Short Communication:
Local perceptions about utilization of invasive alien species *Opuntia ficus-indica* in three Local Municipalities in the Eastern Cape Province, South Africa

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Manuscript received: 8 February 2020. Revision accepted: 26 March 2020.

**Abstract.** Mdweshu L, Maroyi A. 2020. Short Communication: Local perceptions about utilization of invasive alien species *Opuntia ficus-indica* in three Local Municipalities in the Eastern Cape Province, South Africa. Biodiversitas 21: 1653-1659. *Opuntia ficus-indica* is a succulent plant species categorized as invasive in South Africa but has both commercial and non-market uses. This study evaluated local people’s perceptions about utilization of *O. ficus-indica* in three local Municipalities in the Eastern Cape province of South Africa. Data on the local perceptions on *O. ficus-indica* in the study area were documented through focus group discussions and semi-structured interviews via questionnaires with households between June 2018 and August 2019. A sample of 150 participants chosen using snowball-sampling method provided information on utilization of *O. ficus-indica*. The importance of *O. ficus-indica* as a useful plant species was ubiquitously perceived, with all participants reporting its contribution as an important component of their livelihood needs and more than three quarters (88.0%) were using the species on a regular basis. Close to half of the respondents (49.3%) regarded *O. ficus-indica* as an important source of cash income. The positive socio-economic contributions of *O. ficus-indica* need to be taken into account when evaluating the costs and benefits resulting from invasions caused by alien plant species.

**Keywords:** Local community, *Opuntia ficus-indica*, perceptions, South Africa, succulent plant, traditional knowledge

**INTRODUCTION**

*Opuntia ficus-indica* (L.) Mill. is a succulent species that belongs to the Cactaceae or cactus family. *Opuntia ficus-indica* originated in Mexico and the neighboring middle-America but the species is now categorized as an invasive alien plant species in South Africa where the species has been part of the country’s landscapes for over 250 years (Shackleton et al. 2011; Shackleton 2012). Therefore, *O. ficus-indica* is an appropriate species to be used as a model to assess local people's perceptions about the detrimental or beneficial characteristics of an invasive alien species. As invasive species move and occupy new areas or regions, usually their movement results in negative effects on economic, social and/or ecological systems (Van Wilgen and Wannenburgh 2016). The invasive alien species are known to be the major causes of global environmental change and are indicated as the second largest cause of species threat and extinction where there is destruction of the natural habitat (Pejchar and Money 2009). The invasive alien species also pose a serious threat to natural ecosystems that provide basic human securities such as health, food, shelter, good social relations and freedom (Scoones 2009). Research by Shackleton and Shackleton (2018) emphasized the importance of assessing the positive and negative impacts of alien plant species. Some researchers also argue that several invasive species are important to local communities mainly because local people derive direct benefits from invasive alien species (Shackleton et al. 2019). Research by Rai et al. (2012) and Atyosi et al. (2019) showed that some alien plant species serve as pioneer communities and are also used as organic compost by some farming communities. Rai et al. (2012) argued that alien plant species such as *Chromolaena odorata* (L.) R.M. King & H. Rob. are widely used as compost and green manure in Nepal and are known to improve both the physical and chemical properties of the soil.

The increase in trade, transportation of goods and humans led to the increased movement of many alien species (Lindemann-Matthies 2016). As humans take an active part in the introduction, establishment, and spread of invasive species, it is necessary to understand human perceptions and choices regarding the use and management of invasive species (Bardsley and Edwards-Jones 2007; Keller et al. 2011; Bennett 2016; Nanayakkara et al. 2018; Potgieter et al. 2019; Shrestha et al. 2019; Wald et al. 2019). The term perception is defined as the process by which each individual person organizes, selects and assesses the sensory stimulations from the external living and non-living environment to provide meaningful experiences to different individuals (Atmakja and Sills 2016). Other researchers like Schermherhorn et al. (2002) and Shackleton et al. (2019) defined perceptions as processes where individuals organize, select, retrieve,
respond and interpret obtained information from the environment around them to produce mental impressions and constructions which lead to particular behaviors and actions. Therefore, perceptions are usually influenced by social-ecological factors, including socio-economic characteristics of local people, the biology and ecology of invasive species, economic factors and social influences (Shackleton et al. 2019). It is within this background that this study was carried out aimed at investigating the local people’s perceptions about utilization of *O. ficus-indica* in three local Municipalities in the Eastern Cape province of South Africa. We will address the following research questions: which are the most important uses of *O. ficus-indica* locally? How does utilization of *O. ficus-indica* contribute to the livelihood needs of local people?

This study is premised on developing an understanding of local knowledge and perceptions about *O. ficus-indica*. Such human and social dimension is important for effective management of invasive alien species as many control, eradication or prevention programs have been delayed or even failed due to differing public attitudes and feelings towards targeted invasive species (Meyer and Fourdrigniez 2019). Proponents of people-centered approaches to invasive alien species management (Santo et al. 2015; Lurgi et al. 2016; Bravo-Vergas et al. 2019; Martínez and Manzano-García 2019) argue that this management strategy is premised on ensuring social equity in conservation as it minimizes conflict between local communities and conservation organizations. Therefore, the negative and positive impacts of invasive alien species could be reliably assessed through an evaluation of local knowledge and the social benefits associated with such species.

**MATERIALS AND METHODS**

**Study areas**

The research focuses on three local municipalities within the Eastern Cape province in South Africa, the Makana, Ngqushwa and Raymond Mhlaba Local Municipalities (Figure 1). The population density of Ngqushwa (32 people per km²) is significantly higher than that of Raymond Mhlaba (24 people per km²) and Makana (18 people per km²) (Statistics South Africa 2016). The climate of the study area is mild with unevenly distributed annual rainfall received during summer months from October to March. Annual rainfall ranges from 500 mm to 1000 mm while temperature ranges from 4°C in July to 38°C in February (Jari and Fraser 2012; Manyevere et al. 2014). In spite of unfavorable agro-ecological conditions, households practice both livestock husbandry (Ndhleve et al. 2013) and are involved in the production of maize, sorghum, potatoes, cabbage, spinach, beetroot and carrots. The residents also rely on natural plant resources for a diversity of livelihood needs (Alexander et al. 2015). The vegetation of the study area was described by Mucina and Rutherford (2006) as succulent thicket and grassland biomes.

**Data collection**

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. The current study documented local people’s perceptions about utilization of *O. ficus-indica* in Makana, Ngqushwa and Raymond Mhlaba Local Municipalities, a species that
has been in usage in the region since the 1770s (Annecke and Moran 1978). One hundred and fifty participants selected from Makana, Ngqushwa and Raymond Mhlaba Local Municipalities through snowball or chain sampling (Heckathorn 2011) were interviewed between June 2018 and August 2019. The questionnaire emphasized socio-economic characteristics of the participants and the following aspects meant to assess participants’ perceptions on the biology, use values and management of O. ficus-indica as a declared invader plant species according to the South African National Environmental Management: Biodiversity Act 2004 (Government Gazette 2004): (i) Are there any O. ficus-indica plants in this village? If yes, is the species common in the village? (ii) Do you know any uses of O. ficus-indica? (iii) Who uses these products? How do users obtain these products? (iv) Do you know that O. ficus-indica is a weed? If yes, how do you know about this? (v) Do you think that O. ficus-indica should be eradicated? If yes, how do you think this can be done? (vi) What is your opinion about categorization of O. ficus-indica as a weed in South Africa?

In terms of the questions on the perceptions on the biology, use values and management of O. ficus-indica, these were open-ended so as to avoid leading the participants. The responses from the PRA interviews and focus group discussions (FGD) were written down in a notebook as well as tape-recorded.

Data analysis
Some of the data in this study were explained directly because these data were descriptive and qualitative in nature. However, some interview data were coded, divided into themes using content analysis (Msuya and Wambura 2016; Erlingsson and Brysiewicz 2017). Responses from the questionnaire and FGDs were analyzed by identifying similar phrases, patterns, sequences, relationships and differences as outlined by Erlingsson and Brysiewicz (2017).

RESULTS AND DISCUSSION
Socio-economic characteristics of the respondents
The majority of the participants (54.0%) who provided information on their perceptions about the biology, livelihood uses, and management of O. ficus-indica in the study areas were females while 46.0% were males. About two-thirds of the respondents (67.3%) were between 31 years to 60 years, while 14.0% were below 31 years and 18.7% were above 60 years of age. About a third of the participants, 32.0% and 34.7%, were married and single, respectively, while 24.7% were widowed and 8.7% were divorced. The majority of families (68.0% of households) comprised between one and five household members, while 26.0% comprised of six to ten household members and 6.0% had more than ten household members. Most of the respondents were educated up to primary and secondary level (42.7% and 44.0%, respectively) and less than ten percent were either illiterate or educated up to tertiary level (5.3% and 8.0%, respectively). The majority of the participants (56.0%) were unemployed, 26.7% were self-employed, 13.3% employed by a private company and 4.0% employed by government. Close to a third of the participants were dependent on their pension (28.0%), while 23.3% of the participants were managing small informal businesses, 17.3% depended on remittances and 14.7% depended on government grants. The majority of participants (40.7%) had total annual income of R2 000.00 to R10 000.00 (US$142.86 to US$714.29) per month, 30.7% (>R10 000.00 (US$714.29), 18.7% (R200.00 to R1999.99 (US$14.29 to US$142.86) and less than ten percent had either monthly income not exceeding R199.99 (US$14.29) or did not disclose their income.

Perceptions and utilization of Opuntia ficus-indica
The importance of O. ficus-indica as a useful plant species was ubiquitously perceived, with all participants reporting its contribution towards their livelihood needs and more than three quarters (88.0%) using the species on a regular basis. Although 12.0% were not personally using O. ficus-indica, all respondents claimed that the species is one of the most useful natural resources in the province. Table 1 shows the respondents’ perceptions of benefits associated with O. ficus-indica. During FGDs and it was revealed that more than three-quarters of the respondents (79.3%) did not know O. ficus-indica is alien to South Africa, with most respondents expressing surprise when the researcher mentioned that it is originally from Mexico and the neighboring middle-America. Figure 2 shows the number of years the respondents have been using O. ficus-indica. The majority of respondents (32.0%) had been using the species for more than 13 years, followed by the respondents who have been using the species for 10 years to 12 years, and seven years to nine years with 23.0% and 21.0%, respectively. The minority (6.0%) of the respondents have been using the species for less than a year to three years (Figure 2). All the respondents argued that O. ficus-indica has been in use in the province for generations with a village in Raymond Mhlaba Local Municipality called “Tolofiyeni”, named after the vernacular name of O. ficus-indica.

Respondents provided a number of reasons to justify their attitudes and reasons regarding utilization of O. ficus-indica (Table 2). Majority of the participants (88.6% and 84.1%) argued that O. ficus-indica is required as an important source of livelihood needs and/or supplementing or complementing household food, fodder, income, hedge, fence, herbal medicines, homemade soap and beer brewing (Table 2). About 8.3% of the respondents emphasized the aesthetic role played by O. ficus-indica as hedge or live fence and the species is now regarded as an important component of the Eastern Cape province landscape. About 6.1% of the respondents argued that O. ficus-indica is now regarded as an integral part of the social and cultural framework for the local communities in the Eastern Cape with participants emphasizing the use of the species as herbal medicine, beer brewing and the fruits donated to
neighbors or used as gifts to relatives or neighbors (Table 2). Focus group discussions with the respondents revealed that usage of *O. ficus-indica* fruits was a form of cultural identity that is always attached to the species by the rural people as they had grown up eating the fruits. Some of the respondents argued that eating of the fruits is part of their tradition with all respondents perceived *O. ficus-indica* to have been there before they were born. Interviews with respondents revealed that processes of gathering and processing *O. ficus-indica* result in important social benefits as local people cooperate in these activities. The social interactions associated with gathering and processing *O. ficus-indica* could be the basis for community-based systems for managing plant resources. A small proportion of the respondents (1.5%) argued that there was need to highlight the fact that *O. ficus-indica* is an invasive alien species in need of monitoring and control, and there is need to participate in integrated clearing program of the species that is coordinated by Working for Water organization (Table 2).

These respondents argued that the Working for Water Programme significantly increased public awareness about alien species in the Eastern Cape, including *O. ficus-indica*. During FGDs, the respondents argued that *O. ficus-indica* was inextricably linked to local peoples’ food needs, nutrition, health, culture and landscape in a number of fundamental ways. Discussions with respondents during FGDs also revealed that *O. ficus-indica* helps to diversify the household economy, providing seasonal source of income between December and March every year. This small-scale processing and trade of *O. ficus-indica* make up an important part of the rural economy in the province. Interviews with the respondents revealed that the income generated through selling *O. ficus-indica* fruits is used for livelihood needs such as buying electricity, groceries, clothing, school fees, and uniform.

Table 1. Respondents’ perceptions of the benefits associated with *Opuntia ficus-indica* (n = 150). Some respondents indicated more than one response.

| Reasons | Response (%) |
|---------|--------------|
| Respondents deriving benefits from *O. ficus-indica* | |
| Households generate income from selling the fruits | 49.3 |
| Households making jam, syrup, chutney, and beer from the fruits | 20.7 |
| *O. ficus-indica* used as herbal medicine | 12.3 |
| *O. ficus-indica* used as live fence, hedge or ornamental plant | 5.3 |
| *O. ficus-indica* used as fodder | 4.7 |
| Respondents not benefiting from *O. ficus-indica* | |
| *O. ficus-indica* not useful to the community | 2.7 |
| There are challenges associated with harvesting and transporting *O. ficus-indica* | 8.6 |
| *O. ficus-indica* is no-long available in some communities | 3.3 |
| Selling *O. ficus-indica* fruits is not profitable as the prices are too low | 1.3 |

Table 2. People’s attitudes or reasons for using *O. ficus-indica* in Makana, Ngushwana and Raymond Mhlaba Local Municipalities in the Eastern Cape, South Africa (n= 132). Some respondents indicated more than one response.

| Major reason and specific components | (%) |
|-------------------------------------|-----|
| Supplementary role (as fodder, food, hedge, fence, beer brewing, herbal medicine, homemade soap and source of income) | 88.6 |
| Livelihood needs (as fodder, food, hedge, fence, herbal medicine and source of income) | 84.1 |
| Aesthetic role (hedge, live fence, ornamental and garden plant, and an important component of the Eastern Cape province landscape) | 8.3 |
| Cultural role (as herbal medicine, beer brewing, fruits donated to neighbors and used as gifts to relatives and neighbors) | 6.1 |
| An invasive alien species in need of monitoring and control | 1.5 |

**Discussion**

**Socio-economic characteristics of the respondents**

The average annual household income within the sampled community population was low as well as literacy levels with 48.0% either illiterate or educated up to primary level (Table 1) and this is probably due to limited education facilities within the study area. Makiwane and Chimeredan (2010) argued that quality of education in the Eastern Cape province is among the poorest in the country. The same authors argued that there have been some improvements in the educational profile of the provisional population but access to high-quality infrastructure for learning and other better models of human capital development in the province remain a challenge. Similarly, Hamann and Tuinder (2012) and Megbowon and Mushunje
(2018) argued that the levels of education, skills base, infrastructure, healthcare services and poverty in the province are the worst in the country in comparison to other provinces in the country. The authors argued that these socio-economic problems in the province cannot be separated from the lasting legacy of the Apartheid government. Hamann and Tuinder (2012) noted that one of the Apartheid government’s acts of segregation was the Bantu Authorities Act of 1951 which legalized the deportation of blacks into designated homelands or “Bantustans” like Ciskei where two of the study sites Ngqushwa and Raymond Mhlaba Local Municipalities are located. Research by Paungarten et al. (2005) revealed that the majority of the areas in the former homelands such as Ciskei and Transkei in the province are characterized by a strong reliance on migrant remittances and state pensions, low economic activity, low levels of education and poor skills base.

Perceptions and utilization of O. ficus-indica

A significant number of respondents (88.0%) emphasized the importance of O. ficus-indica to the livelihood needs of the local people in Makana, Ngqushwa and Raymond Mhlaba Local Municipalities. Local communities have incorporated O. ficus-indica into their livelihoods which resulted in respondents not knowing that the species is an alien. To the local communities in Makana, Ngqushwa and Raymond Mhlaba Local Municipalities, O. ficus-indica is categorized or recognized like any other indigenous useful plant species in the province. Such a perception was observed by dos Santos et al. (2014) who argued that there is often no differentiation by local communities between invasive alien species and native species as local communities often focus on the ecosystem goods and services provided by such species. Research findings from the current investigation corroborate previous studies which showed that invasive alien plant species may also have positive socio-economic benefits (Zimmermann and Neser 1999; Njoroge et al. 2004; Bigirimana et al. 2011, 2012; Semeny et al. 2012a,b; Maroyi 2017a,b, 2018; Semeny and Maroyi 2018). Borokini and Babalola (2012) argued that economic exploitation of invasive alien species is usually labor intensive and menial jobs are usually created while providing additional means of income for local communities. Similarly, Sladonja et al. (2018) argued that invasive alien plants can be used as catalysts for ecosystem restoration, source of bioenergy, honey, fiber, ornamental plants, and herbal medicines. Exotic plant species are now regarded as an important component of traditional pharmacopeia in many developing countries (Bennett and Prance 2000; Alencar et al. 2010, 2014; Borokini and Babalola 2012; Maroyi 2018; Semeny and Maroyi 2018; Sladonja et al. 2018).

For the poor households, collection of O. ficus-indica is a means of coping with food-supply, nutrition and cash income needs (Palmer 2004). Households living near suitable habitats for O. ficus-indica are typically most dependent on the species and these people are the most active collectors of O. ficus-indica in the study area. In several villages within Makana, Ngqushwa and Raymond Mhlaba Local Municipalities, the collection and gathering of O. ficus-indica were used as a means to manage poverty and to empower local community development in different ways including community engagement, income-generating activities and cultural diversity. There is no doubt that the production of O. ficus-indica will enable poor households to continue to exploit the full potential of the species.

In conclusion, this study showed that although O. ficus-indica is listed as a weed, category 1b invader in the National Environmental Management Biodiversity Act No. 10 of 2004 (Annecke and Moran 1978; Government Gazette 2004) in South Africa, the species has positive economical, social and ecological impacts in the study area. These socio-economic contributions of the species need to be taken into account when assessing the costs resulting from invasions caused by alien plant species. This research provides baseline information regarding utilization of O. ficus-indica in the Eastern Cape province and the utilization pattern of the species and can be easily applied to other useful invasive plant species. Based on the results of this study, the policymakers, government officers, agricultural extension officers, non-governmental organizations (NGO), conservation managers and future researchers on the species need to address these concerns and attempt to find a balance between removing the species because of its invasive characteristics and the associated negative ecological impacts on ecosystem services and biodiversity; and the need to keep the species, particularly where O. ficus-indica invasions are not significant, but the species is used to fulfill the livelihood needs of the local communities.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to Govan Mbeki Research and Development Centre (GMRDC), University of Fort Hare, South Africa for financial support.

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