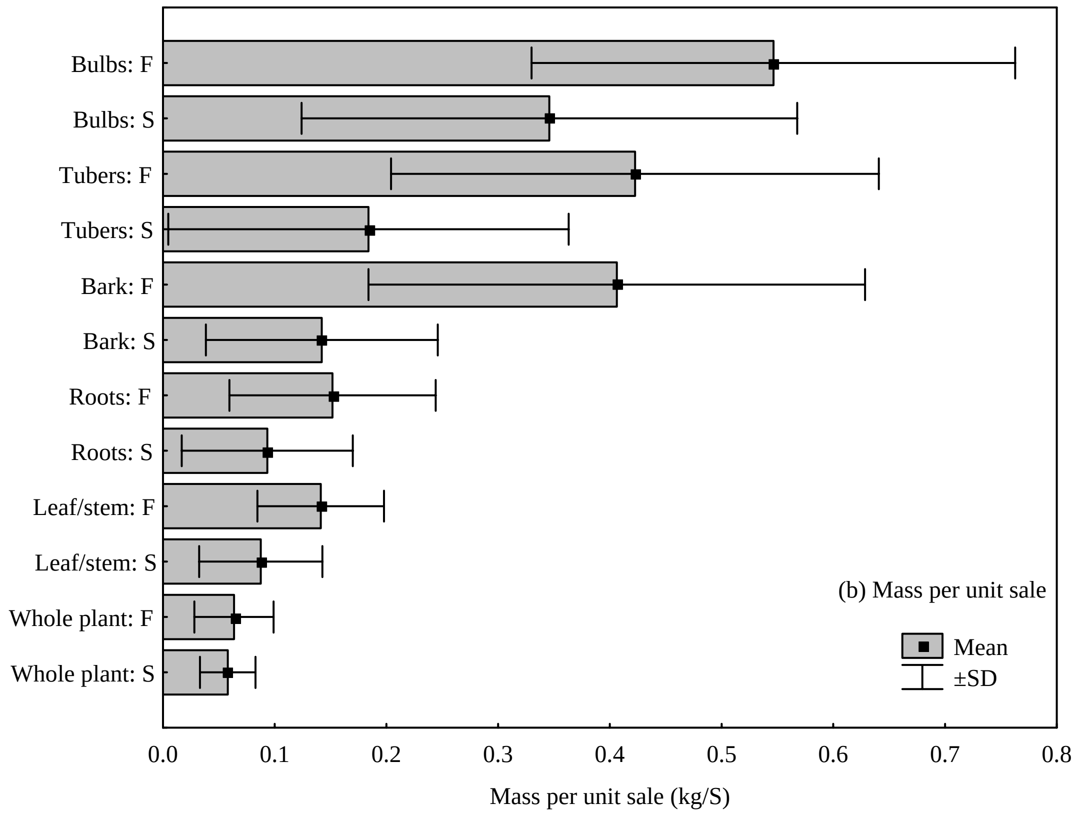


Figure 4 Box and whisker plots for plant part types traded in the *muti* shops (S) in 1995 and Faraday street market (F) in 1995 for (a) R/kg selling price and (b) mass per unit sale (kg/S). The differences in the mean values when comparing shops versus the market were significant for all plant part categories except 'whole plants'

Unit prices of retail sales

A feature of the traditional medicine trade is that products are not sold according to precise mass values (as the relative pricing structures described in the previous section shows), but volume. It is typical for traders to sell plants in small volumes equivalent to a 'handful' for a set unit price. In 1995, the standard unit price per volume sold in the shops ranged between R2–R5, whereas 74.3% of sales in Faraday in 1995 were for R2 (Figure 5). The mean price in the *muti* shops in 1995 was R3.7 ± R1.7 (SD) (n = 380), compared to R2.6 ± R1.2 (n = 155) in the Faraday market in 1995 (differences significant at $P < 0.00001$). Over time, the price of a small-volume unit sale increased. In Faraday in 2001, the average standard unit price of a retail sale had increased to R5, and 62.3% (n = 36) of the plants bought by the customers were for this price (results from Williams 2003).

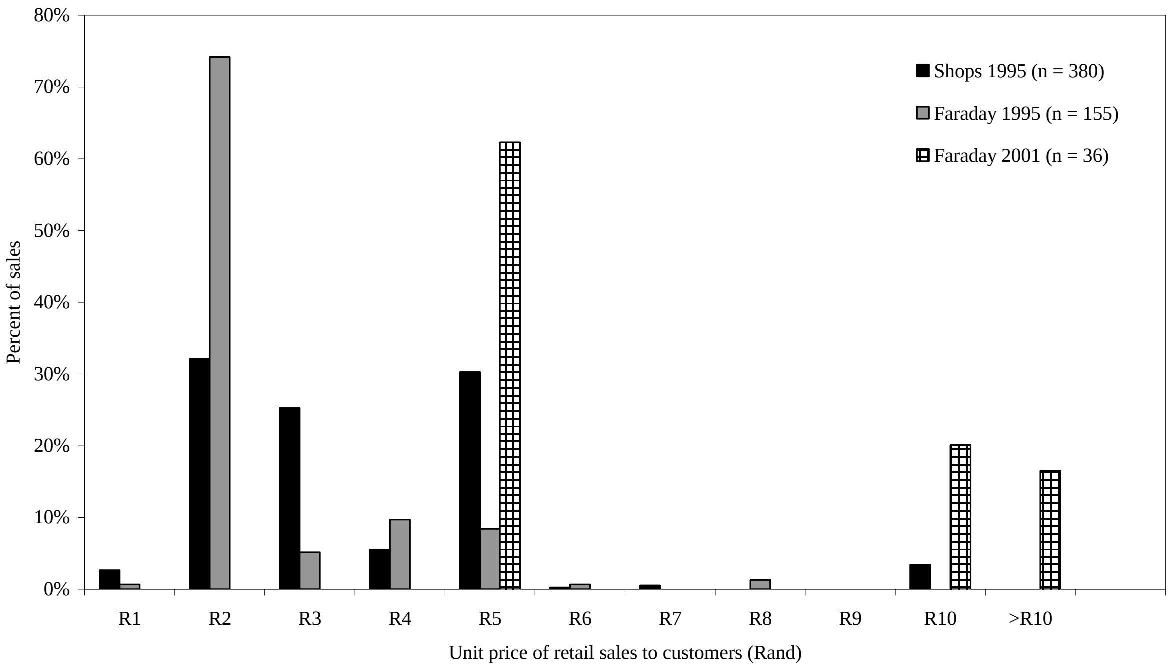
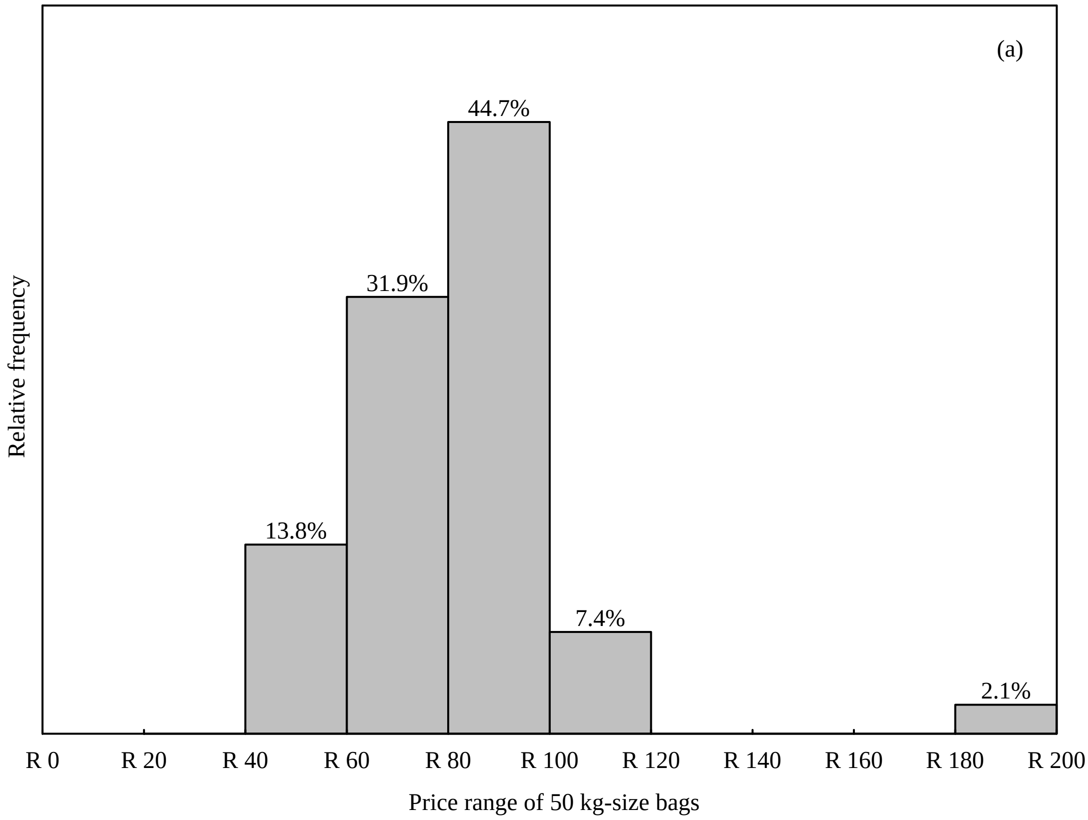


Figure 5 Standard retail prices of small-volume sales to customers between 1995 and 2001.

The wholesale value of 50 kg-size bags

The costs of 50 kg-size bags purchased by *muti* shops from suppliers (including suppliers from Faraday) in 1995 ranged from R20–R250 (Figure 6a, Table 5a). Most bags (44.3%) cost R60 (Table 5a). The most expensive products were the bark of *W. salutaris* (R90–R200 bag^{-1}), *E. transvaalense* (R90-R150 bag^{-1}) and the bulbs of *Drimia* spp. (R95–R200 bag^{-1}). Compared to the roots of other species, *A. amatymbica* was the most expensive with a bag (50 kg-size) costing between R90 and R150. Bulbs and roots were usually more expensive than bark, with the modal price being R60 and R45 respectively (Table 5a).

The modal price of bark increased from R45 in 1995 to R100 in 2001 (Table 5b). However, prices shown in Table 5b and Figure 6b are the wholesale cost to the traders in the market and not the retail price to bulk buyers such as *muti* shops. The modal price of all bags sold to traders in the Faraday market was R100, with most ranging between R70–R100 depending on the species (Table 5b, Figure 6b). Traders in Faraday tended not to buy roots and whole plants in full 50 kg bags, but rather in bundles and quantities less than half of a 50 kg-size bag. Traders also had a habit of sharing costs by buying one bag of plants between several traders and then dividing the contents thereof.



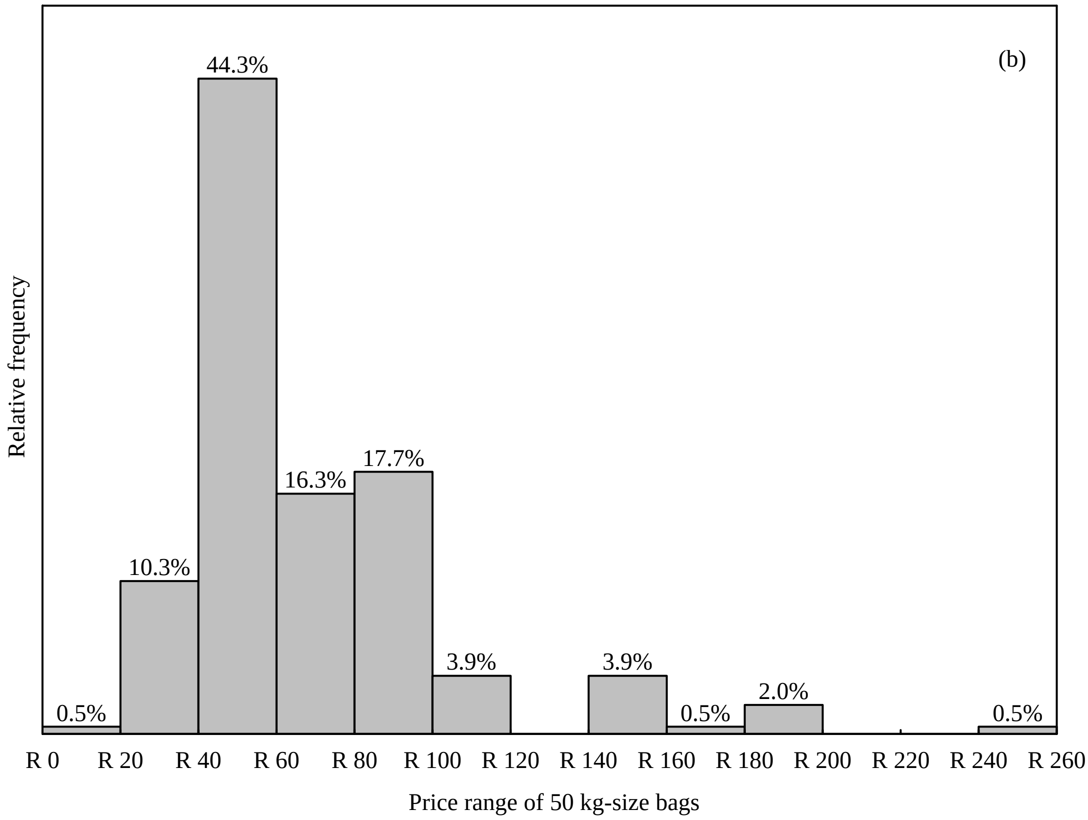


Figure 6 Wholesale price range of 50 kg-size bags (a) bought by *muti* shop traders in 1995 (n = 203 bags), and (b) bought by Faraday traders in 2001 (n = 94 bags).

Table 5 Wholesale price ranges paid for 50 kg-size bags by (a) shop traders in 1995 from the gatherers/suppliers; and (b) Faraday traders in 2001 from the gatherers/suppliers.

Plant parts	Price range (*most expensive sp.)	Mean ± SD	Mode	Modal range	n
(a) 1995 shop trader purchases from gatherers					
Bark	R30 – R250* (**C. camphora*)	R70.7 ± R39.4	R45	R45 – R60	95
Bulbs	R30 – R200* (**Drimia* spp.)	R69.1 ± R27.0	R60	R60 – R80	60
Roots	R30 – R150* (**A. amatymbica*)	R77.2 ± R25.1	R60	R60 – R80	27
Whole plants	R60 – R150* (**D. mooiensis*)	R86.3 ± R32.0	R60	-	8
Tubers	R40 – R100	R61.1 ± R22.1	R45	-	4
Leaves/stems	R20 – R200* (**Helichrysum* spp.)	R121.3 ± R92.8	-	-	4
Fruit	Usually purchased as individual fruits				
All plants	R20 – R250	R77.3 ± R35.6	R60	R50 – R70	203
(b) 2001 Faraday trader purchases from gatherers					
Bark	R50 – R200* (**W. salutaris*)	R87.8 ± R25.6	R100	R70 – R100	37
Bulbs	R50 – R120* (**Drimia* spp)	R84.8 ± R25.6	R70	R70 – R100	25
Stems	R60 – R100	R83.3 ± R19.8	R100	R60 – R100	6
Tubers	R35 – R110* (**Dioscorea* spp.)	R83.7 ± R22.7	R100	R80 – R100	15
Leaves/stems	R70 – R100	R90.0 ± R15.5	R100	R70 – R100	6
Roots	Generally bought in a range of volumes < 50 kg bag; usually ≤ ½ bag for R50–R100				
Whole plants	Usually not bought in bags, but as bundles for R3 each or small volumes for R50–R100				
Fruit	Generally bought as ½ a bag for ≤ R100				
All plants	R35 – R200	R89.3 ± R24.3	R100	R70 – R100	94

DISCUSSION

While it is not possible to obtain precise measures of quantities of the plants sold annually, recognition of the order of magnitude of sales is necessary if resource management alternatives are to be seen in perspective (Cunningham 1988). Similarly, precise measures of the pricing structures and market values are not possible to calculate, but recognition of the relative order of magnitude is important for distinguishing between plant part types and species. The market values of individual taxa vary considerably (Dold and Cocks 2002). Pricing structures fluctuate between markets and over time as the cost of plants per unit mass increases or varies depending on a gatherer's access to resources and the proximity of markets to the harvesting sites. Other factors influencing market volumes and values include the scarcity and availability of the resource over time (including seasonal availability), consumer demand and the plant part traded. Keirungi and Fabricius (2005) found that there was a strong positive relationship between the inverse of the importance rank of 15 medicinal plants harvested at Nqabara in the Eastern Cape and the price of the plants in the market. However, contrary to their expectations, the importance rankings and prices were independent of the time it took to collect the plants (Keirungi and Fabricius 2005).

When the value of a product and the intensity of use are extremely high, it is likely that the resource is being overexploited and may become depleted (Sunderland *et al.* 2004). As a result, the quantities supplied to the market will become lower and the R/kg values higher. While supply is also a function of the amount of product harvested, the demand for a product from a supplier is also a function of the quantities that buyers are willing and able to purchase depending on the capital they have at their disposal (Sunderland *et al.* 2004). In turn, this influences market prices and relative pricing structures.

There is a positive correlation between the prevalence of a species in a shop or market and the volumes purchased and/or present (Figure 1). Hence, the number of traders that sell a species informs the quantities present in the market and the quantity sold per annum. Bulbous species, on a volume basis, accounted for large proportions of the annual quantities bought in 1995 and 2001 (Table 2) as well as the quantities present in the markets (Table 3). Given their high density and moisture content, bulbs would also be expected to contribute to greater proportions of the trade on a weight basis (Mander 1998). Bark species also contribute significantly to market volume and value, with at least 40% of the total number of bags present in the Faraday market being bark products (Williams n.d.). Significant also is that 68% of the traded volume and 73% of the financial value is derived from woodlands and forests (Williams 2003). However, the frequency of wholesale purchases is also related to the perishability of the product. In Faraday in 2001, there was a positive association between the shelf life/perishability of the plant (connected to moisture loss), the age of the product in the market (i.e. how long since it had been purchased) and the frequency of purchases to restock the product (Williams 2003). The more perishable the plant, the more frequently it was purchased. Hence, species like tubers and bulbs were bought more often by traders (every 5– 7 weeks) than bark, stems and roots were (every 11–16 weeks) (Williams 2003).

Given the high mass sold relative to the price per unit, bulbs, like bark, have the lowest R/kg values compared to other products like roots, leaves and whole plants (Figures 2-4). The prices paid for heavier/denser species is thus disproportionate to the mass sold (Figures 2 and 3). Therefore, if one were to use R/kg values as an indicator of value and risk to overexploitation in the market (the reasonable, and often made, assumption being that taxa with high R/kg values are more valuable and face greater potential threats to their persistence in the wild), then scarce, highly valued species like *W. salutaris* (bark sold for ± R43.3 kg^{-1} in 1995) would *appear* to be comparatively lower risk than species that are rarely sold e.g. *K. africana* (fruit sold for ± R116.3 kg^{-1}) (Table 4).

Hence using R/kg as a variable to predict plant vulnerability tends to create a bias in favour of 'lighter' and less dense plant parts typically sold in small quantities because of the nature of the plant part and the manner in which a unit is marketed and required by customers (Figure 3). It is therefore recommended that when comparing price relative to mass, that taxa are first grouped according to the plant part used and then compared within the group. Consequently, among the bark species, *W. salutaris* would rank high in terms of its market value and potential risk compared to *B. maughamii*, especially since scarcities of *W. salutaris* have resulted in smaller quantities being sold relative to the price, and also thinner bark. Similarly, comparisons between bulb taxa would mean that *E. autumnalis* (R6.4 kg^{-1}) would not be ranked as a low value resource when compared with the roots of *P. capensis* (R43.4 kg^{-1}) simply because of differences in the mass sold relative to the price (Table 4).

Another factor in the relative value of species became evident when comparing the R/kg values of bark with features of the species' macroscopic bark anatomy. A study investigating the change in mass and thickness of wet- and oven-dry bark for six species was conducted for five of the species listed in this paper (Williams *et al.* in press). A comparison of the rank order of species in terms of the percentage moisture lost by the bark was similar to that of the rank order of the R/kg values. In other words, species that lost the most moisture after harvesting were the species with the highest R/kg values. Thus *E. transvaalense*, one of the most popular bark species in the market sold frequently in large volumes (Table 2), and which showed a mean decrease in bark mass of 27.8%, had R/kg values half that of *A. xanthophloea,* a species not traded to the same extent but which lost 58.7% of its original bark mass after 12 weeks of air-drying. Thus, R/kg values for some species might be artificially elevated due to characteristics intrinsic of their bark morphology and/or anatomy, such as density and moisture retention. This further serves to confirm that hypotheses on how the market values of taxa can elucidate exploitation risks are not necessarily obvious, and that actual and perceived plant scarcities are only one of the many factors that determine a species' overall value and the potential threat of severe population reduction.

While provincial and sectorial markets (e.g. shops and street markets) will differ in terms of the actual volume sold, the value and the market share of the trade, the trends appear to be similar in terms of the relative order of magnitude for species and plant part types. Bulbs and tubers were the least expensive category of plants in the Witwatersrand (Figure 4a). These results are similar to data trends and trade statistics derived for markets in the Eastern Cape (Dold and Cocks 2002) and Mpumalanga (Botha 2001; Botha *et al.* 2004). However, unlike the Witwatersrand and Mpumalanga, bark was the most expensive category of plant part relative to mass in the Eastern Cape (Dold and Cocks 2002). The reason for this is not known.

The most expensive categories of plant part per unit mass are leaves/stems and roots (Figure 4a). In the Witwatersrand *muti* shops in 1995, except for bulbs, the mean values for most plant parts was >R40 kg^{-1} whereas bulbs tended to be <R20 kg^{-1}. In the Faraday market in 1995, the mean values for bark, bulbs and tubers was <R10 kg^{-1} whilst other species were >R20 kg^{-1}. There are insufficient data to validate the R/kg trends for plants in KwaZulu-Natal, except for the nine species investigated by Mander (1998). However, given the similarities of the Witwatersrand and KwaZulu-Natal markets in terms of the species traded and the origin of the plants, there is no reason to expect that the trends would be much different.

It was not possible to ascertain the percentage mark-up on products purchased by the street traders and *muti* shops. However, given that Faraday is a supplier to the shops, and treating the R/kg prices of the shops in Table 4 *as if* the Faraday market were their sole suppliers (which they weren't), then the difference in the R/kg values is 240% ± 202% (SD). But, Faraday is both a wholesale supplier of large volumes to other retailers and a retail supplier of smaller quantities ('handfuls') to consumers and the plants purchased to derive the values in Table 4 were of a retail nature (<1 kg and ≤R5). Given the R/kg trends for large volume purchases *and* the aggressive bargaining associated with wholesale purchasing of large volumes (Mander 1998), the R/kg values paid by the shops is presumed to be lower than the values reflected for the Faraday market. Hence, the actual percentage mark-up on plants sold by *muti* shops on the Witwatersrand is expected to be >240%. This might make the percent mark-up on the Witwatersrand comparable with the mean value of 612% (for 9 species) added as mark-up and/or profit by shop traders in KwaZulu-Natal (KZN) (Mander 1998). Urban street traders in KZN, however, added ≈ 111% to the rural market price (Mander 1998), and the gross profit margin of street vendors in Mpumalanga was estimated to be ≤ 93% (Botha 2001). It is clear from the Witwatersrand and KZN markets that there is an increase in the price paid for products along the commercial chain of harvested plants from the gatherers/suppliers to the retailers. The price paid per kilogram of a product is cheaper in the street markets than in the *muti* shops (Table 4), and rural markets are cheaper than the urban street markets (Mander 1998).

It is clear from the discussions on pricing structures relative to mass that the quantity of a product sold and its R/kg value are inversely proportional to the mass of the product. This appears to be because transactions in the traditional medicine trade, and other informal trading activities, are typically volume- not mass-based. Most plants are sold in volume units equivalent to 1 or 2 'handfuls' or 1–2 small bundles (Figure 7), the unit price of which is usually standard across a particular market place. Exceptions to the 'handful' rule include large plants such as *Clivia* spp. where 2–4 whole plants equate to a selling unit, and *Helichrysum* spp. which is frequently sold in large, circular bales. Changes in the price of a handful occur every few years due to inflation and increased harvesting costs. Various provincial markets may sell the same plants and product volumes at different prices, for example plants sold in the Durban markets are always a few rand cheaper than at Faraday, almost certainly because the Durban markets are closer to the harvesting sites *and* they supply the Faraday market. Scarce species are usually sold for the same unit price but half the volume, or the same volume for twice the price (Williams 2003). The *muti* shops also sold less product per unit volume than the traders in the Faraday market, as indicated by the mean mass per sale in Figure 2a-e and 4b. The mean mass of sales in the Faraday market is significantly greater than the mean mass of sales in the *muti* shops (0.172 kg and 0.336 kg respectively) (Figure 4b, Table 4). Mander (1998) estimated that the average mass of street-traded products in Durban was 0.216 kg and the mass dispensed by shop traders and healers was 0.083 kg. By comparison, the mass of street traded products sold at Faraday tended to be >0.15 kg, whereas the mass dispensed by shops was usually <0.2 kg (Figure 4b).

Figure 7 Groups of 3–4 *Merwilla plumbea* and *Eucomis autumnalis* bulbs on sale in the Faraday market in 2006 in quantities equivalent to a R10 unit sale per group of bulbs. The paler-coloured *M. plumbea* bulbs on the left are heavier per R10 unit than the *E. autumnalis* bulbs; hence, the R/kg values for the former are lower.

In 1994/1995, the price per unit sale in the shops ranged from R2–R5 per unit (e.g. a 'handful'), compared to Faraday where 74.2% of plant purchases were R2 in 1995 (Figure 5). The price of a unit sale increased in Faraday from R2 in 1995 to R5 in 2001; 62.3% of the plant purchases made by 36 customers interviewed in the market were for R5 and 20.1% were for R10 (Figure 5) (Williams 2003). Plants that were sold in the R4–R10 price range in 2001 include *Drimia* spp., *E. autumnalis*, *M. plumbea*, *A. amatymbica*, *C. camphora* and *W. salutaris*. In 2006, the cost of a purchase unit is ≈ R5–R10 in *muti* shops and ≈ R10 in Faraday; however, the volume sold by *muti* shops is a lot less. The quantity sold per unit sale has also dramatically decreased for some species in the shops due to plant scarcities (C. Dorasamy, pers. comm.). For scarce species like *W. salutaris*, three small pieces of bark cost R5 in 2006 and a 'handful' would cost >R25. Similarly, a single bulb costs ≥ R2.50 in the shops.

In 1995, the cost of a 50 kg-size bag purchased by the shops from their suppliers ranged from R20–R250 per bag, but mostly R50–R70 (Table 5a). Higher prices were usually paid for scarce and threatened species, with *Drimia* spp., *C. camphora*, *W. salutaris*, *E. transvaalense*, *A. amatymbica*, *E. autumnalis* and *M. plumbea* usually costing >R100 per bag, depending on the supplier. The exotic species *C. camphora* as perceived to be very scarce and high prices were being paid for the bark. The tree is, however, usually found on private property and so access to, and availability of, the resource is limited. Because the species is highly valued as a medicinal plant, its relative value is high compared to that of other indigenous species.

Plant scarcities have driven up the wholesale price per bag of certain species and reduced the volume sold. In 2006, a shop trader reported that three-quarters of a 50 kg-size bag of *M. plumbea* and *E. autumnalis* bulbs cost ≈R130 and ≈R170 respectively if purchased from gatherers that came directly to the shop (C. Dorasamy, pers. comm.). However, the same quantity of *M. plumbea* would cost >R200 per bag if purchased from the Faraday market.

It was not always possible, or even necessary, for traders to purchase plants in volumes equivalent to a 50 kg-size bag. Traders also bought plants in quantities equivalent to a 12.5 kg maize-bag or less, depending on the species. The prices paid for these, however, were not proportional to the cost of a 50 kg bag and so the R/kg costs were higher. Results showed that some traders paid the same price for one 12.5 kg-size bag of plants as for one 50 kg-size bag. Factors influencing the quantity purchased included: plant supply and demand, scarcities, availability, the capital available to buy the stock and the space available to store the product. There were many traders in Faraday, for example, who did not have the capital nor the space to buy and sell large quantities of plants. For some, their total stock equated to less than half a bag, whereas the mean for the market was 1.6 ± 2.9 bags per trader. It was the strategy of some *muti* shops in 1995 to buy little and often, thus lowering their potential profit margins and the potential for wastage. Other traders, however, bought plants in bulk less frequently (e.g. 2–3 times a year). Unless the plants are sold quickly, purchasing in bulk will result in plant quality being sacrificed and, as a result, the potential for greater earnings would be compromised.

With the current scarcities of some species, however, some shops have resorted to stock-piling plants more than they did in the past to offset the effects of any potential stock shortages (C. Dorasamy, pers. comm.). When a gatherer comes to a shop with a sack of plants known to be scarce, some shop owners will, in all probability, buy all the plants that the gatherer has and store them (C. Dorasamy, pers. comm.). Furthermore, species like *A. amatymbica* and *E. transvaalense* that could be purchased in 50 kg-size bags in the early 1990s are no longer available in large quantities due to over-harvesting, and gatherers generally supply them in quantities of a half bag or less (C. Dorasamy and S. Mvubu, pers. comm.). In Faraday in 2006, a bag of *E. transvaalense* equivalent in size to a 12.5 kg maize bag could be purchased for R190.

The prices paid for slow-growing or scarce species bear no relation to their vulnerability as these species are 'mined' and not 'managed' (Cunningham 1988). As a result, the costs of replacing the resources through cultivation are not commensurate with the market values, especially for plants with a high individual mass and density, such as bark, bulbs and tubers. These resources are additionally threatened because harvesting tends to be more destructive on account of the whole plant being removed or stems being ring-barked with little to no chance for the plant to recover.

There is evidence that trade statistics for medicinal plants can be used as indicators of risk to plant persistence in the wild. Cunningham (1988) considered vulnerability to be partly a function of demand, and the number of bags sold annually was direct evidence of the demand. In view of that, bulb species are some of the most threatened plants in the medicinal plant trade followed by trees that have been harvested for bark because of the high volumes harvested and sold annually. Rand per kilogram values have also been cited as indicators of potential risk, with high value plants regarded as indicators of scarcity because of the high prices that consumers are prepared to pay for species that are increasingly more difficult to obtain. As the results have demonstrated, however, R/kg values should only be used to compare species within similar plant part groups because of the disproportionately higher prices charged for 'lighter' species. Hence, the correlation between scarcity and market prices is evident only when comparing groups of bulbs, barks or roots.

It is clear that factors influencing the volumes, values and pricing structures of species sold for the medicinal plant trade are not strictly related to supply and demand principles applicable to the trade of goods in the formal sector. Furthermore, it is the heterogeneous nature of the informal markets that defies its reduction to simple economic calculation (Preston-Whyte and Rogerson 1991). Results for this study have also shown that it is difficult to generalise on the factors affecting pricing structures when considering all the species together. As a whole, there was no general trend of increasing R/kg value with increasing plant scarcity and or popularity. These factors can usually only be seen within a plant part group (e.g. all the bark species together). Therefore, it is the manner in which the products are traded – i.e. on a volume basis, and hence the mass and density of a plant part type – that will generally determine a species' overall R/kg value, not its popularity or scarcity in the market. These results serve to bridge existing knowledge gaps and elucidate some of the market factors determining the value of the medicinal plant trade in South Africa.

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