

An Exploratory Study of Gardening Practices and Ornamental Plants in Khartoum State, Sudan

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Abstract

In Sudan, as in many parts of the world, ornamental plants are gaining a growing interest. This study aimed to shed light on gardening (horticulture) and ornamental plants in Khartoum State, Sudan by focusing on gardening practices, verifying people's awareness of the environmental role of these plants, and studying species diversity within major ornamental groups namely; cacti and ornamental palms. Data were collected through structured questionnaires with both gardeners and the general public. The results showed that gardening practices as well as interest in ornamental plants have grown rapidly in recent decades and that most of the gardeners belong to young adults (21-40) with a sex ratio of 1: 1. Aesthetic values and combating desertification have been reported as the most important roles of ornamental plants. The remarkable diversity of ornamental plants in cacti and royal palms is attributed to the adaptive ability of their species to grow in the hot and dry environment of the study area, the simplicity of their reproduction and their profitable sales.

Key words: Sudan; ornamental plants; gardening practices; environmental roles.

1. Introduction

Ornamentals constitute a group of plants employed by humans throughout history [1]. Ornamental plants can be defined in many ways but the main criterion of all is their aesthetic value i.e. they are plants primarily grown for their beauty either for screening, accent, specimen, color or aesthetic reasons.

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The value of ornamental plants is not only aesthetic and decorative, but also of great environmental and economic through the production of cut flowers and contribute to the production of medical and aromatic materials [2]. Urban trees improve air quality, cool local air temperatures, filter and retain storm water, sequester carbon, and contribute to healthier and more beautiful cities. Common ornamental features include leaves, scent, fruit, stem, and bark [3]. Sudan is characterized by its climatic conditions that are very suitable for various ornamental plants. In addition, the difference between the different parts of the country in terms of soil types and climatic factors resulted in a great diversity of ornamental plants, both wild and cultivated. All this helps in establishing public and private gardens, to give our lives happiness and pleasure [4]. Recently, human interest in growing ornamental plants has increased all over the world. Ornamental nurseries in Sudan have become a general feature on the sides of most streets, especially in major cities, but despite this and according to our best knowledge, scientific studies that investigate this area in Sudan are lacking. This is perhaps the motivation for conducting the present study. This study aimed to shed light on gardening practices in Khartoum State, to verify people's awareness of the environmental importance of these plants, and to study the diversity of plant species within two main ornamental groups, namely, cacti and ornamental palms.

2. Materials and Methods

2.1. The study area

Khartoum, the capital of Sudan, is located between latitudes 15°26' and 15°45' N and longitudes 32°25' and 32°40' E, at an altitude of 405.6 m above sea level. The terrain is generally flat or gently sloping, only interrupted by occasional hills of rocky outcrops while sand dunes provide a gently undulating topography. The White Nile has a much lower gradient than the Blue Nile and consequently its terraces rise far more gently [5]. The main climatic conditions of Khartoum are conditioned by its location on the southern fringes of the Sahara. The city experiences four climatic seasons [6]. The winter season extends from mid-November to March, with clear skies, cool and dry air from the north-east, a minimum temperature ranging between 8°C and 10°C which falls to 5°C during night, and maximum temperatures varying from 23°C to 25°C, and a relative humidity which may sometime be as low as 20 per cent. The hot, dry summer season is well in place by the end of March. The maximum temperatures may exceed 45°C by the end of May. Weather instability is indicated by the recurrence of dust storms. The rainy season covers the period from July to September, with August being the rainiest month. Generally, annual rainfall ranges between 110 and 200 mm, but a minimum of only 4 mm was recorded in 1984 and an exceptional maximum of 420 mm in 1988. A short, hot (about 40°C) transitional season occurs between mid-September and the beginning of winter. This changeover season from south-westerly to north-easterly winds is accompanied by dust storms.

2.2. Data collection

The study was conducted during the years 2017 and 2019 in Khartoum State, which consists of three towns: Khartoum, Omdurman, and Khartoum North. Ten nurseries were randomly selected in each of the three towns of the state to make a total of 30 nurseries. The data were collected through structured questionnaires with the operators (gardeners and nursery owners). Pilot visits were made to a few nurseries to validate the questionnaire

and improve any weakness. The questionnaires focused on gardening practice - in terms of the gardeners' gender, age groups, and experiences -, the environmental roles of ornamental plants, and the diversity of species within two ornamental groups: cactus and ornamental palms. Special emphasis on these two groups came from the fact that they are the most abundant in term of species in gardens as observed during the pilot visits. Besides gardeners, 30 local families were questioned in order to investigate their perception about the environmental roles of ornamental plants and compare their results with those of gardeners to see if there is any difference. All the distributed questionnaires were answered, and returned. All the obtained data were tabulated and subjected to statistical analysis using Microsoft Excel version 2013.

3. Results and discussion

3.1. Gardening practices

According to gender, the results of the survey showed that males and females are equally involved, i.e., with the same ratio (15 M :15 F), in operating and managing ornamental nurseries. This is in agreement with the finding of [7] and [8], both in Nigeria, who reported the involvement of both genders in the practice, but with varying ratios (32 M: 68 F) and (73 M: 27 F) respectively. As shown in Figure (1), gardeners belong to different age groups ranging from 20 to 100 years, but the youth group (21 to 40 years) dominates significantly (67%). This great superiority of the youth category may seem reasonable in light of the fact that the elderly, especially those over the age of seventy, are physically less able to engage in such a practice. However, the finding may indicate that this practice could satisfy the financial aspirations of these young people who are at the beginning of their career. This result supports the finding of [7], who reported that respondents with the age group (31 to 40 years) were predominant in gardening practice in Southern Edo State in Nigeria.

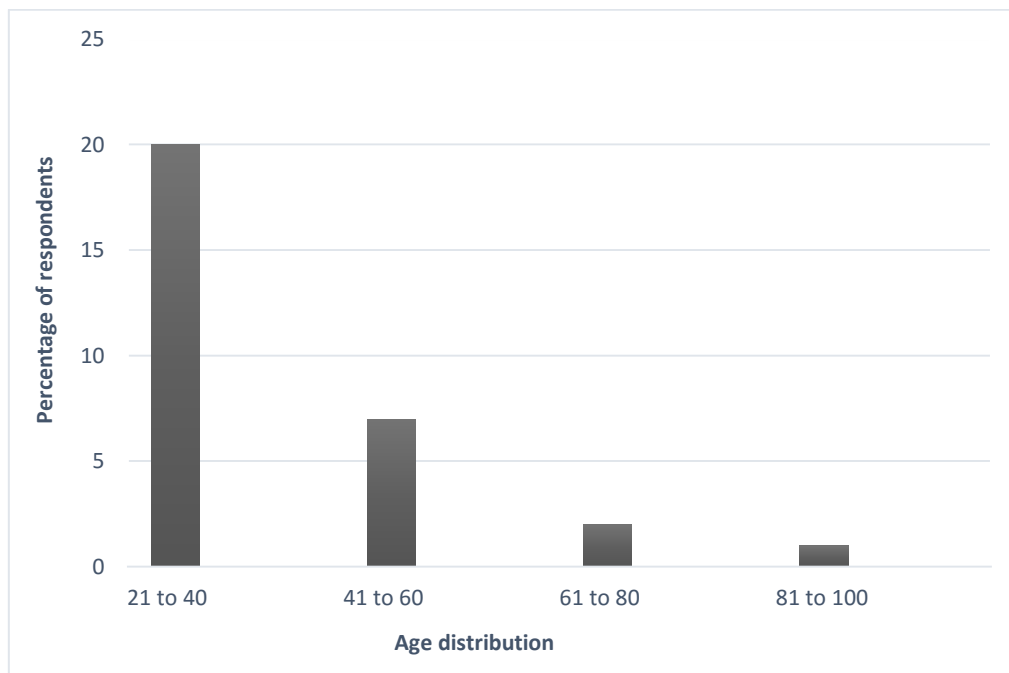


Figure 1: Age distribution of respondents

In regard to the field of specialization (education background), the results illustrated that 25 out of the 30-informants (83%) are specialized in this field i.e., horticulturists or at least they have education background of plant sciences. This means that education is a major factor in developing this culture in the society. The rest (17%) came from other different backgrounds and most of them were attracted to this practice because of the involvement of some of their relatives or friends. With regard to work experience, as shown in Figure (2), there is a clear variation in years of experience with most informants falling in the range of 1-10 years. It is clear that this difference is mainly due to the difference in the ages of the respondents, as most of those with more than 10 years of experience are elderly, while most of those with less than that are young graduates. But these extended years of experience confirm an important fact that this practice is not a temporary practice that people resort to as a secondary option, but rather a permanent investment.

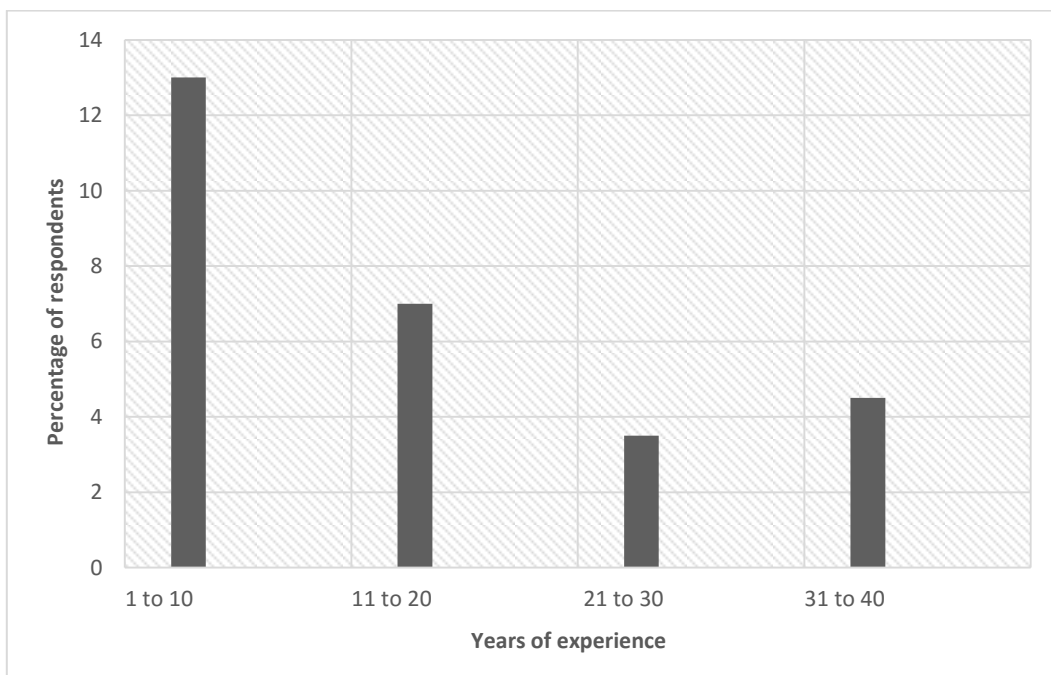


Figure 2: Years of experience of respondents

According to the informants, and as shown in Figure (3), there is a clear increase in the number of gardens that were established in recent decades compared to the past. This was evident in the high percentage of gardens founded after the year 2000 (77%) compared to those established before. This tremendous trend in this practice may explain an increasing interest among local people in ornamental plants and the overspread of this culture in the society. This result is in agreement with several ethno-botanical studies (e.g., [9]; [10]; [11]) that link the recent popularity of urban gardening to the shift from rural mode of life to more modern life style particularly in areas where the influence of West European culture is quite strong and hence the ideas of ecology and community are accepted.

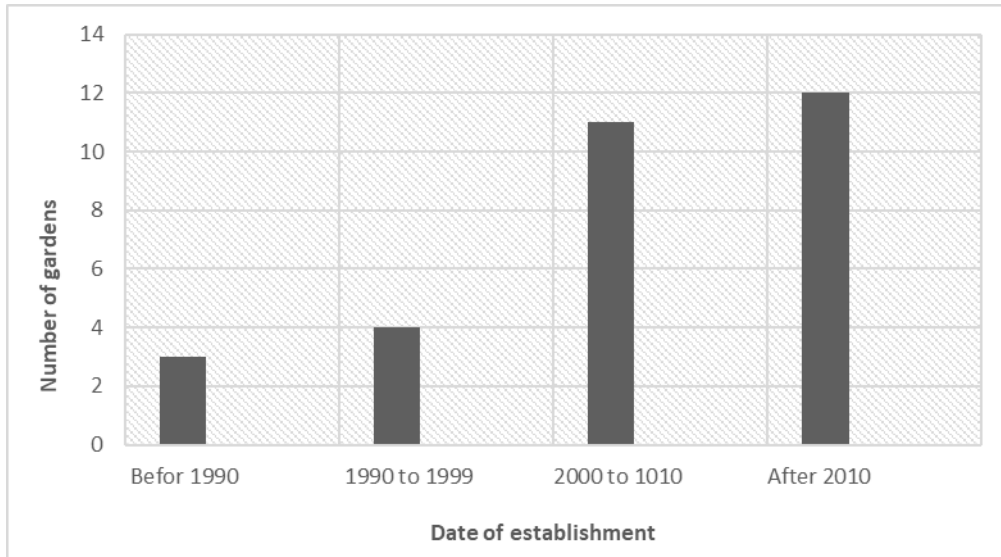


Figure 3: The pattern of growth in garden numbers over time

3.2. Diversity of ornamental plants

For the two ornamental groups under study, i.e., the Cacti and Royal palms, a total of 36 ornamental species were identified (22 cacti species and 14 ornamental palm species).

3.2.1. Cacti and Succulent

According to Fig. 4 and Table 1, all of the 22 reported ornamental species are distributed among 10 families with clear superiority of the species that belong to Agavaceae (26%) and Cactaceae (20%). Table 1 also indicates that most of these species are shrubs and that the most widely used method of propagating them is by offsets. Among the Agavaceae, the species of the two genera: Agave and Yucca are the most common as they represent the most abundant species in over 70% of the surveyed gardens, while the abundance of other species varies from garden to garden. On the other hand, the most abundant species of the Cactaceae family in gardens are those of the genus: Cereus by 40%. The predominance of Agavaceae and Cactaceae over other families can be attributed to their high ability to adapt well to growing in the hot and dry environments that characterize the study area "Khartoum". Other reasons for their dominance, as reported by gardeners are: the simplicity of the methods of their propagation, as most of them can be propagated vegetatively by offsets, cutting, or both methods (table 1), and most importantly, their high commercial value because they are among the best-selling ornamentals in the study area. The wide distribution and dominance of ornamental succulent was reported from many parts of the world. According to [12], Cacti are conspicuous elements of the Western hemisphere; they have long attracted attention due to their peculiar biology, and have maintained close relationships with local settlers. Also, as reported in [13] and [14], cacti are distributed in nearly every ecological region in the Americas, even in rainforests. However, the highest diversity is concentrated in arid and semi-arid regions located between 35° north and south latitudes, and from sea level to 5,000 m. According to [15] Cactaceae is endemic to the Western hemisphere, except for *Rhipsalis baccifera* which is also found in Africa and Asia, it comprises 124 genera and 1,427 specie and the most usage propagation method among the species of the group

is the offsets and common growing habit is shrub.

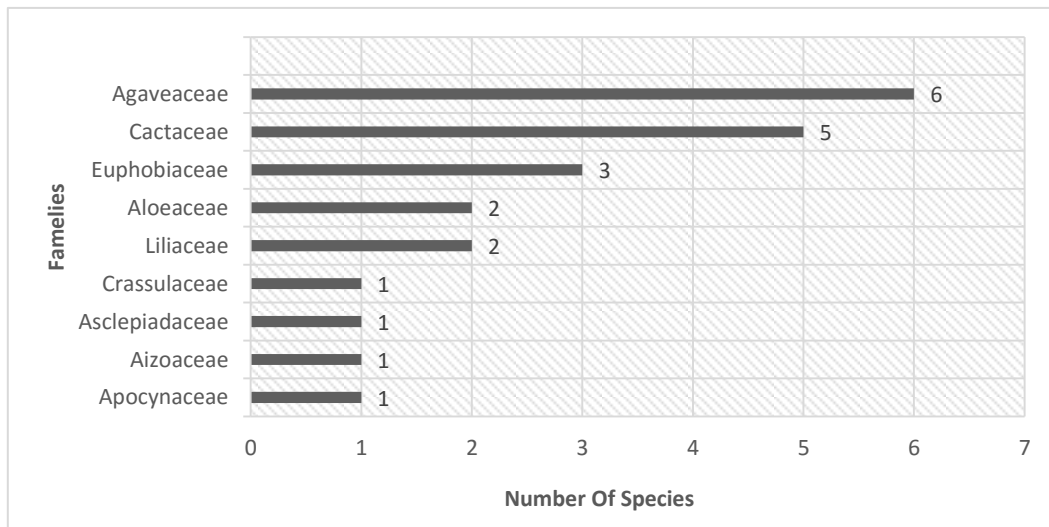


Figure 4: Distribution of cacti species among plant families

Table 1: List of ornamental plants reported in the cacti group and some of their characteristics.

Scientific name	Common name	Family	Main Mode of Propagation	Growth habit
<i>Aloe arborescens</i>	Krantz aloe	Aloeaceae	Off-sets	Shrub
<i>Aloe varigata</i>	Tiger aloe	Aloeaceae	Off-sets	Shrub
<i>Agave Americana</i>	Centry plant	Agaveaceae	Off-sets	Shrub
<i>Agave attenuate</i>	Lionstail, Foxtail	Agaveaceae	Off-sets	Shrub
<i>Opuntia ficus-indica</i>	Pirckly pear	Cactaceae	Cutting	Shrub
<i>Euphorbia milii</i>	The crown of thorns	Euphobiaceae	Off-sets	Shrub
<i>Euphorbia schottiana</i>	Lion's tail	Euphobiaceae	Off-sets	Shrub
<i>Euphorbia arahaka</i>	Angel	Euphobiaceae	Off-sets	Shrub
<i>Kalanchoe marmorata</i>	Penwiper	Crassulaceae	Offsets	Shrub
<i>Sansevieria trifasciata</i>	Snake plant or mother-in-law's tonghe	Agaveaceae	Off-sets and Cutting	Shrub
<i>Sansevieria cylindrica</i>	Snake plant or African spear	Agaveaceae	Off-sets and Cutting	Shrub
<i>Yucca aloifolia</i>	Aloe yucca	Agaveaceae	Off-sets	Shrub
<i>Yucca gloriosa</i>	Adam's needle	Agaveaceae	Off-sets	Shrub
<i>Cereus chalybaeus</i>	Night-blooming cereus	Cactaceae	Off-sets	
<i>Cereus peruvianus</i>	The Peruvian apple cactus	Cactaceae	Off-sets	Shrub or tree-like
<i>Echinocacereus undatus</i>	Dragon fruits	Cactaceae	Off-sets	Shrub
<i>Stapelia gigantean</i>	Carrion plant or zuluginant	Asclepiadaceae	Offsets and Cutting	Shrub
<i>Mesembryanthemum</i>	Ice plant	Aizoaceae	Cutting	Shrub
<i>Gasteria maculate</i>	Ox-tongue	Liliaceae	Off-sets and cutting	Shrub
<i>Haworthia fasciata</i>	Zebra cactus	Liliaceae	Cutting	Shrub
<i>Mammillaria compressa</i>	mother of hundreds	Cactaceae	Off-sets	Shrub
<i>Adenium obesum</i>	The desert rose	Apocynaceae	Off-sets and cutting	Shrub

3.2.2. Ornamental Palms

As shown in table (2), 14 ornamental palm species were listed. All the species belong to only two plant families, Arecaceae and Cycadaceae, with a clear superiority of the members that belong to Arecaceae family (12 species). The most abundant species in term of number/garden was observed to be: *Oreodoxaregia*. The large dominance of Arecaceae species may be attributed mainly to the large number of species that belong to this family, however, informants believe that the high adaptability of this species to grow in the hot and dry environment that characterizes the study area, Khartoum State, along with their economic profitability may be other reasons. This finding is in line with that of [16] in central-western Brazil, who attributed the high value of this family to the diversity of its species, its occurrence in a wide range of habitats, and its status as an integral part of the culture and family-based economy of many traditional and non-traditional societies. Another survey conducted by [17] in Ghana showed that All nurseries surveyed produced at least 15 different species of plants belonging to various families, the Arecaceae family was the most popular and had the greatest number of species. Unlike the listed cacti and succulents, which are mostly shrubs, most of the listed species of this group are trees and the most common method of their reproduction is seeding as in Table 2.

Table 2: List of ornamental plants reported in the royal palm group and some of their characteristics.

Scientific name	Local name	Family	Main Mode of Propagation	Growth habit
<i>Oreodoxa regia</i>	Royal palm	Arecaceae	Seeds	Tree
<i>Ravenala madagascariensis</i>	Travellers palm	Arecaceae	Off-sets	Tree
<i>Livistona chinensis</i>	The Chinese fan palm or fountain palm	Arecaceae	Off-sets	Shrub
<i>Washingtonia filifera</i>	The fan palm	Arecaceae	Seeds	Tree
<i>Chamaedorea elegans</i>	Parlour palm	Arecaceae	Seeds	Shrub or tree-like
<i>Areca alicae</i>	Areca nut palm or betal	Arecaceae	Off-sets	Tree-like
<i>Kentia belmoreana</i>	Howeafosteriana	Arecaceae	Seeds and Off-sets	Tree
<i>Sabal palmetto</i>	Cabbage-palm or sabal palm	Arecaceae	Seeds	Tree
<i>Phoenix canariensis</i>	Canary palm	Arecaceae	Seeds	Tree
<i>Hyophorbelagenicaulis</i>	Bottel palm or palmist gargoulette	Arecaceae	Seeds	Tree
<i>Rhapis excels</i>	Broadleaf lady palm or bamboo palm	Arecaceae	Seeds	Shrub
<i>Caryotalmitis</i>	The clustering fishtail palm	Arecaceae	Seeds and Off-sets	Tree
<i>Cycas revolute</i>	Sago cycad	Cycadaceae	Seeds and Off-sets	Shrub
<i>Zamia decumbens</i>	Sinkhole cycad	Cycadaceae	Off-sets	Shrub

3.3. Roles of Ornamental Plants in Environment

As shown in Figure 4, both the two groups of informants i.e., gardeners and local inhabitants, recognized the importance of the environmental roles played by ornamental plants. The difference between the two groups is

clearly very slight in terms of the overall ranking of these environmental roles. In both cases, aesthetic value, combating desertification, and air improvement were reported as being the most important. However, aesthetic value was ranked first by the local population, while gardeners considered combating desertification as the most valuable. On the other hand, windbreaks and carbon sinks were ranked at the bottom of the list, noting that the latter received very little attention from local residents compared to gardeners. These slight differences between the two groups regarding the environmental roles of ornamental plants may be due to differences in educational background since most gardeners have a botanical background and can thus assess the matter from a more scientific perspective. Several environmental studies from other parts of the world have reported on the important environmental roles that ornamental plants play e.g., [18] revealed that the respondents in Southwestern Nigeria claimed that ornamental plants arrest dust, supplies oxygen and help as wind break and believed that plants reduce erosion and protect the environment from other natural hazard. According to a study conducted by [19] in India, the use of ornamental plants, herbaceous trees and greenery as natural filters for air pollution reduces respiratory disease mortality rates and reduces hospital visits.

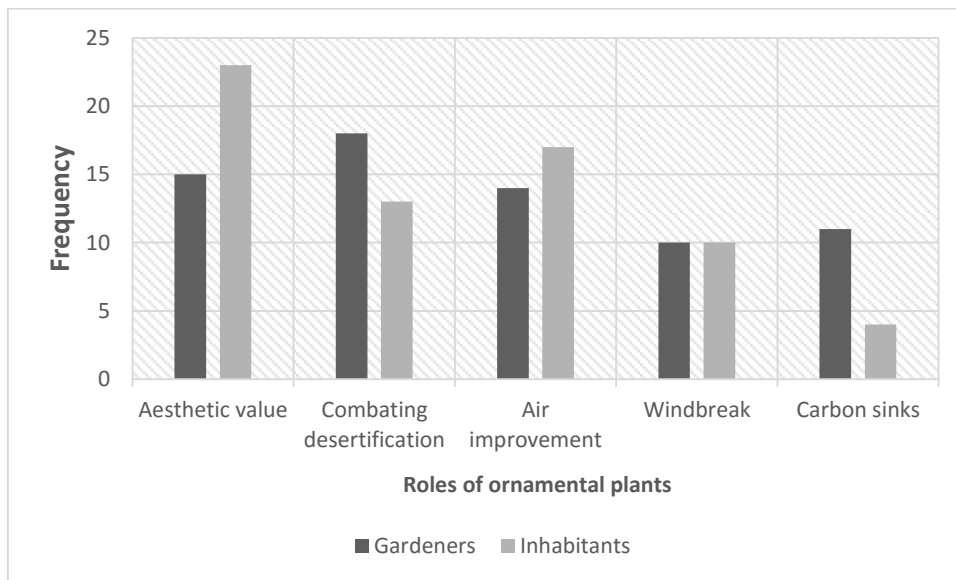


Figure 5: Environmental Roles of ornamental plants

4. Conclusion

This study concluded that awareness and interest in ornamental plants has increased in Khartoum State during the past two decades, which prompted many people of both genders and different age groups to invest in this field. Aesthetic values and combating desertification have been reported as the most important roles of ornamental plants. The remarkable diversity of ornamental plants within cacti and royal palms was attributed to the adaptive ability of their species to grow in the hot and dry environment of the study area, the simplicity of their reproduction and their profitable sales.

5. Recommendation

This study recommends further scientific studies in this field to bridge the gap in information about ornamental

plants and horticultural practices in Khartoum State, in order to provide a database upon which future plans and strategies can be based.

Acknowledgement

The authors sincerely thank Dr. Elnasri Mutwali, Department of Biology at Alzaeim Alazhari University, for his encouragement throughout the study period. We also thank the gardeners and locals in the study area for their positive attitudes and cooperation.

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