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Diversity of edible plants in home gardens of the Eastern Cape Province, South Africa

Alfred Maroyi

Department of Botany, University of Fort Hare, Private Bag X1314, Alice 5700, South Africa

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ABSTRACT

Many plant species cultivated and maintained in home gardens offer a wide range of ecosystem goods and services. The current study was undertaken in the Eastern Cape Province, South Africa to document edible plant species cultivated and maintained in home gardens.Research data were collected through interviews and field surveys carried out in different seasons with one hundred and thirty two randomly selected participants. During the interviews, we documented information on names of edible plants grown and managed in home gardens, uses, plant parts used and preparation of edible plants. A total of 40 edible plantsbelonging to 34 genera and 23 families were recorded in the study area. The plant families with the highest number of edible plants were Amaranthaceae (5 species), followed by Asteraceae and Solanaceae with 4 species each, and Rosaceae with 3 species.The main uses of plants grown and maintained in home gardens were edible fruits (45.0%), leafy vegetables (40.0%), edible tubers (15.0%), edible seeds and culinary herbs or spices (10.0% each). The species which were categorized as important with a relative frequency of citation (RFC) values e"0.3 were *Brassica oleracea* L., *Solanum tuberosum* L., *Zea mays* L., *Cucurbita moschata* Duchesne ex Poir., *Spinacia oleracea* L. and *Cucurbita maxima* Duchesne. Home gardens are important agroforestry land-use systems that need to be recognized in terms of their food production.

Key words : *Agricultural productivity, Agroforestry systems, Food security, Home gardens, Human nutrition, Livelihoods, Biodiversity*

Introduction

A growing body of literature suggests that some communities in the Eastern Cape province in South Africa are still dependent on biodiversity for the provision of ecosystem goods and services (Gugushe *et al*., 2008; Zerihun *et al*., 2014; Maroyi, 2020). These findings corroborate observations made from other countries that subsistence farmers maintain trees, shrubs, grasses, climbers and herbs in and around their homes and farms (Kumar and Nair, 2004; Clarke *et al*., 2014). Thorn *et al.* (2020) argued that these agroforestry systems are associated with higher variations in plant diversity than monoculture croplands. Therefore, understanding of agroforestry systems is important as processes of plant extraction and domestication influence community structure, rate of species turnover, genetic makeup and local responses to environmental changes and degradation (Acharya, 2006; Clarke *et al*., 2014; Thorn *et al.*, 2020). Moreover, plants collected from the wild and cultivated in home gardens are essential for human nutrition and as sources of energy. Research carried by Bennett (2010) revealed that humans obtain 85.0% of their calories from 20 plant species while more than 50.0% of their calories are derived from three plant species only, namely *Oryza sativa* L. (rice), *Triticum aestivum* L. (wheat) and *Zea mays* L. (maize). But in sub-Saharan Africa and other marginal environ-

ments of developing countries, there are several edible plant species often collected from the wild or are grown in home gardens. Maundu *et al.* (2009) argued that there are about 1000 plant species in sub-Saharan Africa that are used as vegetables, with 80.0% of these being leafy vegetables and the rest are cultivated or collected from the wild for their edible fruits, seeds, roots and tubers, stems and flowers. A growing body of literature suggested that home gardens in remote and marginal areas have a significant number of agricultural biodiversity in the form of multiple layered systems of trees, herbs, climbers, grasses and herbs (Kumar and Nair, 2004; Thorn *et al.*, 2020). A home garden is described by Peyre *et al*. (2006) as multi-purpose agroforestry systems that combine both ecosystem goods and services such as food, fuel, vegetables, fruits, fodder, medicines, household income and employment. A home garden is regarded as one of the grass-root community's most adaptable and accessible agricultural farming systems in developing countries, playing an important role in reducing vulnerability and ensuring food security to many households. According to FAO (2001), food security, at the individual, household, national, regional and global levels is achieved when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life. Access to sufficient, safe and nutritious food means that households must have adequate resources either to produce food in different farming systems or to obtain the food in exchange for cash or other commodities. The significance of goods and services provided by homegardens to community livelihoods is appreciated throughout the world (Fernandes and Nair, 1986; Nair *et al.*, 2009; Palheta *et al.*, 2017; Kujawska *et al.*, 2018) including South Africa (Lubbe *et al.*, 2010; Molebatsi *et al.*, 2010; Mosina *et al.*, 2014, 2015). A homegarden is located adjacent to a household dwelling, whose biodiversity composition and structure are continuously transformed according to plans designed by humans that manage those (Larios *et al.*, 2013). Communities worldwide are known to manage edible plants in homegardens to support household well-being and livelihoods (Zaldivar *et al.*, 2002; Reyes-Garcia *et al.*, 2012; Chandrashekara and Thasini, 2016; Özersoy and Fuller, 2016). Despite the growing acknowledgment that homegardens harbor a high proportion of edible plants all over the world, there is limited literature on edible plants cultivated and managed in home gardens in South Africa. This knowledge of edible plants grown and maintained in homegardens is important for the preservation of ethnobotanical knowledge as part of the cultural knowledge and practice of local communities. Therefore, this study was aimed at documenting edible plants cultivated and maintained in the homegardens of the Eastern Cape Province, South Africa.

Materials and Methods

Study area

The study was conducted in three local municipalities, namely Elundi, Mbhashe and Raymond Mhlaba Local Municipalities (Figure 1). The study area is predominantly rural with the dominant land use practice being rearing of livestock and dryland crop production. The climate of the study area varies from hot in summer to extreme cold in winter with temperature ranging from about 4 °C in July to 38 °C in February (Jari and Fraser, 2012; Manyevere *et al.*, 2014). The annual rainfall varies from about 500-1000 mm, with mountainous areas receiving the highest rainfall and low to medium areas characterized by low to average annual rainfall (Jari and Fraser, 2012; Manyevere *et al.*, 2014). Mucina and Rutherford (2006) described the vegetation of the study area as dominated by grasslands, succulent thicket and *Acacia* thornveld.

Fig. 1. The geographical position of the study sites to other provinces in South Africa

Data collection

Data on the diversity of edible plants in home gardens of the Eastern Cape province were collected through interviews and field surveys carried out in different seasons, that is, winter and summer between March 2012-2016. A total of 132 (Table 1) randomly selected participants took part in this study. The majority of the participants (65.2%) were females and their age range was from 19 to 79 years (Table 1). About three quarters (78.9%) of the participants live below the national poverty line and 61.4% of the participants had a total income of less than R1000.00 (US$87.00) per month (Table 1). Close to three-quarters of the participants (68.9%) were unemployed with 65.9% surviving on social grants with household size averaging five family members (Table 1).

Results obtained via the use of the questionnaires were complemented with personal observation, informal discussions and guided field walks or surveys with the participants. Interview discussions took place in the local language, isiXhosa and were translated into English with the help of an interpreter. During the interviews, we documented information on names of edible plants grown and managed in home gardens, uses, plant parts used and preparation of edible plants. Plant species were identified in the field and the taxon names conform to those of Germishuizen and Meyer (2003). The data collected were entered in Microsoft Excel 2007 file and this data was used to determine frequencies and other descriptive statistical patterns. The local importance of edible plant species was assessed using the relative frequency of citation (RFC). This index is a result of the frequency of citation (FC), the number of informants mentioning the use of the species, divided by the total number of informants (N) (Tardio and Pardo-de-Santayan, 2008).

$$RFC = FC/N$$

Box plots featuring medians, first and third quartiles and a range of plant use categories were computed using Palaeontological Statistics (Hammer *et al.*, 2001) version 3.06.

Results

Diversity of food plants in home gardens

A total of 40 plant species belonging to 34 genera and 23 families were recorded in the homegardens in the Eastern Cape province (Table 2). The plant families with highest number of edible plants were Amaranthaceae (5 species), followed by Asteraceae and Solanaceae with 4 species each, and Rosaceae with 3 species (Table 2). The rest of the families were represented by 1 to 2 species each. About 90% of recorded plant species are exotic to South Africa with exception of *Catha edulis* (Vahl) Endl., *Centella coriacea* Nannf., *Mentha longifolia* (L.) Huds. and *Zantedeschia aethiopica* (L.) Spreng.

Edible parts and mode of consumption

More than half of the plant species growing in homegardens in the Eastern Cape province were herbs, followed by trees, shrubs and climbers (Figure 2). The main uses of plants grown and maintained in home gardens were edible fruits (45.0%), leafy vegetables (40.0%), edible tubers (15.0%), edible seeds and culinary herbs or spices (10.0% each) (Figure 3).The species regarded as important with RFC values e"0.3 were *Brassica oleracea* L. (leafy vegetable), *Solanum tuberosum* L. (edible tubers), *Zea mays* (cereal), *Cucurbita moschata* Duchesne ex Poir. (edible fruits, flowers and shoots), *Spinacia oleracea* L. (leafy vegetable) and *Cucurbita maxima* Duchesne (leafy vegetable) (Table 2). The species categorized as of little value with RFC values e"0.008 were *Colocasia antiquorum* Schott (edible tubers), *Rumex lanceolatus* Thunb. (leafy vegetable), *Solanum nigrum*

Table 1. Demographic characteristics of the participants, N = 132

Demographic variable	Value
Gender: Female	65.2%
Male	34.8%
Age	19-79 years (median 56 years)
People living in poverty	78.9%
Household income (<R1000.00 (US$87.00)	61.4%
Unemployed	68.9%
Dependent on social grants	65.9%
Household size	1-12 people (average 5)

Table 2. List of plant species recorded from home gardens in the Eastern Cape Province, arranged in descending order of importance

Scientific name	Family	Xhosa (X) and English (E) names	Habit	Edible part	RFC
Brassica oleracea L.	Brassicaceae	Cabbage (E), ikhaphetshu (X)	Herb	Leaves	0.5
Solanum tuberosum L.	Solanaceae	Amazambane (X), potato (E)	Herb	Tubers	0.5
Zea mays L.	Poaceae	Maize (E), umbone (X)	Grass	Fruits and seeds	0.5
Cucurbita moschata Duchesne ex Poir.	Cucurbitaceae	Butternut (E), ithanga (X)	Climber	Fruits and young shoots	0.4
Spinacia oleracea L.	Amaranthaceae	Imifuno (X), spinach (E)	Herb	Leaves	0.4
Cucurbita maxima Duchesne	Cucurbitaceae	Ithanga (X), pumpkin (E)	Climber	Fruits, seeds and young shoots	0.3
Capsicum annuum L.	Solanaceae	Itshilisi (X), pepper (E)	Shrub	Fruits	0.2
Daucus carota L.	Apiaceae	Carrots (E), umnqathi (X)	Herb	Tubers	0.2
Lycopersicon esculentum Mill.	Solanaceae	Tomato (E), tumata (X)	Shrub	Fruits	0.2
Prunus persica (L.) Batsch	Rosaceae	Ipesika (X), peach (E)	Tree	Fruits	0.2
Citrus sinensis (L.) Osbeck	Rutaceae	Iorenji (X), orange (E)	Tree	Fruits	0.1
Ipomoea batatas (L.) Lam.	Convolvulaceae	Bhatata (X), sweet potato (E)	Climber	Tubers	0.1
Opuntia ficus-indica (L.) Mill.	Cactaceae	Itolofiya (X), prickly pear (E)	Shrub	Fruits	0.1
Phaseolus vulgaris L.	Fabaceae	Bean (E), mbotyi (X)	Herb	Fruits and seeds	0.1
Psidium guajava L.	Myrtaceae	Guava (E), ugwava (X)	Tree	Fruits	0.1
Lactuca sativa L.	Asteraceae	Ilethasi (X), lettuce (E)	Herb	Leaves	0.09
Citrus limon (L.) Burm. f.	Rutaceae	Lamuni (X), lemon (E)	Tree	Fruits	0.08
Musa X *paradisiaca* L.	Musaceae	Banana (E)	Shrub	Fruits	0.08
Pisum sativum L.	Fabaceae	Erityisi (X), pea (E)	Herb	Fruits and seeds	0.08
Brassica rapa L.	Brassicaceae	Turnip (E)	Herb	Leaves and tubers	0.07
Persea americana Mill.	Lauraceae	Avocado (E)	Tree	Fruits	0.07
Amaranthus hybridus L.	Amaranthaceae	Nomdlomboyi (X), Pigweed (E)	Herb	Leaves	0.04
Prunus armeniaca L.	Rosaceae	Appricot (E)	Tree	Fruits	0.04
Vitis vinifera L.	Vitaceae	Umdiliya (X), grapes (E)	Climber	Fruits	0.04
Allium cepa L.	Amaryllidaceae	Itswele (X), onion (E)	Herb	Tubers	0.03
Bidens pilosa L.	Asteraceae	Umhlabangulo (X), Black jack (E)	Herb	Leaves	0.03
Centella coriacea Nannf.	Apiaceae	Unongotyozana (X)	Herb	Leaves	0.03
Malus domestica Borkh.	Rosaceae	Apile (X), apple (E)	Tree	Fruits	0.03
Allium sativum L.	Amaryllidaceae	Garlic (E)	Herb	Tubers	0.02
Catha edulis (Vahl) Endl.	Celastraceae	Iqwaka (X)	Tree	Leaves	0.02
Chenopodium album L.	Amaranthaceae	Imbikicane (X)	Herb	Leaves	0.02
Ficus carica L.	Moraceae	Fig (E), ikwiwane (X)	Tree	Fruits	0.02
Mentha longifolia (L.) Huds.	Lamiaceae	Mint (E)	Herb	Leaves	0.02
Sonchus asper (L.) Hill	Asteraceae	Irwabe (X), spiny sowthistle (E)	Herb	Leaves	0.02
Beta vulgaris L.	Amaranthaceae	Beetroot (E), Bhetruthi	Herb	Tubers	0.02
Colocasia antiquorum Schott	Araceae	Idumbe (X)	Herb	Tubers	0.008
Rumex lanceolatus Thunb.	Polygonaceae	*Idolo lenkonyane* (X)	Herb	Leaves	0.008
Solanum nigrum L.	Solanaceae	Umsobo (X)	Shrub	Fruits and leaves	0.008
Taraxacum officinale Weber	Asteraceae	Uqudalele (X)	Herb	Leaves	0.008
Zantedeschia aethiopica (L.) Spreng.	Araceae	Ntebe (X)	Herb	Tubers	0.008

L. (leafy vegetable), *Taraxacum officinale* Weber (leafy vegetable) and *Zantedeschia aethiopica* (edible tuber) (Table 2). The food use categories characterized by low RFC values were leafy vegetables having mean RFC value of 0.1, edible tubers (0.1), culinary herbs or spices (0.07) in comparison to higher RFC values exhibited by edible fruits (0.2), seeds (0.2), and species used as cereals(0.5) (Figure 4).

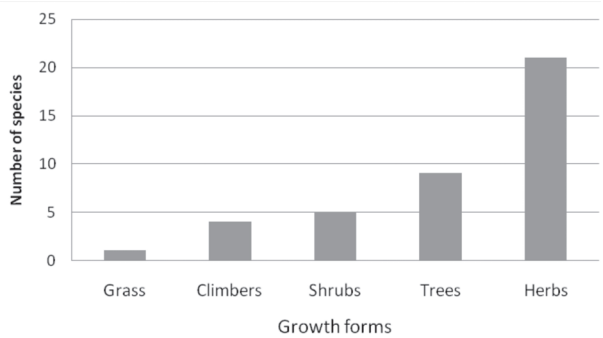

Fig. 2. Growth forms of edible plant species recorded in home gardens of the Eastern Cape province

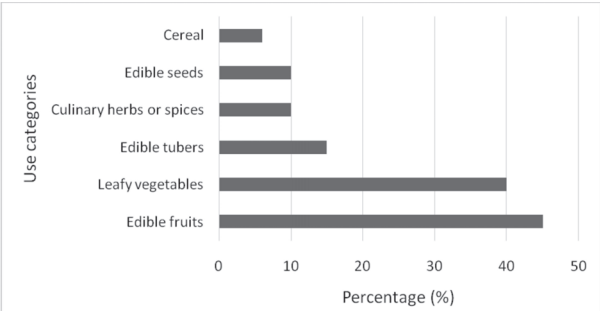

Fig. 3. Categorization of edible plants recorded in home gardens of the Eastern Cape province

Discussion

The high diversity of edible plant species and use categories in the Eastern Cape province demonstrated that households in the province possess diverse information about plants that are useful as sources of food. The total of 40 species encountered is comparable to the figures reported from previous studies in home gardens in South Africa (Zobolo and Mkabela, 2006; Mosina *et al.,* 2015). In the Kwa Zulu-Natal province, Zobolo and Mkabela (2006) identified 22 species while Mosina *et al.* (2015) identified a total of 41 species of edible plants in home gardens of the Limpopo province. The Amaranthaceae, Asteraceae, Solanaceae and Rosaceae families identified in this study as major sources of edible plants are among the largest and economically important sources of food and their species are widespread in the tropics (Van Wyk and Gericke, 2018). In this study, the majority of recorded species (90.0%) were exotic, a phenomenon also reported by Kahane *et al.* (2013) and Caballero-Serrano *et al.* (2016). Some of the exotic food plants recorded in this study such as *Brassica oleracea, Solanum tuberosum, Zea mays, Cucurbita moschata, Spinacia oleracea* and *Cucurbita maxima* are well-known food plants cultivated throughout the world (Semenya and Maroyi, 2020). Kahane *et al.* (2013) and Caballero-Serrano *et al.* (2016) argued that indigenous species are less attractive to home garden owners while the majority of exotic species are easy to cultivate and manage in home gardens. Results of this study revealed that not only supplementary food crops such as leafy vegetables and fruits are

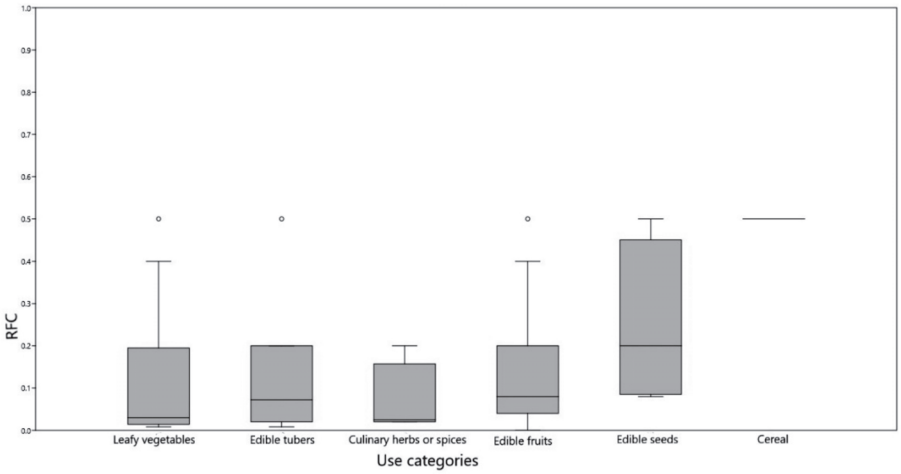

Fig. 4. Relationship of relative frequency citation (RFC) and use of flowers, fruits, leaves, seeds, tubers and young shoots. Box = standard error, whisker = standard deviation, line in box = mean and ◦ = outlier.

cultivated in home gardens but also staple food and cash crops such as *Zea mays* are also widely grown. Similar results were obtained by Nemudzudzanyi *et al.,* (2009) who found that *Zea mays* were cultivated in 58.0% of the home gardens in KwaZulu-Natal province in South Africa. *Zea mays* was also a dominant cereal crop, playing an important role as a staple diet for 38.0% of households in the North-West province in South Africa (Molebatsi *et al.,* 2010).

The identification of indigenous species such as *Catha edulis, Centella coriacea, Mentha longifolia* and *Zantedeschia aethiopica* among edible plants in the current study offers support to the general hypothesis that home gardens are experimental field sites where indigenous species are transferred and tended for household use (Galhena *et al.,* 2013). Kamiyama *et al.* (2016) argued that home gardening activities transmit indigenous culture and knowledge across generations. However, the indigenous species were associated with low RFC values and this observation can be attributed to food preferences and lack of knowledge about the species. Researchers such as Calvet-Mir *et al.* (2012) and Kuhnlein (2014) argued that the cultivation of indigenous species in home gardens allows the provision of diverse ecosystem services, cultural services based on traditional knowledge, sustainable indigenous health systems and well-being.

The most frequently recorded plant species found in this study were herbs followed by trees and shrubs, which is similar to other ethnobotanical studies carried out in home gardens in South Africa (Mosina and Maroyi, 2016; Semenya and Maroyi, 2020). Similarly, Regassa (2016)recorded herbs (44.6%), shrubs (27.1%), trees (24.8%) and climbers (6.2%) as the most dominant life forms of edible plants in Hawassa region in Ethiopia. These results corroborated arguments presented by Bennett (1992) that reasons which impede home garden owners from managing or cultivating some plant species is related to difficulties in plant establishment and slow growth. The author argued that this is one of the reasons why annual and perennial herbaceous plants dominate in domestic home gardens and other agroforestry ecosystems.

Conclusion

The results of this study have added invaluable information on edible food plants that are grown and managed in the home garden in South Africa. These findings corroborate the general hypothesis that the most fundamental social benefit of home gardens is their direct contributions to household food security enabling households to increase food availability, accessibility and utilization. Therefore, home gardens can enable households to produce a variety of food plants needed for creating and maintaining a diverse diet. The value of home gardens as sources of food needs to be appreciated by agriculturalists, government policymakers and scientists responsible for research, extension activities and agricultural policy. This information may enable government officers and policy planners to accurately plan sustainable management of edible plant resources in the province. These research findings have long term management implications on ecosystem goods and services derived from plant resources in the province.

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