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Status Report on Fruits and Vegetables Production and Processing Industry in Sudan

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Abstract

Sudan has a great potential to produce good quality fruits and vegetables. This is because of its large areas of fertile soil, abundant amount of water from rivers, rains and underground water, suitable wide range of climate which allow variability of crops. Studies showed high losses (30→40%) of fruits and vegetables during harvesting, transport and handling. These losses add to the cost of production and have negative impact on marketing and hence national economy. Therefore adoption of proper post-harvest techniques, investment in the infrastructure and post-harvest technology should be established.

Introduction

Sudan is one of the largest countries in Africa (250 million hectares), strategically located in the center of Africa making it a melting pot between Arabs and sub- Saharan peoples. The country shares extensive boarders with nine countries in the northern, central eastern and western Africa.

It lies within the latitudes 4-23 degrees north and longitudes 23-28 east. It has a wide climatic variation with several distinct ecological zones including high altitudes or mountainous regions in the west (Jabel Marra) and east (Red Sea Hills) that have Mediterranean climate.

Considerable water resources are available which include the White Nile, the Blue Nile and the River Nile and their tributaries, seasonal streams and rains with an annual amount of 109 billion m^3 of water in addition to the underground water i.e. the Nubian Sand-Stone Aquifer which is one of the largest water reservoirs in the world with an estimated rechargeable potential of 29 billion $m^3$of water (HS, 2003).

Sudan has 80 million hectares of fertile soil but only 20 million hectares are cultivated. Agriculture remains the leading sector in the Sudanese economy with an estimated contribution of 45% to the GDP. The agricultural sector provides employment for about two thirds of the industrial sector (CBOS, 2008).

1. Status of Fruits and Vegetables Production Compared to Total Agricultural Production

Many types and cultivars of fruits and vegetables can be produced almost all the year round due to the climatic variations plus available land and water. This large potential could supply both local and export markets. However, horticultural crops represent about 12% of the national agricultural income, compared to 17% for cotton and 29.6% for cereals and oil seeds. Hence the economic impact of fruits and vegetables is still very limited compared to their actual production potential in the country. This is due to less attention paid to them compared with the cash crops e.g. cotton, gum Arabic and the staple food grains. Even reliable data on the area and production of fruits and vegetables are still difficult to obtain.

Various vegetables are grown in both irrigated and rain–fed plots, in a total area of about 273,000 ha i.e. about 3% of the total cultivated area producing on average about 3.4 million tons of vegetables. The most important vegetables are onions and tomatoes followed by potatoes, okra, eggplant, water melons, cucumbers, pumpkins and a number of leafy vegetables. Vegetables are grown in small plots with pumped water including the national corporations such as Gezira Scheme where about 30,000 ha are devoted to vegetables. Table 1 shows area and production of some major vegetables during the period 2005 to 2009.

Fruit production in Sudan needs very little agro-chemicals thus the fruits are relatively free of chemical residues which if certified could give a comparative edge and a competitive advantage in international markets. The variations in climate and topography created conditions for the production of various types of fruits including date palms, citruses, mangoes, guava, pine apples and banana**.** In the high areas of Jabal Marra temperate fruits such as apples, grapes, strawberries and sweet oranges grow well. However, commercial production is hampered by the lack of investments and poor transportation facilities. The estimated total fruit production in Sudan is about 1.9 million tons in a cultivated area of about 186,000 ha. The area and production of some major fruits grown in Sudan during the period 2006-2009 are shown in Table 2.

Table 1. The area ('000 feddan) and production ('000 tons) of common cultivated vegetables crops in Sudan.

Year	**2005**		**2006**		**2007**		**2008**		**2009**	
Crop	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
Onion	110	688	113	900.8	115	920	117.3	938.4	128	1024
Tomato	66	396	68.3	409.8	72	432	76.3	453	80	480
Okra	42	210	45	220	48	235	48.4	249	48.9	252
Egg-plant	8.2	65.6	8.8	70.4	9	72	9.2	75.6	9.4	75.2
Potato	36	252	37.7	263.9	39	273	41	284	43	301
Cucurbits	72	504	78	546	81	567	84.2	589	88	616
Leafy -Vegetables	10.8	54	11	55	13	65	15	66.3	17.2	68.8
Sweet potato	16	112	17	119	19	133	21	147	32	216

One hectare = 2.38 feddan. (HS, 2009).

Table 2. The area ('000 feddans) and production ('000 tons) of the major fruits grow in Sudan.

Year	2006		2007		2008		2009	
Crop	Area	Product.	Area	Product.	Area	Product.	Area	Product.
Mango	67.8	611	68	632	68.2	651	68.5	616.5
Banana	43	516	45.2	540	47.2	561.6	52	624
Lime	30	210	32	224	34	233	36	236
Grape fruit	24.5	147	26	156	27.5	165	29	174
Orange	23	115	24	120	24.9	124.8	25	124
Dates	83	332	84	336	84.8	339.3	85.5	422
Guava	16.5	115.5	17	119	17.5	122.5	18	126

One hectare = 2.38 feddan. (HS, 2009).

Mango tree is the number one fruit tree in terms of production, followed by banana, date palm and lime. Sudan produces about 5.7% of the total Arab world production.

Mango is the main fruit produced in the northern states e.g. Western Darfur, Southern Kordofan, Northern and Khartoum states. Kassala State is the main area for banana production (*ca.* 35%), followed by Blue Nile (*ca.* 25%), Gezira, Sennar and Khartoum states. Grapefruit and oranges are mainly produced in the Northern State (*ca*. 60% & 40% respectively). Oranges are also produced in River Nile and Western Darfur states. Both dry (75%) and semi–soft (25%) dates are produced by small farmers in the Northern and River Nile states (PAB, 2003).

2. Major Constrains in Fruits and Vegetables production:

1. Lack of sufficient improved management technologies.
2. Inadequate financial and credits facilities.
3. Land fragmentation.
4. Poor vegetables seed production.
5. Limited application of agricultural research findings due to inadequate extension services.
6. Low productivity due to poor and traditional cultural practices.
7. High cost and improper local transportation.
8. Weeds, pests and diseases.

3. Main Distribution and Production of Fruits and Vegetables

Most of the horticultural production in Sudan is under irrigated farming system, along valleys and streams in the western states and the areas of high rainfall in the south. Most of southern Sudan and the fertile locations in South Kordofan, Southern Darfur, Southern Sennar and Blue Nile states are considered main potential areas for horticultural production (HS, 2009).

The most important vegetables are mentioned in Table 1. Other vegetables like carrot, cabbage,

red beet and cauliflower are grown at the outskirts of large cities. These vegetables are grown in different areas and marketed in the same or other areas. Vegetables acreage increased tremendously in the last few years due to the increased urbanization, awareness of their nutritive value and high returns per unit area. Both production and consumption of fresh vegetables and fruits are increasing due to relatively high demand locally and externally. The rate of consumption from fresh vegetables and fruits per annum is about 43 kg and 32 kg/person respectively (PFS, 2005). The increase in vegetable production is rather horizontal, productivity remains low and lags far behind international yields indicating high potential for improvement through better cultural practices, improved varieties and protection against pests and diseases. At present horticultural production is a flourishing enterprise in the country. The national strategy (2002-2027) emphasized the importance and role of the horticultural sector in development plans and on the national income (Abdelkareem, 2003).

4. Post-harvest Handling and Processing

Generally, huge losses occur in the horticultural crops due to poor post-harvest practices. Losses range between 30% - 40% (HS, 2003). These have a negative impact on the national economy.

5. Storage

Refrigeration of fruits and vegetables started in the early seventies (FRC, 1998) with the compelling need for potato storage. Later, many cold stores were established to about 10.000 tons capacity with extra storage in the Northern State.

Exhibition of fruits and vegetables at the local markets is very poor because the markets are not properly equipped for their exhibition. Numerous packing materials mainly for bulk packing are used that do not satisfy the consumer taste, for example:

- 15 kg tin packs for tomatoes.
- Different sizes of local containers made of palm trees leaves.
- Onions jute bags 50 kg.
- Potato jute bags 50 kg.
- Fertilizers sacks which are used for eggplant and okra.

All these containers are available at the local markets and are the main reason for post-harvest losses for retailers (FRC, 2008). These containers are against the requirements of ISO 9000 and Environment ISO 14000 (Elyas, 2008).

The horticultural crop supply chain

The chain involves:

Harvesting: Manual.

Handling and preparation: Cleaning, sorting and grading all carried out manually.

Packaging: Manual e.g. tomatoes packed in 4-gallons tins, mangoes and grapefruits in locally made baskets and imported jute sacks for dates/lime or oranges.

Transport: Most of the crops are transported by animals or lorries to local consumption villages or urban cities' central markets.

Marketing: The products are sold at road sides, village household stalls, urban cities street markets and some supermarkets. Some producers sell their products directly at different markets i.e. to an assemblers or itinerant wholesalers. No real markets exist in this case. The products are being transferred directly from the centre of supply to the centre of consumption.

The following practices are specific causes of post-harvest losses

(1)Banana

Bananas are grown in the Blue Nile and Kassala states about 600 km from Khartoum markets. They are transported in 5-6 tones trucks where banana bunches are stacked to the maximum permissible load. Most of the bruises which appear later after ripening are due to the harvest and transport methods. Post-harvest losses of bananas are about 35%.

Dwarf Cavendish is the predominant cultivar which in spite of its locally preferred taste and flavor, it has short fingers and is a poor keeper and shipper, a major reason for its unacceptability in the world markets. Fortunately, new banana cultivars have been released recently from the Sudan National Variety Release Committee targeting the export markets such as Granien and William.

(2)Mango, Guava and Citruses

Mango, guava and citruses (lemon, oranges, mandarin and grape fruits) are harvested mainly by using a hook and stick. This method increases losses during handling and storage due to the fall and contact with the ground that causes fruit deterioration. International cultivars of mangoes and grape fruits were recently introduced such as Kit, Kent, Tomyattkins, Sensasion and Haden for mangoes and Ray Robby, Rio ruby, Chamber, Froset march for grape fruits to secure the export market.

(3)Melon

Export of Gallia cultivar induced the producers to use improved methods of harvesting and packing but the main problems are time of harvest and packaging. Post-harvest losses of melons are about 15-20%.

(4)Dates

Dates are harvested manually by cutting the bunch and dropping it to the ground. causing losses of up to 50%.

(5)Leafy vegetables

Leafy vegetables like Jews mallow, garden rocket, dill, purslane and parsley are produced for the

local markets. These vegetables are packed in local straw containers and exhibited covered with jute sacks soaked in water. They are totally lost after 24 hours from harvest.

(6)Potatoes

Potatoes are harvested manually when the vines turn yellow. Tubers are cured for 10 days in the field in shallow pits called 'Boata' covered with potato vines. The tubers are then packed in jut sacks and placed in the same field under the direct sun rays (30-37°C) for 2-3 days waiting for loading to the cold store. This method leads to poor potato quality and about 30% losses.

6. Post-harvest Research

Research in the field of post-harvest technology is mainly conducted at the Post-harvest Physiology and Storage Department, Food Research Centre. It was established in 1969 to improve post-harvest techniques by minimizing the losses, improving the storability and maintaining the quality of the horticultural crops. A number of researches were carried out on the:

- Improvement of local harvesting methods (maturation and maturity indices, best local tools for harvest and suitable containers for harvest, handling and export).
- Preparation of fruits and vegetables for export (sorting, grading, waxing and packing).
- Ripening of climacteric fruits (banana, mango and guava).
- Degreening of citrus.
- Suitable storage temperatures for export fruits and vegetables.
- Improvement of local methods of onion storage.
- Introduction of cold storage techniques for fruits and vegetables such as, potato, mango and citrus.
- Publishing booklets on the standard metrology indices for Sudanese fresh fruits and vegetables for local market.
- Extension of shelf life of vegetables and fruits using gamma irradiation (potato, guava, mango, banana and onion).
- Evaluation of fruits and vegetables for processing and export markets.

Studies on post-harvest technology including canning (jams, tomato paste etc), drying (okra, potato) are conducted in the dehydration and canning sections, Food Research Center.

However, the research findings are poorly applied hence their low contribution to the national economy. This is due to inadequate extension services and limited investment in the food industry. Post-harvest technology research can contribute more to the national economy since Sudan can add to the world markets' supply of mango, grapefruit, lime, guava, pineapple and papaya whether fresh or concentrates.

7. Post-harvest Research Constraints

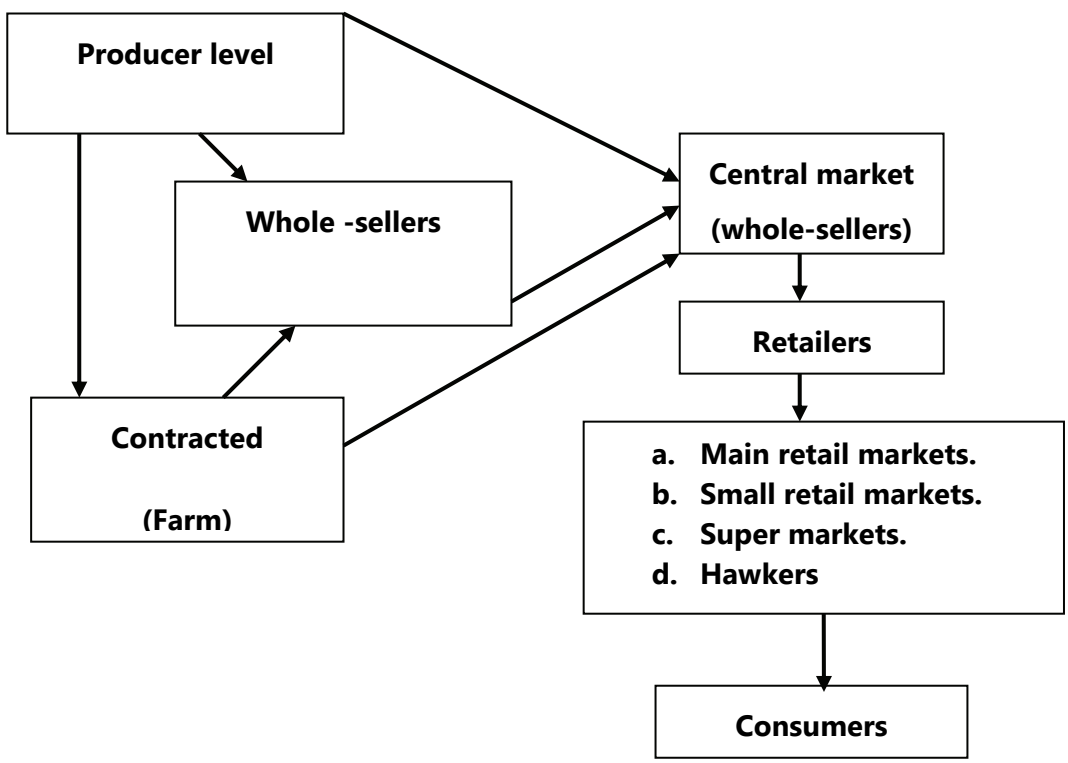
- Limited number of well trained technical staff.

- Weak linkage between research and the industrial sector.
- Limited training opportunities for research scientists and technical staff abroad.
- Weak linkage with the international information and research centers.

8. Fruits and Vegetables Markets

There are no marketing institutions dealing with fruits and vegetables. Farmers and producers deal as individuals directly with local traders and exporters. The trade lacks exhibition sheds, loading and unloading platforms, cold stores and trucks loading equipments. Therefore the producers sell their products early in the morning at very low prices especially perishable vegetables, i.e. tomatoes. The central markets are administrated by local authorities who collect fees for services (waste disposal) and rents for selling stalls and shops. Farmers and traders associations exist in Kassala, Gedarif, River Nile and Northern states.

The main local markets are in Khartoum, Khartoum North, Omdurman, Wad Madani and Port Sudan (Abdalazeez, 2005). The trends in domestic, regional and international markets are shown in the following diagram:



The performance of the horticultural crops marketing system is irregular in terms of prices, profits and cost of production and is unsustainable hence it is a traditional and ineffective system. Table 3

shows the cost of production of some horticultural crops in Kassala State.

Table 3. Average cost of production and financial profit margin for main vegetables and fruits in Kassala State.

Crops	Cost of production (SDG/ton)	Selling price (SDG/ton)		Profit (SDG/ton)	
		During season	Off season	During season	Off season
Onions	150	200	1200	50	1050
Tomatoes	500	1000	10000	500	9500
Mangoes	535	1162	4980	827	4645
Grapefruit	325	600	2000	275	1675

Source: Ministry of Agriculture, Kassala State (2003).

The selling price fluctuates greatly at the beginning of the season and during the season. For example, tomatoes will be sold at a low price at the start of the winter season and for two months but in summer the price will increase to up to 10000 SDG/ton (for two months).

Industry

There are many factors dealing with fruits and vegetables processing in Sudan but most of these factories are out of functioning because the grown variety is unsuitable for processing characteristic, financial storage and lack of technical experiences.

9. Import of fruits and vegetables

Import of fruits started in the mid nineties from Egypt, China, Quarter and Lebanon. These are grapes, strawberries, apples, cherries, kiwis and pears.

10. Export of Fruits and Vegetables

In spite of the high potential and diversification of horticultural products, the export of fruits and vegetables is very limited as it contributes around 2% of the total exported food commodities (HS, 2009).

The export business started in the early seventies and the amounts exported are still low (Idris, 2006). Most of the Sudanese vegetables are produced in winter (November-March) which is the best time to fill the seasonal gap demand in European markets for onions, eggplant, sweet pepper, snap-bean, Gallia melon, hot pepper, squash and okra. Fruits with high export potential are mango, banana, grapefruit, dates and lime. Export links with European and Gulf countries is being established e.g. Holland, England, Italy, France, Greece, Saudi Arabia, Qatar, Kuwait, Jordan, Bahrain and United Arab Emirates (Elyas, 2008). Gezira State is the most important state in the export of fruits and vegetables, followed by River Nile and Northern states. Average amounts exported are shown in

Table 4.

Table 4. Average amounts of yearly exported fruits and vegetables.

Crop	Amount (ton)
Onion	185
Tomato	27
Snap-bean	73
Lime	57.1
Mango	305.8
Banana	271.2
Grape fruits	26.4
Melons	727

Source: Sudanese Standardization and Metrology Organization, Ministry of Ministries.

10.1. Factors affecting programs and plans for fruits and vegetables export

1. Small holding fields for export crops and poor cultural practices.
2. The absence of suitable export varieties to compete in international markets.
3. Lack of suitable and well defined technologies for growing fruits and vegetables for export.

10.2. Major Constrains facing the export of fruits and vegetables

(1)Post-harvest practices

- Poor infra-structure and logistics which include inadequate transport system, absence of refrigerated transport, insufficient cold storage, grading and packing facilities.
- Lack of proper knowledge in post-harvest practices by both producers and exporters.
- Complicated custom services.
- Poor airport handling i.e. pallets handling.

(2)Air-freight

Horticultural crops are mainly exported by air. Problems faced are:

- High cost of air-fright 1000-1200 US$ per one ton to Europe.
- Frequent delays in flight schedules.
- Charter flights contracted are not equipped with noise isolation system which is necessary to land in European countries.
- High cost of rented planes.
- High competition with other exporting countries.

(3)Marketing

Technical barriers

- Poor quality of produce as far as post-harvest treatments is concerned.
- Lack of sustainability.
- Poor internal transportation system and processing facilities.
- Poor production and the lack of specialized varieties for export.
- Absence of sanitary certificates required at the other end.
- Unreliable feed back and absence of market information.
- Limited technical marketing expertise.
- Limited marketing organization with resources capable of gathering and disseminating market information.

Financial barriers

- Lack of agricultural finance.
- High production and export risks which limits banks credit and finance.
- High cost of service fees and taxations.
- High cost of the agricultural inputs.
- Poor marketing extension in Sudan.

Constraints and potentialities of the horticulture sector

- Low productivity due to disease and pest problems, lack of certified seeds and availability and high post-harvest losses (50%).
- Irregular production, consumption and prices.
- High temperatures lead to irregular flowering e.g. optimum flowering for mango is 8-15ºC at night. It also increases the rate of ripening and hence relatively short shelf-life.
- High cost of agricultural inputs.
- Availability of proper packaging materials.
- Inadequate cold chain. Preservation of quality requires an unbroken chain from the field to the consumers. No cold stores facilities are available at the centers of production, central markets and airports.
- Weak entrepreneurial skills.
- Inadequate market knowledge and weak marketing channels and mechanisms. No effective market linkages are established.
- Weak management skills in the fields of production planning, production practices and organization of harvesting at the correct maturity for fresh consumption, processing and export.
- Lack of extension services and weak technology dissemination mechanism for the application of proper post-harvest operations developed by Food Research Center (FRC) and the Agricultural Research Corporation (ARC).
- Availability and access to credit and finance.

Potentialities

- Horticultural crops are products of high demand locally and in overseas markets.

- There are great potentialities to expand production areas e.g. in Kassala, Northern and Gedarif states.
- There is a winter window of opportunity in export markets (during December – March) due to a long growing season (winter and summer seasons) e.g. in Kassala State.
- The value added through processing is high and hence its impact on GDP will be appreciable.
- Availability of experienced laborers and accessibility to cheap water and irrigation infrastructure.
- Availability of an extensive range of institutions and skills in the public sector e.g. Ministry of Agriculture and Forestry, ARC, FRC and universities.

Conclusion

In conclusion, there are slight increases in fruits and vegetables production and limited amounts exported. Thus there is an urgent need for a total revision of Sudan's horticultural policies with the objective of increased production and better qualities of produce. Agricultural scheme should be adopted and financed, taxation policies should be revised to make the sector competitive in international markets.

Recommendations

- Investment in infrastructure and post-harvest technologies. The government of Sudan adopted a series of macro economic policies to promote the investment environment in the field of agriculture. These policies insures no discrimination between the invested fund by reason of being local or foreign, or by reason of its being a public, private, co-operative or joint sector. Investment act gives privileges such as:
  1. Exemption from the business profit tax, for a period not exceeding five years.
  2. Exemption may not exceed 70% of the custom duties and any other taxes.
  3. Production and consumption duties.
  4. Allotment of necessary land at an encouraging price for the project to competent bodies.
- Improvement of productivity per feddan through the introduction of new high quality breeds and by development of the local hybrid seed production.
- Development of integrated horticulture supply chain.
- Promoting an enabling environment through:
  1. Increasing awareness and market information.
  2. Making credit more affordable.
  3. Improving technology dissemination and extension services.
  4. Creation of an effective market linkage.
- Establishment of a regional training centre run by public and private sectors e.g. in Kassala State in order to link R & D's, extension departments and farmers.
- Supporting R & D institutions financially and technically.

- Application of proper post-harvest operations developing by FRC to reduce losses, increase productivity and up-grade qualities.
- Economical utilization of existing vegetables and fruit factories' capacities i.e. Kassala Canning and Onion Dehydration factories to increase the revenue from the added value. The objective should be exporting processed products instead of raw materials. International companies and firms are encouraged to invest in this sector.

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