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PRODUCTION, STATUS AND IMPACT OF TRADITIONAL LEAFY VEGETABLES IN HOUSEHOLD FOOD SECURITY: A CASE STUDY OF BONDO DISTRICT-SIAYA COUNTY-KENYA

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ABSTRACT

Traditional African Leafy Vegetables play an important role in African agricultural and nutritional systems, but previously received little attention in most "Research and Development" programs. Production has mainly been on a subsistence basis; and confined to the rural areas. Traditional vegetables offer a significant opportunity for the poorest people to earn a living as producers and/or traders without requiring large capital investments. These vegetables provide an economic pillar upon which women's rural livelihood is supported. They play a crucial role in food security and in improving the nutritional status of poor families. The study was carried out in Bondo District (Kenya). This study shows that about 80% of the households in Bondo district are food insecure. Women and young people should be the main target groups for interventions in increasing production of traditional vegetables. They should be facilitated in terms of inputs especially certified seed, as well as market information and access.

Keywords: traditional vegetables, food security, household, FFS.

INTRODUCTION

It has been noted globally that the world's food and agriculture depend on an increasingly fragile agro-biodiversity. Lack of a comprehensive systematic approach accelerates the rates of agricultural biodiversity losses. The shift towards introduced species and improved varieties from traditional crops is detrimental to agricultural biodiversity and sustainability of rural farming communities; especially for farmers that do not use external inputs which are required for maximum productivity of improved varieties. African leafy vegetables are considered as traditional crops; and though some were planted, others were readily available and harvested as volunteer crops or weeds (Ngugi *et al*, 2006). Consumption of traditional vegetables has greatly declined over the years (IPGRI 2006; Adebooye and Opabode, 2004).

Although African leafy vegetables play an important role in African agricultural and nutritional systems, they were regarded as minor crops by scientists; hence received little attention in most "research and development" programs. Africa has a diversity of plants and their usage as food; unfortunately, this reservoir is threatened by negligence, insufficient knowledge and population growth which lead to destruction of habitat. Edible wild vegetables form a significant proportion of the diet for majority of the population who are either in low or middle-income category.

According to Ngugi *et al*, (2006), Kenya has more than 210 species of leafy vegetables that are part of traditional diets and have not been fully utilized. Traditional vegetables are more commonly used in Western Kenya and the Coast (Mijikenda) (Maundu, 1997). The most commonly used species are the *Solanum nigrum* complex, *Cleome gynandra*, *Amaranthus sp*, *Vigna unguiculata*, *Crotalaria brevidens*, *Corchorus olitorius*, and *Brassica carinata*. Just as the use of traditional vegetables has greatly declined over the years, the same applies to local knowledge about their cultivation and management. However, these plant resources still play a significant role in nutrition, food security, ecological, agronomic, cultural values and income generation. Traditional vegetables thrive during hot/wet season thereby filling the scarcity gap. They also do not require high inputs of pesticides or fertilizers in their production, thus reducing the risks of environmental pollution. They are also better adapted to local climatic conditions than the exotic vegetables. It is generally assumed that traditional vegetables are of a supplementary or emergency nature in the diet. This, however, may not be the case, since these vegetables could fill a valuable niche in food production in the rural areas, particularly in low rainfall areas; as most e.g. *Crotalaria spp*. can grow under nutrient deficient soils and are drought tolerant (Abukutsa-Onyango, 2007). Production has mainly been on a subsistence basis; and confined to the rural areas, where they are mostly harvested from shrub land. They are often intercropped and rarely occupy a significant proportion of the farm. Production is majorly rain fed, and management practices are basically traditional; with most seed being obtained from previous season's crop, neighbours, or bought from local markets.

In tropical Africa, the daily diet is dominated by starchy staples; and African indigenous leafy vegetables (ALVs) are the cheapest and most readily available sources of important proteins, vitamins, especially the pro vitamin A and essential amino acids (Kwenin *et al*, 2011). According to IPGRI (2006), Amaranthus is a good source of vitamins A, B complex, C and E; and have 13 times more iron and 57 times more vitamin A than cabbage.

A considerable number of African indigenous leafy vegetables have long been known to have health

protecting properties and uses. According to Kwenin *et al*, (2011), several of them are used for prophylactic and therapeutic purposes by rural communities. *Solanum nigrum* leaves are used to treat stomach ulcers, abdominal upsets, boils and swollen glands (Opiyo, 2000); while a concoction of *Cleome gynandra* leaves may be drunk to cure scurvy; and is recommended for pregnant and lactating women (reduces dizziness in pregnant women and eases childbirth). The health promoting and protecting attributes of ALVs is clearly linked to their nutritional and non-nutrient bioactive properties (Kwenin *et al*, 2011).

African Leafy Vegetables contain non-nutrient bioactive phytochemicals that have been linked to protection against cardiovascular and other degenerative diseases. Nonetheless, some of these phytochemicals found in some of these vegetables may pose toxicity problems when consumed in large quantities or over a long period of time (Kwenin, 2011). Some substances found in leafy vegetables are harmful; or may prevent absorption of other nutrients, e.g. oxalates in taro leaves and cyanide in cassava. Toxicity in *Solanum sp*. has been attributed to the alkaloid solanine. Most of the traditional vegetables contain phenolics, oxalates and nitrates.

Consumers are becoming increasingly aware of the nutritional and medicinal value of traditional leafy vegetables. This has led to an upsurge in the demand, especially in the urban centres. Consumption of traditional vegetables in Nairobi was estimated to be 31 tonnes with a farm gate value of USD. 6000 in 2003. In 2006, the estimated consumption was 600 tonnes valued at USD. 142, 000 (Mwangi and Mumbi, 2006). Unfortunately, the supply of these vegetables has not kept pace with this growing demand.

Traditional vegetables offer a significant opportunity for the poorest people to earn a living as producers and/or traders without requiring large capital investments (Schippers, 2000). Vegetables provide very important sources of employment for those outside the formal sector in peri-urban areas because of their generally short, labour intensive production systems, low levels of investment and high yield (Kwenin *et al*, 2011). These vegetables provide an economic pillar upon which women's rural livelihood is supported. During a survey in Kakamega, of the 20 vendors and 20 farmers interviewed, only one was a man (Nekesa and Meso, 1997). In marketing, at each vegetable exchange point, a profit of well over 75% is made. Women participate in all segments of the chain, and dominate wholesale and retail activities.

Household food insecurity is a serious recurrent problem for Kenyan smallholding farmers for who hunger periods and/or nutritional deficiencies are frequent and many experience both transitory and chronic food insecurity (Figueroa *et al*, 2009). Increased production of traditional crops, including commercialized growing of traditional vegetables will greatly improve food security in the country. During periods of relish shortage, especially during dry season, traditional vegetables previously preserved by drying are very important in household food security. Their ability to grow quickly and become harvestable within a short period makes them useful in sustaining nutrition-intervention programs. Because of their accessibility, they play a crucial role in food security and in improving the nutritional status of poor families (Gotor, 2010). Although they may be consumed in small quantities (Mavengahama *et al*, 2013), they influence the intake of cereal staples, manage hunger and play a central role in household food security for the poorer rural groups. Their commercialization in the domestic markets would result in raising the standard of living of those involved in its trading activities, in both the rural and urban centres (Oladele, 2011).

This study aimed at documenting the traditional leafy vegetables and cropping systems for their production and farm-level support for household food security in Bondo district; as well as investigating the underlying factors for decline in their production and consumption.

METHODOLOGY

Background information of study area

The study was carried out in Bondo District (Siaya County) which has land area of 972 km^2; with a total population of 248,003 comprising of 118,428 males and 129,575 females - about 52% female and 48% male - (NCAPD, 2005). About half (47 %) of the population is poor and 41% of households live below the poverty line (KNBS 2007). Bondo has a bi-modal rainfall pattern, with an annual average range from 800 - 1500 mm. The long rains are in April/May to August and the short rains in September/October to December. The district has three main agro-ecological zones - Lower Midland 2 (LM2, marginal sugarcane zone), LM3 (sub-humid cotton zone) and LM4 (sorghum/millet zone) (Jaetzold and Schmidt 1982).

Questionnaire and focus group discussions

Respondents were drawn from all the five divisions of Bondo namely, Usigu, Maranda, Nyangoma, Madiany and Rarieda. Representative samples were selected from 9 farmer field schools (FFS) and independent non-FFS members. The samples were obtained using a combination of purposive sampling of the farmer field schools and simple random sampling of the individual respondents for purposes of minimizing bias. Although 10 farmers were targeted per FFS (90 farmers), only 80 respondents were achieved. Focused group discussions were held in all the FFS. Additionally, 30 respondents were randomly selected from non-FFS members.

Seed sampling and testing

Traditional vegetable seeds were collected from FFS members and from the local market in Bondo town, and analyzed at the Kenya Plant Health Inspectorate Services (KEPHIS) seed testing laboratory in Nakuru. Seed germination and purity tests were conducted according to the International Seed Testing Association (ISTA) procedures.

Statistical analysis

Data from the questionnaires was analysed using simple descriptive statistics.

RESULTS AND DISCUSSIONS

Household characteristics

Of the Famer Field Schools (FFS) respondents, 67% were females and 33% males while for the non-FFS farmers, 47% were females and 53% males. This typically describes the situation in Bondo where a significant proportion of households are female headed. On the basis of cropping systems, 69% of the females practiced mono-cropping compared to 31% males amongst the FFS respondents. Inter-cropping of traditional vegetables was practiced by 80% females and 20% males. Whether mono-crop or inter-crop, female farmers formed the bulk of both practices. This implies that the gender of an individual is likely to influence the cropping system of traditional vegetables; which may be attributed to a culture, where vegetable growing is a domain of women.

Contrary to expectations, majority of the respondents were in their prime age in contrast to the notion that farming is meant for those advanced in age. The mean age was 41 years for the FFS respondents and 44 years for the non-FFS; and ranged from 18 to 65 years. The younger a farmer is, the more likely that s/he will practice inter-cropping. The mean age of those practicing intercropping was 37 years (Table-1) while the older ones preferred mono-cropping. Farmers are rational because intercrops are more demanding in terms of labor and skill.

The education level had an impact on the cropping systems used by the farmers. For the FFS respondents, the majority (55%) had primary education, 30% secondary education and only 2% had tertiary education. A small proportion (13%) had no formal education at all. A similar pattern was exhibited by the non - FFS respondents with 52% having attained primary level education, 34 % secondary and 14 % had tertiary level education. However, there were no illiterate farmers in this group.

Inter-cropping was practiced by 6% of the FFS respondents without any level of education, 56% with primary level and about 38% with the secondary level education. This shows that education influenced the type of cropping system that a farmer practiced. Most of those with secondary and primary education engaged in both cropping systems (Table-1). A higher number of individuals without any form of education engaged in mono-cropping than in inter-cropping. It is possible that the less educated are likely to view intercrops as a complex practice that is best avoided!

Land was a constraining factor in the survey area with an overall mean of 3.80 acres for the FFS respondents and 2.09 acres for the non-FFS. The largest farm was 20 acres and the smallest at 0.25 acre for the FFS respondents and 6.77 acres and 0.25 acres for the non-FFS respectively. In total, farms with mono-cropping had a mean of 2.99 acres; inter-cropped farms had a mean of 4.33 acres; and 4.40 acres being those farms with both mono and inter-cropping. Mono-cropped farms and inter-cropped farms had no substantial disparities in their mean farm sizes. Traditional vegetables inter-crop occupied a mean area of 0.59 acres for the FFS respondents and 0.67 acres for the non-FFS, with area planted ranging from 0.01 to 3.0 acres. Traditional vegetables mono-crop occupied a mean area of 0.25 acres for the FFS respondents and 0.13 acres for the non-FFS farmers, with area planted ranging from 0.0 to 2.0 acres. This shows that the most preferred practice is inter-crops where farmers maximize resources by producing as many crops in one piece of land.

Traditional vegetables and their cropping systems

Majority of the households amongst both FFS respondents (96%) and non-FFS respondents (97%) were growing traditional vegetables, although the types grown varied (Table-2). The most common traditional vegetables under cultivation were: Cowpea (*Vigna unguiculata*), Spiderplant (*Cleome gynandra*) Crotalaria (*Crotalaria spp.*), African nightshade (*Solanum nigrum complex*) and rarely Amaranthus (*Amaranthus sp*); and to a limited extent "Atipa" (*Asystasia mysorensis*).

The preferred cropping system in growing traditional vegetables was found to be mono-cropping, with 49% for FFS respondents and 43 % for the non-FFS farmers. Those who intercrop accounted for 22% for the FFS, and 27% for the non FFS respondents. However some of the farmers used both systems.

A number of food crops are inter-cropped with traditional vegetables (Figure-1) among the FFS households. Most farms (61%) used maize to inter-crop with traditional vegetables, 17% used sorghum as an inter-crop, 14.6% used finger millet, 2.4% used cassava, 2.4% used pigeon peas, and the remaining 2.4% used other crops. Maize was planted by most of the households. It was also found that cowpea was intercropped by most farmers (68%). This was a typical practice in both FFS and non-FFS households. About 73% of the farmers (both FFS and non-FFS) intercrop their traditional vegetables during the long rains, while only 7 % intercrop during the short rains; however, 20% intercropped during both the long and short rain seasons.

Through experience, farmers know which crops are best suited for intercropping and monocropping. Crotalaria was mostly monocropped (33%), followed by cowpeas (29%), spiderplant (14 %) and African nightshade and Ethiopian kale (each comprising 5%).

Soil amendments

A variety of soil amendments were found to be used in the production of traditional vegetables. For the FFS households, where inter-cropping was practiced, 56% of households used organic fertilizers, while 7.3% used inorganic fertilizers (Figure-2). About 34% did not use any kind of fertilizers, while the remaining 2.4% made use of other kinds of amendments in their farms. Comparatively, 44 % of mono-crop farms used organic fertilizers, 11.5% used inorganic fertilizers, and 44.2% did not apply any form of fertilizers. For the non-FFS farmers, the practice was similar to the FFS respondents, with most farmers not

using any amendments in both monocrop (68%) and intercrops (59%). However, the non-FFS farmers used less organic amendments in their monocrop (23%) as well as in the intercrop (32%). The use of inorganic fertilizer was similar in both groups (about 10%). It seems that the FFS respondents benefited from the learning they received from the Schools on sustainable agriculture.

Most of the farmers (68%) who practiced inter-cropping used ox-plough to cultivate their farms (Figure-3). However, 61 % of farmers who mono-cropped mostly tilled their farms by hand. This implies that ox-plough and hand digging were the most common forms of tillage employed in Bondo. The same tillage practices were observed for non-FFS respondents where ox-ploughing for the intercrops was done by 44 % and 56 % hand digging. Hand digging was used more in monocropped vegetables (76%) with ox-plough being used in only 24% of the households. This is mainly because the area planted to local vegetables is generally small.

Economics of traditional vegetable production

The major costs of production for traditional vegetables were due to tillage (either tractor or ox-plough) and weeding for both intercrops and monocrops. Monocropped farms incurred higher costs for inorganic fertilizer compared to those intercropped, while the converse was true for organic manure (Figure-4). This reflects that higher amounts of inorganic fertilizer are used in monocropped farms. Hand digging was the cheapest tillage option compared to ox-plough and use of tractor. Since vegetables are planted on small area, hand digging is cheaper.

The main outlets for traditional vegetables were local markets (6 %), neighbours (28 %), regional markets (7%) and home consumption (5%). The fact that most produce ended up with neighbours and in local markets is evidence that with proper planning, traditional vegetables can be a major source of income.

The information presented in Table-3 show the high potential of traditional vegetables to improve rural incomes. In areas where market outlets exist, near large cities like Nairobi, returns from traditional leafy vegetables can be more than three times those reported for Bondo (Mwangi and Kimathi, 2006). In addition to fresh markets, different value addition options such as packaging and drying could be pursued.

Seed test results

Of the 16 samples tested, 10 (62½%) did not meet KEPHIS quality standards (CAP 326 of the Seed and Plant Varieties) either due to low purity or poor germination or both. However, according to Abukutsa (2007), the minimum acceptable germination for a seed lot is 85%; in which case none of the seed samples met the set minimum standards.

Farmers' food adequacy

Of all the farmers interviewed in Bondo only 19% had adequate food (crops) throughout the year (Table-4), while those with adequate food supply for part of the year were 43%. For livestock products 8% reported adequacy throughout the year and 45% inadequate (Table-9). From these findings, it can be deduced that about 80% of the households in Bondo district are not food secure in both crop and livestock products. A deliberate effort must be made to redress this situation.

Households adopted a number of strategies to counter food shortages, key among them being buying from the market (92%). However a few (6%) opt to reduce their food intake. Given the lack of employment in rural areas, it is not clear to what extent food purchases are sustainable.

Most of the respondents (97%) agreed that farming is a form of employment and needs to be given more attention. However, the main challenge is how to make farmers practice farming as a commercial entity. Majority of the farmers (93%) agreed that there is a possibility of commercializing farming if they devoted more time to it.

A large number of farmers (95%) were willing to allocate more of their available land to cultivation and increase the number of livestock. While only 5% would like to maintain the *status quo*. Although they are willing to expand agriculture, they rarely wanted to commit their resources to buy inputs (75%) and even expected monetary incentives (80%). Willingness to expand production must be backed up by corresponding willingness to buy inputs.

CONCLUSION AND RECOMMENDATIONS

It is apparent that female farmers were the majority and they practiced both monocropping and intercropping. Even in male headed households, the location and amount of local vegetables to be planted was mostly decided by the wife. The level of education changes how a farmer views different technologies. Most of those with secondary and primary education engaged in both cropping systems. A higher number of individuals without any form of education engaged in mono-cropping than in inter-cropping. Intercropping was the preferred systems of farming and most farmers considered it to provide better food security than monocropping. The less educated are likely to view intercropping as a complex practice and would not adopt it.

Majority of the households had both crop and livestock enterprises. The main crops grown are maize, sorghum, beans, millet and cowpeas. It is interesting to note that sorghum, millet and cowpeas are among the main crops although they are grown on small acreages. Majority of the farmers were growing one or more traditional vegetables albeit in small land parcels. The most common vegetables were cowpeas, spider-plant and crotalaria in that order. Maize was the preferred intercrop for traditional vegetables. Generally farmers used their own or purchased seed for planting. Most of the farmers had increased the area planted to traditional vegetables mainly because the vegetables provided good income. However, the outlets for most produce were the local markets and neighbours and this explains why there is little evidence of commercialization in this enterprise. In contrast,

introduced vegetables fetched more income and had better market outlets in larger towns.

Most of the farmers either planted traditional vegetables and food crops with organic manure or without any amendment. Very few used inorganic fertilizers. A large amount of the traditional vegetable seed obtained from Bondo did not meet the minimum quality standards for germination and purity. However, most of the soils in the district were suitable for growing a majority of traditional vegetables.

General policy implications

a) Women and young people should be the main target groups for interventions in increasing production of traditional vegetables because of the key role they play. They should be facilitated in terms of inputs especially certified seed, as well as market information and access.
b) Intercropping was the preferred systems for improved yields and soil productivity. Information on optimal crop combinations and agronomic practices that maximise on per unit output are some of the management strategies that may increase productivity.
c) The largest numbers of households were food insecure for at least part of the year. Some of the ways in which this may be addressed is through awareness creation on the importance of multiple cropping systems and diverse agroecosystems. Another factor contributing to food insecurity is the lack of self reliance.
d) There is need to raise awareness among the farmers on the need to be self-reliant. This may help change a majority of the farmers' attitude towards the need for government incentives to farm.
e) Seed inputs are an integral part of productivity increase. The availability of pure and viable seeds including traditional vegetables is a challenge in the district. The use of poor quality seed by about half the number of households exacerbates the problem. Some of the interventions would include training farmers on seed selection and storage to maintain quality. Community seed bulking initiatives should be facilitated.
f) Lack of markets for traditional vegetables is a big challenge to increasing production. Interventions should include improved market linkages with urban centres e.g. through formation of farmers marketing federations. This can be facilitated through already existing groups such as FAO - FFS groups

Table-1. Household characteristics.

Characteristic	Cropping systems		
	Monocrop	Intercrop	Both
Age (mean, yr)	42	37	42
Gender (%)			
Female	69	80	54
Male	31	20	46
Education (%)			
None	22	6	_
Primary	6	56	54
Secondary	19	38	46
Post secondary	3	_	_

Table-2. Types of traditional vegetables grown in Bondo.

	Frequency	Percent
Cowpea	27	35
Spider plant	19	24
Crotalaria	16	21
Nightshade	7	9
Amaranthus	2	6

Table-3. Yields and Profitability of Traditional Vegetables, maize and sorghum in ¼ acre monocrop.

Type	Yield (Kg)	Bunches (0.7 kg)	Farmgate price (Ksh)	Market value	Cost of prodn	Gross Profit (Ksh)	Gross Profit ($)
Spider plant	900	1286	5	6,428	800	5,628	87
Cowpea	766	1094	5	5,471	800	4,671	72
African nightshade	798	1139	5	5,697	800	4,897	75
Maize	90	1 bag	1200	1200	1500	-300	-5
Sorghum	180	2 bags	1400	2800	1050	1750	27

Source: Field data 2007

Table-4. Adequacy of food and livestock products.

	Crops		Livestock	
	Frequency	Percent	Frequency	Percent
Adequate throughout the year	12	19	5	8
Adequate for part of the year	28	43	9	14
Somehow adequate	1	2	21	33
Not adequate	24	36	29	45

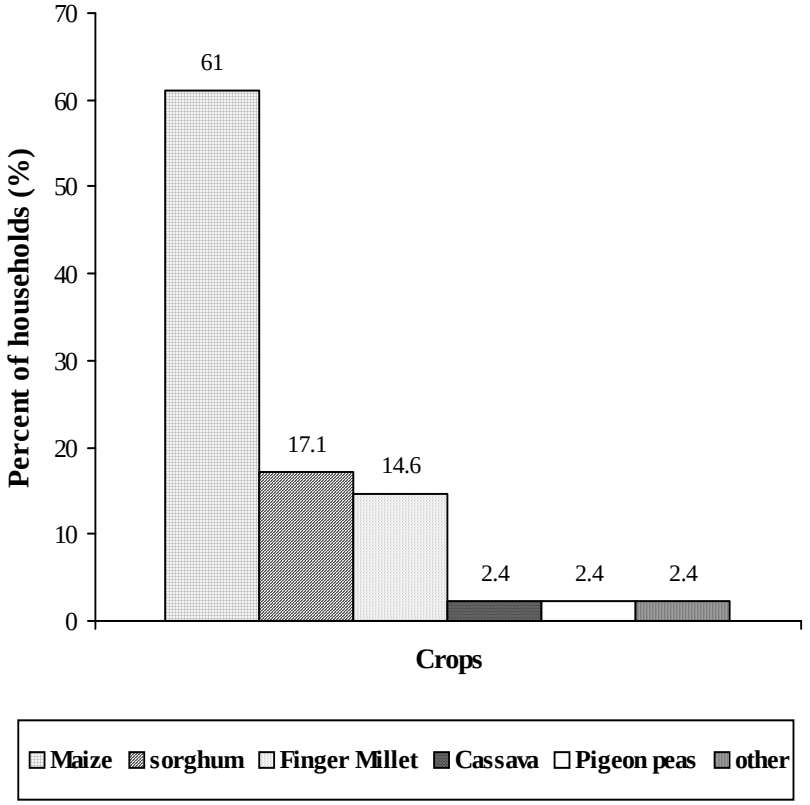

Figure-1. Crops intercropped with traditional vegetables by FFS farmers.

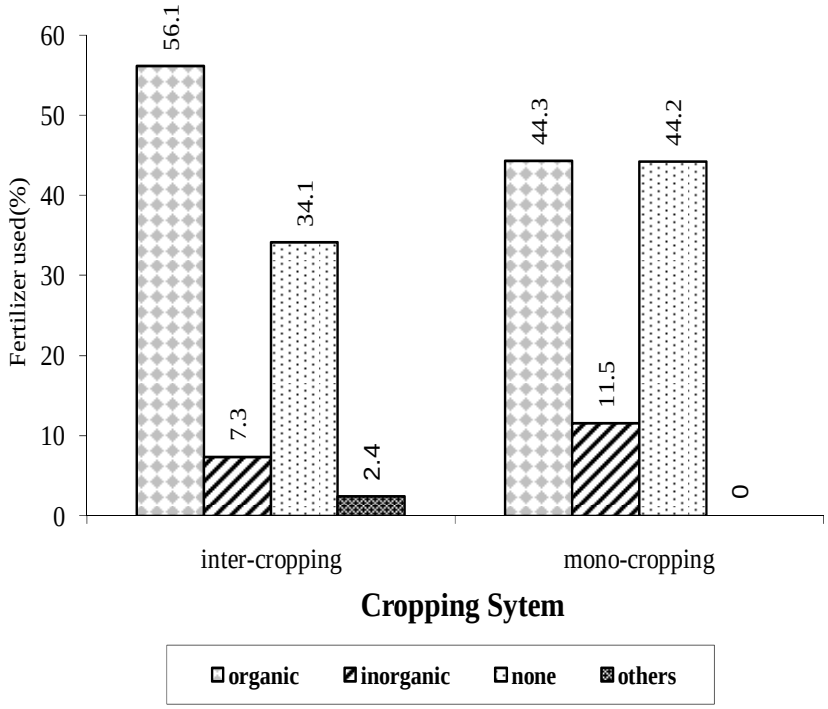

Figure-2. Fertilizer used for traditional vegetables by FFS farmers.

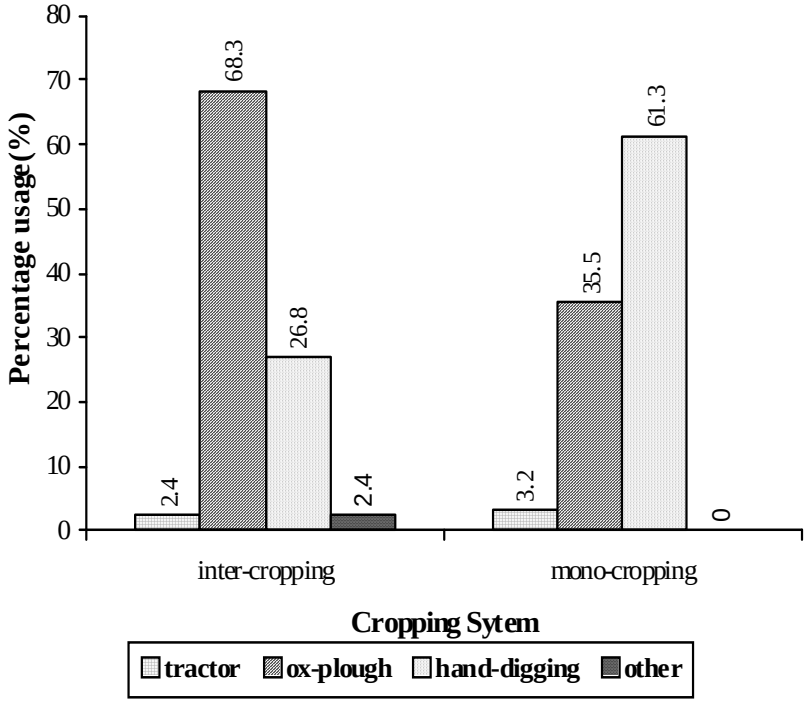

Figure-3. Tillage methods used for traditional vegetables.

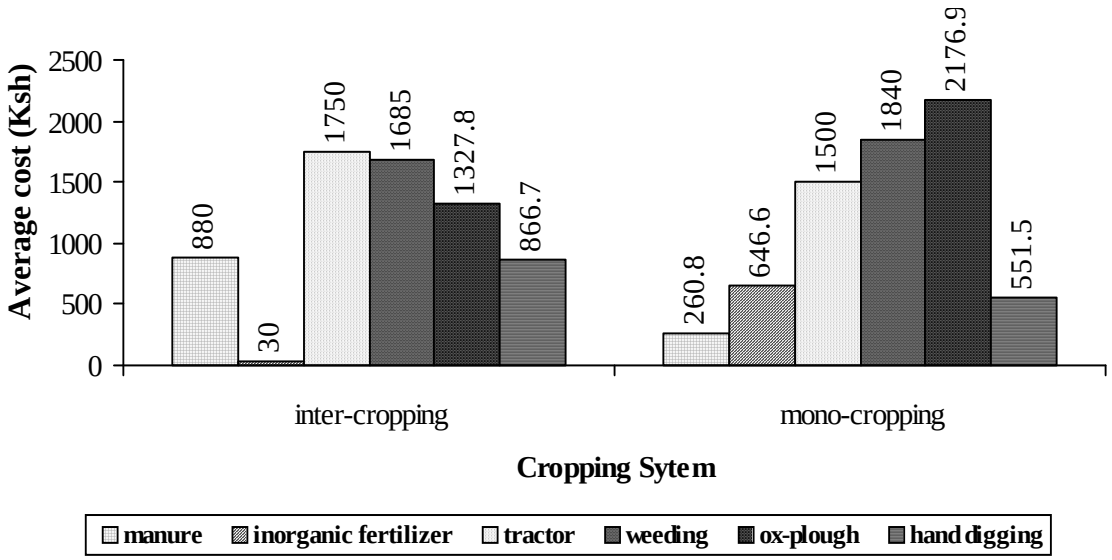

Figure-4. Costs incurred in traditional vegetable production.

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