

Edible plants of urban domestic gardens in the Capricorn District, Limpopo Province, South Africa

G. K. E. MOSINA¹ & A. MAROYI^{2*}

¹*Department of Microbiology and Plant Pathology, Forestry, Agriculture and Biotechnology Institute, University of Pretoria, Lynnwood Road, Pretoria*

²*Medicinal Plants and Economic Development (MPED) Research Centre, Department of Botany, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa*

Abstract: This study conducted between May and October 2012, was aimed at investigating the contribution of urban domestic garden flora in the Capricorn District, Limpopo Province, South Africa to household food supply. Semi-structured interviews, observations and guided field walks with 62 participants were employed to obtain ethnobotanical data on edible plants growing in domestic gardens. Based on ethnobotanical information provided by the participants, botanical specimens were collected, numbered, pressed and dried for identification. A total of 51 edible plants belonging to 44 genera and 26 families was recorded. Plant parts identified as important sources of food included: edible fruits (26 species), leaves cooked as leafy vegetable (12 species), edible bulbs, roots and tubers (six species), culinary herbs or spice (five species), edible seeds (four species), edible stems (two species) and fruit juice made into local beer (one species). Food plants in urban domestic gardens contribute to the livelihoods needs of local people.

Key words: Food security, Limpopo Province, South Africa, urban domestic gardens.

Handling Editor: Demel Teketay

Introduction

Urban domestic gardens, i.e. areas adjacent to a household dwelling where the household has control over the home garden, provide multiple ecosystem services that contribute to quality of life in cities, air quality regulation, carbon capturing, temperature regulation, storm water run-off mitigation, recreational benefits and social cohesion (Colding 2007; Dunnett & Qasim 2000; Marco *et al.* 2010; Pandey *et al.* 2014; Takano *et al.* 2002; Wu *et al.* 2003). Knowledge of urban floras is, therefore, important for maintaining and improving these ecosystem services of the urban environment and to keep them favourable for life within urban centres (Lubbe *et al.* 2011). Domestic urban gardens can also serve as important sources

of both food and cash income for vulnerable households in urban areas. The uses of domestic gardens vary, as some are used for subsistence agriculture and others for the commercial production of food crops (Vogl *et al.* 2004). The private and public open spaces in the cities of the developing world are dotted with gardens producing vegetable species, herbs, spices, fruits and livestock (Mouget 2006). With increasing urbanisation, resulting in expanding urban creep and sprawl into productive farmlands, the rural farming areas are becoming increasingly distant from urban consumers (Shackleton *et al.* 2010). The authors concluded that the potential contribution of urban agriculture to livelihoods and markets is growing. Research by Marco *et al.* (2010) showed that private gardening is

*Corresponding Author; e-mail: amaroyi@ufh.ac.za

particularly linked to personal tastes and pleasure, which differ according to the species planted and/or maintained in domestic gardens.

Despite the growing acknowledgment of the importance of urban domestic gardens in the urban environment, very little research has been carried out on the role and value of such gardens to human well-being (Dunnnett & Qasim 2000). The important contribution domestic gardens make to the green space infrastructure in residential areas must be acknowledged, as their reduction will impact on biodiversity conservation, ecosystem services and the well-being of the human population. Previous studies in Brazil (Akinnifesi *et al.* 2009; Eichemberg *et al.* 2009), India (Jaganmohan *et al.* 2012), Karelia (Antipina 2003), Nicaragua (González-García & Sal 2008), UK (Gaston *et al.* 2005; Loram *et al.* 2007, 2011; Smith *et al.* 2006) and Turkey (Acar *et al.* 2007; Altay *et al.* 2010) showed that urban residents attach a high value to urban flora because of the goods and services they provide. Similar studies in Africa, including Egypt (Shaltout & El-Sheikh 2002) and Niger (Bernholt *et al.* 2009) showed that urban domestic gardens are repositories of biodiversity for domesticated and wild plants and animal species that need to be developed to meet livelihood needs of communities. Despite the increasing evidence that show urban domestic gardens to be important in the provision of food, income and ecosystem services to the growing urban population in South Africa (Lubbe *et al.* 2010, 2011; Molebatsi *et al.* 2010; Nemudzudzanyi *et al.* 2010), this knowledge on urban domestic gardens is not adequately documented. The present study, therefore, investigated the contribution of urban domestic garden flora in the Capricorn District, Limpopo Province, South Africa to household food supply.

Materials and methods

Study area

The study was conducted in two towns (Fig. 1) of the Limpopo Province, South Africa. The sites selected for this study were Seshego (23° 15' S 29° 23' E) in Polokwane municipality and Lebowakgomo (24° 31' S 29° 57' E) in Lepelle-Nkumpi municipality (Fig. 1). Seshego is located 13 km north-west of Polokwane, the capital of Capricorn District. It is close to the economic core of the District with access to formal economy of Polokwane municipality. The township was planned

as a dormitory town for workers in Polokwane (Donaldson & Boshoff 2001). Lebowakgomo is located 55 km south-east of Polokwane. The main employment sector in Lebowakgomo is the mining industry. The two towns are tertiary or quaternary in nature with 44 and 36 % of the businesses in Lebowakgomo and Seshego, respectively, being retail shops (Donaldson & Boshoff 2001).

The studied areas are semi-arid, susceptible to frequent droughts and characterised by summer rainfall. Mean annual rainfall ranges from 300 to 500 mm. Daily temperatures vary from mid-20 to mid-30 °C, with an average range of between 17 and 27 °C in the summer and 4 to 20 °C in winter (M'Marete 2003). The vegetation is classified as semi-arid savanna, characterised by a mixture of trees, shrubs and grasses (Mucina & Rutherford 2006). Dominant tree species include *Acacia*, *Albizia* and *Combretum* species and *Sclerocarya birrea* (A. Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro with patches of *Hyparrhenia*, *Eragrostis*, *Heteropogon* and *Digitaria* species of grasses.

Data collection

Data on the contribution of urban domestic gardens in the Limpopo Province to household food supply were collected by means of semi-structured and structured interviews and personal observation. Thirty one randomly selected individuals from each town were interviewed between May and October 2012. Verbal informal consent was obtained from each individual who participated in the study and the researchers adhered to the ethical guidelines of the International Society of Ethnobiology (www.ethnobiology.net, accessed on 12-3-2012). The interviews were conducted in the Sepedi Language since the main author is a native speaker of the language. The aim and purpose of the investigation was explained to selected participants. Interviews were conducted individually whenever possible in an attempt to avoid any direct influences from third parties and to ensure that the data supplied by the participants were as direct and reliable as possible (Phillips & Gentry 1993).

The questionnaire used during interviews was designed to gather data on socio-demographic characteristics of participants and food plants cultivated and/or maintained in urban domestic gardens. Voucher specimens of plants identified in domestic gardens were collected during the field trips when encountered for the first time and again when they were flowering or fruiting for easy

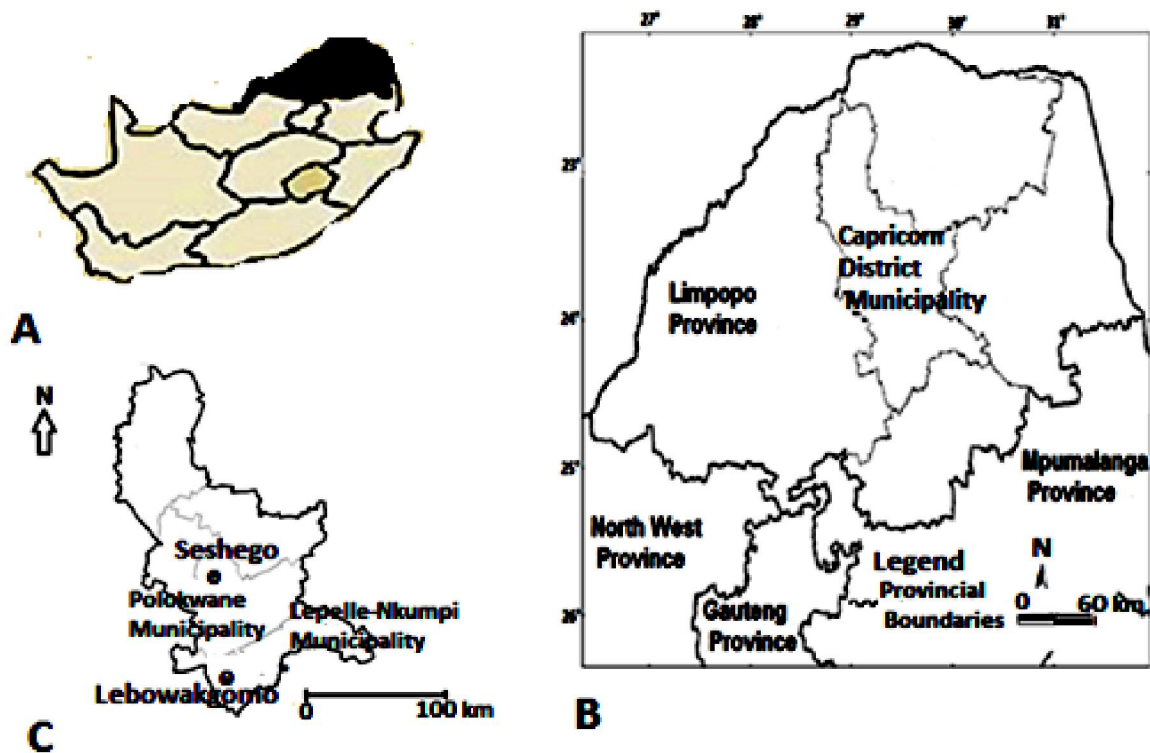


Fig. 1. A: Geographical location of the study area in South Africa. B: Map of Limpopo Province, showing the geographical position of Capricorn District. C: Detailed map of the study area.

identification. The voucher specimens were processed using standard taxonomic procedures (Bridson & Foreman 1998; Victor *et al.* 2004). Each herbarium specimen included important parts such as leaves, stems, flowers and fruits whenever available. For small herbaceous plants, the whole plants were collected. These specimens were deposited for future reference at the Larry Leach Herbarium (UNIN) of the University of Limpopo.

Results and discussion

Socio-economic characteristics of the participants

Of the sixty two participants who took part in the interviews, 69 % were female and 31 % were male (Table 1). Their ages ranged from 19 to 73 years, with 48 years as the median. The majority of participants were married (58 %), while 32 and 10 % were divorced and single, respectively (Table 1). The majority of households (81 %) comprised between three and six family members, while 18 % lived alone and one household had seven family members (Table 1). The majority

(53 %) of the participants were educated up to secondary level, while 29 % had attained tertiary education, 11 % had attained primary level and 7 % were illiterate. More than half of the participants (57 %) were unemployed, surviving on less than R¹ 2000.00 a month (Table 1). A very small proportion of the participants had constant income as either self-employed (15 %) or employed by a company (29 %), and 27 % of the participants did not disclose their monthly income (Table 1).

Species composition

A total of 51 edible plants belonging to 44 genera and 26 families was recorded from 62 domestic gardens in Lebowakgomo and Seshego in the Limpopo Province (Table 2). Dicotyledons constituted the majority of the useful plants growing in urban domestic gardens with 45 species (88 %) and monocotyledons contributed six species (12 %). More than three quarters of edible plants (77 %) found in domestic gardens in the Limpopo Province are exotic to South Africa. About half of the food plants (48 %) are from six families (Table 3). The other 20 families had less represen-

¹R = R and: currency of South Africa (1 USD = 8.70 Rand at the time of the study).

Table 1. Socio-economic characteristics of the study sample (N = 62).

Socio-economic variables		Number	Proportion (%)
Gender	Female	43	31
	Male	19	69
Age (years)	< 20	1	2
	20 - 29	11	18
	30 - 39	10	16
	40 - 49	17	27
	50 - 59	11	18
	> 60	12	19
	Marital status	Single	6
Married		36	58
Divorced		20	32
Household size	1 - 2	11	18
	3 - 4	28	45
	5 - 6	22	36
	7 - 8	1	2
Highest level of education	No education	4	7
	Primary	7	11
	Secondary	33	53
	Tertiary	18	29
Occupation	Unemployed	35	57
	Employed	18	29
	Self-employed	9	15
Combined monthly income	Less than R1000*	22	36
	R 1001 - 2000	7	11
	R 2001 - 3000	7	11
	R 3001 - 4000	4	7
	R 4001 - 5000	2	3
	More than R 5001	3	5
	Not disclosed	17	27

*1 Rand = US\$0.115.

tation, between one to two species each. Plant families with the highest number of edible plants were: Rosaceae (six species), Anacardiaceae, Brassicaceae and Lamiaceae (four species each), Amaranthaceae and Poaceae (three species each). The genera with the highest number of edible plants were *Brassica* with four species, followed by *Allium*, *Citrus*, *Prunus* and *Vigna* with two species each (Table 2). Lamiaceae, Poaceae and Rosaceae are among the largest families in South Africa characterised by more than 200 species each (Germishuizen *et al.* 2006). These families are also among the largest and most economically important sources of food and are widespread in

the tropics and sub-tropics. Similar results were obtained by Della *et al.* (2006) who revealed that people tend to use the plants that are easily available to them.

Edible parts and mode of consumption

There are mainly four types of growth forms of the plant species cultivated and/or maintained as food plants in urban domestic gardens in the Limpopo Province; and these include trees, shrubs, herbs and climbers (Fig. 2). Herbs constituted the largest proportion of growth forms with 39 %, followed by trees (29 %), shrubs (22 %) and climbers

Table 2. List of edible plants cultivated and/or maintained in domestic gardens of the Capricorn District, Limpopo Province, South Africa. Species marked with asterisk (*) are exotic to South Africa.

Family and species name	English name	Habit	Food type	No. of citations %
Alliaceae				
* <i>Allium cepa</i> L.	Onion	Herb	Edible bulb added to vegetable species or meat	16
* <i>Allium schoenoprasum</i> L.	Chives	Herb	Edible bulb added to vegetable species or meat	3
Amaranthaceae				
<i>Amaranthus hybridus</i> L.	Cape pigweed	Herb	Leaves cooked as leafy vegetable	23
* <i>Beta vulgaris</i> L. ssp. vulgaris	Beetroot	Herb	Bulb cooked as vegetable	10
* <i>Spinacia oleracea</i> L.	Spinach	Herb	Leaves cooked as leafy vegetable	29
Anacardiaceae				
<i>Harpephyllum caffrum</i> Bernh.	Wild plum	Tree	Fruit pulp edible	29
* <i>Mangifera indica</i> L.	Mango	Tree	Fruit pulp edible	81
<i>Sclerocarya birrea</i> (A. Rich.) Hochst. subsp. <i>caffra</i> (Sond.)	Marula	Tree	Fruit pulp edible and juice made into beer. Other use: medicinal	57
Kokwaro				
<i>Searsia lancea</i> (L. f.) F. A. Barkley	Rhus	Tree	Fruit pulp edible. Other use: ornamental	15
Apiaceae				
* <i>Coriandrum sativum</i> L.	Coriander	Herb	Added to vegetable species or meat as spice. Other use: medicinal	2
* <i>Daucus carota</i> L.	Carrot	Herb	Root cooked as vegetable	13
Brassicaceae				
* <i>Brassica carinata</i> A. Braun	Cabbage	Herb	Leaves cooked as leafy vegetable	7
* <i>Brassica juncea</i> (L.) Czern.	Brown mustard	Herb	Leaves cooked as leafy vegetable	29
* <i>Brassica napus</i> L.	Rape	Herb	Leaves cooked as leafy vegetable	8
* <i>Brassica rapa</i> L.	Turnip	Herb	Leaves and roots cooked as vegetable	5
Cactaceae				
* <i>Opuntia ficus-indica</i> (L.) Mill.	Prickly pear	Shrub	Fruit pulp edible. Other use: ornamental	21
Capparaceae				
<i>Cleome gynandra</i> L.	Spider plant	Herb	Leaves cooked as leafy vegetable	16
Caricaceae				
* <i>Carica papaya</i> L.	Pawpaw	Shrub	Fruit pulp edible. Other use: medicinal	69
Convolvulaceae				
* <i>Ipomoea batatas</i> (L.) Lam.	Sweet potato	Climber	Edible tuber	8
Cucurbitaceae				
<i>Citrillus lanatus</i> (Thunb.) Matsum. & Nakai	Watermelon	Climber	Fruit pulp edible	7
<i>Cucurbita pepo</i> L.	Pumpkin	Climber	Leaves cooked as leafy vegetable, fruit edible	13
Lamiaceae				
* <i>Lavandula angustifolia</i> Mill.	Lavender	Shrub	Added to vegetable species or meat as spice. Other use: medicinal	10
<i>Mentha longifolia</i> L.	Wild mint	Herb	Added to vegetable species or meat as spice. Other uses: medicinal and ornamental	3
<i>Ocimum basilicum</i> L.	Basil	Herb	Added to vegetable species or meat as spice. Other use: medicinal	2

Contd...

Table 2. Continued.

Family and species name	English name	Habit	Food type	No. of citations %
<i>*Rosmarinus officinalis</i> L.	Rosemary	Herb	Added to vegetable species or meat as spice. Other use: medicinal	3
Lauraceae				
<i>*Persea americana</i> Mill.	Avocado	Tree	Fruit pulp edible	66
Malvaceae				
<i>*Corchoru solitorius</i> L. var. <i>olitorius</i>	Jute mallow	Shrub	Leaves cooked as leafy vegetable	3
Moraceae				
<i>*Ficus carica</i> L.	Fig	Tree	Fruit pulp edible	16
<i>*Morus alba</i> L.	Mulberry	Tree	Fruit pulp edible	32
Musaceae				
<i>*Musa</i> sp.	Banana	Shrub	Fruit pulp edible	52
Myrtaceae				
<i>*Psidium guajava</i> L.	Guava	Tree	Fruit pulp edible	47
Papilionaceae				
<i>Vigna unguiculata</i> (L.) Walp.	Cow pea	Climber	Leaves cooked as leafy vegetable, seeds and fruits edible	10
<i>Vigna subterranea</i> (L.) Verdc.	Bambara groundnut	Herb	Seeds cooked as a meal	2
Passifloraceae				
<i>*Passiflora edulis</i> Sims	Granadilla	Shrub	Edible fruit	8
Poaceae				
<i>*Saccharum officinarum</i> L.	Sugar cane	Herb	Sweet stem edible	8
<i>*Sorghum bicolor</i> (L.) Moench	Sorghum	Herb	Cereal and sweet stem edible	2
<i>*Zea mays</i> L.	Maize	Herb	Cereal, dry seeds pounded into mealie meal or samp. Green mealies roasted, cooked	13
Punicaceae				
<i>*Punica granatum</i> L.	Pomegranate	Tree	Fruit pulp edible	3
Rosaceae				
<i>*Eriobotrya japonica</i> (Thunb.) Lindl.	Loquat	Tree	Edible fruit	8
<i>*Fragaria x ananassa</i> Duchesne	Strawberry	Herb	Edible fruit	2
<i>*Malus domestica</i> Borkh.	Apple	Tree	Edible fruit	13
<i>*Prunus armeniaca</i> L.	Apricot	Tree	Edible fruit	31
<i>*Prunus persica</i> (L.) Stokes	Peach	Tree	Edible fruit	73
<i>*Pyrus communis</i> L.	Pear	Tree	Edible fruit	8
Rubiaceae				
<i>Vangueria infausta</i> Burch. subsp. <i>infausta</i>	Wild medlar	Shrub	Fruit pulp edible	2
Rutaceae				
<i>*Citrus limon</i> (L.) Burm. f.	Lemon	Shrub	Fruit pulp edible	55
<i>*Citrus sinensis</i> (L.) Osbeck	Orange	Shrub	Fruit pulp edible	52
Sapindaceae				
<i>*Litchi chinensis</i> Sonn.	Litchi	Tree	Fruit pulp edible	10
Solanaceae				
<i>*Capsicum frutescens</i> L.	Chilli	Shrub	Fruits added to vegetable species or meat	5
<i>*Lycopersicon esculentum</i> L.	Tomato	Shrub	Fruits added to vegetable species or meat	15
Vitaceae				
<i>*Vitis vinifera</i> L.	Grape	Climber	Fruit pulp edible	23

Table 3. Families with more than three species of edible plants in the Capricorn District, Limpopo Province, South Africa.

Family	No. of species	Proportion (%)
Rosaceae	6	12
Anacardiaceae	4	8
Brassicaceae	4	8
Lamiaceae	4	8
Amaranthaceae	3	6
Poaceae	3	6

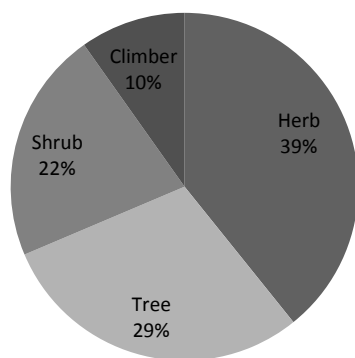


Fig. 2. Growth habit of edible plants cultivated and/or maintained in the Capricorn District, Limpopo Province, South Africa.

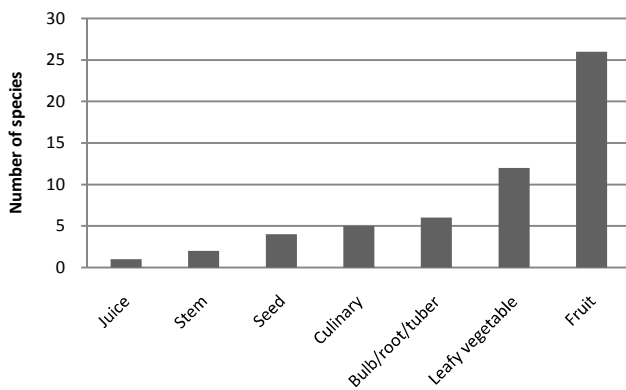


Fig. 3. Classification of edible plants cultivated and/or maintained in the Capricorn District, Limpopo Province, South Africa.

(10 %) (Fig. 2). Plant parts identified as important sources of food included: edible fruits (26 species), leaves cooked as leafy vegetable species (12 species), edible bulbs, roots and tubers (six species), culinary herbs or spice (five species), edible seeds (four species), edible stems (two species) and fruit juice

made into local beer (one species) (Fig. 3). The number of food plants recorded in this study is higher when compared with 14 fruit trees, 11 vegetable species, three legumes, two condiments and one cereal crop documented by Nemudzudzanyi *et al.* (2010) in both the rural and peri-urban home gardens of KwaZulu Natal Province, South Africa. Molebatsi *et al.* (2010) documented 31 fruit trees, 24 vegetable species, 28 leafy vegetable species, 11 grains and four tubers in rural and peri-urban areas of the North West Province, South Africa. Although all three studies recorded fruit trees as the main food product obtained from domestic gardens followed by vegetable species, there are variations in the species composition, partly due to different environmental conditions, sampling procedures, socio-economic and cultural factors. All these studies emphasised the importance of food plants cultivated and/or maintained in urban domestic gardens as a vital natural asset needed for livelihood strategies of local people. Authors in South Africa (Lubbe *et al.* 2010, 2011; Molebatsi *et al.* 2010; Nemudzudzanyi *et al.* 2010; Paumgarten *et al.* 2005; van Jansen Rensburg *et al.* 2007) have confirmed this, emphasising the value of food plants to alleviating food insecurity.

Important edible plants cultivated and/or maintained by more than 30 % of the participants in urban domestic gardens in the Limpopo Province included (in their order of importance) *Mangifera indica* L. (Mango), *Prunus persica* (L.) Stokes (Peach), *Carica papaya* L. (Pawpaw), *Persea americana* Mill. (Avocado), *Sclerocarya birrea* subsp. *caffra* (Marula), *Citrus limon* (L.) Burm. f. (Lemon), *Musa* sp. (Banana), *Citrus sinensis* (L.) Osbeck (Orange), *Psidium guajava* L. (Guava), *Morus alba* L. (Mulberry) and *Prunus armeniaca* L. (Apricot). Only *Sclerocarya birrea* subsp. *caffra* is indigenous to South Africa, and the rest are well-known exotics, extensively cultivated as fruit trees throughout the world. Another study in the Limpopo Province reported that although indigenous trees were maintained, people actively planted fruit trees such as *Mangifera indica*, *Psidium guajava* and *Carica papaya* (Paumgarten *et al.* 2005). *Carica papaya* and *Sclerocarya birrea* subsp. *caffra* have additional uses as medicinal plants (Table 2). The dominance of cultivated and/or maintained exotic plant species is mainly due to deliberate introductions of exotic species in domestic gardens. Unfortunately, some of these species pose an immediate and significant threat by virtue of their aggressive qualities and having

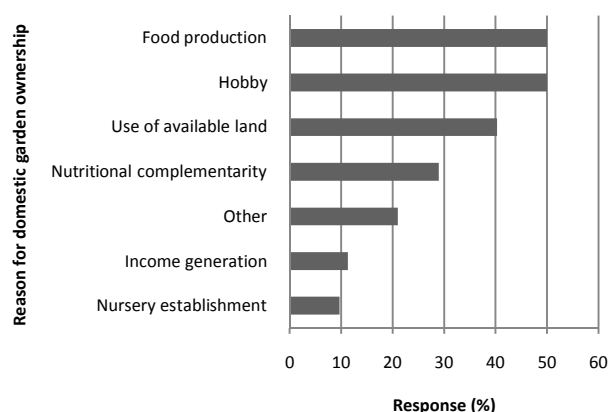


Fig. 4. Reasons for garden ownership by households in the Capricorn District, Limpopo Province, South Africa. Some participants indicated more than one response.

the capacity to invade natural habitats and overwhelm some of the indigenous species (South Africa 1983). Previous research by McKinney (2006) showed that urbanisation reduces the diversity and abundance of indigenous species, because of the homogenisation of the habitat in urban areas.

The majority of food plants with edible fruits were either trees or shrubs (85 %) with *Citrillus lanataus* (Thunb.) Matsum. & Nakai (Watermelon), *Cucurbita pepo* L. (Pumpkin), *Fragaria x ananassa* Duchesne (Strawberry), *Vigna subterranea* (L.) Verdc. (Cow pea) and *Vigna unguiculata* (L.) Verdc. (Bambara groundnut) as the only herbaceous plants with edible fruits. All edible fruits, except *Cucurbita pepo*, *Vigna subterranea* and *Vigna unguiculata* were consumed raw (Table 2), with no kind of preparation. Top five vegetable species cultivated and/or maintained by between 16 - 29 % of the participants (in their order of importance) included *Spinaciao leracea* L. (Spinach), *Brassica juncea* (L.) Czern. (Brown mustard), *Amaranthus hybridus* L. (Cape Pigweed), *Cleome gynandra* L. (Spider plant), *Allium cepa* L. (Onion). *Amaranthus hybridus* and *Cleome gynandra* are traditional or indigenous leafy vegetable species. Other indigenous leafy vegetable species documented in this study included *Corchorus olitorius* L. var. *olitorius* (Jute mallow), *Ipomoea batatas* (L.) Lam. (Sweet potato), *Vigna unguiculata* (Cow pea) and *Cucurbita pepo* (Pumpkin) (Shackleton *et al.* 2010; van Jansen Rensburg *et al.* 2007). The majority of indigenous leafy vegetable species (79 %) are herbs with

Capsicum frutescens L. (Chilli), *Corchorus olitorius* var. *olitorius* and *Lycopersicon esculentum* L. (Tomato) growing as shrubs. Home production of indigenous leafy vegetable species and other food plants is an important contribution to household food security and a strategy to save cash to cover other household expenses (Maroyi 2009, 2013; Shackleton *et al.* 2010).

The presence of fruit trees was higher in comparison with vegetable species (Fig. 3), with more than 30 % of the participants having fruit trees against less than 30 % of the participants having vegetable species in their home gardens (Table 2). These results correlate strongly with the findings of Bernholt *et al.* (2009), who found high numbers of fruit trees followed by vegetable species in the urban and peri-urban gardens of Niamey, Niger. Previous research in the Eastern Cape and Limpopo Provinces, South Africa (Paumgarten *et al.* 2005), showed the dominance of trees in homegardens cultivated and/or maintained for fruit and shade. Fruit trees, shade and ornamental plants are widely cultivated in urban centres because they are easy to maintain. Whilst vegetable cultivation is more evident in rural home gardens (Maroyi 2009, 2013; Molebatsi *et al.* 2010; Nemudzudzanyi *et al.* 2010), where home garden products are an important social and economic unit of rural livelihoods characterised by diverse and stable supply of economic products and benefits (Paumgarten *et al.* 2005).

The results of this study revealed that the majority of species (82 %) were used exclusively for food (Table 2), with *Carica papaya*, *Coriandrum sativum* L., *Lavandula angustifolia* Mill., *Mentha longifolia* L., *Ocimum basilicum* L., *Rosmarinus officinalis* L. and *Sclerocarya birrea* subsp. *caffra* used as medicines. *Mentha longifolia*, *Opuntia ficus indica* (L.) Mill. and *Searsia lancea* (L. f.) F. A. Barkley were also used as ornamentals. All food species from Amaranthaceae and Brassicaceae families were used as vegetable species while all members of the Lamiaceae family were used as culinary herbs and medicines. *Saccharum officinarum* L. (sugar cane) was grown in patches in damp places at low elevation for its edible stem and *Zea mays* L. was also grown for its green mealies roasted or cooked. The use of plants as both food and medicine is a widespread practice in Africa (Della *et al.* 2006; Maroyi 2009, 2013; Paumgarten *et al.* 2005).

People plant and maintain plants in urban domestic gardens for the goods and services they provide. Half of the participants were involved in

home gardening activities in the Limpopo Province as a hobby and for food production (Fig. 4), 40 % had no other use for the available land except home gardening activities, while 29 % used their gardens for dietary and nutritional complementarity. Other participants cultivated and/or maintained ornamental, shade and windbreak plants, used their domestic gardens for relaxation and interacting with nature (21 %), income generation (11 %) and nursery establishment (10 %). Results obtained in this study that urban domestic gardens are luxury spaces used for relaxation and cultivation of both ornamental and food plants differ from earlier research by Vogl *et al.* (2004) that showed domestic gardens to be used for agriculture and commercial production of food crops. It is noteworthy that the majority of participants in our study had limited education and formal skills (Table 1), but equated food production with other uses of garden plants like ornamental uses, etc. According to the participants, food production is important to 50 % of the households (Fig. 4) and only a few of them (11 %) engaged in *ad hoc* sales of domestic garden produce. Production of fruit trees and other food plants in urban domestic gardens in the Capricorn District, Limpopo Province is, therefore, important to household food security and other ecosystem services that enhances the quality of life in the city (see Colding 2007; Dunnett & Qasim 2000; Marco *et al.* 2010; Takano *et al.* 2002; Wu *et al.* 2003).

A significant lesson that can be learned from this study is that food plants in urban domestic gardens contribute to livelihoods of local people through provision of ecosystem services, food supplements and income generation. Therefore, this implies that policy makers responsible for designing of strategies for improved utilisation and management of urban garden flora need to understand the important role of these resources in the livelihood of the local people. There is also need to formulate clear agricultural policies to guide and promote cultivation of food plants in urban domestic gardens in South Africa. In addition to this, there is also a need to initiate education campaigns among local communities on the importance of urban garden flora to biodiversity conservation and livelihood strategies. Knowledge on urban domestic garden plant use is essential for designing effective measures for conservation and sustainable natural resource management and for policy makers to evaluate the impact of urban garden flora on South Africa's natural resource conservation policies.

Acknowledgements

We are indebted to the National Research Foundation, South Africa, for funding this research. Our sincerest appreciation goes to the friendly people of Lebowakgomo and Seshego for allowing us into their gardens. We are also grateful to anonymous reviewers for constructive comments on the manuscript.

References

- Acar, C., H. Acar & E. Eroglu. 2007. Evaluation of ornamental plant resources to urban biodiversity and cultural changing: a case study of residential landscapes in Trabzon city (Turkey). *Building and Environment* **42**: 218-229.
- Akinnifesi, F. K., G. Sileshi, O. C. Ajayi, A. I. Akinnifesi, E. G. de Moura, J. F. P. Linhares & I. Rodrigues. 2009. Biodiversity of the urban homegardens of São Luís city, Northern Brazil. *Urban Ecosystems* **13**: 29-146.
- Altay, V., I. I. Özyiğit & C. Yarci. 2010. Urban flora and ecological characteristics of the Kartal District (Istanbul): a contribution to urban ecology in Turkey. *Scientific Research and Essay* **5**: 183-200.
- Antipina, G. S. 2003. Urban flora as a component of the urban ecosystems in the Taiga zone: an example of Karelian cities. *Russian Journal of Ecology* **34**: 215-218.
- Bernholt, H., K. Kehlenbeck, J. Gebauer & A. Buerkert. 2009. Plant species richness and diversity in urban and peri-urban gardens of Niamey, Niger. *Agroforestry Systems* **77**: 159-179.
- Bridson, D. & L. Foreman. 1998. *The Herbarium Handbook*. 2nd edn. Royal Botanic Gardens, Kew, Richmond.
- Colding, J. 2007. Ecological land-use complementation for building resilience in ecosystems. *Landscape and Urban Planning* **81**: 46-55.
- Della, A., D. Paraskeva-Hadjichambi & A. C. Hadjichambis. 2006. An ethnobotanical survey of wild edible plants of Paphos and Larnaca countryside of Cyprus. *Journal of Ethnobiology and Ethnomedicine* **2**:34. doi:10.1186/1746-4269-2-34.
- Donaldson, S. E. & E. Boshoff. 2001. Household linkages in dispersed settlement around Pietersburg and implication for household resources management. *Journal of Family Ecology and Consumer Sciences* **29**: 20-27.
- Dunnett, N. & M. Qasim. 2000. Perceived benefits to human well-being of urban gardens. *Hort Technology* **10**: 40-45.

- Eichemberg, M. T., M. C. de Mello Amorozo & L. C. de Moura. 2009. Species composition and plant use in old urban homegardens in Rio Claro, Southeast of Brazil. *Acta Botanica Brasiliica* **23**: 1057-1075.
- Gaston, K. J., P. H. Warren, K. Thompson & R. M. Smith. 2005. Urban domestic gardens (IV): the extent of the resource and its associated features. *Biodiversity and Conservation* **14**: 3327-3349.
- Germishuizen, G., N. L. Meyer, Y. Steenkamp & M. Keith. 2006. *A Checklist of South African Plants*. Southern African Botanical Diversity Network Report No. 41. SABONET, Pretoria.
- González-García, A. & A. G. Sal. 2008. Private urban green spaces or "patios" as a key element in the urban ecology of tropical Central America. *Human Ecology* **36**: 291-300.
- Jaganmohan, M., L. S. Vailshery, D. Gopal & H. Nagendra. 2012. Plant diversity and distribution in urban domestic gardens and apartments in Bangalore, India. *Urban Ecosystems* **15**: 911-925.
- Limpopo State of the Environment Report (LSOER). 2005. *State of the Environment Reports*. <http://www.environment.gov.za> (accessed on 18 March 2012).
- Loram, A., P. H. Warren, K. Thompson & K. J. Gaston. 2011. Urban domestic gardens: the effects of human interventions on garden composition. *Environmental Management* **48**: 808-824.
- Loram, A., J. Tratalos, P. H. Warren & K. J. Gaston. 2007. Urban domestic gardens (X): the extent and structure of the resource in five major cities. *Landscape Ecology* **22**: 601-615.
- Lubbe, C. S., S. J. Siebert & S. S. Cilliers. 2011. Floristic analysis of domestic gardens in the Tlokwe City Municipality, South Africa. *Bothalia: African Biodiversity and Conservation* **41**: 351-361.
- Lubbe, C. S., S. J. Siebert & S. S. Cilliers. 2010. Plant diversity in urban domestic gardens along a socio-economic gradient in the Tlokwe Municipal area, North-West Province. *South African Journal of Botany* **76**: 411-412.
- Marco, A., S. Lavergne, T. Dutoit & V. Bertaudiere-Montes. 2010. From the backyard to the backcountry: how ecological and biological traits explain the escape of garden plants into Mediterranean old fields. *Biological Invasions* **12**: 761-779.
- Maroyi, A. 2013. Use and management of homegarden plants in Zvishavane District, Zimbabwe. *Tropical Ecology* **54**: 191-203.
- Maroyi, A. 2009. Traditional homegardens and rural livelihoods in Nhema, Zimbabwe: a sustainable agroforestry system. *International Journal of Sustainable Development and World Ecology* **16**: 1-8.
- McKinney, M. L. 2006. Urbanization as a major cause of biotic homogenization. *Biological Conservation* **127**: 247-260.
- M'Marete, C. K. 2003. *Climate and Water Resources in the Limpopo Province*. Limpopo Department of Agriculture, Polokwane.
- Molebatsi, L. Y., S. J. Siebert, S. S. Cilliers, C. S. Lubbe & N. E. Davoren. 2010. The Tswana Tshimo: a home garden system of useful plants, with a specific layout and function. *African Journal of Agricultural Research* **5**: 2952-2963.
- Mouget, L. J. A. 2006. *Growing Better Cities: Urban Agriculture for Sustainable Development*. International Development Research Centre (IDRC), Ottawa.
- Mucina, L. & M. C. Rutherford. 2006. *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Nemudzudzanyi, A. O., S. J. Siebert, A. M. Zobolo & L. Y. Molebatsi. 2010. The Zulu Muzi: a homegarden system of useful plants with a specific layout and function. *African Journal of Indigenous Knowledge Systems* **9**: 57-72.
- Pandey, C. B., M. Begum, S. K. Singh & D. Saha. 2014. Coconut-based homegardens: Mechanisms of complementarity in sharing of growth resources among homegarden trees in the South Andaman Islands of India. *Tropical Ecology* **55**: 339-348.
- Paumgarten, F., C. Shackleton & M. Cocks. 2005. Growing of trees in home gardens by rural households in the Eastern Cape and Limpopo Provinces, South Africa. *International Journal of Sustainable Development and World Ecology* **12**: 365-383.
- Phillips, O. L. B. & A. H. Gentry. 1993. The useful plants of Tambopata, Peru: I. Statistical hypothesis tests with a new quantitative technique. *Economic Botany* **47**: 15-32.
- Shackleton, C., F. Paumgarten, T. Mthembu, L. Ernst, M. Pasquini & G. Pichop. 2010. Production of and trade in African indigenous vegetables in the urban and peri-urban areas of Durban, South Africa. *Development Southern Africa* **27**: 291-308.
- Shaltout, K. H. & M. A. El-Sheikh. 2002. Vegetation of the urban habitats in the Nile Delta region, Egypt. *Urban Ecosystems* **6**: 205-221.
- Smith, R. M., K. Thompson, J. G. Hodgson, P. H. Warren & K. J. Gaston. 2006. Urban domestic garden (IX): composition and richness of the vascular plant flora, and implications for native biodiversity. *Biological Conservation* **129**: 312-322.
- South Africa. 1983. *Conservation of Agricultural Resources Act No. 43 of 1983*. Government Printer, Pretoria.

- Takano, T., K. Nakamura & M. Watanabe. 2002. Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *Journal of Epidemiology and Community Health* **56**: 913-918.
- van Jansen Rensburg, W. S., W. van Averbeke, R. Slabbert, M. Faber, P. van Jaarsveld, I. van Heerden, F. Wenhold & A. Oelofse. 2007. African leafy vegetables in South Africa. *Water SA* **33**: 317-326.
- Victor, J. E., M. Koekemoer, L. Fish, S. J. Smithies & M. Mössmer. 2004. *Herbarium Essentials: The Southern African Herbarium User Manual*. Southern African Botanical Diversity Network Report No. 25. SABONET, Pretoria.
- Vogl, C. R., B. Vogl-Lukasser & R. K. Puri. 2004. Tools and methods for data collection in ethnobotanical studies of home gardens. *Field Methods* **16**: 285-306.
- Wu, J., G. D. Jenerette & J. David. 2003. Linking land-use change with ecosystem processes: a hierarchical patch dynamic model. pp. 99-119. In: S. Guhathakurta (ed.) *Integrated Land Use and Environmental Models*. Springer, Berlin.

(Received on 11.10.2013 and accepted after revisions, on 13.06.2014)