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Full Length Research Paper

A case study on the production of traditional African vegetables in Burkina Faso

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Lack of dietary diversity is a key causal factor of malnutrition in Burkina Faso because the population consumes mostly cereals crops. Nutrient-dense traditional African vegetables provide an excellent means to complement cereal staples for better nutrition, in particular for women and children, as well as for income generation. This study characterized the production of traditional African vegetables in Burkina Faso based on a questionnaire administered to 250 respondents. Results indicate the majority (75%) of the producers had no formal education and generally practiced gardening in lowland areas near water damsandstreams. Tomato was cultivated by 35% of the respondents, followed by okra (32%) and African eggplant (20%). Overall, more land was used for traditional African vegetables compared to exotic species, but individual global vegetables occupied more space than traditional vegetables; tomato was produced on 467 m^2 and okra on 315 m^2. About 98% of the producers practiced manual irrigation with watering cans, compared to only 1% for drip irrigation. Soil and water conservation options such as mulching and *zaï* were practiced by 76 and 21%, respectively. The producers were quite familiar with and had access to improved seeds (73.2%), chemical fertilizers (72.4%) and nursery techniques (69.6%), but were less knowledgeable about postharvest handling, integrated pest management and biological control. There is ample scope for improving vegetable production practices through capacity building coupled with sensitization for increased consumption of traditional African vegetables.

Key words: Traditional African vegetable, production, Burkina Faso.

INTRODUCTION

Sub-Saharan Africa is home to more than a quarter of the world's undernourished people, owing to an increase of 38 million hungry people since 1990 to 1992 (FAO, IFAD & WFP, 2014). Most countries in West and Central Africa, including Burkina Faso, fall within the worst affected countries globally with respect to the proportion of

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chronically undernourished children (FAOSTAT, 2015). Overcoming food and nutritional insecurity among women, pregnant and lactating mothers, and children under five years of age remains a challenge in many developing countries in sub-Saharan Africa (Andersen et al., 2003). The food harvest has been very poor in Burkina Faso for several successive years, which has aggravated the country's persistent problems of food insecurity and malnutrition. Prevalence rates of acute malnutrition far exceed the World Health Organization (WHO) cut-off point for high public health significance in Burkina Faso. The national nutrition survey using Standardized Monitoring and Assessment of Relief and Transitions (SMART) conducted in 2013 revealed global acute malnutrition (GAM) rates of 10.2% nationally (7.8% as moderate and 2.4% as severe acute malnutrition) (WHO, 2006). The most important forms of undernutrition are inadequate intake of protein and deficiencies in vitamins A and C, folate, iodine and zinc. Annually, Burkina Faso loses USD 158 million to vitamin and mineral deficiencies (World Bank, 2006; UNICEF, 2004). Lack of dietary diversity is a key causal factor because the population consumes mostly cereals crops. These crops are high in carbohydrates but low in nutrients and vitamins. Scaling up core micronutrient interventions would cost less than US$10 million per year (WHO, 2006). Nutrient-dense traditional African (leafy) vegetables provide an excellent means to complement cereal staples for better nutrition, in particular for women and children, as well as for income generation.

Traditional vegetables are valuable sources of nutrients (Nesamvuni et al., 2001; Yang and Keding, 2009), with some having important medicinal properties (Hilou et al., 2006). Vegetables contribute substantially to food security (Yiridoe and Anchirinah, 2005). Traditional vegetables often provide higher amounts of provitamin A, vitamin C and several important minerals than common, intensively bred vegetables both on a fresh weight basis and after preparation (Ojiewo et al., 2010). With usually shorter growing cycles than staple crops, vegetables can be less affected by environmental threats such as drought. In general, they require less space than staple crops and can maximize the use of natural resources when water and nutrients are scarce (Tenkouano, 2011). Traditional vegetables are adapted to specific marginal soil and climatic conditions, and often can be grown with minimal external inputs (Hughes and Ebert, 2013). The diversification of production systems with traditional vegetables will increase their heterogeneity and will subsequently lead to better resilience to abiotic and biotic stresses (Newton et al., 2011). USAID (2009) is engaged in addressing food insecurity and improving nutrition in Burkina Faso through diversifying rural livelihoods.

Nearly one-third of Burkina Faso is acutely malnourished and child malnutrition rates areamong the highest in the world (FAO, 2012). More than half of rural households are poor and do not own land. Agriculture is central to reducing malnutrition and food insecurity, which currently affect more than 2.8 million people (FAO, 2012). The production of traditional African vegetables could be an effective means to cope with food shortages, especially if they are grown during the dry season, when most farmers become inactive due to lack of water. Vegetable gardening is an intensive production system that can be carried out on small areas of land. The production, sale and consumption of traditional African vegetables will strengthen income, food and nutrition security in locations with erratic rainfall.

Traditional African vegetables have been gaining attention in recent years and have become more economically competitive compared to global species. However, these crops receive little research attention compared to other food crops despite their economic potential, their role in ensuring food security, and their cultural acceptance. Local statistics remain poor on these crops, which prompted us to conduct a field survey. This study sought to characterize traditional African vegetable production in Burkina Faso.

METHODOLOGY

The study was conducted in six villages of two provinces (Figure 1): Bapla, Nanè, Moutori and Saapariin the Southwest region and Gampela and Gonsé in the central region. The Southern region is located in the Soudano Guinean zone, where rainfall ranges from 650 to 1100 mm for 5 months (June to October). In the central region, the growing season starts in July and ends in mid-October, with rainfall ranging from 450 to 600 mm.

Sampling

The groups targeted for the survey were selected based on the extent of involvement in the production of traditional African vegetables. An exhaustive survey of vegetable producers conducted in all six villages in 2012 identified more than 500 producers. A total of 250 interviewees were randomly selected from this population for the survey. Table 1 describes the geographical distribution of surveyed farmers.

Data collection

Data were collected mainly by means of semi-structured questionnaires. The questionnaires were jointly developed by the University of Development Study (UDS) in Ghana and AVRDC – The World Vegetable Center. Additional data was collected through focus group discussions where necessary. The questionnaire had seven components: general information; producer and household characteristics; land use; farm household resource endowment; production of vegetables; traditional African vegetable field characteristics and management; processing and marketing of traditional African vegetables, and training needs oftraditional vegetable farmers.

Data analysis

All data sheets were processed manually to check the quality of the

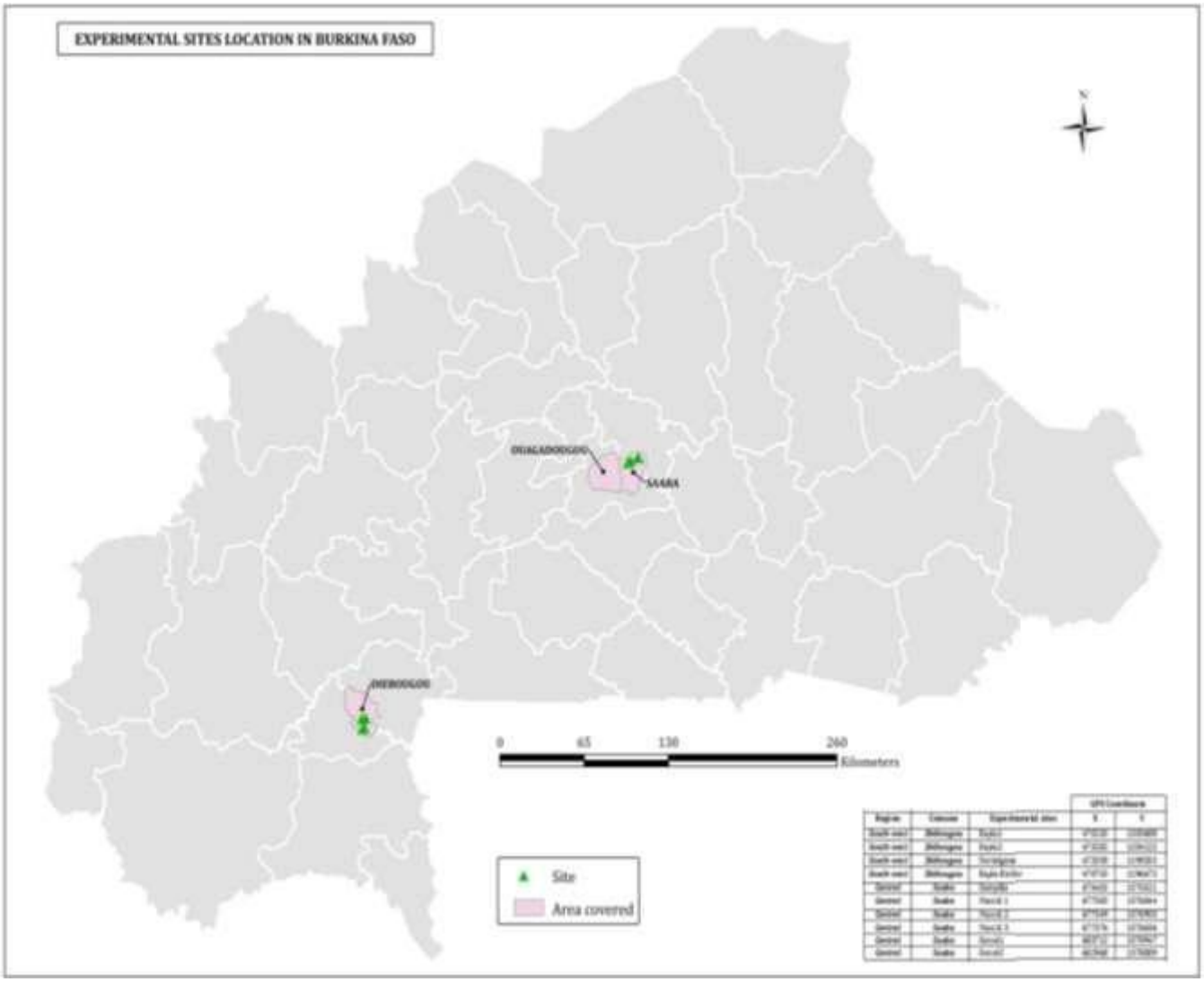

Figure 1. The study area.

Table 1 . Distribution of producers surveyed per village (Survey Data, 2014).

Region	Villages	Number	Percentage
Southwest region	Bapla	58	23
	Nanè	40	16
	Moutori	44	18
	Saapari	58	23
Central region	Gampela	10	4
	Gonsé	40	16
Total	6	250	100

information collected. Erroneous information was corrected either by contacting the investigator who conducted the survey, or by going back to the farmer respondent. Validated data were entered using Epidata software, and then transferred to SPSS for analysis.

Table 2. Distribution of interviewees by sex (Survey Data, 2014).

Gender	Frequency	Percentage
Male	230	92
Female	20	8
Total	250	100

Table 3. Ethnic background of respondents (Survey Data, 2014).

Social group	Frequency	Percentage
Native	220	88
Non-native	30	12
Total	250	100

Excel software was used for calculation of percentages and ratios.

RESULTS AND DISCUSSION

General characteristics of the producers and the survey sites

Gender

Out of the 250 farmers surveyed, 8% of the interviewees were women (Table 2). Most of the interviewees were heads of households, meaning that the 8% of women in this survey were the owners of their gardens and heads of their households. This result demonstrates the situation confronting women in agricutural production, they are poorly resourced and have limited access to resources for agricultural production, particularly land. Moreover, married women are expected to support their husbands to cultivate the family farm in addition to their household responsibilities. Consequently, most women have little time to undertake agricultural production on their own.

Ethnicity

Eighty-eight and 12% were native and non-native, respectively (Table 3). The non-native respondents either benefited from usufruct rights to the land they farmed (83%) or were tenants (17%). The majority of the native traditional vegetable farmers (85%) were owners of their land, with only 15% of them borrowing the land they were cultivating.

Education

The majority (75%) of producers had no formal education (Figure 2). This is not surprising, as the overall adult literacy rate for Burkina Faso is about 40% (UNICEF, 2013). The lack of education could slow down the process of capacity building for traditional vegetable production and efforts to promote increased consumption. This calls for innovation in farmer education by adopting methods that would ensure effective delivery of extension and nutritional information to farmers. Effective partnership between civil society organisations, which are active in the rural areas could significantly improve, access to information by vegetable farmers.

Types of vegetables cultivated

The commonly cultivated vegetable crops at all sites were okra, tomato and African eggplant produced by 20, 32 and 35% of the respondents, respectively (Table 4). These crops respectively yielded 22, 23, and 25 t/ha. Tomato covered the largest cultivated area (467 m²), followed by okra (315 m²). Despite the fact that more land was used for traditional vegetables (1448 m²) compared to global species (1126 m²) (Table 4), individual global vegetables occupied more space than traditional vegetables. Other crops such as papaya, spinach and cassava were also found at some sites.

Characteristics of the production system

Access to water

Gardening was generally practiced in lowland areas near water dams and streams. However, the Gampela site was an exception; land was cultivated around a borehole equipped with a solar pump system. At this site, special emphasis is put on drip irrigation. Water availability is a key factor in vegetable production. Four main sources of water were identified namely: surface water (dams),

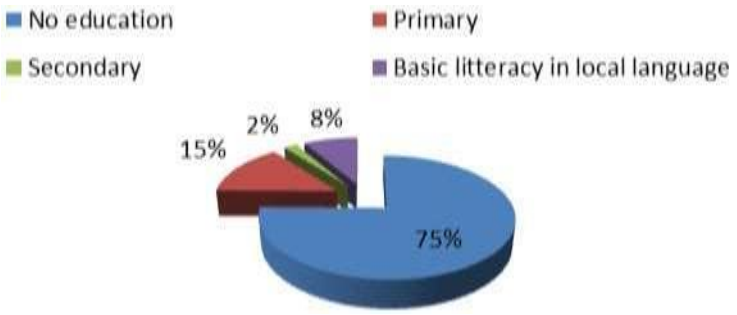

Figure 2. Level of education of the farmers interviewed.

Table 4. Major vegetable crops produced in the study area (Survey Data, 2014).

Vegetable type	Growers (%)	Area per grower (m^2)	Yield (t/ha)
African eggplant	**20**	**158.8**	**23**
African nightshade	3.8	150	32
Amaranth	9.5	150.9	16
Jute mallow	3.5	197.5	12
Okra	**32**	**315**	**22**
Gourd	10.7	193.2	35
Sorrel	17.3	193.2	17
Beanleaf	3.2	89.6	12
Total traditional vegetables		1448.1	21.2
Onion	13.1	158	25
Tomato	**35.0**	**467**	**25**
Cabbage	21.9	201.2	22
Cucumber	10.9	150	15
Zucchini	19.1	150	35
Total global vegetables		1126	24.4

shallow wells, boreholes, and streams (Figure 3).

More than 95% of the respondents used surface water dams and streams as primary water sources for irrigation. Most of these producers were based in the southwest region (Bapla, Nane Moutori and Saapari) and Gonsé. It is important to note that effective water harvesting is critical for sustainable vetetable cultivation as these these areas are located in the arid and semi-arid savannah zones. Any effort to promote large scale vegetable production must therefore, be supported by measures to ensure adequate access to water during the long dry season by harvesting and storing water during the rainy season when water is usually abundant. Shallow wells and mechanized boreholes were used by 7 and 4% of the respondents, respectively. The use of shallow wells for vegetable production is only possible in valley bottoms and other lowland that allow easier access to water by farmers. However, most of these shallow wells dry up in the course of the dry season and are only able to sustain vegetable production for 2 to 3 months during the dry season. In recent times vegetable gardening in lowlands has reduced in scale as a result of poor rains resulting in early drying of lowlands. Farmers cultivating vegetables along streams take advantage of the annual flooding of rivers and streams during the rainy season to establish vegetable gardens along such rivers. Vegetable production usually ends when the rivers and streams dry up and does not go far into the dry season. The gardeners based around dams and boreholes started their activities less than 20 years ago when these facilities were made available. Those along the stream have been doing gardening for a far longer time.

Although water availability is one factor that determines participation in gardening, water management remains critically inappropriate and unsustainable. For instance, the garden plots were set up in the immediate vicinity of water bodies without appropriate conservation measures. This exposes the soil to erosion, resulting in the silting up

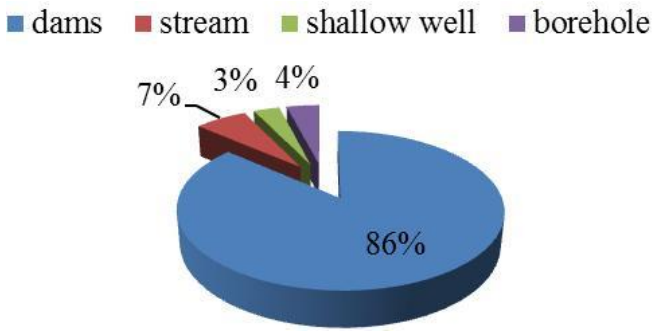

Figure 3. Water sources for vegetable production.

of the water bed. At all sites, producers indicated that water bodies dry up much earlier than before. Water levels in the dams and wells at the different sites have decreased considerably in recent times, further constraining vegetable production by forcing producers to suspend their activities until the following year. The silting of reservoirs and rivers also explains frequent flooding in the study regions, which many producers do not relate to their bad soil and water management practices.

Access to tools and equipment

Apart from small hand tools such as pick axes, hoes, and watering cans which all producers had, only 10.4% owned a water pump, 2.8% owned a treadle pump and 0.4% used other irrigation equipment. Nearly, all (98%) producers practiced manual irrigation with watering cans, compared to only 1% for drip irrigation (Figure 4). About 24.8% had a pesticide sprayer. This justifies the fact that access to irrigation equipment is a major constraint to vegetable production among vegetable farmers in Burkina Faso. Vegetable farmers are smallholder farmers who are generally constrained by access to resources. For vegetable farmers, most of whom cultivate vegetables during the dry season, this situation is even more critical as they must irrigate their crops. The general lack of irrigation equipment therefore, restricts the scale of production.

Access to improved technologies

The technologies mostly accessible to traditional African vegetable producers were improved seeds (73%), chemical fertilizers (72%) and improved nursery techniques (70%) (Figure 5). Some good agricultural practices such as improved postharvest handling, integrated pest management and biological control of pests that can enhance traditional African vegetable production and improve yield and income were not accessible to producers.

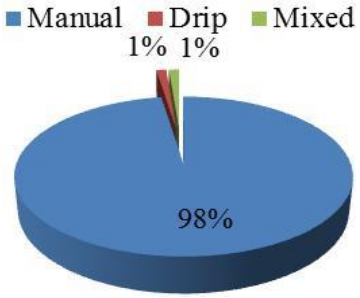

Figure 4. Irrigation techniques used on project sites.

The soil and water management techniques identified were mulching (76%), *zaï* (22%), drip irrigation (1%), gravity irrigation (1%) (Figure 6). *Zaï* is a traditional land rehabilitation technology developed by farmers in Burkina Faso to rehabilitate degraded dry lands and restore soil fertility. *Zaï* are small pits 20 to 30 cm in diameter and 10 to 20 cm deep dug into degraded soils. Farmers place about two handfuls of organic material at the bottom of the pits. The *zaï* collect and concentrate water at the plant root zone, which reduces the risk of water stress.

Access to inputs

Chemical fertilizers were the most used input in vegetable production (Figure 7). Farmers stressed that these fertilizers were available on the market at an acceptable price. Manure and compost were both used to maintain soil fertility. However, compost was less used as there was a lack of water for processing it, and many farmers had not received any training in composting techniques.

Farm machinery is expensive for gardeners, which was why only 2% of respondents used it. Vegetable gardening sites were usually too small and confined to justify the use of such bulky equipment. The use of pesticides among vegetable farmers has increased in recent times.

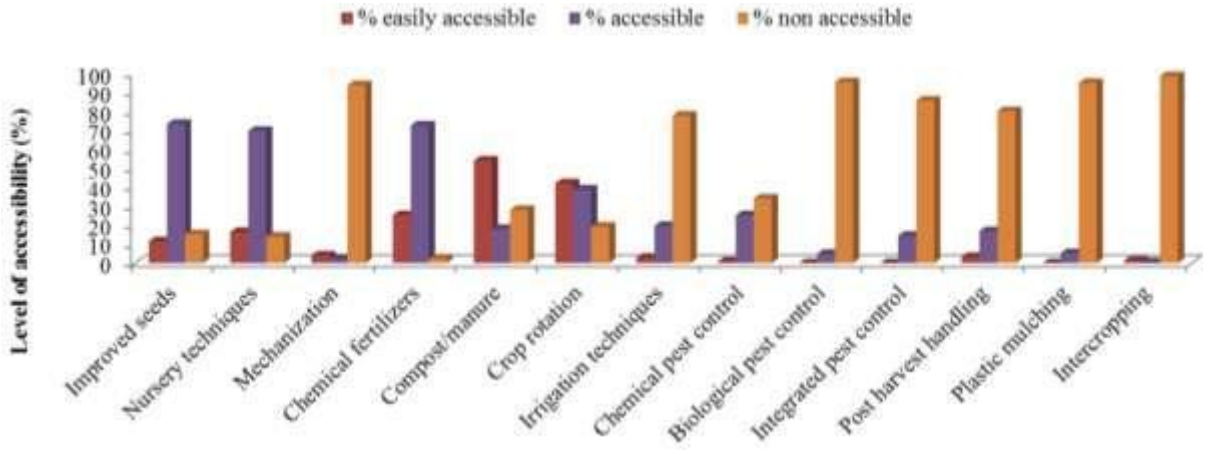

Figure 5. Level of adoption of technologies

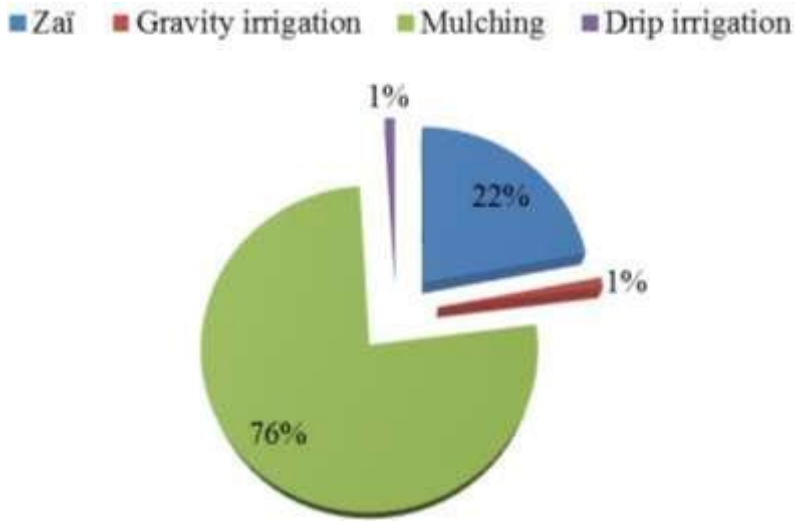

Figure 6. Soil water management techniques.

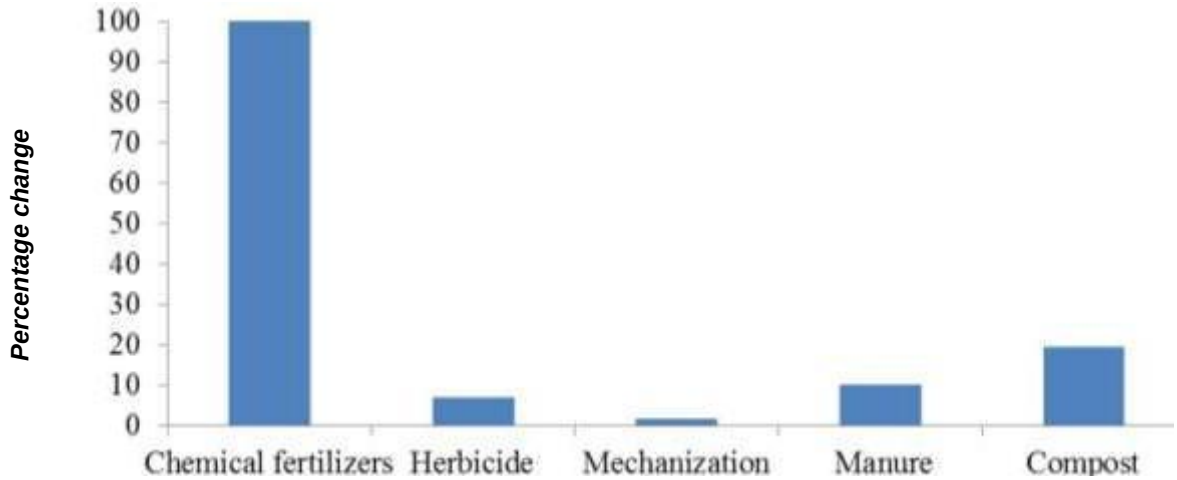

Figure 7. Changes in practices over the past 5 years.

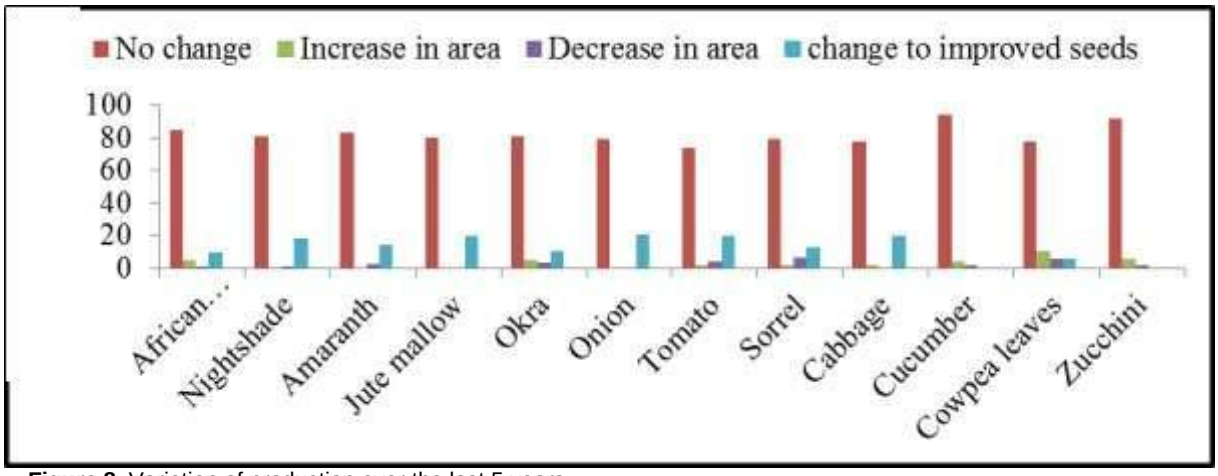

Figure 8. Variation of production over the last 5 years.

Table 5. Local and improved varieties of targeted traditional African vegetables found at survey sites (Survey Data, 2014).

TAV	Pourcentage	Variety (%)		Area (%)	
		Local	Improved	upland	Lowland
African eggplant	29.6	29.2	0.4	28	1.6
African nightshade	5.6	4.4	1.2	5.6	0
Amaranth	14	14	0	10	4
Jute mallow	5.2	5.2	0	5.2	0
Okra	45.6	16	29.6	40.8	4.8

This raises some concerns about the safety of vegetables produced by farmers who use such chemicals. This is because the proliferation of such chemicals is hardly regulated with farmers using different kinds of pesticides, some of them prohibited. Consequenlty, effective regulation of chemical inputs in vegetable cultivation is required in order to safeguard the safety of consumers.

Evolution of the production over the past 5 years

During the past 5 years, the most important change observed for the different crops was related to seed (Figure 8).

All the producers emphasized that they obtained good yield with improved seeds. The production of African eggplant, okra, cowpea leaves and zucchini has increased as a result of an increase in their respective market prices. Priority seems to be given to high value crops.

Analysis of targeted traditional African vegetables

Five traditional vegetables were targeted for the study: African eggplant, African nightshade , amaranth, jute mallow and okra.

African eggplant

African eggplant was produced by 29.6% of the respondents (Table 5). The total area harvested was estimated at 1.18 ha with an associated production of 27.5 t. The yield varied between 15 and 25 t/ha. The share among the different uses of African eggplant showed that it was mostly consumed (Table 6). The market price of local eggplant was estimated at 150 FCFA/kg in the southwest, although it sometimes exceeded 200 FCFA in the Ouagadougou peri-urban area (Gonsé and Gampela).

African nightshade

African nightshade was cultivated by 5.6% of the respondents, but exclusively in the southwest area. The total area cropped was approximately 0.21 ha, with a total production of 6.72 t, yielding between 2 and 35 t/ha. The share among the different uses of African nightshade shown most was sold (Table 6). The sale price of the African nightshade was estimated to be 110 FCFA/kg.

Table 6. Share among the different uses of the localtraditional African vegetables (Survey Data, 2014).

Vegetable	Sale (kg)	Storage (kg)	Consumption (kg)	Seed (kg)	Losses (kg)
African eggplant	2 0224	300	6 315	781	896
Nightshade	4 340	250	1 640	270	220
Amaranth	6 890	0	1 465	15	130
Jute mallow	2 910	0	625	182	83
Okra	58 888	2114	18 293	1772	633

Amaranth

Amaranth was produced by 14% of the respondents, both in the southwest and in the central regions. The total area cropped was approximatly 0.5 ha with a corresponding total production of 8.4 t and a yield between 12 and 28 t/ha. The share among the different uses of amaranth show that most was sold (Table 6). Amaranth was sold either in bags (wholesalers) or in heaps (retailers) and its price was estimated between 100 and 125 FCFA/kg at all sites.

Jute mallow

The production of jute mallow was done by 5.2% of the respondents, and the total production was 3.8 t on an area of 0.25 ha, both regions combined. However, it was more commercialized in the central region than in the southwest. The yield varied between 12 and 15 t/ha. The share among the different uses of jute mallow shows that most was sold (Table 6). Jute mallow is sold either in bags (whole sellers) or heaps (retailers) and its price was estimated between 100 and 125 FCFA/kg at all sites.

Okra

Okra was produced by 45.6% of the respondents. This vegetable is very popular at all sites. The total cropped area in 2013 was estimated at 3.7 ha with a corresponding total production of 81.7 t. The yield varied between 20 and 25 t/ha. The share among the different uses of okra shows that most was sold (Table 6). Okra was sold either in bags (whole sellers) or by heaps (retailers) at about 150 FCFA/kg in the southwest and 175 FCFA/kg in the Ouagadougou peri-urban area.

Constraints to production of traditional African vegetables

Lack of water

Vegetables are mainly cultivated during the dry season by more than 4,000 women and men, most of whom are youth. However, although the dry season extends for 6 months in the south and 9 months in the north, vegetable production is limited to 3 to 4 months, when water is available in lowland areas around streamsand along rivers. The farmers are forced to wait until November or December for the water to recede and free the land for cropping. Evapotranspiration is high in the hot and dry climate, resulting in rapid drying of streams, and cycling down of gardening activities beginning in March.

Lack of skilled producers

Good command of appropriate production techniques and market operations are prerequisites for good yields and sale of traditional vegetable crops. It was observed that 92% of the respondents had never received training on vegetable production. All the farmers surveyed practiced gardening as a secondary activity, just to meet their daily needs of cash and food. This could explain why they tended to overlook appropriate technologies, and why their yields were low. Damage due to pests was widely observed as a major constraint to vegetable production, yet only a few farmers had training in pest management. A lack of water and poorly functioning markets were also factors discouraging farmers to fully invest in vegetable production.

Poor organization

Only 4.8% respondents belonged to a producer group. This low level of organization made the supply of inputs and the sale of products very difficult.

Low level of investment

Farmers did not invest in vegetable production in part due to a lack of business skills.

Storage and conservation

Although most vegetable produce are perishable, very little processing and storage was carried out in the survey

areas. This justified the high rate of losses observed (Table 6) from decay, dehydration and deformation. Most farmers had not been trained in processing and storage techniques.

Conclusion

This study assessed the share of traditional African vegetables in dry season gardening in Burkina Faso. These vegetables are generally produced in the same way as global ones. However, their importance and production varies among locations, and they were mostly produced in the southwest region. The limited availability of water and poor access to training for farmers seem to be the most important constraints to traditional vegetable production. Water limitations in particular determine the size of the garden plot, the quantities of vegetables produced, the duration of production during the dry season, and the low level of investment and organization observed. Most traditional African vegetables were produced for sale, except for African eggplant. There is a need for sensitization and awareness about the health benefits of consuming traditional African vegetables.

Conflict of Interests

The authors have not declared any conflict of interests.

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