BIODIVERSITAS
Volume 21, Number 9, September 2020
Pages: 3982-3988

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d210908

Short Communication: Ethnobotanical study of wild and cultivated vegetables in the Eastern Cape Province, South Africa

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Manuscript received: 12 July 2020. Revision accepted: 6 August 2020.

Abstract. *Maroyi A. 2020. Short Communication: Ethnobotanical study of wild and cultivated vegetables in the Eastern Cape Province, South Africa. Biodiversitas 21: 3982-3988.* Vegetables are an important component of agricultural biodiversity required for providing a wide range of ecosystem goods and services. The current study was undertaken in the Eastern Cape Province, South Africa to document wild and cultivated vegetables. Research data were collected by means of interviews and field surveys carried out in different seasons with one hundred and thirty-eight randomly selected participants. During the interviews, we documented information on names of edible vegetables, uses, plant parts consumed, and their preparation. A total of 32 species belonging to 26 genera and 15 families were recorded in the study area. The plant families with highest number of vegetable species were Amaranthaceae, Asteraceae, and Solanaceae with at least four species each. The main uses of vegetables identified in the study area were leafy vegetables (59.4%), edible fruits and tubers (21.9% each), culinary herbs or spices (12.5%), edible seeds (9.4%) and edible stems (6.3%). The species which were categorized as important with relative frequency of citation (RFC) values >0.3 were *Brassica oleracea*, *Solanum tuberosum*, *Cucurbita moschata*, *Spinacia oleracea*, and *Cucurbita maxima*. Both vegetable species collected from the wild and conventional vegetables cultivated in home gardens are important to livelihoods needs of the local people.

Keywords: Agricultural biodiversity, food security, livelihoods, Eastern Cape Province, South Africa, vegetables

INTRODUCTION

Plants are essential for human nutrition and as sources of energy. Bennett (2010) argued that humans obtain 85% of their calories from 20 plant species while more than 50% 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 environments of developing countries, there are several edible plant species often collected from the wild or grown in home gardens. Research by Maundu et al. (2009) revealed that there are about 1000 plant species in sub-Saharan Africa that are used as vegetables, with 80% 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 suggests small to medium-sized farming communities in remote and marginal areas have significant number of agricultural biodiversity required for food security and the wider provisioning of crucial ecosystem goods and services (Kumar and Nair 2004; Clarke et al. 2014; FAO 2019; Thorn et al. 2020). 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 ecosystem goods and services provided by vegetables to community livelihoods is appreciated throughout the world (Afari-Sefa et al. 2011; Keatinge et al. 2011; Ebert 2014; Ojiewo et al. 2015; Ochieng et al. 2017). Towns and Shackleton (2018) argued that these different species of vegetables contribute to the dietary diversity, and are an important part of alimentary traditions, cultural identity of local communities in sub-Saharan Africa and make significant contribution to the development of agricultural biodiversity, but have suffered as neglected and underutilized species. These vegetable species have potential to be developed into new crops through domestication and their documentation is necessary for the identification of food sources from different environments and regions in order to serve as gene pools for genetic improvement of crops to achieve higher productivity, disease resistance and compatibility with global climate change (Turner et al. 2011; Ju et al. 2013; Abbet et al. 2014; Das et al. 2016; Aryal et al. 2018; Shin et al. 2018). There is now a general consensus that vegetables and other wild edible plants play an important role to the food basket in much of the developing world (Rubatzky and Yamaguchi 1997; Sundriyal et al. 2004; Ali–Shtayeh et al. 2008; Misra et al. 2008; Menendez-Baceta et al. 2012; Thakur et al. 2017; Bhatia et al. 2018; Chauhan et al. 2018) and leafy wild vegetables and fruits

are an important source of food during drought periods when the staple crops fail (Shin et al. 2018; Ojelel et al. 2019).

There is growing interest on vegetables since daily diet of fruits and vegetables is strongly associated with improved gastrointestinal health, reduced risk of heart diseases, stroke, chronic diseases such as diabetes, eye problems and various forms of cancer (Heinrich et al. 2005; Leonti et al. 2006; Dias 2012; Romojaro et al. 2013; Rush et al. 2018; Sansanelli et al. 2018). Similarly, Schreinemachers et al. (2018) argued that vegetables are the most affordable food source of vitamins and minerals needed by humans for good health. It is, therefore, within this context that this study was undertaken focusing on wild and cultivated vegetables in the Eastern Cape Province, South Africa. The term vegetable is defined as an annual or perennial horticultural crop with its parts such as roots, stalks, flowers, fruits, and leaves that can be consumed wholly or partially in raw form or after cooking (Welbaum 2015; Ülger et al. 2018). This knowledge on vegetables is important for preservation of ethnobotanical knowledge as part of the cultural knowledge and practice of local communities. Therefore, the aim of this study was to assess diversity, use categories, and local knowledge of both wild and cultivated vegetables in the Eastern Cape Province in South Africa.

MATERIALS AND METHODS

Study area

The study was conducted in three local municipalities in the Eastern Cape Province in South Africa, namely Elundi, Mbhashe, and Raymond Mhlaba Local Municipalities (Figure 1). The area is characterized by a subtropical climate with cold and wet winters, and warm and wet summers. Annual temperatures range from 4 °C in winter to a maximum of 40 °C in the summer (Jari and Fraser 2012; Hosu et al. 2016; Ndhlevu et al. 2017). The study area experiences an annual rainfall ranging from 550 mm to 1000 mm (Manyevere et al. 2014; Hosu et al. 2016; Ndhlevu et al. 2017). The local residents also rely on natural plant resources and the surrounding environment for a diversity of livelihood needs (Alexander et al. 2015) in addition to subsistence agriculture and migrant labor. The general livelihood system in the study area can be described as a mixed farming system, with residents engaging in both crop and livestock farming. Crop production is mainly through irrigation and rain-fed farming and some of the cultivated crops include maize (*Zea mays*), sorghum (*Sorghum bicolor* (L.) Moench), potatoes (*Solanum tuberosum* L.), cabbage (*Brassica oleracea* L.), spinach (*Spinacia oleracea* L.), beetroot (*Beta vulgaris* L.) and carrots (*Daucus carota* L.) (Ndhleve et al. 2013). The most common livestock species in the study area include cattle, chickens, donkeys, goats, horses, pigs, and sheep (Mapekula et al. 2009; Fayemi and Muchenje 2014; Mthi et al. 2017). Other sources of livelihoods include temporary employment, art and craft activities, social grants, and remittances from family members working in towns. The grassland biome and succulent thicket are by far the most dominant biomes in the study area (Mucina and Rutherford 2006).

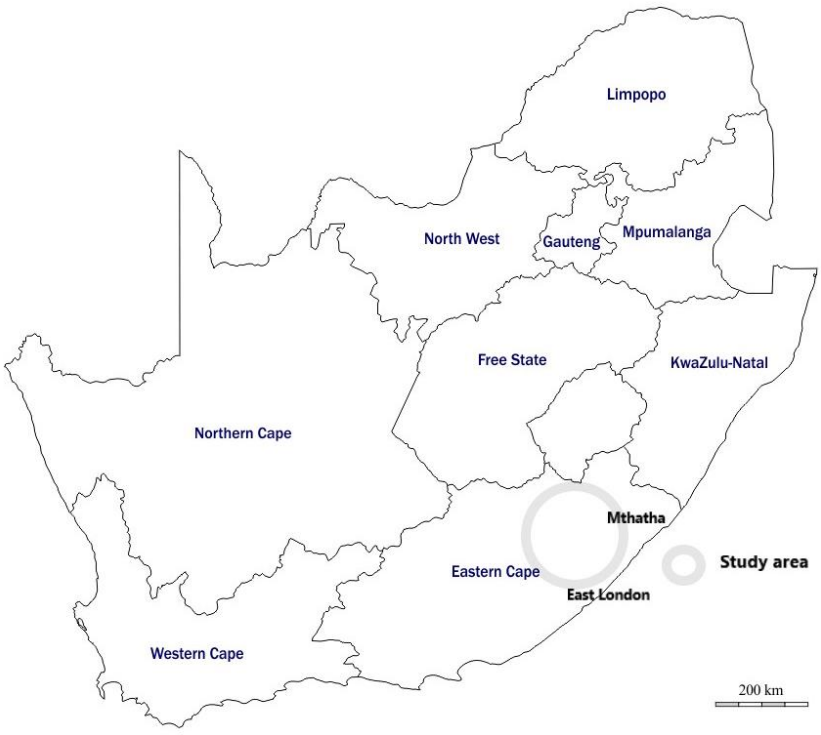

Figure 1: The geographical position of the study sites in relation to other provinces in South Africa

Data collection

Data on the diversity of wild and cultivated vegetables in the Eastern Cape Province were collected by means of interviews and field surveys carried out in different seasons, that is, winter and summer. One hundred and thirty eight (Table 1) randomly selected participants took part in this study conducted between March 2012 to March 2017. This study utilized the participatory rural appraisal (PRA) methods (Chambers 1994), focusing on in-depth discussions using open-ended questionnaires and participant observation with local communities in data gathering. 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 vegetables, uses, plant parts consumed, and their preparation. Plant species were identified in the field and the taxon names conform to those of Germishuizen and Meyer (2003). The majority of these participants (65.9%) were females and their age range was from 19 to 81 years (Table 1). More than 80% of the participants live below the national poverty line and 62.3% of the households had total income of less than R1000.00 (US$87.00) per month. Close to three-quarters of the participants (73.9%) were unemployed, with 63.0% surviving on social grants (Table 1).

Data analysis

This research employed combination of qualitative and quantitative methods. 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 vegetable 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) (Tardío and Pardo-de-Santayana 2008).

$$RFC = FC/N$$

The informant consensus factor (ICF) of vegetables was also assessed aimed at evaluating the level of homogeneity of information provided by the participants (Trotter and Logan 1986). The index was calculated as the number of use citations in each category minus the number of species used divided by the number of use citations in each category minus one. The formula of ICF index is:

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

Where,

Nur = number of use reports from informants for a particular plant-use category,

Nt = number of species that are used for that plant use category based on information provided by participants.

The 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 AND DISCUSSION

Diversity of edible vegetables

A total of 32 plant species belonging to 26 genera and 15 families were recorded in the Eastern Cape Province (Table 2). More than three-quarters of the documented vegetables (81.3%) are from nine families, namely Asteraceae, Solanaceae, Amaranthaceae, Amaryllidaceae, Apiaceae, Araceae, Brassicaceae, Cucurbitaceae, and Fabaceae (Table 3). The other plant families were represented by one species each. Similar research by Achigan-Dako et al. (2011) focusing on diversity of vegetables in Benin revealed dominance of species belonging to families Amaranthaceae, Asteraceae, Cucurbitaceae, Fabaceae and Solanaceae. Moreover, the major families identified in this study are among the largest plant families in South Africa characterized by more than 50 species each (Germishuizen and Meyer 2003). Some of the vegetable species belonging to families Amaranthaceae, Amaryllidaceae, Apiaceae, Araceae, Asteraceae, Brassicaceae, Cucurbitaceae, Fabaceae, and Solanaceae are included in the book "Plant Resources of Tropical Africa 2: Vegetables", a monographic guide to the most commonly used vegetable species in tropical Africa, including their botany, distribution, main uses and phytochemical properties (Grubben and Denton 2004).

More than three quarters (81.3%) of recorded vegetables are exotic to South Africa with the exception of *Catha edulis* (Vahl) Endl., *Centella coriacea* Nannf., *Mentha longifolia* (L.) Huds., *Portulacaria afra* Jacq., *Solanum retroflexum* Dun. and *Zantedeschia aethiopica* (L.) Spreng. Turreira-García et al. (2017) argued that presence of 55.0% exotic leafy vegetable species in Thailand serves as confirmation of international crop exchange in that country. Similarly, Maundu et al. (2009) argued that exotic species reported in this study such as *Cucurbita maxima* Duchesne and *C. moschata* Duchesne ex Poir. are originally from South America and now widely cultivated in tropical Africa for their edible fruits and leaves. In previous research focusing on edible vegetables in the KwaZulu-Natal province in South Africa, Ntuli et al. (2012) revealed that 47.0% of the documented species were exotic to South Africa. The authors argued that indigenous knowledge systems of local communities in KwaZulu-Natal province are dynamic and usually incorporate exotic species as new food sources.

Table 1. Socio-economic characteristics of the study sample, n = 138

Socio-economic variable	Value
Gender: Female	65.9%
Male	34.1%
Age	19-81 years (median 57 years)
People living in poverty	80.4%
Household income (<R1000.00 (US$87.00)	62.3%
Unemployed	73.9%
Dependent on social grants	63.0%
Household size	1-12 people (average 4.5)

Table 2. List of vegetable species recorded 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	0.572
Solanum tuberosum L.	Solanaceae	Amazambane (X), potato (E)	Herb	Tubers	0.543
Cucurbita moschata Duchesne ex Poir.	Cucurbitaceae	Butternut (E), ithanga (X)	Climber	Fruits and young shoots	0.507
Spinacia oleracea L.	Amaranthaceae	Imifuno (X), spinach (E)	Herb	Leaves	0.486
Cucurbita maxima Duchesne	Cucurbitaceae	Ithanga (X), pumpkin (E)	Climber	Fruits, seeds and young shoots	0.428
Capsicum annuum L.	Solanaceae	Itshilisi (X), pepper (E)	Shrub	Fruits	0.283
Daucus carota L.	Apiaceae	Carrots (E), umnqathi (X)	Herb	Tubers	0.268
Lycopersicon esculentum Mill.	Solanaceae	Tomato (E), tumata (X)	Shrub	Fruits	0.254
Ipomoea batatas (L.) Lam.	Convolvulaceae	Bhatata (X), sweet potato (E)	Climber	Tubers	0.152
Phaseolus vulgaris L.	Fabaceae	Bean (E), mbotyi (X)	Herb	Fruits and seeds	0.130
Lactuca sativa L.	Asteraceae	Ilethasi (X), lettuce (E)	Herb	Leaves	0.094
Pisum sativum L.	Fabaceae	Erityisi (X), pea (E)	Herb	Fruits and seeds	0.087
Brassica rapa L.	Brassicaceae	Turnip (E)	Herb	Leaves and tubers	0.079
Amaranthus hybridus L.	Amaranthaceae	Nomdlomboyi (X), Pigweed (E)	Herb	Leaves	0.072
Allium cepa L.	Amaryllidaceae	Itswele (X), onion (E)	Herb	Tubers	0.065
Bidens pilosa L.	Asteraceae	Umhlabangulo (X), Blackjack (E)	Herb	Leaves	0.058
Sonchus oleraceus (L.) L.	Asteraceae	Ihlaba (X), wild sowthistle	Herb	Leaves	0.051
Centella coriacea Nannf.	Apiaceae	Unongotyozana (X)	Herb	Leaves	0.051
Allium sativum L.	Amaryllidaceae	Garlic (E)	Herb	Tubers	0.051
Catha edulis (Vahl) Endl.	Celastraceae	Iqwaka (X), khat (E)	Tree	Leaves	0.043
Chenopodium album L.	Amaranthaceae	Goosefoot (E), imbikicane (X)	Herb	Leaves	0.043
Mentha longifolia (L.) Huds.	Lamiaceae	Mint (E)	Herb	Leaves	0.036
Sonchus asper (L.) Hill	Asteraceae	Irwabe (X), spiny sowthistle (E)	Herb	Leaves	0.036
Beta vulgaris L.	Amaranthaceae	Beetroot (E), Bhetruthi	Herb	Tubers	0.029
Portulaca oleracea L.	Portulacaceae	Igwanisha (X), pigweed (E)	Shrub	Leaves and stems	0.029
Solanum retroflexum Dun.	Solanaceae	Nightshade (E), umsobo wehlathi	Shrub	Fruits and leaves	0.029
Colocasia antiquorum Schott	Araceae	Idumbe (X)	Herb	Tubers	0.021
Portulacaria afra Jacq.	Didiereaceae	Igwanitsha (X), Spekboom (E)	Shrub	Leaves and stems	0.021
Rumex lanceolatus Thunb.	Polygonaceae	Idolo lenkonyane (X)	Herb	Leaves	0.014
Solanum nigrum L.	Solanaceae	Nightshade (E), Umsobo (X)	Shrub	Fruits and leaves	0.014
Taraxacum officinale Weber	Asteraceae	Uqudalele (X)	Herb	Leaves	0.007
Zantedeschia aethiopica (L.) Spreng.	Araceae	Ntebe (X)	Herb	Tubers	0.007

Table 3. Different plant families with at least two species of edible vegetables in the study area

Family	No. of species	Proportion (%)
Asteraceae	5	15.6
Solanaceae	5	15.6
Amaranthaceae	4	12.5
Amaryllidaceae	2	6.3
Apiaceae	2	6.3
Araceae	2	6.3
Brassicaceae	2	6.3
Cucurbitaceae	2	6.3
Fabaceae	2	6.3

Edible parts

More than half of the plant species recorded as vegetables in the Eastern Cape Province were herbs, followed by shrubs and climbers (Figure 2). Similar results were reported by Ntuli et al. (2012) based on research of edible vegetables in the KwaZulu-Natal province in South Africa who reported dominance of herbs (65.0%), followed by semi-woody or herbaceous climbers (24.0%), shrubs and trees (11.0% in total). Results from ethnobotanical research of edible vegetables conducted in other African countries like Benin, Cameroon, Guinea-Bissau and Kenya revealed the dominance of herbs with overall percentage ranging from 61.5% to 64.5% (Orech et al. 2007; Dansi et al. 2008; Ngone et al. 2016; Catarino et al. 2019). Among the main uses of vegetables identified in the study area were leafy vegetables (59.4%), edible fruits and tubers (21.9% each), culinary herbs or spices (12.5%), edible seeds (9.4%) and edible stems (6.3%) (Figure 3). The species regarded as important with RFC values >0.3 were *Brassica oleracea* (leafy vegetable), *Solanum tuberosum* (edible tubers), *Cucurbita moschata* (edible fruits and leafy vegetable), *Spinacia oleracea* (leafy vegetable) and *Cucurbita maxima* (edible fruits, seeds, and leafy vegetable) (Table 2). The species categorized as of little value with RFC values <0.02 were *Rumex lanceolatus* Thunb. (leafy vegetable), *Solanum nigrum* L. (edible fruits and leafy vegetables), *Taraxacum officinale* Weber (leafy vegetables), and *Zantedeschia aethiopica* (edible tubers) (Table 2). The edible stems and leafy vegetables were not popular food sources as supported by low RFC values in comparison to other use categories like edible tubers, fruits

and seeds, and culinary herbs or spices (Figure 4). In the present study, the ICF values for the documented vegetables ranged from 0.21 to 0.71 (Table 4). The highest agreement between the participants was observed for leafy vegetables while the least agreement was for edible stems (Table 3).

Interviews with participants revealed that species like *Rumex lanceolatus*, *Solanum nigrum*, *Taraxacum officinale*, and *Zantedeschia aethiopica* were rarely eaten by the local inhabitants, while conventional cultivated vegetables like *Brassica oleracea*, *Solanum tuberosum*, *Cucurbita moschata*, *Spinacia oleracea*, and *Cucurbita maxima* were preferred and, thus, scored higher RFC values (Table 2). The exotic vegetable species such as *Brassica oleracea*, *Solanum tuberosum*, *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 and wild species are less attractive to communities as these species are usually seasonal and inaccessible in some cases unlike the majority of conventional vegetable species that are easy to cultivate and manage in home gardens. Previous research on wild vegetables in the Eastern Cape Province by Bhat and Rubuluza (2002) and Bvenura and Afolayan (2014) also found a decline in wild vegetable consumption. Uprety et al. (2012) argued that documentation and conservation of wild edible plants are important as this would ensure that the highest priority genetic diversity is preserved and made available for use in crop improvement programs as a contribution to future worldwide food security. Moreover, documenting such information on utilization of plant species based on perceptions of local communities is an important step in trying to understand and initiate a management protocol that incorporates public perceptions and values associated with utilization of plant resources (Atyosi et al., 2019).

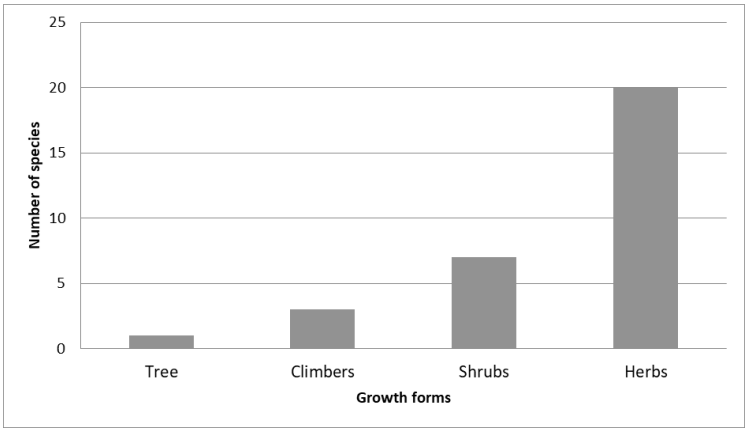

Figure 2. Growth forms of vegetable species recorded in the Eastern Cape Province

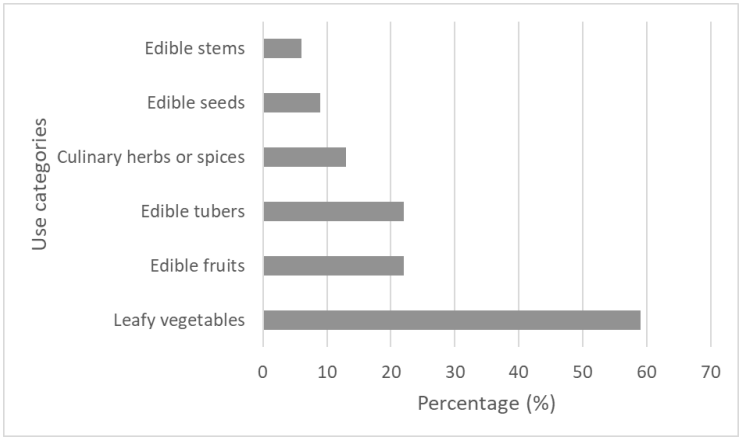

Figure 3. Categorization of vegetables recorded in the Eastern Cape Province

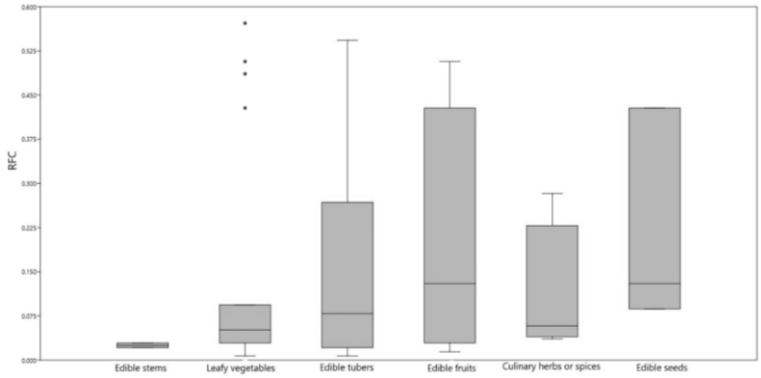

Figure 4. Relationship of relative frequency citation (RFC) and different use values. Box = standard error, whisker = standard deviation, line in box = mean and ◦ = outlier

Table 4. Number of species and informant consensus factor (ICF) in each use category

Use category	No. of species	% of species used	ICF
Leafy vegetables	19	59.4	0.71
Edible tubers	7	21.9	0.68
Culinary herbs or spices	4	12.5	0.57
Edible fruits	7	21.9	0.56
Edible seeds	3	9.4	0.37
Edible stems	2	6.3	0.21

In conclusion, results of this study have added invaluable information on edible vegetable species in the Eastern Cape Province in South Africa. The value of different forms of vegetables as sources of food needs to be appreciated by agriculturalists, government policymakers, and scientists responsible for research, extension activities, and agricultural policy. Irrespective of their social or economic status all participants in this study shared their knowledge and how different vegetable types are used. Therefore, both wild vegetable species and conventional vegetables are relevant to livelihood needs of the local people.

ACKNOWLEDGEMENTS

The author would like to thank local communities for participating in this study.

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