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Full Length Research Paper

A study of the commercialization of glasshouse vegetables and ornamentals as a means of changing the dynamics of the Nigerian agricultural industry

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Agriculture is the backbone of most African economies and people's livelihoods because it employs 70% of the population. In Nigeria, the population growth rates remain among the highest in Africa; it is presently estimated at 160 million. While population grows at a rate of 3.5% per annum, food production increase is 2.5% or less. This specifies the importance of glasshouse cultivation of vegetables and ornamentals as an augment against the present situation of food crisis in Nigeria. Glasshouse vegetable production has potential as a niche market for out-of-season, all year round produce and as a sustainable method of production. There are however, factors frustrating successful introduction of glasshouses into the Nigerian agricultural sector such as low technology transfer, limited empowerment of farmers with respect to access to financial and technological inputs necessary for sustained agricultural production and poor public perception of modern technology influencing the direction of innovation in the commercialization of agriculture. In order that farmers adopt the use of glasshouses in cultivation of vegetables and ornamentals, the government should make its adoption easy by financing glasshouse construction as a model for commercial farmers to follow. Efforts in creating awareness should be increased; the active role of the private sector, government and collaboration between research institutes, universities, and colleges of technology within and outside Nigeria should be enhanced. This paper examines the need for the commercialization of glasshouse vegetables and ornamentals as a means of increasing human agricultural activity including expansion of cultivated area and changing the dynamics of the agricultural industry of Nigeria thus changing the status of economy.

Key words: Glasshouse, vegetables, ornamental, agricultural production, Nigeria.

INTRODUCTION

In Africa, underdevelopment of agriculture is long-standing retarding the growth of its economies with negative implications for people's livelihoods. Many farmers have limited access to financial and technological inputs necessary for sustained agricultural production (Ebong, 1991). Hence, agricultural development is therefore critical to present and future economic growth and improvements in the welfare of Africa and the livelihood of its people. Governments should actively support new investments in agriculture and rural development, which will ensure that people witness a start in the turnaround of these negative trends (Ogbuagu, 1995). Most of the world's poor are rural based, and agriculture is a catalyst for a broad-based economic growth and development in most low-income countries including Nigeria where farmers need to move from subsistence to more market oriented production, which will enable them to meet other basic needs (IFPR, 2002). This paper focused on the need for cultivation of glasshouse crops, the achievement of high yields and

good quality possible due to the precise control of nutrition and all the growing conditions.

Greenhouses also called glasshouse are framed or inflated structured covered with transparent or translucent material large enough to grow crops under partial or fully controlled environmental conditions to get optimum growth and productivity (Ross, 2000). It is also a building with glass walls and roof, for the cultivation and exhibition of plants under controlled conditions. It is a structure, primarily of glass in which temperature and humidity can be controlled for the cultivation or protection of plants. The structure can be covered with glass, fiber glass or plastic (Woods, 1988).

The greenhouse heats up because incoming solar radiation from the sun warms plants, soil, and other things inside the building faster than heat can escape the structure. The air warmed by the heat from hot interior surfaces is retained in the building by the roof and wall. These structures range in size from small sheds to very large buildings and can be divided into glass and plastic greenhouses (Cunningham, 2000). The glass greenhouses are filled with equipment like screening installations, heating, cooling, and lighting and may be automatically controlled by a computer. The glass used for a greenhouse which works as a barrier to air flow and its effect is to trap energy within the glasshouse, which heats both the plants and the ground warming the air near the ground and preventing it from rising and flowing away (Vleeschouwer, 2001). This principle is the basis of the automatic cooling. Glasshouses can allow certain crops to be grown year round such as lettuce and other vegetables. Glasshouses can protect the plants from the adverse climatic conditions such as wind, cold, dust storms and blizzards, precipitation, excessive radiation, extreme temperatures, insects and diseases. Light and temperature control allows glasshouses to turn in arable land into arable land and can be useful in feeding starving nations where corps can't survive especially in the harsh deserts and Arctic wastes. The closed environment of a glasshouse has its own unique requirements, compared with outdoor production, pests and disease infestations and extremes of heat and humidity, are also controlled. Glasshouses are often used for growing vegetables, fruits and flowers. Also, glasshouse production require relatively small amount of area compared with field-grown produce and, the return on investment can be good if the requisite markets can be found. Glasshouse-grown vegetables cannot compete with comparable field-grown crops based on price; therefore, Glasshouse-grown vegetables often are marketed to buyers based on superior quality and off-season availability.

Types of glasshouses

As a result of the advantages of greenhouses a number of countries especially in Africa have in recent times imbibed the idea of greenhouse farming. Kenya for example introduced greenhouse production of tomatoes to ensure that the popular vegetable will yield sufficient quantity to meet local demand and excess for export also increase the income of rural households. Egypt has about 1000 ha greenhouses consisting mainly of plastic covered tunnel type structures the main crops grown are tomatoes, cucumbers, peppers, melons and nursery plant materials (Anonymous, 2011c).

In Nigeria the use of greenhouses has been confined to research institutes and tertiary institutions where they are often used for on-going research and private ownership of greenhouses is not too popular. Although the federal government has repeatedly restated her commitment to the food security programmes. They have not been able to harness greenhouse farming as one of the many options that have been used elsewhere which could possibly be introduced in the Nigerian environment. As such, greenhouse farming is grossly underutilized/popularized and there is need for government to invest more in this agricultural sector to make Nigeria self sufficient in the area of food production especially in areas like Vom in Plateau State that has being identified as a place where many exotic plants for example Passion fruit, Irish potatoes, Cabbage, Roses, other ornamentals, Turnip and Strawberries can be grown because of the temperate nature of the weather in the area. If the government can institute the greenhouse project initiative in a place like the Plateau then Nigeria as a nation will be one of the leading countries in terms of food production.

Glasshouses /greenhouse structures of various types are used for crop production they can range from simple homemade designs to sophisticated prefabricated structures. Different types of greenhouses are designed to meet specific needs the types based on shape, utility, materials and construction are;

Type based on shape:

a) Lean to type b) Even span c) uneven span d) ridge and furrow e) saw tooth f) Quonset g) Interlocking ridge and furrow type Quonset h) ground to ground greenhouse.

b) Based on utility, it depends on functions and/or utilities and of the different utilities, artificial cooling and heating are more expensive and elaborate hence we have: a) greenhouse for active heating; b) greenhouse for active cooling.

c) Based on construction: the type of construction is influenced by structural material therefore we have a) wooden framed structure; b) pipe framed structure; c) truss framed structure.

d) Based on covering material: this have direct influence on greenhouse effect inside the structure and they alter the air temperature inside; a) Glass glazing; b) Fibre glass reinforced plastic (FRP) glazing; i) plain

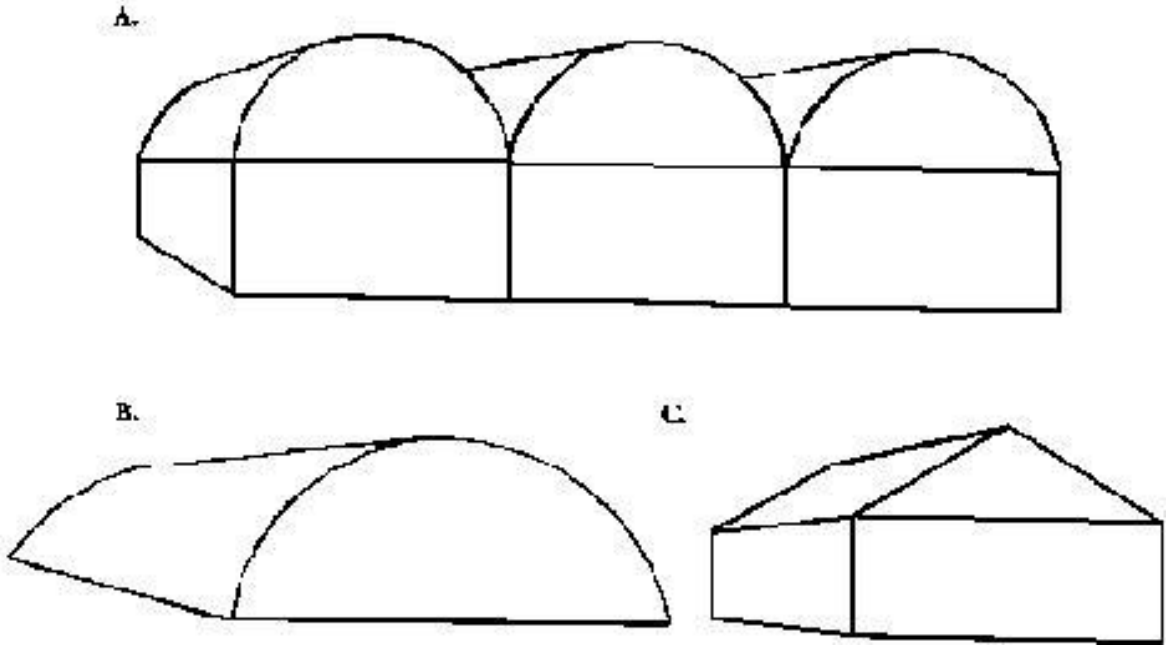

Figure 1. Commercial greenhouse structures: A) Gutter connected; B) Free standing Quonset; C) Single gable.

sheet; ii) corrugated sheet.

e) Plastic film i) UV Stabilized LDPE Film ii) Silpaulin type sheet iii) Net house.

Several factors should be considered when choosing a particular glasshouse design, not the least of which is local building codes. Care must be taken to ensure that all building codes are met and necessary permits secured before construction begins. Structural load from environmental forces as well as for trellises should be considered in the design. Sufficient heating and cooling capacity must be incorporated into the design to meet the crop's needs for the given geographic location. Because of the specialized nature of a glasshouse structure, obtaining a proven design before construction begins is advisable. In addition, an experienced designer and builder may be in order. Figure 1 shows several different styles of Glasshouses (Hochmuth, 1991b).

The efficiency and productivity of a greenhouse operation is largely dependent on the type of growing structure used. Since there are many designs to select from, it is important to become familiar with the advantages and disadvantages of each. The following is a brief discussion of commercial greenhouses and their structural components.

There are three types of greenhouses: lean-to, detached, and ridge and furrow or gutter connected. Few lean-to greenhouses are used for commercial production because of limitations in size. This type of house is the most popular among hobbyists.

Detached greenhouses stand independently from one another. However, they may be connected to a work area or access another greenhouse through a corridor. The most common type of detached greenhouse for commercial production is the Quonset. These houses are constructed from arched rafters and usually have solid end walls for additional support. Quonset greenhouses are suitable for the production of most crops, but the growing area is somewhat restricted near the side walls. This reduces efficiency as well as productivity.

Ridge and furrow greenhouses are connected at the eave by a common gutter. Generally an internal wall below the gutter is not present allowing for increased efficiency. Ridge and furrow greenhouses may be gabled or curved arch. Gabled houses are usually suitable for heavy coverings (that is glass, fiberglass) while curved arch houses are covered with lighter materials (i.e. polyethylene, polycarbonates). Several connected ridge and furrow greenhouses are often referred to as a "range".

The efficiency and productivity of a greenhouse structure is greatly influenced by its design. Also, the initial and long term costs of the facility are affected by the type of materials used. Ridge and furrow houses provide the greatest efficiency in crop production. Aluminum is the most durable and commonly used framing material for commercial greenhouse structures. Double sheets of polyethylene film are the most economical covering material used in greenhouse (Muijzenberg and van Den, 1980).

Several covers can be used with a Glasshouse. The most widely used covering materials are ultraviolet (UV) light resistant polyethylene plastics. These covers are often installed two layers thick with an inflated air space

between. This increases the cover's insulating capabilities while reducing the chances of a catastrophic loss because of wind-induced flexing. These materials are specially manufactured for the glasshouse industry. Common polyethylene plastic is not the same, because it has not been manufactured to withstand UV radiation. Common polyethylene will not last a year; UV resistant polyethylene plastic is designed to last one to four years, depending on the grade. Many of these coverings have additives to reduce condensation in the house as well as to trap more infrared (heat) radiation.

Rigid plastic materials such as polycarbonate can also be used however; the initial cost is higher than polyethylene but generally less than glass. Light transmittance is greater than polyethylene but, again, less than glass. Impact resistance is the best of any material available. Rigid plastic materials are available in different grades with guarantees ranging from five to 20 years. They are also available in single- (corrugated) or double-layer construction.

Glass is an excellent choice for high light transmission and longevity. Glass can last 25 years or more. Glass does have some disadvantages, such as high initial cost and low impact resistance (Phillips and Park, 2002).

Factors considered for site selection

Several factors should be considered in selecting a suitable site. Whenever practical, the site should be level or nearly so because sloped sites do raise construction costs considerably therefore the site must be leveled or terraced to accommodate the new structure. The site should also be near a power source and have a ready supply of usable water. Typically, water from a well is better than surface water because there is less likelihood of disease and algae contamination. Water is critically important in glasshouse production, especially if one of the various hydroponic systems is used. The water used in the fertilizer solutions must be tested before beginning the crop cycle. In addition, the water may contain significant levels of dissolved minerals, particularly calcium and magnesium. City water systems may be troublesome for growers, especially if the water has been chlorinated because chlorine can cause problems for plants, for example, lettuce.

Availability of labor is equally very important particularly labor that is conscientious, skilled, or at least trainable because much of the work in crop production is repetitive and tedious. Access to good roads and proximity to expected markets should also be considered (Hochmuth, 1991).

CROPS COMMONLY GROWN IN THE GLASSHOUSE

In Nigeria the existing greenhouses are mainly owned and located within the teaching and research institutions and are therefore primarily used for the purpose of research and as nurseries. Although these greenhouses have been successfully used in the cultivation of vegetables and ornamentals which cannot be cultivated under normal climate they have proved useful in the cultivation of highly demanded crops thereby providing an opportunity for income generation. These advantages notwithstanding, the cost of construction, maintenance and lack of awareness of its potential have discouraged the commercial farmers and entrepreneurs from venturing into the business of greenhouse farming in Nigeria. For example, the construction cost of greenhouses varies with size for a 6.1 m by 0.1 m by 4.5 m. The cost varies between one and three million naira while the annual maintenance cost would vary between USD 3000 and USD3500 that 500,000 and 600,000 naira.

This prohibitive cost of construction and maintenance is assumed to be one of the reasons why many people especially many of the Nigerian farmers' majority who are peasant farmers cannot venture into the business of greenhouse farming without support from government in form of grants and/or subsidy (Yahaya and Gbadebo, 2011).

Although whatever investment may be made in the erection of greenhouses such could be recovered within a short period of time therefore the introduction of greenhouse farming for crop production is one of the many options of combating food insecurity in Nigeria.

Several vegetables have however been successfully produced in a glasshouse, including cucumbers, peppers, lettuce, herbs and by far the most important, tomatoes (Wilson 1993).

Tomatoes are the leading glasshouse vegetable crop, followed by cucumbers, lettuce, peppers and culinary herbs such as basil, sage, and rosemary, while ornamentals such as roses, spring bulbs, Oxalis, Cineraria, Calceolaria, Primula, Cyclamen, Azalea and Lilies are also common in controlled environment. Year-round production is important in maintaining the glasshouse's profitability.

Tables 1 and 2 both indicate the regions and seasonality of field-grown vegetables while data for ornamentals were not computed. This further indicated the rare value of making use of glasshouses in cultivation of these crops as there is possibility of year-round cultivation which will further increase the income earnings of the famers.

In Nigeria, labor and energy are usually the two greatest glasshouse expenses. If small growers can find a way to decrease costs of either or both of these, their chances of making a profit are strengthened (NNPC, 2007). This can be achieved by using cheap sources of energy; sunlight, decomposing compost, and animal heat are three ways to decrease energy costs (Adenikinju, 1998; Schnep, 2007).

Table 1. Vegetable production in the different zones in Nigeria.

Zones	Vegetables
North West North East	Onion, Tomato and Pepper Tomato, Onion, Pepper Okra, Egg-plant, Amaranthus, Roselle, Pumpkin, Water-melon Carrot, Lettuce, Cabbage
Central	Pepper, Onion, Tomato, Okra, Amaranthus, Egusi- Melon, Cucumber, Water- Melon, Garlic, Ginger
South West	Tomato, Pepper, Okra, Melon, Amaranthus, Celosia, Corchorus, Egg-plant.
South East	Egusi-melon, Okra Amaranthus, Gnetum, Water leaf, Vernonia, Egg- Plant, Pepper, Tomato

Table 2. Seasonal availability of major vegetables in Nigeria.

Vegetable	Available period
Onion	December – February
Tomato	April – November (South) February – June (North)
Okra	July – October January – April
Pepper	April – November
Amaranthus	February – June
Carrot	July – November
Melon	February – July
Corchorus olitorius (Ewedu)	July – November
Hibiscus sabdariffa (Sobo)	July - November
Adansonia digitata (Baobab leaves)	November – January

Like other agricultural, crops, the production of flowering or ornamentals crops play crucial in the developing economies. A number of Nigerians now establish vegetable and ornamental horticulture gardens across the country (Jesse and Phillip, 2002). The economic benefits and total outputs values of these enterprises are tremendous in the country. The incomes that accrue from commercial ornamental plant production through the sales of flowers and other ornamental plants could be very significant and could contribute substantially to the nation's economy (Omokhua et al., 2002).

IMPORTANCE OF GLASSHOUSE TO AGRICULTURAL PRODUCTIVITY IN NIGERIA

The decline in agricultural productivity, leading to hunger, poverty and malnutrition, could be attributed to several interrelated and complex factors. These include weak

and inappropriate policies concerning price controls and restrict internal trade in farm produce, as well as heavy taxation of agricultural export to generate the capital for industrialization, which contributes to the reduction of incentives for agricultural production in Nigeria (Nyong, 2008).

With respect to the latter, many farmers have limited access to financial and technological inputs necessary for sustained agricultural production.

All these further specify the importance of glasshouse cultivation of vegetables and ornamentals as an augment against the present situation of food crisis in Nigeria. Other factors frustrating successful introduction of glasshouses into the Nigerian agricultural sector are low technology transfer and limited empowerment of farmers. The country remains essentially a producer of primary goods for the rest of the world, while at the same time; it is steadily losing its world market shares for major export crops like coffee, tea and cocoa. The issue of the competitiveness of Nigeria's agriculture is a challenge. It is clear that Nigeria urgently needs long-term solution to end this cycle of despair (Amoako, 1999). The country is in search of new ways and means to battle its long-standing developmental problems. The most recent demonstration of this is the pledge by the government to face up to the pressing duty to eradicate poverty and to place the country on a path of sustainable growth and development and to participate actively in the world economy and politics through The New Partnership for Africa's Development (NEPAD). Unlike field or row crop agriculture, which base production costs on land area, glasshouse costs are calculated on a per square metre of growing area or per plant basis. In addition expenditures for glasshouse structures and plant material are considerable therefore the need to promote and invest in glasshouse production in Nigeria

Economics of glasshouse vegetable production in Nigeria

Glasshouses are expensive to build and operate. A commercial glasshouse (30' x 100') with complete heating, cooling and ventilation systems will cost between USD 5000 to N750,000 to N2.5 million to erect and equip.

Low cost glasshouse-like hoop houses and attached solar glasshouses-can be constructed for as little as USD 1000 to USD 2000N150,000 to N300,000. Hoop houses are similar to plastic Quonset glasshouses but are not equipped to heat or cool, and are used primarily for season extension. Solar glasshouses work fine for small scale production-especially for the production of transplants and cool-season lettuces-but may not provide adequate space or climate control for commercial tomato, cucumber, or pepper production.

Glasshouse vegetable yields determine potential gross sales. Typical yields of glasshouse tomatoes are 9 to 13 kg per vine, or 0.9-1.4kg per square metre. Glasshouse cucumbers yield around 2 dozen fruits per vine and peppers yield 2½ - 3 kg.

Challenges to glasshouse crops management in Nigeria

Public perception of modern technology is now one of the factors that influence the direction of innovation in the commercialization of agriculture in Nigeria. It is widely influenced by values and physiological factors as well as public confidence in scientific institutions responsible for risk assessment and management (Fakayode et al., 2008). It is also influenced by information coming from the industry, governments, scientists, public interest groups and the media. In order that many people adopt the use of glasshouses in cultivation of vegetables and ornamentals, there is an urgent need to increase the efforts in creating awareness. People would initially reject new technologies because they fear the unknown (Abegunde et al., 2009). The introduction of glasshouse vegetables and ornamentals is faced with a challenge of meeting up with the quality required at initiation. Rural farmers cannot possibly accept glasshouse as a solution if the federal government does not first make its adoption easy by financing early glasshouse construction as a model for commercial farmers to follow.

CONCLUSION AND PROSPECTIVES

The actual commercialization of glasshouse vegetables and ornamentals will change the dynamics of the agricultural industry in Nigeria thus changing her economy.

In the area of storage, the establishment or erection of cold rooms for storage of ornamentals and vegetables at peak periods of production for subsequent use during the lean period is not available.

Consequently, high losses are experienced. Establishment of processing companies in the country will attract good dividends, as the few available companies in existence cannot cope with the high output of horticultural produce (especially Flowers).

Also, with the glasshouses, good quality vegetables can be produced in the wet season thereby ensuring an all year round vegetable production. With the high rate of vegetable seed usage, the establishment of vegetable seed companies within Nigeria will greatly ameliorate the dearth for high quality and viable seeds.

RECOMMENDATIONS

In view of all the enumerated uses of glasshouse crops, the unexploited and untapped resources in glasshouse

cannot be over-emphasized. Also the active role the private sector as well as the government could play in the development of glasshouse cannot be over-looked. There is a great need for collaboration between Research Institutes, Universities, and Colleges of Technology within and outside Nigeria. Finally the plea that government should boost glasshouse to attain its rightful place in the Nigerian economy should be viewed with all seriousness. There is also the role which the developing countries can play in putting glasshouse crop and seed export in its rightful place in the international market so as to have greater socio-economic impact.

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