



KEYHOLE GARDENS SYSTEM ASSOCIATED WITH TREES FOR FAMILY FARMING AND FOOD SECURITY IN IBO ISLAND, NORTHERN MOZAMBIQUE

SISTEMA DE JARDINES OJO DE CERRADURA ASOCIADO CON ÁRBOLES, PARA LA AGRICULTURA FAMILIAR Y LA SEGURIDAD ALIMENTARIA EN LA ISLA DE IBO, NORTE DE MOZAMBIQUE

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ABSTRACT

The Keyhole garden is a system based on raised bed cropping, it can promote a cheap and suitable technic for family vegetable production that can be done beside existing fruit trees, thus increasing food security and reduce the dependence from imported items. Ibo island has a density of population about 147 people per km² and their number increases much due to migration from the mainland and to the many foreign tourists. Despite the high number of people, food production is mainly fishery, agriculture is disfavoured by the rocky shallow and arid soil and because of soil salinity close to the sea. Some fruit trees are able to grow but very few vegetables can be grown. Agricultural foods are imported from the mainland. Research has been done in 2015-2016, building some keyhole gardens with local materials or cement blocks, choosing with a participative approach the vegetable species to grow, and listing the tree species that can be associated with Keyholes planted in dug pits. The research was planned at the University of Florence (Italy) and supported locally by Italian NGO *Istituto Oikos* within the *Pemba Verde* project and held in *Alemo association*, Pemba, Cabo Delgado. The research has risen great response and interest in local people, has identified some of the most suitable vegetable crops, and some of the most convenient fruit trees to associate with the vegetable production in Keyholes.

Keywords: food production, vegetable crops, fruit trees, local materials, development

RESUMEN

El huerto en forma de cerradura es un sistema basado en el cultivo en canteros, puede promover una técnica barata y adecuada para la producción familiar de verduras que se puede realizar junto a los frutales existentes, lo que aumenta la seguridad alimentaria y reduce la dependencia de los artículos importados. La isla de Ibo tiene una densidad de población de aproximadamente 147 personas por km² y su número aumenta mucho debido a la migración desde el continente y a los numerosos turistas extranjeros. A pesar del alto número de personas, la producción de alimentos es principalmente pesquera, la agricultura se ve desfavorecida por el suelo rocoso, poco profundo y árido, y por la salinidad del suelo cerca del mar. Algunos árboles frutales son capaces de crecer, pero muy pocas verduras. Los alimentos agrícolas se importan del continente. Se realizó una investigación en 2015-2016, se construyeron huertos en forma de ojo de cerradura con materiales locales o bloques de cemento, se eligieron con un enfoque participativo las especies vegetales que se cultivarán y se enumeraron las especies de árboles que se pueden asociar con los huertos en forma de ojo de cerradura plantados en pozos excavados. La investigación se planificó en la Universidad de Florencia (Italia) y contó con el apoyo local de la ONG italiana *Istituto Oikos* en el marco del proyecto *Pemba Verde*, y se llevó a cabo en la asociación *Alemo*, Pemba, Cabo Delgado. La investigación ha suscitado una gran respuesta e interés entre la población local, y ha permitido identificar algunos de los cultivos de hortalizas más adecuados y algunos de los árboles frutales más convenientes para asociarlos a la producción de hortalizas en huertos en forma de cerradura.

Palabras clave: Producción de alimentos, cultivos de hortalizas, árboles frutales, materiales locales, desarrollo

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INTRODUCTION

Food insecurity in Mozambique is linked to climate, geography, social conditions, and it is worse in rural areas and in the north of the Country. Agronomic causes are the unfertile soil, lack of selected seeds, little crop diversification and lack of financial resources to invest (Vunjanhe & Adriano, 2015). Ibo island is inhabited by about 7061 people with a density of 147 inhabitants per km², the population increases yearly due to migration from mainland and seasonally due to tourism from abroad (*Início - Portal do Governo da Provincia de Cabo Delgado*, 2016).

The vegetation is scattered with herbs and little trees including guava, mango, lemon, orange, papaya and the most important coconut. Trees (especially mangroves) are also building material and fuel and their number is reducing due to overexploitation. Agriculture in Ibo Island is the second income source after fishing however at the moment it is considered more for the self-subsistence of the family than a commercial activity. Subsistence agriculture is done by small groups of families in small farms on average 0.5 to 1 ha, they normally use intercropping systems with cassava and grain legumes such as cowpeas and groundnuts. Too few fruit trees are left on the land. The livestock is little and in little number (*Início - Portal do Governo da Provincia de Cabo Delgado*, 2016).

Agriculture in the island is very disfavoured by environmental constraints, the islanders use to live on marine food with little dietary diversification. Even home gardens are difficult to rise because the soil is shallow, rocky, salty (Molinero et al., 2010). Stones removal is obviously advisable but difficult by hands and costly by machinery. In this harsh environment the Keyhole Garden technology can provide small areas with good soil, organic wastes recycle, easy weed management, and consequently is a starting point for family run agriculture. Keyhole Gardens are a kind of raised-bed agricultural system useful where the area available is limited and soils are not good (Allen, 2018), they are so called because of their shape when viewed from above.

Keyhole gardens were developed in the 1990's by C-SAFE (Consortium for Southern Africa Food Security Emergency) in Lesotho, they were designed to help people living with HIV/AIDS and poverty to survive using local resources to build sustainable gardens (Bonti-Ankomah, 2001). From this beginning the keyhole system spread to several Countries (Stahlman & Austin, 2013).

The structure is circular, made of rocks or concrete blocks, 1 -1.2 meters high and 2-3 meters wide, good soil is put into the structure and enriched with compost. The keyhole requires little maintenance for up to five years, after the central composting basket has to be rebuilt (Stahlman & Austin, 2013). Vegetables are grown inside much closer than in open field agriculture.

The overall objective of our research was to promote family vegetable production and consumption on Ibo Island. Specific tasks were: to engage the local community in starting agricultural production; to train people on how to implement a “Keyhole” Garden Technology, and to teach how to grow and manage vegetables inside, to introduce the association of such raised gardens with nearby fruit trees.

MATERIALS AND METHODS

The research has been done in Ibo Island, offshore the northern Mozambique. Temperatures are tropical always around 26 °C, the hottest period is from October to April with a monthly average between 26 °C and 28 °C. The annual rainfall is 800-1000 mm, with one rainy season from mid- November to half April (Loureiro et al., 2013).

The experimental Keyholes were planned, built and cropped with a participative approach. We involved a pilot group of 45 families and the building was attended by 30 of them, all materials were provided by the beneficiaries (Joshua, 2017).

The preferred building materials were rocks because available for free, and cement blocks easier to set and economically affordable for a preliminary demonstration. Mangrove branches were used to make the central composting basket. Four to six hours were needed to make a single keyhole.

Each day a total of 20 litres of water (10 litres clean water and 10 litres of waste water) were given using a plastic watering can; 10 litres in the morning and 10 litres in the evening. We prevented infestations of parasites and especially the whitefly using a mosquito net around the keyhole. Some organic pesticides were sprayed during the cropping phase (pepper+onion water).

A preliminary interview was done among the families, plus managers and Governmental officers, and it took into consideration the building materials, the preferred crops and their management, the fruit trees to associate nearby keyhole gardens. At the end of the project a final talking involved all the participants.

RESULTS AND DISCUSSION

Building the structures

Five keyholes were built, each 2 m wide, and the central basket 50 cm wide, an entrance triangle was left opened from the external wall to the central basket. The native ground inside was covered with wasted paperboards to stop weeds. Then soil was placed up to the rim of the wall, whilst the central basket was filled with organic material from wastes. Finally, the “Keyhole” garden was covered by coconut leaves and water applied for a week before planting seeds. Four workers within the trained participants are now teaching how to build more “Keyhole” garden.

Preferred crops, sowing and management

Sowing the crops

The crops were sown after germination test. Later, when the seedlings had 3 to 4 leaves and firm, excess plants were eliminated to have a spacing of 20-40 cm according to the expected final size. The preferred crops were 7 vegetables (Table 1).

Of the seven vegetables proposed initially, six had a very high appreciation from people, four of these were chosen and sown (Table 2). A total of 114 plants were grown in the five Keyholes, a much higher density in comparison to what possible in the nearby open fields. This has been possible thanks to better soil, easier weeding, possible irrigation.

The first crop to germinate was lettuce and the last was carrot. Carrots are slow to germinate because they have hard seed coats. Lettuce had the highest germination rate (100%) and onion had the lowest (82%). The preferred crops for the keyholes were only food vegetables, an attempt can be done to enlarge this group of plants to include also officinals, medicinals and strategic plants (Pardini et al., 2017).

Management

Important management practices were irrigation and pests' control

The use of waste water from the kitchen for irrigation can also favour the composting of the organic wastes in the central compost basket, in turn this helps to maintain clean the surroundings of the house thus reducing hygienic risks especially cholera (*Vibrio cholerae*).

Infestations of parasites and especially the whitefly were prevented using a mosquito net around the keyhole. Spraying organic pesticides during the cropping phase helped control insect damage and actually only 3 plants were lost because of ants.

Fruit trees to associate

The people were interviewed to know which fruit species are more appreciate (Table 3), and the trees were actually planted in apposite pits nearby the keyholes in order to have a dietary diversification, and a better microclimate. The most appreciated was the mango both for the fruit and the shadow deriving from the large canopy, leaves are also forage for the little livestock, and actually there is much interest about antitumoral effects of the *Mangiferin* chemical compound present in the fruit peel and the kernels of the plant.

Final talking with the beneficiaries

A final talking to all the participants to the project has proven a complete satisfaction of the results got in such a short time, and the proposal to spread further the technology on the island.

CONCLUSIONS

The Keyhole technology can help to increase self-subsistence vegetable production in Ibo Island, where common home gardens are almost impossible due to shallow and rocky soils. Their diffusion can improve food security and reduce marine resources dependence.

The beneficiaries were all satisfied with the results got in a short time, also in view to overcome climatic difficulties and the present hard economic situation.

Further recommendations to spread the keyholes on the island are the setting of a plant nursery to have shorter growing periods and consequently more crops; use only organic pesticides to keep good quality; further involve the Government and its extension officers in the diffusion of this technology; provide facilities (seeds, water cans); train farmers.

Table 1. Preferred Crops and percentage of appreciation by the people.

Crop		Percentages of appreciation
Latin name	Common name	
<i>Solanum lycopersicum</i>	Tomato	100 a
<i>Brassica oleracea</i>	Cabbage	100 a
<i>Lactuca sativa</i>	Lettuce	100 a
<i>Daucus carota</i>	Carrot	100 a
<i>Allium cepa</i>	Onion	100 a
<i>Allium sativum</i>	Garlic	100 a
<i>Eruca sativa</i>	Arugula	70 b

Table 2. Germination time and percentage of the sown crops

Sown crops	Germination Days	% of germination
Lettuce	3	100 a
Onion	4	82 ab
Cabbage	7	90 a
Carrots	15	96 a

Table 3. Fruit tree appreciation for nearby the keyholes

Fruit tree		Percentages of appreciation
Latin name	Common name	
<i>Mangifera indica</i>	Mango	100%
<i>Annona squamosa</i>	Ata	80%
<i>Carica papaya</i>	Papaya	40%
<i>Psidium guajava</i>	Guava	50%
<i>Adansonia digitata</i>	Baobab	20%

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