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Useful Plants Grown and Maintained in Domestic Gardens of the Capricorn District, Limpopo Province, South Africa

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ABSTRACT The objective of this study was to document useful plants in urban domestic gardens in the Limpopo Province, South Africa. Data on plant use categories of urban domestic gardens in the under-developed areas of the Limpopo Province were collected by means of interviews and personal observations between May and October 2012.A total of 126 taxa belonging to 110 genera and 62 families were recorded from 62 urban domestic gardens. More than half of the species (52.4%) recorded in the surveyed domestic gardens are exotic to South Africa and 9.5 percent of the total garden flora are "indigenous cultivated", introduced in the Limpopo Province from other provinces of South Africa. The dominant plant use category in domestic gardens was ornamental, followed by fruit trees. The present study revealed that plants grown and maintained in urban domestic gardens play a vital role in the livelihoods of the people of Limpopo Province.

INTRODUCTION

Review of Recent Literature on Domestic Gardens

Recent studies carried out in Ethiopia (Linger 2014; Mekonnen et al. 2014) and Uganda (Whitney and Gebauer 2014) displayed that domestic gardens can contribute to the development, nutrition and well-being of households managing these agricultural systems. This agro forestry system is believed to be more diverse and, therefore, provide multiple environmental services for households than other monocropping agricultural systems. Other literature on domestic gardens, including Blanckaert et al. (2004), Eichemberg et al. (2009), Maroyi 2013b, Maroyi and Mosina (2014), Molebatsi et al. (2010), Mosina et al. (2014), and Nemudzudzanyi et al. (2010) documented aspects such as food security, income generation, medicinal uses and ecosystem services that are associated with domestic gardens. From literature, domestic gardens are not only important as sources of food, medicines and income for households involved in their management, but are also important for *in-situ* conservation of genetic resources for food and agriculture (Agnihotri et al. 2004). The importance of domestic gardens is evident across several countries and societies (Blanckaert et al. 2004; Eichemberg et al. 2009; Molebatsi et al. 2010; Nemudzudzanyi et al. 2010; Maroyi 2013b; Linger 2014; Maroyi and Mosina 2014; Mekonnen et al. 2014; Mosina et al. 2014; Whitney and Gebauer 2014), but there is dearth of information on the importance of urban domestic gardens in South Africa. Thus, the current study was undertaken to investigate plant diversity and uses in urban domestic gardens of the Limpopo Province, South Africa.

A domestic garden is a luxury space around the house used for relaxation, play areas, keeping pets, outdoor eating and cultivation of ornamental plants (Molebatsi et al. 2010). In urban areas flora is important for human well-being and provision of ecosystem services. Urban domestic gardens provide multiple ecosystem services that contribute to quality of life in cities, air quality regulation, carbon capturing (Dunnett and Qasim 2000), temperature regulation (Marco et al. 2010), storm water run-off mitigation

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(Takano et al. 2002), as well as recreational benefits and social cohesion (Wu et al. 2003). Kuruneri-Chitepo and Shackleton (2011) displayed that urban biodiversity enables urban inhabitants to interact with nature; thereby, enhancing appreciation and understanding of the important ecological, social and psychological functions green areas perform. Domestic gardens can also serve as important sources of both food and cash income for vulnerable households in urban areas. The private and public open spaces in cities of the developing world are dotted with gardens producing vegetables, herbs, spices and fruits (Mouget 2006). Private gardening is known to be linked to personal tastes and pleasure (Marco et al. 2010) and which differ according to the garden layout and planted species (Lubbe et al. 2010; Molebatsi et al. 2010). About 22-36 percent of the total urban green space that produces these useful plants, ecosystem goods and services is located in private domestic gardens (Gaston et al. 2005; Mathieu et al. 2007) and probably on 3-4 percent of the total land mass (Alloway 2004; Gibbons et al. 2011; Cameron et al. 2012).

Relatively little has been researched or published on the importance of urban domestic gardens in South Africa. Due to lack of comprehensive data on urban domestic gardens in South Africa, the potential value of urban flora in the provision of food, income and ecosystem services to the fast growing urban population is not clearly known. Previous studies on South African urban domestic gardens focused mainly on plant species distribution, abundance and composition. For instance, McConnachie and Shackleton (2010) and McConnachie et al. (2008) assessed the extent of urban biodiversity across ten small towns in the Eastern Cape Province and found that there was a significant correlation between income levels and public green space provision. The authors found that affluent suburbs had more and diverse public green spaces than poorer ones, an observation also made by Lubbe et al. (2010) based on home gardens in the Tlokwe city municipality in the North West Province. Lubbe et al. (2011) recorded 835 plant species in the Tlokwe city municipality, with 61 percent cultivated for ornamental purposes, 16 percent documented as weeds, 9 percent and 7 percent classified as food and medicinal plants, respectively. Kuruneri-Chitepo and Shackleton (2011) assessed the distribution, composition and abundance of street trees across three towns in the Eastern Cape Province. The authors found noticeable differences in tree density and species richness across suburbs, being highest in the more affluent suburbs and poorly represented in the low income townships. In another study, in the North West Province by Molebatsi et al. (2010), results revealed specific garden layout characterised by six micro-gardens, namely food gardens, medicinal gardens, ornamental gardens, structural species, open and natural areas. Nemudzudzanyi et al. (2009) recorded a total of 149 plant species consisting of 91 medicinal plants, 32 food and 26 spiritual plants in rural and peri-urban domestic gardens in the KwaZulu-Natal Province. Nemudzudzanyi et al. (2009) and Molebatsi et al. (2010) further emphasised the importance of domestic garden plants as sources of food, medicine and structural materials, especially for the poor members of community. All these studies emphasise the potentially significant contribution urban domestic garden flora has to human well-being and urban biodiversity in South Africa. This investigation is part of a larger study (see Mosina et al. 2014) aimed at documenting the ethno botanical knowledge held by local people residing in under-developed areas of the Limpopo Province, South Africa. The current study, therefore, attempts to fill this gap on the knowledge of domestic urban garden flora in the Limpopo Province, South Africa. The study examined the different plant use categories of urban domestic garden plants in the Capricorn District of the Limpopo Province, focusing on both indigenous and alien garden plants.

Objective of the Study

The objective of this study was to document useful plants in urban domestic gardens in the Limpopo Province, South Africa.

METHODS

Study Area

The study was conducted in two towns (Fig. 1) of the Limpopo Province, South Africa. The sites selected for the study were Seshego (23°15'S29°23'E) in Polokwane Municipality and Lebowakgomo (24°31'S29°57'E) in Lepelle-Nkumpi Municipality (Fig.1). Seshego is locat-

ed 13 km north-west of Polokwane, the capital of the Capricorn District. It is close to the economic core of the district with access to the formal economy of Polokwane Municipality. The township was planned as a dormitory town for workers in Polokwane (Donaldson and Boshoff 2001). Lebowakgomo is located 55 km south of Polokwane. The main employment sector in Lebowakgomo is the mining industry. The two towns are tertiary or quaternary in nature with 44 percent and 36 percent of the businesses in Lebowakgomo and Seshego respectively being retail shops (Donaldson and 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 (LSOER 2004). Daily temperatures vary from mid-20°C to mid-30°C, with an average range of between 17°C and 27°C in summer and 4°C to 20°C in winter (M'Marete 2003). According to the vegetation classification of Mucina and Rutherford (2006), the Capricorn District has a semi-arid savanna, characterised by a mixture of trees, shrubs and grasses. Dominant tree species include *Acacia* spp., *Albizia* spp., *Combretum* spp. and *Sclerocarya birrea*, with patches of *Hyparrhenia* spp., *Eragrostis* spp., *Heteropogon* spp. and *Digitaria* spp. grasses.

Research Design and Procedure

Data on plant use categories in urban domestic gardens in the Limpopo Province were collected by means of semi-structured and structured interviews and personal observations. Thirty one randomly selected individuals from each town were interviewed between May and October 2012.

The interviews were conducted in Sepedi language, since the main author is a native speaker of the language. The aim and purpose of the investigation was explained to the selected participants. The questionnaire used during interviews was designed to gather data on use-

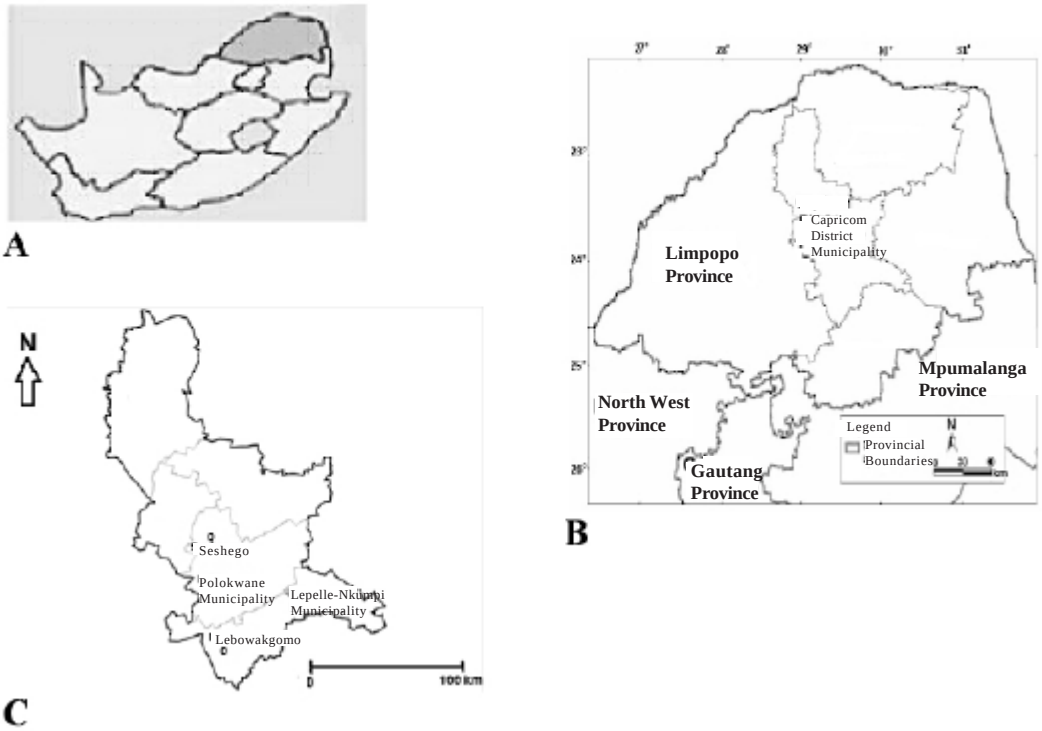

Fig.1. A: Geographical location of the study area in South Africa. B: Map of Limpopo Province, showing the geographical position of Capricorn District. C: Detailed map of the study area.

ful plant species (food, medicinal and ornamental) grown and maintained in the domestic gardens. A plant species was included in this study if the home owner could indicate its use. 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 identification. 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. The International Plant Name Index (www.ipni.org) and the Royal Botanic Garden and Missouri Botanic Garden plant name database (www.theplantlist.org) were used to validate plant scientific names, plant families and plant authorities.

Analysis of Data

The data collected were entered in Microsoft Excel 2007 program and were later analysed for descriptive statistical patterns. During analysis, data on useful plants were summarised into major themes by content analysis (Chambers 1994). Descriptive statistics, such as percentages and frequencies were used to analyse the data obtained from the questionnaires. Bar graphs were generated using Microsoft Excel 2007 program.

Species are described as native or alien based on Pyšek et al. (2004). According to Pyšek et al. (2004), naturalised species are defined as aliens that reproduce consistently without direct human intervention, and invasive aliens as naturalised species producing offspring in large numbers and at considerable distances from the parent plants with the potential to spread over a large area. This definition of invasive alien species used in this study is different from the Convention on Biological Diversity (CBD) Conference of Parties' definition of an invasive alien species, where an alien is defined as a species outside its indigenous geographic range, whose introduction and spread threatens biodiversity (UNEP 2002). Another important species classification used in this study is the "indigenous cultivated" category, referring to species indigenous to South Africa and not occurring naturally in the Capricorn District, Limpopo Province, but cultivated in domestic gardens. The origin of "indigenous cultivated" species was determined from Germishuizen et al. (2006). Alien invader species were identified from the national legislation, South Africa 1983, Conservation of Agricultural Resources Act no. 43 (South Africa 1983), and threatened species were identified from the National Red Data List of South Africa's plants (http://redlist.sanbi.org/redcat.php).

Ethical Considerations

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 Ethno biology (www.ethnobiology.net). 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 and Gentry 1993).

RESULTS

Species Diversity

A total of 126 useful taxa belonging to 110 genera and 62 families were recorded from 62 domestic gardens in Lebowakgomo and Seshego in the Limpopo Province (Table 1). Pteridophytes were represented by a single species, *Nephrolepis exltata* (L.) Schott (family Nephrolepidaceae). Gymnosperms were represented by the Cycadaceae and Zamiaceae families, which in turn consisted of *Cycas revoluta* Thunb. and *Encephalartos transvenosus* Stapf and Burtt Davy, respectively. Dicotyledons constituted the majority of the useful plants cultivated in urban gardens in the Limpopo Province, with 95 species (75.4%) and monocotyledons contributed 28 species (22.2%). More than half of the species found in the surveyed domestic gardens are exotic to South Africa (52.4% of the total garden flora), and 9.5 percent of the total garden flora are "indigenous cultivated"; introduced in the Limpopo Province domestic gardens from other provinces of South Africa (Table 1). A large number (54%, n=68) of the useful plants in the studied gardens are from 16 families (Fig. 2).The other 46 families had less representation, between 1 to 2 species each. Plant families with the highest number of useful plants were: Asteraceae (10 species), Rosaceae (7 spe-

Table 1: List of identified plants. Species marked with asterisk (*) are exotic while those marked with a hatch (#) have been introduced into urban domestic gardens in the Limpopo Province from other provinces in South Africa

Family, species name	*English name*	*Life form*	*Use category*	*No. of citations*
Agapanthaceae				
#*Agapanthus africanus* (L.) Hoffmanns ssp *africanus*	Agapanthus	Herb	Medicinal	22.6
Agavaceae				
**Agave americana* L.	Agave	Shrub	Medicinal	6.5
Alliaceae				
**Allium cepa* L.	Onion	Herb	Vegetable	16.1
**Allium schoenoprasum*L.	Chives	Herb	Vegetable	3.2
Tulbaghia violacea Harv.	Wild garlic	Herb	Medicinal/ornamental	4.8
Amaranthaceae				
Aerva leucura Moq.	Aerva	Herb	Ornamental	6.5
Amaranthus hybridus L.	Cape Pigweed	Herb	Vegetable	22.6
**Beta vulgaris* L. ssp vulgaris	Beetroot	Herb	Vegetable	9.7
**Spinacia oleracea* L.	Spinach	Herb	Vegetable	29.0
Amaryllidaceae				
Ammocharis coranica (Ker Gawl.) Herb.	Ground lily	Herb	Medicinal/ornamental	14.5
#*Clivia miniata* (Lindl.) Regel var. *miniata*	Bush lily	Herb	Ornamental	32.3
Anacardiaceae				
Harpephyllum caffrum Bernh.	Wild plum	Tree	Edible fruit	29.0
**Mangifera indica* L.	Mango	Tree	Edible fruit	80.6
**Schinus terebinthifolius* Raddi	Brazilian pepper tree	Tree	Medicinal/ornamental	48.4
Sclerocarya birrea (A. Rich.) Hochst. ssp *caffra* (Sond.) Kokwaro	Marula	Tree	Edible fruit/medicinal	56.5
Searsia lancea (L. f.) F. A. Barkley	Rhus	Tree	Edible fruit/ornamental	14.5
Anthericaceae				
Chlorophytum comosum (Thunb.) Jaques	Spider plant	Herb	Ornamental	48.4
Apiaceae				
**Coriandrum sativum* L.	Coriander	Herb	Culinary/medicinal	1.6
**Daucus carota* L.	Carrot	Herb	Vegetable	12.9
Apocynaceae				
**Catharanthus roseus* (L.) G. Don.	Periwinkle	Shrub	Medicinal/ornamental	64.5
Pachypodium sp		Shrub	Ornamental	6.5
Araceae				
**Aglaonema sp*		Herb	Ornamental	32.3
**Monstera deliciosa* Liebm.	Delicious monster	Shrub	Ornamental	27.4
Zantedeschia aethiopica (L.) Spreng.	Arum lily	Herb	Ornamental	8.1
Asphodelaceae				
#*Haworthia fasciata* (Willd.) Haw		Herb	Ornamental	30.6
Asteraceae				
Artemisia afra Jacq. ex Willd.	Wild wormwood	Herb	Medicinal	8.1
**Artemisia vulgaris* L.	Wormwood	Herb	Medicinal	11.3
**Chrysanthemum sp*		Herb	Ornamental	29.0
#*Euryops chrysanthemoides* (DC.) B. Nord.	Daisy bush	Shrub	Ornamental	51.6
Euryops sp		Shrub	Ornamental	32.3
Felicia sp	Bush felicia	Shrub	Ornamental	4.8
Gazania sp		Herb	Ornamental	40.3
Gerbera jamesonii Adlam	Barberton daisy	Herb	Ornamental	29.0
Kleinia longiflora DC.	Sjambok bush	Shrub	Medicinal	8.1
**Tagetes erecta* L.	Mexican marigold	Shrub	Medicinal	3.2
Begoniaceae				
#*Begonia homonyma* Steud.	Wild begonia	Shrub	Ornamental	45.2
Bignoniaceae				
**Tecoma stans* (L.) Juss. ex Kunth	Yellow bells	Shrub	Ornamental	53.2

Table 1: Contd...

Family, species name	*English name*	*Life form*	*Use category*	*No. of citations*
Boraginaceae				
#*Lobostemon fruticosus* (L.) H. Buek	Pajama bush	Shrub	Ornamental	4.8
**Symphytum officinale* L.	Comfrey	Herb	Medicinal	1.6
Brassicaceae				
**Brassica carinata* A. Braun	Cabbage	Herb	Vegetable	6.5
**Brassica juncea* (L.) Czern.	Brown mustard	Herb	Vegetable	29.0
**Brassica napus* L.	Rape	Herb	Vegetable	8.1
**Brassica rapa* L.	Turnip	Herb	Vegetable	4.8
**Nasturtium officinale* W.T. Aiton	Watercress	Herb	Ornamental	22.6
Cactaceae				
**Echinopsis spachiana* (Lem.) Friedrich and G.D. Rowley	Cactus	Shrub	Medicinal/ornamental	3.2
**Opuntia ficus-indica* (L.) Mill.	Prickly pear	Shrub	Edible fruit/ornamental	21.0
Caesalpiniaceae				
Peltophorum africanum Sond.	Black wattle	Tree	Ornamental	12.9
Cannabaceae				
**Cannabis sativa* L.	Marijuana	Herb	Medicinal	6.5
Capparaceae				
Cleome gynandra L.	Spider plant	Herb	Ornamental/vegetable	16.1
Caricaceae				
**Carica papaya* L.	Pawpaw	Shrub	Edible fruit/medicinal	69.4
Cassuarinaceae				
**Cassuarina sp*		Tree	Ornamental	14.5
Commelinaceae				
Commelina sp		Herb	Ornamental	4.8
Convolvulaceae				
**Ipomoea batatas* (L.) Lam.	Sweet potato	Herb	Edible tuber	8.1
Crassulaceae				
Cotyledon orbiculata L.	Pig's ear	Shrub	Medicinal/ornamental	48.4
Crassula capitella Thunb. ssp *capitella*	Crassula	Shrub	Medicinal/ornamental	40.3
**Kalanchoe sexagularis* N.E.Br.	Kalanchoe	Shrub	Ornamental	17.7
Kalanchoe sp	Kalanchoe	Shrub	Ornamental	29.0
Kalanchoe tubiflora (Harvey) Hamet	Chandelier plant	Shrub	Ornamental	27.4
Cucurbitaceae				
Citrillus lanatus (Thunb.) Matsum. and Nakai	Watermelon	Herb	Edible fruit	6.5
Cucurbita pepo L.	Pumpkin	Herb	Edible fruit/vegetable	12.9
**Echevieria sp*		Shrub	Ornamental	6.5
Cycadaceae				
**Cycas revoluta* Thunb.	Cycad	Shrub	Ornamental	4.8
Cyperaceae				
Cyperus sexangularis Nees		Herb	Ornamental	71.0
Dracaenaceae				
Sansevieria hyacinthoides (L.) Druce	Mother-in-law's tongue	Shrub	Medicinal/ornamental	45.2
Euphorbiaceae				
Euphorbia sp	Euphorbia	Shrub	Ornamental	4.8
Geraniaceae				
#*Pelargonium peltatum* (L.) L'Hér	Ivy-leaved pelargonium	Shrub	Medicinal/ornamental	30.6
#*Pelargonium zonale* (L.) L'Hér	Horse-shoe pelargonium	Shrub	Medicinal/ornamental	40.3
Hyacinthaceae				
Drimia elata Jacq. ex Willd.		Herb	Medicinal	4.8
#*Drimiopsis maculata* Lindl. and Paxton	Spotted-leaved	Herb	Ornamental	19.4
Hypoxidaceae				
Hypoxis hemerocallidea Fisch., C.A. Mey. and Avé-Lall	Star flower	Herb	Medicinal/ornamental	4.8
Hypoxis obtusa Burch. ex Ker Gawl.	Star lily	Herb	Medicinal	1.6

Table 1: Contd...

Family, species name	*English name*	*Life form*	*Use category*	*No. of citations*
Iridaceae				
[#]*Dietes grandiflora* DC	Large wild iris	Herb	Ornamental	22.6
Iris sp	Iris	Herb	Ornamental	1.6
Kirkiaceae				
Kirkia wilmsii Engl.	Mountain kirkia	Tree	Medicinal	1.6
Lamiaceae				
[*]*Lavandula angustifolia* Mill.	Lavender	Shrub	Culinary/medicinal	9.7
Mentha longifolia L.	Wild mint	Herb	Culinary/medicinal/ ornamental	3.2
Ocimum basilicum L.	Basil	Herb	Culinary/medicinal	1.6
[*]*Rosmarinus officinalis*L.	Rosemary	Herb	Culinary/medicinal	3.2
Lauraceae				
[*]*Persea americana* Mill.	Avocado	Tree	Edible fruit	66.1
Malvaceae				
[*]*Corchorus olitorius* L. var. *olitorius*	Jute mallow	Shrub	Vegetable	3.2
[*]*Hibiscus sp*		Herb	Ornamental	30.6
Mesembryanthemaceae				
Carpobrotus edulis (L.) L. Bolus	Hottentot fig	Herb	Medicinal	29.0
Moraceae				
Ficus sp		Tree	Ornamental	11.3
[*]*Ficus carica* L.	Fig	Tree	Edible fruit	16.1
[*]*Morus alba* L.	Mulberry	Tree	Edible fruit	32.3
Moringaceae				
[*]*Moringa oleifera* Lam.	Horseradish	Tree	Medicinal	11.3
Musaceae				
[*]*Musa sp*	Banana	Shrub	Edible fruit	51.6
Myrothamnaceae				
Myrothamnus flabellifolius Welw.	Resurrection plant	Shrub	Medicinal	6.5
Myrtaceae				
[*]*Psidium guajava* L.	Guava	Tree	Edible fruit	46.8
Nephrolepidaceae				
[*]*Nephrolepis exltata* (L.) Schott	Maidenhair	Fern	Ornamental	4.8
Nyctaginaceae				
[*]*Bouganvillia sp*	Bouganvillia	Shrub	Ornamental	41.9
Papilionaceae				
Erythrina lysistemon Hutch.	Common coral tree	Tree	Medicinal/ornamental	32.3
Vigna unguiculata (L.) Walp.	Cow pea	Herb	Edible fruit/vegetable	9.7
Vigna subterranea(L.) Verdc.	Bambara groundnut	Herb	Edible fruit	1.6
Passifloraceae				
[*]*Passiflora edulis* Sims	Granadilla	Shrub	Edible fruit	8.1
Poaceae				
[*]*Saccharum officinarum* L.	Sugar cane	Herb	Edible stem	8.1
[*]*Sorghum bicolor* (L.) Moench	Sorghum	Herb	Cereal	1.6
[*]*Zea mays* L.	Maize	Herb	Cereal	12.9
Polygalaceae				
Securidaca longepedunculata Fresen	Violet tree	Tree	Medicinal/ornamental	25.8
Punicaceae				
[*]*Punica granatum* L.	Pomegranate	Tree	Edible fruit	3.2
Rosaceae				
[*]*Eriobotrya japonica* (Thunb.) Lindl.	Loquat	Tree	Edible fruit	8.1
[*]*Fragaria x ananassa* Duchesne	Strawberry	Herb	Edible fruit	1.6
[*]*Malus domestica* Borkh.	Apple	Tree	Edible fruit	12.9
[*]*Prunus armeniaca* L.	Apriot	Tree	Edible fruit	30.6
[*]*Prunus persica* (L.) Stokes	Peach	Tree	Edible fruit	72.6
[*]*Pyrus communis* L.	Pear	Tree	Edible fruit	8.1
[*]*Rosa sp*	Rose	Shrub	Ornamental	30.6
Rubiaceae				

Table 1: Contd...

Family, species name	*English name*	*Life form*	*Use category*	*No. of citations*
Vangueria infausta Burch. ssp *infausta* Rutaceae	Wild medlar	Shrub	Edible fruit	1.6
[*]Citrus limon (L.) Burm. f.	Lemon	Shrub	Edible fruit	54.8
[*]Citrus sinensis (L.) Osbeck	Orange	Shrub	Edible fruit	51.6
[*]Ruta graveolens L. Sapindaceae	Rue	Herb	Medicinal	1.6
[*]Litchi chinensis Sonn. Solanaceae	Litchi	Tree	Edible fruit	9.7
[*]Brunfelsia pauciflora (Cham. and Schltdl.) Benth.	Yesterday, today and tomorrow	Shrub	Ornamental	29.0
[*]Capsicum frutescens L.	Chilli	Shrub	Vegetable	4.8
[*]Lycopersicon esculentum L.	Tomato	Shrub	Vegetable	14.5
Petunia sp Strelitziaceae	Leopard tree	Herb	Ornamental	17.7
[#]Strelitzia nicolai Regel and Koern.	Natal wild banana	Tree	Ornamental	4.8
[#]Strelitzia reginae Banks ex Aiton ssp *reginae* Theaceae	Bird of paradise	Shrub	Ornamental	30.6
[*]Camellia sp Verbenaceae		Shrub	Ornamental	8.1
[*]Duranta erecta L.	Sheenas gold	Shrub	Ornamental	45.2
Lippia javanica (Burm. f.) Spreng Vitaceae	Fever tea	Shrub	Medicinal	9.7
[*]Vitis vinifera L. Xanthorrhoeaceae	Grape	Shrub	Edible fruit	22.6
Aloe ecklonis Salm-Dyck	Grass Aloe	Herb	Ornamental	1.6
Aloe sp.	Aloe	Herb	Medicinal	1.6
[*]Aloe vera (L.) Burm. f. Zamiaceae	Aloe	Herb	Medicinal/ornamental	29.0
Encephalartos transvenosus Stapf and Burtt Davy	Modjadji cycad	Tree	Ornamental	21.0

cies), Anacardiaceae, Brassicaceae and Crassulaceae (5 species each), Amaranthaceae, Lamiaceae and Solanaceae (4 species each) and Alliaceae, Araceae, Cucurbitaceae, Moraceae, Papilionaceae, Poaceae, Rutaceae and Xanthorrhoeaceae (3 species each)(Table 2). The genera with the highest number of useful plants were *Brassica* with four species, followed by *Aloe* and *Kalanchoe* with three species each, and *Allium, Artemisia, Citrus, Euryops, Ficus, Hypoxis, Pelargonium, Prunus, Strelitzia* and *Vigna* with two species each (Table 1).

Table 2: Families with the largest number of useful plants (with more than 3 species) in the Limpopo Province

Family	*No. of species*	*%*
Asteraceae	10	7.9
Rosaceae	7	5.6
Anacardiaceae	5	4.0
Brassicaceae	5	4.0
Crassulaceae	5	4.0
Amaranthaceae	4	3.2
Lamiaceae	4	3.2
Solanaceae	4	3.2
Alliaceae	3	2.4
Araceae	3	2.4
Cucurbitaceae	3	2.4
Moraceae	3	2.4
Papilionaceae	3	2.4
Poaceae	3	2.4
Rutaceae	3	2.4
Xanthorrhoeaceae	3	2.4

Seven major uses of domestic garden plants identified in this study (Table 1, Fig. 3) were: Ornamental (44 species), food (41 species), medicinal (16 species), medicinal and ornamental (15 species), food and medicinal (7 species), food and ornamental (3 species) and one species used as food, medicinal and ornamental. The dominant plant use category in domestic gardens was ornamental (Table 1, Fig. 3), followed by fruit trees. Medicinal plants and vegetables were recorded in less than 20%) of the domestic gardens (Table 1).

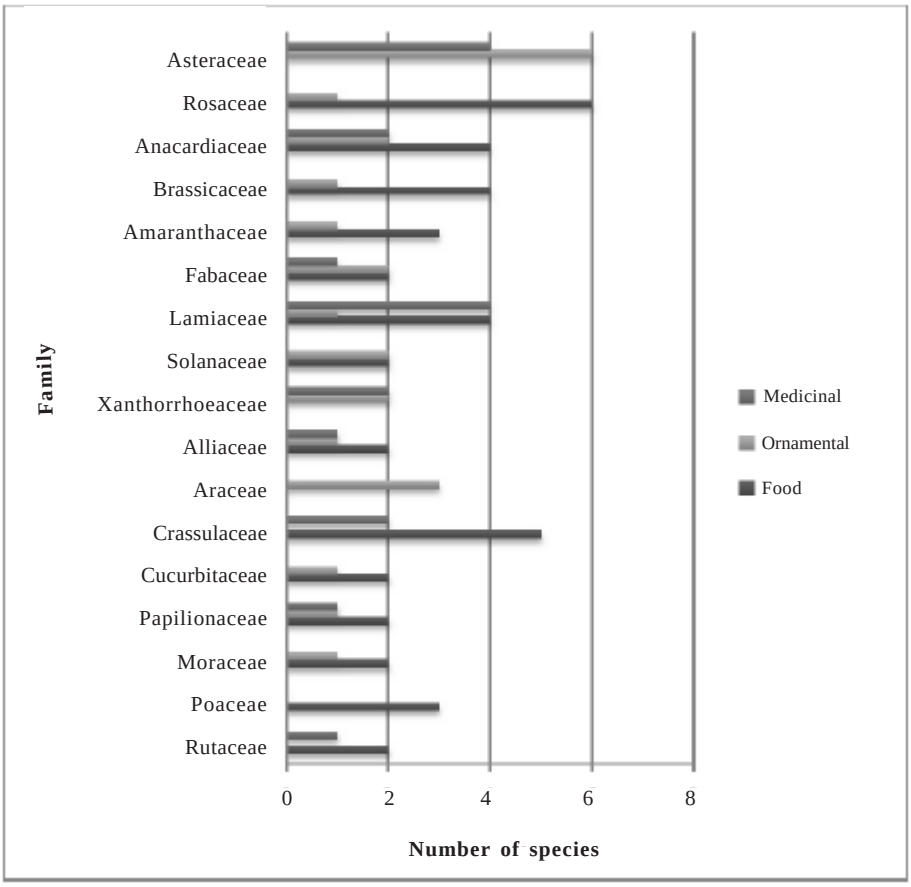

Fig. 2. Families with the largest number of useful plants in the Limpopo Province

Ornamental Plants

The ornamental plants constituted 49.2 percent of the total urban domestic garden flora in the surveyed gardens with 62 taxa distributed in 42 families. The most important families were: Asteraceae with 6 species, Crassulaceae and Araceae with 5 and 3 species, respectively. Frequent species cultivated and/or maintained by more than 40 percent of the participants included *Begonia homonyma*, *Bouganvillia* sp., *Chlorophytum comosum*, *Cyperus sexangularis*, *Duranta erecta*, *Euryops chrysanthemoides*, *Gazania* sp. and *Tecoma stans*. *Catharanthus roseus*, *Cotyledon orbiculata*, *Crassula capitella* subsp *capitella*, *Pelargonium zonale*, *Sansevieria hyacinthoides*, *Schinus terebinthifolius* occurred in more than 40 percent of the domestic gardens as both ornamental plants and medicines. The majority of plants cultivated and/or maintained in domestic gardens in the Capricorn District, Limpopo Province as ornamentals are indigenous to South Africa (67.7%).

The following "indigenous cultivated" species were introduced to the Limpopo Province domestic gardens from other provinces: *Begonia homonyma* (Eastern Cape, KwaZulu-Natal); *Clivia miniata* var. *miniata* (Eastern Cape, KwaZulu-Natal, Mpumalanga); *Dietes grandiflora* (Eastern Cape, KwaZulu-Natal); *Drimiopsis maculata* (Eastern Cape, Gauteng, KwaZulu-Natal, Mpumalanga); *Euryops chrysanthemoides* (Eastern Cape, KwaZulu-Natal); *Haworthia fasciata* (Eastern Cape); *Lobostemon fruticosus* (Western Cape); *Pelargonium peltatum* (Eastern Cape, Western Cape); *Pelargonium zonale* (Eastern Cape, KwaZulu-Natal, Western Cape); *Strelitzia nicolai* (Eastern Cape,

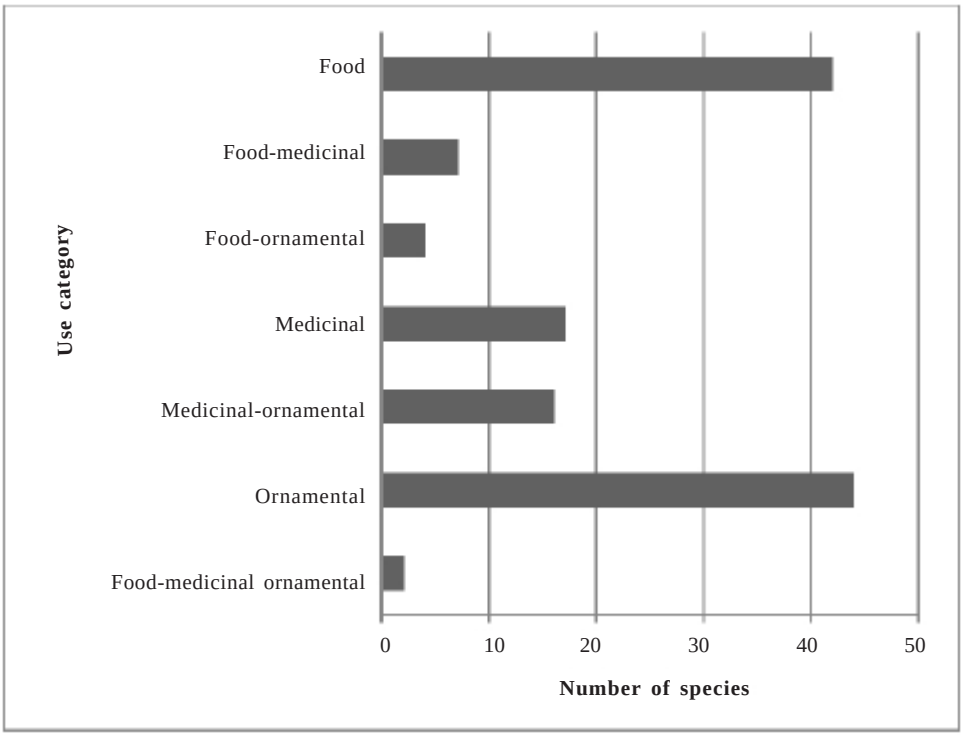

Fig. 3. Number of plants used for food, medicine and as ornamentals in the Limpopo Province

KwaZulu-Natal) and *Strelitzia reginae* subsp *reginae* (Eastern Cape, KwaZulu-Natal).

Food Plants

A variety of food plants were recorded in the studied domestic gardens, mainly fruits (29 species, 23%), vegetables (14 species, 11.1%), culinary herbs (5 species, 4%), cereal (2 species) and edible tuber (1 species). Among plants with miscellaneous uses were *Saccharum officinarum* and *Zea mays*. *Saccharum officinarum* was grown in patches in damp places at low elevation for its edible stem and *Zea mays* was grown for its green corn, which are either roasted or cooked. The most represented families were Rosaceae represented by 6 species; Anacardiaceae, Brassicaceae and Lamiaceae with 4 species each; and Amaranthaceae and Poaceae with 3 species each. The majority of food plants (76.5%) were exotic. Most food plants (85.2%) with edible fruits were either trees or shrubs, with *Citrillus lanataus*, *Cucurbita pepo*, *Fragaria X ananassa*, *Vigna subterranean* and *Vigna unguiculata* as the only herbaceous plants.

Important exotic fruit trees cultivated and/or maintained by more than 40 percent of the participants included *Carica papaya*, *Citrus limon*, *Citrus sinensis*, *Mangifera indica*, *Musa* sp., *Persea americana*, *Prunus persica* and *Psidium guajava*. Indigenous fruit trees cultivated and/or maintained by households included *Harpephyllum caffrum*, *Sclerocarya birrea* subsp *caffra* and *Vangueria infausta* subsp *infausta*. Most vegetables (78.6%) were herbs with *Capsicum frutescens*, *Corchorus olitorius* var. *olitorius* and *Lycopersicon esculentum* growing as shrubs. All food species from Amaranthaceae and Brassicaceae families were used as vegetables, while members of the Lamiaceae family were used as culinary herbs and/or medicines.

Medicinal Plants

Medicinal plants constituted 34 species (27%) of the total urban domestic garden flora in the Limpopo Province. The most important families were Asteraceae and Lamiaceae represented by four species each. The medicinal plants consisted of mainly herbs (19 species), followed by shrubs (12 species) and four trees. All plants used sorely for medicinal purposes were recorded in less than 29 percent of the domestic gardens. Medicinal plants recorded in more than 30 percent of the domestic gardens were also cultivated and/or managed as ornamentals; and included *Catharanthus roseus, Cotyledon orbiculata, Crassula capitella* subsp *capitella*, *Erythrina lysistemon*, *Pelargonium peltatum*, *Pelargonium zonale*, *Sansevieria hyacinthoides* and *Schinus terebinthifolius. Carica papaya* and *Sclerocarya birrea* subsp *caffra* were the only fruits trees with medicinal uses recorded in more than 30 percent of the domestic gardens.

The following "indigenous cultivated" were introduced to the Limpopo Province domestic gardens from other provinces for their medicinal properties: *Agapanthus africanus* subsp *africanus* (Western Cape); *Pelargonium peltatum* (Eastern Cape, Western Cape); *Pelargonium zonale* (Eastern Cape, KwaZulu-Natal, Western Cape).

Cultivation of Endemic and Weedy Species in Domestic Gardens

Agapanthus africanus subsp *africanus*, endemic to the Western Cape Province was introduced in the Capricorn District domestic gardens for traditional medicine (Table 1). *Pelargonium peltatum* and *Pelargonium zonale* were cultivated as ornamentals and for traditional medicine. Most of the endemics (7 species), which included *Begonia homonyma, Clivia miniata* var. *miniata*, *Dietes grandiflora*, *Drimiopsis maculata*, *Euryops chrysanthemoides*, *Haworthia fasciata*, *Lobostemon fruticosus* and *Strelitzia reginae* subsp *reginae* were cultivated as ornamentals.

About 10 percent (13 species) of the total garden flora recorded in this study are declared weeds and invaders in South Africa, listed under the Conservation of Agricultural Resources Act (1983) No. 43 of 1983. Among them were: *Agave americana*, *Catharanthus roseus*, *Duranta erecta*, *Echinopsis spachiana*, *Eriobotrya japonica*, *Morus alba*, *Nasturtium officinale*, *Nephrolepis exltata*, *Opuntia ficus-indica*, *Passiflora edulis*, *Psidium guajava*, *Schinus terebinthifolius* and *Tecoma stans.*

DISCUSSION

Cultivation and Maintenance of Plants in Domestic Gardens

The results obtained in this study corroborate those from other countries, demonstrating that urban dwellers are actively engaged in planting and maintenance of plant species in domestic gardens, a fact often overlooked in debates around urban planning. For example, Linger (2014) and Mekonnen et al. (2014) argued that domestic gardens in Ethiopia are diverse and therefore able to provide multiple goods and ecosystem services to households than monocropping agro forestry systems. Whitney and Gebauer (2014) found domestic gardens in Uganda to be sustainable small-scale agro forestry systems important as sources of food, income and medicines as well as important for conservation of biodiversity. Results obtained in the current investigation showed a range of uses, indicating that garden owners have a broad knowledge of plants and their uses. Across the two towns, the predominant use of cultivated and maintained plants in domestic gardens is ornamental purpose. The term ornamental is here used in a wide and general sense including all decorative uses, that is, hedge and house plants. Based on these results, it can be inferred that species diversity grown and maintained in domestic gardens in the Capricorn District play a major aesthetic and decoration function. Nair (1993) explored that the high number of ornamental plants in urban gardens is associated with the aesthetic role of domestic gardens in cities, since they are not used for subsistence, except among low income city dwellers. Similarly, Reichard and White (2001) showed that large number of plant species introduced into the urban environment are for horticultural purposes.

The dominance of ornamental plants in the Capricorn District urban gardens implies that food plants in these gardens play a supplementary role. These results are comparable to studies done by Blanckaert et al. (2004), who found ornamental plants dominating the plants culti-

vated in home gardens of San Rafael Coxcatlan, valley of Tehuacan-Cuicatlan, Mexico, representing as much as 65.7 percent of the total garden flora, while edible plants and medicinal were 29.6 percent and 8.6 percent, respectively. In a survey conducted in Rio Claro, southeast Brazil, of 410 species documented in urban home gardens, 257 species were cultivated for ornamental purposes, 98 species for food and 93 species for medicinal uses (Eichemberg et al. 2009). In peri-urban domestic gardens of the North West Province, South Africa, Molebatsi et al. (2010) recorded 60 percent ornamental, 21 percent food and 12 percent medicinal plants. In another study, in the North West Province, Lubbe et al. (2011) recorded 61 percent ornamental, 16 percent weedy species, 9 percent food and 7 percent medicinal plants. The number of ornamental plants is said to be high in Tlokwe Municipality, North West Province because of large variety of plants that are available to the home gardener from nurseries and also nurseries promoting planting of ornamentals (Lubbe et al. 2011). The emphasis of urban home gardening appears not to be food or traditional medicine production as is the case in rural domestic gardens (Kumar and Nair 2004). But urban dwellers manage plant species to meet diverse livelihood needs, including the enhancement of human well-being given the social benefits and recreational opportunities that garden plants offer to inhabitants (Kuruneri-Chitepo and Shackleton 2011). Further, it was found that although food plants were cultivated and maintained, people actively planted fruit trees such as *Carica papaya*, *Citrus limon*, *Citrus sinensis*, *Mangifera indica*, *Musa* sp, *Persea americana*, *Prunus persica* and *Psidium guajava*. Only two cereal and fourteen vegetable species (Table 1) were cultivated and maintained in the Capricorn District urban gardens. Medicinal plants made very small contributions to the diversity of the garden flora in the Capricorn District. A low representation of medicinal plants in urban gardens was also noted in Brazil (Blankaert et al. 2004) and the North West Province of South Africa (Lubbe et al. 2011; Molebasti et al. 2010).

Cultivation of Weedy and Endemic Species in Domestic Gardens

Exotic and invasive plant species are widely cultivated in the Limpopo Province urban gardens, among them are: *Agave americana*, *Catharanthus roseus, Duranta erecta, Echinopsis spachiana, Eriobotrya japonica, Morus alba*, *Nasturtium officinale*, *Nephrolepis exltata*, *Opuntia ficus-indica, Passiflora edulis, Psidium guajava*, *Schinus terebinthifolius* and *Tecoma stans.* The majority of these species pose an immediate and significant threat by virtue of their aggressive qualities and having the capacity to invade natural habitats and overwhelm some of the indigenous species (South Africa 1983). Due to the ecological effect invasive species have on the environment with regard to their serious health risk to humans or livestock, causing serious financial losses to land users, their ability to invade undisturbed environments and transform or degrade natural plant communities, use more water than the plant communities they replace or be particularly difficult to control, Regulation 15, Act No. 43 of 1983 was enacted. Second to habitat destruction and modification, alien invasion is recognised as having the largest impact on natural vegetation, ecosystem processes and interfering with agricultural practices (Heywood 1995; Mooney and Hobbs 2000; Binns et al. 2001; Bigirimana et al. 2011, 2012). The Capricorn District urban gardens harbour 66 exotic species (52.4% of the total garden flora) that could escape from the gardens and naturalise. Similarly, Lubbe et al. (2011) recorded 88 declared invader and weedy species in the Tlokwe city municipality, the North West Province. In South Africa, at least 161 species cause serious problems in natural and semi-natural ecosystems (Henderson 1995), impacting on approximately 8.6 percent of the country's total land surface or roughly 10 million hectares (Le Maitre et al. 2000). This is because the cities act as immigration sources from which the alien species can disperse into the surrounding landscape (McConnachie et al. 2008; Bigirimana et al. 2011, 2012). During 2005/2006 financial year, R3.2 billion was spent on clearing alien vegetation on 1.6 million hectares of land (Marais and Wannenburgh 2008). This cost is further compounded by follow up clearing programs (Maraiset al.2004). Studies by Zimmermann and Neser (1999), Stepp and Moerman (2001), Njoroge et al. (2004), Bigirimana et al. (2011, 2012), Semenya et al. (2012) andMaroyi (2013a) showed that invasive plants may also have positive economical, social and ecological significance and these need to be taken into account when assessing the costs resulting from invasions.

Five invasive species documented in this study: *Agave americana* (medicinal), *Catharanthus roseus* (medicinal/ornamental), *Eriobotrya japonica*and *Psidium guajava* (edible fruits) and *Opuntia ficus-indica* (edible fruit/ornamental) are all used as herbal medicines by Bapedi traditional healers in the Limpopo Province (Semenya et al. 2012; Semenya and Potgieter 2014). Similarly, Dold and Cocks (2002), noted that of the 130 plant species used as traditional medicine by Xhosa traditional healers in the Eastern Cape Province, 33 are declared exotic species. *Opuntia ficus-indica* and *Psidium guajava* are widely cultivated for fruit production in South Africa (Zimmermann and Neser 1999) and Zimbabwe (Maroyi 2013b). There is now a large body of evidence supporting human dependency on invasive alien plant species for food, shelter, ecosystem services, aesthetic enjoyment and cultural identity (Zimmermann and Neser 1999). The results of this study, therefore, calls for a review of the socio-economic benefits of exotic plants to local communities in South Africa before blindly advocating for their eradication. In addition, the extensive use of exotic plants is seen as imperative for their ultimate control and should ultimately form part of their management strategy (Semenya et al. 2012). As part of this management strategy, garden owners should be educated on the management of some of the invasive species, especially those listed in category 1 of the Conservation of Agricultural Resources Act (1983) No. 43 of 1983.

The researchers noted, like in a previous study by Lubbe et al. (2011), a high proportion of "indigenous cultivated" species (9.5%, n=12) in our studied urban gardens in the Capricorn District. All these species with the exclusion of *Strelitzia nicolai* are endemics. *Agapanthus africanus* subsp *africanus* was introduced because of its medicinal properties (Table 1), while *Pelargonium peltatum* and *Pelargonium zonale* were introduced for medicinal and ornamental uses. *Begonia homonyma, Clivia miniata* var. *miniata, Dietes grandiflora, Drimiopsis maculata, Euryops chrysanthemoides, Haworthia fasciata, Lobostemon fruticosus, Strelitzia nicolai* and *Strelitzia reginae* subsp *reginae* were cultivated for ornamental purposes.The presence of these species from other provinces may point out to the possibility of exchange and sharing of ethno botanical information concerning particularly traditional medicines. Research by Maroyi (2013a) showed that household owners give home garden products to neighbours and relatives, and this exchange between households and relatives strengthen relationships.

Further, domestic gardens can play a unique role by contributing to livelihood needs of households, selection and distribution of species, as well as conservation of endemic or economically valuable species. Management of plant diversity in the domestic gardens in this way ensures their availability to the present as well as future generations and this is a combination of *ex situ* and *circa situ* conservation (Hamilton 2004). This conservation initiative appears not to be planned and we doubt if the owners of the domestic gardens are aware that some of the cultivated species are endemics. Species listed in the South African Red Data List benefiting from this initiative are *Begonia homonyma, Clivia miniata* var. *miniata, Haworthia fasciata* and *Hypoxis hemerocallidea.* All these species are cultivated in the Capricorn District for ornamental purposes with the exclusion of *Hypoxis hemerocallidea* cultivated for medicinal purposes (Maroyi and Mosina 2014). But conservation assessments made by (Raimondo et al. 2009) revealed that over-exploitation of these species as traditional medicines and habitat loss are major causes of threats. *Begonia homonyma* (EN C2a(i) is generally rare and over-exploited for traditional medicine. *Clivia miniata* var. *miniata* (VU A2abcd), is threatened by harvesting for the traditional medicine trade. *Haworthia fasciata* (NT B1ab(ii,iii,iv,v),is threatened by habitat loss due to urban expansion around Port Elizabeth, as well as ploughing for pasture and agricultural expansion around Humansdorp in the Eastern Cape Province. *Hypoxis hemerocallidea* is listed as declining (Raimondo et al. 2009). However, the species is heavily harvested for the medicinal plant trade throughout the country and is also threatened by land transformation and habitat loss in Gauteng Province. There is a need, therefore, to encourage households to manage these species in domestic gardens, before their medicinal value vanishes as they disappear through over-exploitation and habitat loss in South Africa.

CONCLUSION

The study revealed that plants grown and maintained in domestic gardens play a vital role

in the livelihoods of the people of the Limpopo Province, South Africa. They are important as ornamental, food and medicines. Although the majority of these species are exotic and some "indigenous cultivated", these species have become imbedded in the lives and cultures of the people of the Limpopo Province. These findings with respect to the importance of urban domestic gardens and their preferences for certain species and use categories, has implications for policy regarding the planting and management of plants in urban domestic gardens. It is difficult for public authorities to influence the management of private gardens but local authorities can educate communities in urban centres on some of these aspects. The role and value of plants to urban livelihoods should be taken into account in planning by the relevant municipal and government agencies. Moreover, maintenance of green spaces and trees within urban areas is now widely recognised as one of the primary strategies available to urban planners to contribute to urban ecology and regular human contact with nature for their physical and psychological well-being. It is recommended that urban households be made aware of the extensive variety of goods and services trees provide and the important role plants can play in helping to sustain urban livelihoods.

RECOMMENDATIONS

The potential value of urban domestic gardens in the provision of goods and environmental services to the highly growing urban population in South Africa is not known, due to lack of comprehensive data on urban domestic garden flora. This study demonstrated that urban domestic gardens in the Limpopo Province, South Africa are of potential significance to biodiversity conservation, ecosystem services and the well-being of the local communities as sources of food and medicinal plants. Documentation of garden flora is, therefore, a critical starting point in trying to understand the importance of plant biodiversity in urban domestic gardens to the livelihoods and provision of ecosystem services to local communities. There is need therefore, to carry out similar studies in other provinces of South Africa to enhance appreciation and understanding of the ecological and social importance of urban domestic garden flora.

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