Horticulture Sector Study for Nigeria

Commissioned by
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Prepared by
Taste
Developing Fair-Trade Markets

For
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ADVISORY AND SOLUTIONS SERVICES

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1 Preface

The current study is the result of a three month voyage into the horticultural sector of Nigeria, trying to identify two things:

- what are the challenges of the Nigerian horticulture sector? How can it be improved if it wants to improve the food security and nutrition of the population?
- how can Nigeria quickly launch itself into the world horticultural trade and become a net exporter instead of a net importer?

Trying to answer these questions within the scope of the time frame that was given to us by the Netherlands Embassy, which has graciously commissioned this study, we have made a tour through almost the entire country. We have had the priceless assistance of hundreds of Nigerian women and men, farmers, traders, retailers and scientists, who have shared their best insights and most valuable data to draw a fairly complete picture of the sector, of the hopes and challenges, the problems and aspirations.

There are only a few countries in the world that are so large, so diverse and so colourful as Nigeria. Trying to be complete and to cover the whole country is an impossible task. We are confident though that with the approach taken, we have been able to give a good picture of what is essential in the sector. We have drawn from results collected in different States, in the dry North and in the wet South, the populous South East as well as the very different North West, trying to do some justice to the diversity. We conclude that many of the structural challenges are very similar, while the local conditions vary extremely.

It has been impossible to cover all aspects, as the whole sector has to cope with so many interrelated factors. Everything influences everything. Nothing is linear. Only this report is linear and that is a limitation.

Many reports have been written in the course of time. As farmers shed the sweat from their faces as they toil on their plots, so do report writers behind their desks. Both know that what finally counts, is not the effort, but the result. It is not the intention that this is a perfect report, but that it aspires to give a stimulus to sensible action. It is not intended as a blueprint for the sector. A blueprint can never do justice to the dynamics of people, markets, climate and climate change. Nevertheless, a few well planned actions, designed in close discussion with the private sector, a continuous attentive dialogue between policy makers and the private sector will soon lead to the first successes. And success will draw attention and create more success. Such an approach is called a “whiteprint” approach, where different styles of interventions are woven together, where the goal is clearly set, but where there is flexibility to respond to the challenges and dynamics of a fast changing society. This study contains some clear indications of where these successes can be quickly achieved.

It is our pleasure to thank all those who have contributed to this study and without whose help it would have been impossible to complete. We thank the whole team of ALTS Consulting Ltd., Lagos, TASTE, Barendrecht, Netherlands, the project leader of the Embassy, Mr Taco Westerhuis, the National Statistical Service, which provided the input for the commodity maps, and the students of HAS University (Bas Ammerlaan, Jamil Hazim and Mathijs van Lelieveld) who prepared commodity maps that present a very graphic and colourful picture of the horticultural sector in Nigeria and its performance. Colin Middleton took care of linguistic revision and layout of the text.
2 Introduction

TASTE has been asked to conduct a study on the Nigerian Horticulture Sector by the Royal Netherlands Embassy in Abuja, Nigeria. The commission was given at the end of December 2014, for completion by the end of the first quarter 2015. Given the limited scope and time frame, the approach was to prepare a concise report, but full of information and practical by nature.

2.1 Terms of Reference

2.1.1 Rationale

Since 2011, the Nigerian government has been working to transform the Nigerian agriculture sectors, which have shown a declining trend since the oil boom of the 1970s. The policy framework under which this takes place, is the Agricultural Transformation Agenda. The agenda particularly focuses on the restoration or establishment of the value chains in the various product groups, from seeds to retail and exports. Given its success so far, combined with the necessity to provide food security to the growing Nigerian population, it is assumed that the policy will not be altered under the next Nigerian government after the elections of February 2015.

In the Netherlands, there is renewed interest in Nigeria as a country for cooperation, trade and investment. This was reinforced during the visit of Minister Ploumen of International Trade and Development Cooperation in June 2014. The Netherlands aims to expand its activities on agrofood and horticulture within the relations with Nigeria.

Nigeria is the largest economy in Africa with a fast growing middle class. As such there is growing market potential. However, more than 50% of Nigerians still live in poverty and qualitative and quantitative hunger is still far from eradicated. This too provides a justification for the study, given the positive influence improved value chains in food-horticulture have both for the rural population, often working in agriculture, as well as the growing urban class that needs access to agricultural produce.

On the Dutch side, private and even public institutions are hardly familiar with the situation in Nigeria and the opportunities for cooperation, trade and investment. The agrofood and horticulture sectors are regarded as Dutch ‘top sectors’, contributing substantially to the Dutch economy, to innovation and to exports. As a matter of policy, Dutch knowledge, products and innovations are to contribute to food security worldwide. To make the connection however, it is imperative to first provide a good picture of the situation in Nigeria.

Obtaining a good overview is in fact one of the major challenges: it is hard to get a comprehensive picture of what is going on in the different areas in which the Agricultural Transformation Agenda is implemented. Every value chain is different and each has its specific obstacles. The study should therefore provide an overview of the chains, with focus on vegetables, staple food and seed propagation materials, where Dutch expertise and products can make a difference.

2.1.2 Bilateral cooperation and business

Given the market potential and developments, cooperation with Nigeria and the Agricultural Transformation Agenda is considered a two-way street. A good understanding of the strengths and weaknesses of the present value chains and networks in Nigeria (including information about the produce grown, the Nigerian market, modes of transport, packaging, standards and certification, ports of exit, etc.) can give a clear picture for the Dutch horticulture sector were Dutch expertise and products could contribute. The study will then serve as a basis for further Dutch-Nigerian cooperation: B2B, B2G or G2G.
The results of the study will be presented to the Dutch ‘Topsector Horticulture and Starting Materials’, and should serve as a foundation for the public and private sectors to become active in and with Nigeria. Its second purpose is to function as a starting point for discussions and cooperation between Dutch and Nigerian parties, including the Ministry of Agriculture and rural development and the Netherlands Ministries of Economic Affairs (Directorate General for Agriculture) and the Ministry of Foreign Affairs, about cooperation in horticulture. These discussions will in turn determine business and political choices and the application of instruments such as workshops, attendance at agricultural fairs, missions, matchmaking activities etc.

The urgency for the study is backed a. by European (EU) – ECOWAS relations, aiming at getting Nigerian produce to the EU market under a soon to be signed European Partnership Agreement (EPA), and b. Dutch policies that promote regional trade and investment flows in West Africa, as well as providing technical assistance as part of Dutch food security programmes.

2.2 Approach

A structured, systematic approach is necessary for the study. A common mistake in many horticulture development projects is the single-issue approach, e.g. directed towards varietal improvement for export, without recognizing the strong interdependence between agronomic themes and other production factors such as land and natural resources, the availability of labour and human resources, and the necessary investment in capital goods and working capital1.

2.2.1 Overview of the Nigerian horticulture sector

As far as is possible we will sketch a picture of the sector in a qualitative, and within the scope of the study, quantitative framework. The most important vegetables, fruits and staple foods will be identified, based on their production volumes. The regions of production, climate zones and areas of consumption will be charted. The support structure, like government extension services, institutes of higher agricultural learning and supply business (farm inputs such as fertilizers, seeds) will be mapped.

2.2.2 The Value Chain Analysis

The value chain analysis is based on the method of (Kaplinsky & Morris 2001). Based on the available statistical data, the flows of goods will be mapped. An attempt will be made to create basic value chain maps for the most important products using the value chain mapping technique. This will also indicate the major bottlenecks in the value chains or networks, as well as the potential for improvement. The value chain maps and quantitative information will be complemented with interviews with value chain actors. This will quickly provide more colour to the “black-and-white” picture of the value chain map.

If enough quantitative data is available (which is not certain), we will attempt to create a “horticultural sector atlas” by using appropriate geoplotting techniques.

Care will be taken to split the chains into two main streams, that of the local and that of the export market, even though the export market is still very small. However, there is a potential for export, and if that is realized, this will also have a carry back effect on the local markets, and influence especially the food safety aspects and the

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1 As a philosophy, SCM takes a systematic approach to viewing the supply chain as a single entity, rather than as a set of fragmented parts, each performing its own function (Ellram and Cooper 1990; Houlihan 1988; Tyndall et al. 1998). In other words, the philosophy of supply chain management extends the concept of partnerships into a multifirm effort to manage the total flow of goods from the supplier to the ultimate customer (Ellram 1990; Jones and Riley 1985). Thus, SCM is a set of beliefs that each firm in the supply chain directly and indirectly affects the performance of all the other supply chain members, as well as ultimately, overall supply chain performance (Cooper et al. 1997). JOURNAL OF BUSINESS LOGISTICS, Vol.22, No. 2, 2001
standards of supply. It is well known that professional commercial parties in Nigeria prefer to purchase high quality horticultural products from countries like South Africa and Morocco, rather than producing themselves in sufficient quantities, and especially sufficient quality.

The market and demand for local market products is well known. The export products need to be identified based on the demand for products in the export market. As many products are interchangeable between countries, and few countries have such specific growing advantages that they can carve out niches for themselves, the export position is largely determined by advantages in the production factors and the logistic possibilities. Export markets can be the EU, but also markets in the sub-region and the Middle East. This analysis will provide a range of products that have agronomic and economic potential.

The bottlenecks in inputs, equipment, experience and knowledge (the hardware and software) will be mapped and interventions will be proposed. The interventions will be proposed by superposing the matrix of the Dutch horticulture top sector offering of products and services over the matrix of demands or gaps identified by the value chain analysis.

2.2.3 Export logistics

The products identified as having export value form a matrix of potential products. All these products are scored against the requirements of logistics, such as transit times and refrigeration regimes. The available logistic modalities and their costs are listed and products are matched. The cost of production and logistics will determine how competitive these products will be in export markets and hence which weight should be given to their development. The cooperation of the consultant with AgroFair and its network of shipping and air freight partners will make the analysis straightforward and practically reliable.

2.3 Dutch private sector opportunities

A matrix of Dutch expertise will be constructed in the various elements of the value chain or network system. The needs assessment in the value chains will be matched with the matrix of Dutch expertise and product offering. On this basis, a quick appraisal will be made of Dutch opportunities both on the giving and receiving side. The consultants have good relations with Dutch companies working in Africa, such as seed improvement companies, fertilizer providers, horticulture equipment providers (cold stores, packing lines, glass house constructions), as well as the Dutch academic sector, such as Wageningen UR, HAS Den Bosch and others. Membership of the Netherlands African Business Council means that the consultant is very well embedded in the Afro-Dutch trade community.

2.4 Methodology

The study will be conducted by carrying out thorough literature and desk research. This will consist of analysing the available production and yield statistics per state to give an overview of the relative importance of the various crops and the centres of major production in Nigeria. This will be contrasted with the exported and imported quantities, as reported by the Nigerian Customs.

The value chains of three crops of special importance will be studied in more detail. This will consist of a careful analysis of the research into the data and information already collected and available through means of scientific dissemination. It is our hypothesis that it is far more efficient, within the scope of this study, to collect, analyse and integrate the research efforts of a great many excellent Nigerian scientists, practitioners and their institutions than to conduct a cursory field study
which will be limited in scope and depth, given the constraints of time, resources and the sheer size of the area of study.

Where clear gaps of data or understanding appeared, interviews have been conducted to supplement the picture arising from the data.

![Figure 1 Political Map of Nigeria. Source: United Nations](image)

2.5 Reading the report

The report starts in fact with section 4 with an overview of the most important horticultural crops. Section 3 is a quick overview of the role that the Dutch industry can play in the horticulture and floriculture sector in Nigeria. It is far from comprehensive, because the professional horticulture industry is still very little developed. That means that there are many opportunities, but also that there is still little clear industrial structure or “fabric” present. Instead of going for a “big dash” for the opportunities, it is advisable to read on and understand more of the structure, the bottlenecks, the challenges and the opportunities that the Nigerian horticultural sector presents. The most important horticultural crops are discussed in their agronomic context in section 4. Section 5 focuses on understanding the value chain from the farms, the input suppliers, the traders and transporters to the consumers. The value chains of tomatoes, onions and plantains are taken as example. Section 6 explores the opportunities for export. It is clear that improving the performance of the local production and value chains is primordial. Nevertheless, a focus on export, be it even on a relatively modest scale, can provide important impetuses for the national industry, especially by playing an exemplary role of good practices, breeding ground for human resources and exposure to technology and ideas. The report ends by discussing suggestions for further interventions. In the margins, text boxes sometimes highlight issues deemed particularly relevant or interesting to the Dutch industry.
3 What role can the Dutch horticulture/floriculture sector play?

3.1 Policy development, project and programme management
As stated earlier, modernizing the horticultural sector requires the development of tailor-made plans. A national high-level programme, more concerned with the “how” and the process and governance than with the “what” and “when” needs to be created and then be refined and translated into State-level programmes consisting of a range of time-framed projects. A number of Dutch consultancies can provide some assistance based on their vast experience with the Dutch horticulture/floriculture sector and development issues. Examples are Arcadis, Twynstra Gudde, Berenschot, but there are a number of other, specialized consultancies.

3.2 Seeds
The use of high-yielding hybrid seeds, but especially the development of seeds that are useful in the agroecological conditions of Nigeria, is a specialization of Dutch companies. About 70% of horticultural seed development worldwide takes place in the Netherlands. Dutch seed improvement companies can also provide assistance to farmers by training distributors. Among these companies are Rijk Zwaan, East-West, Enza and Nunhems. Also the production of seeds and propagation for export can be an industry of interest to Nigeria.

3.3 Soil Science, Irrigation, Growing Technology
Soil & More is a leading Dutch consultancy firm specializing in soil science. The Wageningen University and Research Centre (WUR) is the leading Dutch agricultural university and has a world-class reputation. Its institutions have wide experience ranging from soil science, quality management and irrigation technology to post-harvest technology, green houses, tropical horticulture, water management and much more. WUR cooperates with many universities and institutions throughout the world. An example is also the PPP between a Ghanaian agribusiness (Wienco), the WUR and a Ghanaian university, where Wienco sponsors a part-time professor from the WUR and has set up a fund for research for Ghanaian university staff and students. WUR also has expertise of greenhouse technology especially suited for the tropics. Dutch companies have gained extensive experience operating in countries like Kenya and Ethiopia where they have been drivers of the horticulture industry.

Water management is a specialization of various Dutch universities and consultancies. Since the Netherlands is situated in a river delta, there is extensive knowledge and experience of land and water management in delta's.

3.4 Transport, Infrastructure, Logistics
The Netherlands is Europe’s most densely populated country and the transport and logistics hub for North-West Europe. Horticulture logistics has been developed to the highest level. Cold store management, auction systems (“Dutch auction” is the word for it!), value chain integration, port management are all world-class specializations.

The Port of Rotterdam is very interested in playing a role in the development of African ports, as is shown by their presence at the Africa Cool Logistics conferences during recent years. The Dutch company APM Terminals is operating container terminals in the Netherlands and in many other countries, such as in Abidjan, Ghana and Costa Rica.

Keeping ports and sea routes open is the business of the Dutch dredging industry.
The Schiphol Airport group (Schiphol being the 3rd largest airport in Europe and the 2nd largest in terms of cargo) is involved in managing several other airports, including a terminal of JFK airport in the US.

There are a number of companies that provide CKD (completely knocked down) cold stores for use in tropical countries. These cold stores, which are very sturdy and economical to operate, have been established on farms and in pack houses all over Africa (Kenya, Tanzania, Ethiopia, Burkina, Ghana). Some of the companies have their own regional network of technicians that can build and service the installations.

Fruit and vegetable sorting and packing equipment is available from a number of suppliers. They can be highly sophisticated and performant, requiring reliable power supply and maintenance, but can also be more basic and robust, catering for the need of easy to maintain, durable but effective equipment. It is our experience that with limited budgets, high performance pack houses can be built, fully equipped that, when put in the hands of capable entrepreneurs, are able to operate at very high utilization rates and hence be very cost competitive.

Railway transport is provided by a number of cargo railway operators, including the DB Schenker Netherlands group (former state railways). Movares (former Holland Rail Consult) providing consultancy on railway building projects and operational management models.

A number of companies are specialized in door-to-door perishable handling solutions.

3.5 Knowledge, Training, Education

Dutch companies, such as Control Union and KIWA, are offering quality inspection services and advise on the implementation of food safety quality systems, such as GlobalGAP and organic production.

DLV Plant is a privatised provider of agricultural extension services. They execute projects in African countries, especially focused on knowledge transfer, extension and capacity building.

The role of the WUR has already been mentioned. A number of universities for professional education provide professional training and practical consultancy, such as HAS Den Bosch and Van Hall Larenstein University.

The Netherlands University Foundation for University Cooperation (NUFFIC) provides bursaries, grants and finance cooperation projects between Dutch universities and overseas partners.

A number of Dutch non-governmental organizations are involved in rural development, such as ICCO Development, Solidaridad, Oxfam Novib, Cordaid and Hivos. They especially focus on fair trade, inclusive business and pro-poor development.
4 The most important horticultural crops

4.1 Nigeria profile

With more than 160 million people, the population of Nigeria is the largest in Africa and accounts for 47 percent of West Africa's total population. Nigeria is also the biggest oil exporter in Africa, with the continent's largest natural gas reserves. Nigeria's oil wealth has helped it maintain relatively steady economic growth despite recent global financial downturns. The country's GDP grew from 6 percent in 2008 to 8.4 percent in 2010 (World Bank Data). Unemployment remains a significant problem, however, with an estimated 50 million youth unemployed. In 2011, the government launched a comprehensive public works programme to stimulate employment and expand vital infrastructure and services.

Despite its significant natural resources and continued economic growth, poverty remains widespread in Nigeria and has even increased in some areas since the late 1990s. An estimated 70 percent of Nigerians live on less than US$1.25 per day. Nigeria was ranked 40th out of 79 on the 2012 Global Hunger Index and 156th out of 187 on the 2011 UNDP Human Development Index. Poverty is especially widespread in rural areas, where 80 percent of the population lives below the poverty line.

Agriculture is the mainstay of Nigeria’s economy, employing approximately two-thirds of the country's total labour force and contributing 40 percent to Nigeria's GDP. Nigeria is the world’s largest producer of cassava, yam and cowpea; yet it is a food-deficit nation and depends on imports of grains, livestock products and fish. Of an estimated 71 million hectares of cultivable land, only half is currently used for farming; there is similar potential for an expansion of irrigation, which now only covers 7 percent of irrigable land. Most of the rural population farm at a subsistence level, using small plots and depending on seasonal rainfall. A lack of infrastructure such as roads further exacerbates poverty in rural areas by isolating rural farmers from needed inputs and profitable markets (IFAD and World Bank). Pressure from growing populations is also impacting already diminished resources, further threatening food production. Over-farmed land, deforestation and overgrazing are severe in many parts of the country. Drought has become common in the north, while erosion and flooding is a major problem in the south.

4.2 The volumes of crops produced nationally

Figure 2 is a graph of the total production of the crops included in the National Agricultural Sample Survey conducted in 2010/11 (NASS 2012). It is clear that the products with the greatest volumes are staple foods, constituting the daily diet of millions of people. Cassava and yam are the most important staple crops in this study. Not included are cereals like rice and wheat. Apart from maize, these are mainly imported. Nigeria is not self-sufficient in these cereals and imports significant quantities as is shown in Figure 3.
Figure 2 Production of selected (horticultural) crops according to the NASS 2011 survey, in '000 metric tonnes.

Figure 3 Imported volumes of cereals in Nigeria in 2011. Source: FAOSTAT 2014.
## 4.3 Description of the most important horticulture crops
(and their significance for food)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Latin name</th>
<th>Food value</th>
<th>Storage</th>
<th>Main nutritional value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava</td>
<td><em>Manihot esculenta</em></td>
<td>A basic staple food, used to prepare flour. From this flour, a porridge or paste is prepared, known as fufu. The crop contains mainly starch, and is a good source of energy. It is poor in proteins, vitamins and minerals. An unbalanced diet leads to growth disorders.</td>
<td>Poor</td>
<td>Starch</td>
</tr>
<tr>
<td>Yam</td>
<td><em>Dioscorea spp</em></td>
<td>There are several cultivars of this endemic West-African tuber crop. A basic staple food, rich in starch. It contains protein, but the amino acid composition is unbalanced. An unbalanced diet of yam or cassava leads to kwashiorkor, a severe form of malnutrition.</td>
<td>Poor</td>
<td>Starch</td>
</tr>
<tr>
<td>Onion</td>
<td><em>Allium cepa</em></td>
<td>An important vegetable used widely in soups, stews and sauces.</td>
<td>Reasonable</td>
<td>Savour</td>
</tr>
<tr>
<td>Maize</td>
<td><em>Zea mays</em></td>
<td>A basic staple food, known in two forms, viz. white and yellow. Low in protein, but contains some B-vitamins and minerals. Widely milled and used to prepare pastes and porridges.</td>
<td>Excellent</td>
<td>Starch</td>
</tr>
<tr>
<td>Guinea corn</td>
<td><em>Sorghum bicolor</em></td>
<td>Also known as sorghum. A very drought and temperature tolerant food crop, that is widely cultivated in West Africa, Nigeria being the leading producer. It contains a high amount of protein. Because of its hardiness and protein content, a very important crop in times of famine.</td>
<td>Excellent</td>
<td>Starch, protein</td>
</tr>
<tr>
<td>Millet</td>
<td><em>Various grass families</em></td>
<td>More an agricultural class than a taxonomic group, millet are small-seeded grasses widely grown as a cereal. Very drought resistant, requiring little fertilization.</td>
<td>Excellent</td>
<td>Starch, protein</td>
</tr>
<tr>
<td>Rice</td>
<td><em>Oryza sativa</em></td>
<td>A cereal grain, the seed of a grass species, an important source of calories for human intake. Very low content of protein and vitamins.</td>
<td>Excellent</td>
<td>Starch</td>
</tr>
<tr>
<td>Crop</td>
<td>Latin name</td>
<td>Food value</td>
<td>Storage</td>
<td>Main nutritional value</td>
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<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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<td>----------------------------------------</td>
</tr>
<tr>
<td>Groundnut</td>
<td><em>Arachis hypogaea</em></td>
<td>A legume, with the fruit growing in a pod that bends down and grows under the ground. Low requirements on soil condition. Important nutritional value. High susceptibility to food loss and contamination with <em>Aspergillus flavus</em> mould, releasing toxic and carcinogenic compounds. Numerous applications: oil, flour, peanut butter, raw or roasted consumption and ingredient in sauces.</td>
<td>Reasonable</td>
<td>Fat, protein, energy</td>
</tr>
<tr>
<td>Beans</td>
<td><em>Fabaceae family, e.g. Phaseolus vulgaris</em></td>
<td>A large variety of leguminosae, like common beans. An important crop providing energy and protein and good storage potential. Excellent sources of minerals, vitamins and dietary fibre.</td>
<td>Excellent</td>
<td>Protein, starch, minerals vitamins</td>
</tr>
<tr>
<td>Cocoyam</td>
<td><em>Colocasia esculenta</em></td>
<td>Also known as taro or eddo. Grown for its starchy corm and for its leaf, eaten as a vegetable. Inedible when raw. The leaves are a good source of vitamin A.</td>
<td>Poor</td>
<td>Starch (corm), vitamins (leaves)</td>
</tr>
<tr>
<td>Plantain</td>
<td><em>Musa acuminata × M. balbisiana ABB</em></td>
<td>Cooking banana, eaten cooked, baked or steamed, a source of starch and sugars. Very low in protein, vitamins and minerals. High potassium content.</td>
<td>Poor</td>
<td>Starch</td>
</tr>
<tr>
<td>Potato</td>
<td><em>Solanum tuberosum</em></td>
<td>Edible tuber, also known as Irish potato.</td>
<td>Poor</td>
<td>Starch</td>
</tr>
<tr>
<td>Tomato</td>
<td><em>Solanum lycopersicum</em></td>
<td>Grown for its edible fruits, used widely in salads, stews and sauces. Used for processing into juice, tomato paste and canned tomato.</td>
<td>Poor</td>
<td>Vitamins and minerals</td>
</tr>
<tr>
<td>Leafy vegetable</td>
<td><em>Various</em></td>
<td>A variety of plant leaves eaten as a vegetable. Examples are lettuce, spinach, amaranth, e.g. *Celosia argentea « Lagos spinach ». Important in soups and sauces. High contents of vitamins and minerals. The seeds contain valuable proteins.</td>
<td>Poor</td>
<td>Vitamins and minerals, proteins (seeds)</td>
</tr>
<tr>
<td>Orange</td>
<td><em>Citrus x sinensis</em></td>
<td>Widely cultivated fruit eaten fresh, juiced or processed. High vitamin C content. The cultivars in Nigeria do not turn orange, but remain green.</td>
<td>Reasonable</td>
<td>Vitamins and minerals</td>
</tr>
<tr>
<td>Pumpkin</td>
<td><em>Cucurbita pepo</em></td>
<td>A range of pumpkins, gourds and squashes, eaten cooked or baked as vegetables and sauce ingredients. Important nutritional value. High vitamin A content.</td>
<td>Reasonable</td>
<td>Vitamins and minerals</td>
</tr>
<tr>
<td>Crop</td>
<td>Latin name</td>
<td>Food value</td>
<td>Storage</td>
<td>Main nutritional value</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Pineapple</td>
<td>Ananas comosus</td>
<td>The polycarp is a fruit eaten fresh as a snack or dessert.</td>
<td>Poor</td>
<td>Vitamins and minerals</td>
</tr>
<tr>
<td>Pepper</td>
<td>Capsicum annuum</td>
<td>A variety of capsicum fruits, like bell peppers and pungent peppers. An important savoury ingredient in sauces and salads.</td>
<td>Poor</td>
<td>Vitamins and minerals</td>
</tr>
<tr>
<td>Palm oil</td>
<td>Elaeis guineensis</td>
<td>The fruit of the African palm tree, contains a high amount of olein. The fruit is pressed for oil. The oil is widely used as cooking oil. The fruits are also consumed ripe in stews and sauces. The fatty acid composition is relatively unfavourable with a high percentage of palmitic saturated and oleic monounsaturated acid.</td>
<td>Excellent</td>
<td>Fat</td>
</tr>
<tr>
<td>Okra</td>
<td>Abelmoschus esculentus</td>
<td>A West-African native, derived from the Igbo word Okuru. A mucilaginous vegetable, used in sauces and soups.</td>
<td>Poor</td>
<td>Vitamins and minerals</td>
</tr>
<tr>
<td>Cotton</td>
<td>Gossypium spp</td>
<td>A cash crop grown for the fibre. The seeds are pressed to make vegetable oil used for cooking. Excellent fatty acid composition with high mono- and polyunsaturates.</td>
<td>Excellent</td>
<td>Fat</td>
</tr>
<tr>
<td>Melon</td>
<td>Cucurbitaceae spp</td>
<td>Various cultivars of Cucurbitaceae fruits. A popular fruit eaten as a snack, ingredient in soups and salads. Moderate vitamin and mineral content.</td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td>Sugar cane</td>
<td>Saccharum officinarum</td>
<td>A perennial true grass with high sugar content. Used to produce sugar.</td>
<td>Excellent</td>
<td>-</td>
</tr>
<tr>
<td>Banana</td>
<td>Musa acuminata × Musa balbisiana AAA</td>
<td>The fruit of a herbaceous flowering plant is popular as a snack or a dessert. A high content of digestible carbohydrates, vitamins and minerals. Especially rich in vitamin B and C.</td>
<td>Poor</td>
<td>Starch, vitamins and minerals</td>
</tr>
<tr>
<td>Cocoa</td>
<td>Theobroma cacao</td>
<td>The fruit is used to prepare chocolate. A typical cash crop.</td>
<td>Good</td>
<td>-</td>
</tr>
<tr>
<td>Crop</td>
<td>Latin name</td>
<td>Food value</td>
<td>Storage</td>
<td>Main nutritional value</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Soy bean</td>
<td>Glycine max</td>
<td>A legume, known as an oilseed rather than a pulse. The bulk of the production is processed into oil and soy flour. The vegetable varieties have better cooking attributes. The meal has a high protein content. Many other applications include soy milk, flour, cheese (tofu and tempeh), meat replacement.</td>
<td></td>
<td>Excellent, Protein, fat</td>
</tr>
<tr>
<td>Cashew</td>
<td>Anacardium occidentale</td>
<td>The seed inside the cashew fruit (cashew apple) is used as a nut. It is high in fats and proteins. The fatty acid composition is favourable. A good source of minerals.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sesame seed</td>
<td>Sesamum indicum</td>
<td>A flowering plant, known for its oilseed. It also contains high percentages of protein. The oil is prized for culinary use. There are some storage issues, especially microbiological contamination.</td>
<td></td>
<td>Excellent, Fat, protein</td>
</tr>
<tr>
<td>Kola nut</td>
<td>Cola acuminate</td>
<td>A caffeine and theobromine containing the nut of evergreen trees, native to the rainforests of Africa. Important in traditional ceremonies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cucumber</td>
<td>Cucumis sativus</td>
<td>The fruit of a creeping vine used in salads and sauces.</td>
<td></td>
<td>Poor</td>
</tr>
<tr>
<td>Garden egg</td>
<td>Solanum melongena</td>
<td>Also known as eggplant or aubergine. Various cultivars are known. High culinary value due to its flavour and consistency, as an ingredient in soups and sauces. No special health benefits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bambara nut</td>
<td>Vigna subterranean</td>
<td>An important legume in West Africa, a neglected and underutilized species, that grows well in marginal soils and dry climates and is slightly susceptible to pests and diseases. Important nutritional value as meat replacement, in value comparable to soy.</td>
<td></td>
<td>Excellent, Protein</td>
</tr>
</tbody>
</table>
4.4 Population

4.5 Physiography and climate

4.5.1 Physiography

Nigeria’s physiography is characterized by large areas of flat lands, especially the valley of the river Niger and its tributary R. Benue. There is a plateau around the city of Jos, called the Jos Plateau with an average elevation of 1200 m (ASL) and highlands rising up towards the Adamawa range in Cameroon. The South is characterized by the river delta. The North is characterized by the Sahelian semi-desert plains.

![Physiography of Nigeria](figure4.jpg)

**Figure 4 Physiography of Nigeria.**
CC Licence Sadalmelik, Wikipedia.

4.5.2 Climate zones

The country has three different climate zones that are relevant for horticulture. They can be characterized according to the international Köppen classification.

<table>
<thead>
<tr>
<th>Area</th>
<th>Climate type</th>
<th>Köppen classification</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td>Tropical rainforest</td>
<td>Af – tropical wet – no dry season</td>
<td>Guinean</td>
</tr>
<tr>
<td>Central</td>
<td>Tropical savannah/steppe</td>
<td>Aw – tropical wet and dry – winter dry season (Jos Plateau above 1520 m is temperate, AwH Highland)</td>
<td>Sudanic or Savannah</td>
</tr>
<tr>
<td>North</td>
<td>Sahel Climate</td>
<td>Bsh – Subtropical dry semi-arid – evaporation exceeds precipitation on average</td>
<td>Sahelian</td>
</tr>
</tbody>
</table>
The climate is influenced by the monsoons originating over the Atlantic Ocean, where heating of the water by the sun creates flows of moist air towards the North, influenced by the Coriolis forces of the earth. From the north, the sun heats the landmass, creating dry, hot flows of air towards the South. Where the two flows meet, they collide, creating the Intertropical Convergence Zone (ITCZ). The ITCZ remains over the land, so that the South has rainfall throughout the year. The central area has a marked wet and dry season, depending on the shifting of the ICTZ following the zenith of the sun during the year.

![Figure 5: Annual average precipitation in Nigeria. Source: ORSTOM editions 1996](image)

4.5.3 Climate change

Climate change is an important factor affecting the mainly rain-fed agriculture in Nigeria. (Ogungbenro & Morakinyo 2014) studied weather station data over a 90-year period and found that in the three climate zones, marked shifts in average rainfall could be observed. The graphs of Figure 6 clearly show how the climate zones have become drier, with peaks in the curves shifting to the left, towards lower amounts of rainfall. As some of the curves also become wider, this shows that the variability also increases.
Figure 6 Shift in average annual rainfall in the main climate zones

The conclusion is that, especially in the Sahelian zone, farmers need to adopt farming techniques that are resilient to less dependable rainfall. Crops with a short growing cycle, drought tolerant crops and cultivars will be important to decrease the risk of failed harvests. Irrigation can also be an important strategy to reduce dependence on rain.

### 4.6 Soil types

The soils in Nigeria are comprised of various soil types, such as listed in Table 1.

<table>
<thead>
<tr>
<th>Agroecological Zone</th>
<th>Major soil types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humid forest</td>
<td>Ferralsols, Nitisols, Gleysols</td>
</tr>
<tr>
<td>Coastal Savannah</td>
<td>Ferralsols, Luvisols, Nitisols, Arenosols, acrisol, lithosols</td>
</tr>
<tr>
<td>Guinea Savannah</td>
<td>Luvisols, acrisol, ferralsols, lithosols,</td>
</tr>
<tr>
<td>Central Savannah</td>
<td>Ferralsols, nitosols</td>
</tr>
</tbody>
</table>

Table 1 Major soil types in Nigeria. 
Source: (Salako 2004)

Ferralsols is the well-known, strongly weathered reddish or yellowish soil of the humid tropics. They have good soil physics with a high percentage of clay minerals and are rich in iron and aluminium oxides, which causes the red colour, but have a poor nutrient holding capacity, especially phosphate. Their acidity requires frequent liming and fertilization.

Nitisols are well-drained, weathered soils with high percentages of clay minerals. They have a good structure and a high cation exchange capacity, allowing them to keep nutrients. They are neutral to alkali and have favourable characteristics.
They are considered to be the most fertile and productive soils in the tropics, especially when phosphorus is added.

Acrisols are strongly weathered acidic soils with low fertility.

Luvisols are heavy fertile soils, where water logging may be a problem.

Lithosols are rock soils with very low fertility.

Soil erosion plays an important role in all the climate zones. The quality of soils on the savannahs seems to be generally fragile, with shallow top soils, relatively acidic, and relatively coarse particles. The coarse sand particles limit the water retention capacity of the soils. This compromises the resistance to drought for the crops that are grown. The acidity limits the effective absorption of minerals necessary for the growth of the crops and for increasing the yields. “It is therefore imperative that appropriate soil management options for sustainable crop production and improved soil and environmental quality be found for the tropics” (Salako 2004). This also means that there is a need for adapted soil working technology. For instance, poorly considered ploughing techniques could damage already sensitive soils.

4.7 Areas suitable for Large Scale Agriculture

The Africa Soil Information Service has performed calculations and developed a decision model to determine how much area in Nigeria would be biophysically suitable for large scale agriculture. Large scale agriculture is understood as agriculture in commercial, industrial types of farms, using tractors on land that does not have too much slope, on lands of reasonable fertility, temperature and rainfall and with reasonable access to mapped roads (not necessarily surfaced).

![Figure 7 Land biophysically suitable for large scale agriculture.](source: africasoils.net)

The result was that about 23,000 km² of land is suitable for large scale agriculture, as depicted in Figure 7. The figure does not take into account the human settlements and already existing land use. The importance of the figure is that whereas popular belief holds that there is ample arable and underutilized land available, a closer analysis of all the necessary constraints and requirements (agronomic, economic and social) for intensive agriculture is necessary before suitable policies can be developed.
5 The value chains

5.1 Value Chain Methodology

The scope of this study does not permit the study of all crops in detail. As the focus is horticulture, staple crops like cassava, yam and maize are omitted, and instead a selection of some important vegetables for local markets is chosen, supplemented by some crops that could have importance for export.

5.1.1 Local crops

Even though the selection will only comprise a few crops, the conclusions of the analysis will be relevant to other crops. The selected local crops are tomatoes, onions and plantains. Tomatoes and onions are important vegetables for use in soups and stews and widely consumed. Onions are the most widely traded vegetable crop, while tomatoes are also important for fresh consumption, and are also imported in the form of tomato paste. Plantains is a staple crop that is growing in popularity.

5.1.2 Export crops

As export crops, we examine mango, air freighted vegetables, citrus and ornamentals. Export is dominated to a large extent by the opportunities that international transport offers. Hence, we will start with analysing logistics, and then select suitable crops to go with the logistics.

The value chain methodology was developed by (Kaplinsky & Morris 2001). They start with the well-known concept of supply chains, defined as a chain of production, transport and trading steps that transform a raw material over space and time into a consumer product. The value chain analysis was developed as a response to increasing globalization where developing countries increasingly take their part in international supply chains. The question is however, to what extent do developing countries and their populations participate in the value that these chains generate for their actors. A value chain taken as a chain of processes can be understood where every actor in the chain takes a rent from the activity that it undertakes. The extent to which this happens depends on the ease with which this rent taking can happen. The higher the barriers for entry into a part of the chain, the more effective the rent taking can be. Examples are access to certain information, technology, certain seeds, contacts, know-how, land or capital. Generally, farmers struggle to take an adequate rent from their farming activity.

An important concept in the value chain analysis, is the governance of the chain. Usually, one or more actors in the chain exercise control over the lower parts of the chain. They set the conditions for supply, the prices, usually because they control the market. More recently, they have started to not only set conditions for pricing and supply, but also for quality standards, quality management down the chain and even more recently, the social performance of their suppliers. The concept is especially useful and relevant in international horticultural chains, where the supermarkets in developed countries set the standards for pricing, quality control and social compliance.

The value chain concept allows the study of a chain, evaluating where there are bottlenecks, e.g. at points where excessive rents are taken, and what kind of interventions can be taken to allow the chain to work more efficiently. Chain partners can study the opportunities to upgrade their role in the chain, thus becoming more effective and profitable. It allows interventions for governments to increase competitiveness of the country on world markets, without losing sight of the needed equitableness in the chain. It is also useful to highlight that there are multiple actors operating in the chain and that competitiveness on world markets requires a multivariate analysis.

Finally, it helps to understand the factors that influence the distribution of value in the chain among the various chain actors. We will elaborate value chain maps in a
qualitative way for the selected crops and use these to chart paths for upgrading the chains.

Below, we will follow the value chain for tomatoes, onions and plantains by examining the production path from farmers and their input suppliers, through to traders who buy and transport to markets and consumers. We will then discuss the support structures.

5.2 Farmers

Crop producers in Nigeria are mainly small farmers. Corporate farms exist but are generally not focused on horticulture production. It is estimated that there are some 18 million crop holders in the country. The majority (86%) of these are male individuals.

Figure 8 shows the age distribution of farmers in Nigeria compared to the total population. It shows that farming is an activity for the older population groups. Farmers are underrepresented in the 15-29 age group and overrepresented in the other age brackets, notably in the 50-65 age group. The age structure is clearly linked to the ownership of land, which is generally owned by older people and the financial structure of the farming businesses, with farms being financed primarily with own funds. It takes time to build up own funds in the absence of access to formal credit. It is also related to farming activities being an activity that generates revenues for retirement, with younger people performing non-farm jobs that older people cannot easily do.

The general population distribution also shows how Nigeria will grow significantly in the near future, and how food security and food safety will be very important themes. Improving yields per hectare, making farming attractive for young people, reducing food losses and spillage, will be important elements in policy making.
Production of Tomatoes, Onion and Plantain in Nigeria, 2011

Figure 9 Production of tomatoes, onions and plantains per State.

Production of Bananas in Nigeria, 2011

© National Agricultural Sample Survey 2011
5.3 Input suppliers

5.3.1 Seeds

The production of seeds is supervised by the National Agricultural Seed Council (NASC). What is unusual about Nigeria is the large presence of local government in seed production and distribution. As a Federal State, the NASC oversees the production of seeds. At the State level, Agricultural Development Projects produce foundation seeds and improved seed to be sold to seed companies and farmers.

Both public and private sector entities are significant in the formal sector value chain, with the public sector playing a leading role in breeding and foundation seed production, and the private sector playing the lead role in propagating, marketing and distributing seed (although in practice private seed companies are also producing foundation seed). Seed policy in Nigeria was given a legal framework by the Agricultural Seed Decree of 1992, which established the National Agricultural Seed Council as the main policy body for the seed system and, beneath that body, the National Seed Service in the Federal Department of Agriculture, which acts as the primary regulator of the seed industry. The formal sector, however, accounts for less than 10% of seed supply, with the exception of cassava where it is estimated that 20% of planting material is supplied through formal channels (Adetumbi et al. 2010).

The seed companies focus on the main staple crops, notably maize, rice, cassava and sorghum. Also soy beans and groundnuts are incorporated in programmes. The seed sector is itself a value chain, with the development, production and propagation being important, but with the distribution of the seeds and quality control being equally important. Seeds are vulnerable to damage through temperature, moisture, sunlight, transport and farmers have to put a great deal of trust in the supplier.

The source of vegetable seeds marketed by seed suppliers originates partly from research stations, but the bulk is sourced from private firms, open markets or personal farms (Adetumbi et al. 2010). It is clear that the quality and uniformity leaves a lot to be desired in this situation. It also shows the low level of government attention given to vegetables. Many seed dealers also offer ancillary services to farmers, such as information dissemination, seed dressing and pest management services. Only a small percentage offer credit. It was found for maize and cowpea that the viability loss of the seed marketed ranged from 27 to 37% respectively. The seed dealers are inspected by the National Agricultural Seed Council, but inspections were not popular and generally not frequent enough. Many seed traders indicated that they need more training (Adetumbi et al. 2010).

Vegetable seeds are generally imported and farmers keep a part of their harvest for seed use. Most vegetable farmers in one area of study (Osun, Ogun, Oyo States) used some kind of improved seed. Almost 60% used seed collected from previous harvests and 30% purchased from seed dealers. The results of the study further indicate that the "farmers" demand for the seeds of improved varieties could be elicited with the availability of varieties that meet production challenges (high yields) and market needs (consumer preferences). The implications of the results with respect to prospects for commercial vegetable breeding and seed production were discussed. But indications are that the seed system can be improved when crop breeders and seed producers regularly evaluate the dynamics of consumer quality preferences and continuously generate varieties that satisfy them.” (Daniel & Adetumbi 2004).

The use of seeds with improved resistance to diseases (especially hybrid cultivars) is limited. The improvement of cultivars with the breeding objective of better storage and transport capability, better resistance to diseases and drought tolerance, presents an
important opportunity. The Dutch plant breeding sector can play an important role here, for instance by setting up a research and production station in the country. It seems important to note however, that the use of improved seeds as a single intervention may not be useful. Olayi et al (2010) studied eight different tomato cultivars, among which five high-yielding hybrids. In the study area and under the usual husbandry regime, the local (non-hybrid) cultivars performed just as well as the highest yielding hybrid cultivar. Farmers will make careful decisions when purchasing hybrid seeds and careful balance the probability of higher yields or better quality to the risk that they take. Seed companies should be aware of that and invest significantly in local research and demonstration facilities. Similar results were found by Aniso et al (2015) indicating that a non-hybrid had best performance in the open field, whereas higher yielding hybrids performed well, provided they were grown in glasshouse conditions.

Every State has its own Agricultural Development Projects that play a role in the development and production of seeds, especially for the staple crops. The National Agricultural Seed Council of Nigeria is a specialized agency overseeing the Nigerian seed industry to assure affordable access for farmers of improved quality seeds.

The seed industry is united in the Seed Association of Nigeria, with its office in Zaria.

A number of leading seed companies include:

Premier produces its own inbred lines for hybrid maize. Premier also produces seed of OPV maize, rice, soybeans, cowpeas, groundnuts, sorghum, pearl millet, cotton, okra and various local leafy vegetables, such as tete (Amaranthus hybridus), soko (Celosia argentea) and ewedu (Corchorus olitorius). Premier imports seeds of tomato, watermelon, cucumber, carrot, onion, sweet pepper, cabbage and lettuce. Other companies are Alheri Seed, Nagari Seed, Maslaha Seed.

5.3.2 Fertilizers and plant protection

Nigerian agriculture is dominated by smallholder and traditional farmers. Most farmers use rotational fallow agriculture, semi-permanent or permanent and mixed agriculture. These are low external input methods for soil fertility conservation. The average yield in this low external input system reduces the yields quite dramatically. Improving soil fertility maintenance is therefore of the greatest importance. The critical elements in soil fertility are organic matter and mineral content. After three or four cropping cycles, organic matter and mineral content have declined to a critical extent and yields decline, whereas weed invasion increases.

Toenniessen (2008) observed that soil nutrient mining is killing Africa, particularly in Nigeria where more than 60 kg/ha of nutrient loss was recorded in 1995-1997, and 30-60 kg/ha in 2002-2004. A major reason for the high soil nutrient deficiency is the low level of fertilizer use in Africa compared to the rest of the world. Indeed, Nigeria’s fertilizer use was reported to be 7 kg/ha in 2005, compared to 121 kg/ha in India. This is low, because since the 1970s, the government of Nigeria has sponsored various programmes to increase fertilizer use. The federal and state governments have been involved in the purchase and distribution of fertilizer and have even subsidised it, up to levels of 95%. The impact has been disappointing, while the burden on the government budget has been substantial. According to data of the Henrich Boell Stiftung, 43% of the Nigerian government budget for agriculture was spent on fertilizer subsidies (Chemnitz et al. 2015) (Fadare et al. 2009), known as the “Fertilizer subsidy program” under the Federal Market Stabilization Programme (1976-1997, 1999-2012). Little evidence has been produced that agricultural productivity increases (Bosede, 2010). The system has now been replaced by a system in which the commercial sector is leading and the government supports farmers by issuing vouchers.

Among factors influencing the effectiveness of fertilizer are the poor road and transportation system. This increases the farm gate prices of fertilizers considerably,
and affects the potential for farmers to sell their output. Where rain fed agriculture is dominant, and where responsive types of seed are not present, farmers find it too risky to adopt fertilizer use (certainty to increasing cost price, uncertainty to have higher yield, hence higher risk of lower economic return). Figure 10 shows the required yield increase multiplier to offset the cost of a bag of fertilizer for cereals. It shows that the application of fertilizer is not the ideal way to improve yields in all cases.

Another constraint is the low level of education of farmers, which limits the knowledge of its proper use. Fertilizer application (type, dosage, timing) need to be carefully adapted to the type of soil, type of crop and the condition of the soil. If not, the results may be disappointing or even detrimental. Too much fertilizer use can destroy soils by salinization and acidification. Proper application requires good understanding of soil science and the presence of laboratory facilities for soil analysis. The Agricultural Development Projects (ADPs) can play an important role by providing extension and access to the proper fertilizers (Banful et al, 2010).

The use of fertilizer can be improved, if proper attention is given to soil improvement by means of composting, the use of leguminous plants and microbial nitrogen fixing. Sewage sludge and night soil are often used for fertilization of vegetable production, as is waste water. Studies indicate that this puts the health of growers and consumers at high risk due to the presence of parasites and microbial contamination. A survey in Jos in Plateau state indicated that of 1250 samples of vegetables examined, 450 (36.0%) tested positive for intestinal parasites, cabbage recorded the highest prevalence of 64% while tomatoes had the least prevalence of 20% (Damen et al. 2007).

Sustainable soil technology is of primary importance to protect and improve soils and hence food security. Compost technology developed in the Netherlands can be exported.
5.4 Producers

5.4.1 Tomatoes, onions and other vegetables

The bulk of tomatoes are produced in Kaduna State, with Kano being second. The production is estimated at 3,600,000 metric tonnes per year (Figure 11). The centres of consumption being the large urban centres in the South.

The production of onions, the second most important vegetable in Nigeria, is also concentrated in the North of the country. Kaduna State is the largest producer, followed by Kano. The total Nigerian production was almost 18,000,000 metric tonnes in 2011 (NASS 2012). Significant quantities are also imported from Niger, which is the major supplier in the region.

Onions, tomatoes and other vegetables are often produced in mixed systems with tomatoes. They are grown to a large extent in fadama lands (seasonally irrigated flood plains in the Northern savannah) (Hussaini & Abayomi 2010).

Farmers select their cultivars for growing based on consumer preference and yield. The durability and shelf life of the product will be important selection criteria, especially for their buyers, the traders. Land races seem to give good results for producers, and this is a testament to the local knowledge and adaptability acquired over many generations that needs to be taken seriously before any improvements and innovations are suggested (Olaniyi et al. 2010).

Production of Tomatoes in Nigeria
Traders select their crops based on perceived returns and the risk profile. Onions offer good margins, but come at a high risk. The risk consists of natural risks, such as pests and diseases, droughts and winds. The main risk is the market risk, which is difficult to control for the farmers. The production is highly fragmented among small farms and the costs for marketing are high. Traders usually have a group of more or less loyal producers who they patronize and bind by means of credits, advice and provision of inputs. Farmers could reduce the market risk by forming cooperatives and get more market power in the chain (Alimi & Wall 2005).

The production of tomatoes takes place on small farms of less than 1 hectare to farms of several hectares. Many farmers depend for the larger part of their income on the production of tomatoes. They often practice intercropping and rotation with other vegetables (such as onions, peppers, lettuces, carrots, cabbages and peas) to reduce the susceptibility to pests and diseases and spread risks (Umeh et al. 2002).

The tomato production in the North is mainly done during the dry season. During the wet season, the disease pressure is too high and the land is often used for grain production, which is necessary to supply the staple crops. Tomatoes are therefore preferred in the dry season. The yield is lower, so the use of irrigation is a sensible investment. Farmers using irrigation do indeed have higher economic returns.

A study showed that most farmers using irrigation were male, indicating gender inequality in farmers’ access to irrigation facilities. The majority of the farmers are above 50 years of age, with low literacy and an average family size of 8 per household. Results also showed that the gross margins per hectare under irrigation and rain-fed systems were N153,500 (EUR 720) and N68,000 (EUR 320) respectively and that average net profits per hectare were N128,750 (EUR 606) and N57,050 (EUR 268), indicating the profitability of tomato crop under both systems (Ayoola 2014).
The land for tomato production is often rented, with holdings of 0.5-2 ha. Investments are made with personal savings, farmers are mostly males in their active years, with on average six household members in their charge. They have been cultivating tomatoes for many years and the majority have no formal education (i.e. illiterate).

In spite of pests and diseases forming a major problem, and difficulties experienced with storage and transport, a study conducted in Adamawa State reported an economic return of 33% on investment. Farmers benefiting from extension achieve better returns (Usman & Bakari 2011).

It was therefore concluded that tomato crop was more profitable and economically efficient under irrigation and that increased access to land, herbicides and improved seeds would promote profitability of the crop in the Bassa and Makurdi Local Government Areas of Kogi and Benue States in Nigeria. Land policies that increase access of farmers (with special consideration for women farmers) to adequate land, irrigation facilities, herbicides and good quality improved planting material would promote gender equality in irrigation farming and profitability of tomato production; thus contributing to food security in Nigeria and enhancing the income potential of farmers (Ayoola 2014).

**Pests and diseases**

Tomatoes in the tropics suffer from a number of pests and diseases, among which various fungal and bacterial diseases are important, as well as some viral diseases and insect attacks. Pests and diseases are an important cause of food losses as they reduce the yields and marketability of the fruit. Wrong dosages of pesticides by farmers seem to play an important role. This is a reason for concern, as is also exposed in the following case study. In the rainforest agroecological zone, insect pressure is higher than in the Northern savannah, which gives the latter region an advantage in terms of quality (Umeh et al. 2002).

5.4.2  **Socio-economic aspects of market gardening in the Plateau.**

(Case study)

The Jos Plateau is an important area for the production of vegetables, especially temperate vegetables, such as tomatoes, because the plateau is situated at altitudes of over 1300 m above sea level. Market gardening has become an important activity. It is reported that its growth has been strong and that this is considered a success, but also leads to tensions. In addition to tomatoes, farmers also grow other vegetable crops. In spite of less attention being paid to agriculture during the petroleum boom, the vegetable production started to grow, driven by the demand from a growing middle class population in the cities. It has now expanded beyond the peri-urban sites. The growth was further increased by protective measures, such as an import ban on tomato paste and fresh fruit and vegetables. Water from disused mine ponds was used for irrigation in the dry season. Former tin mining workers changed to vegetable gardening. The preference is for production close to paved roads, but in absence of road access, vegetables are grown wherever water is present. Entrepreneurial farmers secured access to land, credit from traders, input sellers and neighbours and secured markets for their produce. Everything depends on nurturing intensive personal relations. The low cost petrol fuelled pumps made small scale irrigation a feasible option. The economic results have been positive, with more children being sent to school, better mobility (motor cycles) and better access to health care. The increased use of the land leads to impoverishment of the soil. Inorganic fertilizer has been provided, but the poor soil structure causes leaching, affecting drinking water reservoirs and gives poor increases in yields, because the soils cannot retain the fertilizer. Organic material needs to be provided, but this is not easily available because of a scarcity of animal farming. There is animal farming, when Fulani herdsmen bring their herds to the tsetse-free and water-rich areas of the Plateau during the dry season. Hence, farmers have turned to urban refuse. This has
adverse effects, as urban waste increases the chances of contamination with typhoid, cholera and intestinal worms. The continuous, intensive cropping also increases pest and disease pressure. Shared irrigation systems increase the propagation of pests. Farmers have very limited knowledge of plant diseases and pests. The extension services are not able to fill that gap. Advice is usually given by chemical sellers, but that advice may not be appropriate. This leads to frequent overdosage of pesticides and the application of the wrong pesticides. There have been no attempts to impose cropping regulations, e.g. through the introduction and enforcement of closed seasons or fixed planting dates.

Farmers complain that the water resources dry up before the planting season ends. This needs to be addressed by better irrigation equipment and a more rational application of water, based on the real plant requirements as measured by evapotranspiration, not by the judgement of the farmer. A lot of suboptimal behaviour was reported due to water rationing schemes where farmers want to consume their whole allocation, no matter whether this was conducive to plant growth or not.

The use of petrol pumps in tomato and onion farming and the use of fertilizer makes the production quite energy-inefficient. The use of energy efficient irrigation e.g. use of solar powered pumps, is highly recommended (Hussaini & Abayomi 2010).

The vegetable growing industry also leads to ethnic tensions, between the original Berom population, immigrant Hausa ex-lin mine culturalists living there for several generations and migrant Fulani pastoralists. Then there are immigrants coming from other states. As the Hausa had historically been the most enterprising in vegetable production, having a culture of vegetable farming from their homes in Northern Nigeria, using the shaduf, the local Berom people followed this example. With increased pressure on the land, tensions between the groups mounted. Next to this, there is tension between Fulani pastoralists and the vegetable producers, when the Fulani come to graze their cattle in the dry season. Tensions also exist in the marketing networks. The successful Berom farmers usually sell up to 1000 baskets of tomatoes in distant markets, facing hazards on the road and informal taxes. However, Hausa traders still dominate the trade, which depends heavily on personal relationship networks and trusting relations in a society with little formal possibilities to enforce contracts. The success of the Hausa traders has bred envy and discontent (Porter et al. 2003).

The result from the study shows that the business is profitable. The variables that significantly influenced marketing efficiency were cost of transportation, volume of sales, amount of credit used and household size. Major problems of onion marketing include the frequent price fluctuations, high transportation cost and insufficient capital. Based on findings from the study, it was recommended that the significant factors that influenced marketing efficiency should be considered in policy issue to enhance efficiency. Also, access to credit should be enhanced in order to expand the capacities of these marketers. Policies that will ensure the provision of social and marketing infrastructure and that can assist in reducing marketing costs should also be implemented.

In a study conducted in the onion producing area of Kebbi State to determine the risk and risk management strategies in onion farming, analyses (using frequency distribution, importance indices and a portfolio model) of primary data collected from onion farmers revealed that the output price followed by the input price were ranked highest among the various sources of risk. Onion farmers were poor in the use of risk reducing strategies to the extent that no risk reducing strategy exists for market risk. A reason for the non-use of some risk reducing strategies is either that they are not available or difficult to implement. The most popular risk reducing strategy used was crop enterprise diversification. A risk-loving farmer should only engage in an onion enterprise and a risk averse farmer in a non-onion crops enterprise if crop enterprise specialization is compulsory. In enterprise diversification, a farmer with low risk aversion should devote a high proportion of the farm to onion, which reduces as risk...
aversion increases until the onion crop is 20% of the total farm size for a farmer with high risk aversion. It is suggested that agricultural policy makers should encourage the use of formal insurance and cooperative marketing among onion farmers. Research effort should be directed at obtaining improved seed/seedling and efficient and effective storage and processing technologies that will lengthen the shelf life of onion (Alimi & Wall 2005).

This study involved 5 Retail and 15 wholesale onion traders in the Gashua and Geidam Local Government Areas in Yobe state. Two markets were purposively selected for the study each from Gashua and Geidam. A questionnaire was the main instrument of data collection while a multistage sampling technique was employed for collecting primary data from a sample of forty (40) onion traders in the study area. Analytical tools used were; descriptive statistics, marketing efficiency model and inferential statistics. The majority (65%) of onion traders fall within the age bracket of 25-54 years. The years of onion trading experience of the respondents in the study area indicates that most of the respondents (37.5%) had less than 5 years of trading experience and 40% had between 5-14 years, while only 22.5% had between 15-24 years of experience. The result of the costs and returns analysis revealed that onion marketing was profitable to the tune of N 5515 and N3 469 per bag for wholesale and retail traders during peak periods of onion supply; and N 3801 and N 3671 per bag for wholesale and retail traders during off-peak periods of onion supply respectively. This result also indicated that the marketing of onion during the off-peak period is efficient with a total efficiency of 1,610%. This is more than during the peak period of onion supply with a total efficiency of 1,577%. Major problems of onion marketing include the frequent price fluctuations and high transportation costs. The introduction of the product to the international markets and the establishment of onion dehydration plants were suggested (Grema et al. 2015).

5.4.3 Yields and efficiency

Table 2 shows a comparison of yields of tomatoes and onions for Nigeria and two selected European countries. The Netherlands is a leading producer of onions in the open air and produces for the local market and for export. In fact, the Netherlands is the largest exporter of onions in the world (about 20% of the world total exports).

<table>
<thead>
<tr>
<th>Country</th>
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<th>Parameter</th>
<th>2013</th>
<th>flag</th>
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</thead>
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<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Onions, dry</td>
<td>Yield (t/Ha)</td>
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<td>Fc</td>
</tr>
<tr>
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<td></td>
<td>Production (tonnes)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Onions, shallots, green</td>
<td>Area harvested (Ha)</td>
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<td>Im</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yield (t/Ha)</td>
<td>24,5</td>
<td>Fc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Production (tonnes)</td>
<td>45.948</td>
<td>Im</td>
</tr>
<tr>
<td></td>
<td>Tomatoes</td>
<td>Area harvested (Ha)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Yield (t/Ha)</td>
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<td></td>
<td>Production (tonnes)</td>
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</tr>
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<td>Onions, shallots, green</td>
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</tr>
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<td></td>
<td></td>
<td>Yield (t/Ha)</td>
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<td>Fc</td>
</tr>
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<td></td>
<td>Production (tonnes)</td>
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</tr>
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</tr>
<tr>
<td></td>
<td>Yield (t/Ha)</td>
<td>Production (tonnes)</td>
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</tr>
<tr>
<td>--------------------------------</td>
<td>--------------</td>
<td>---------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onions, shallots, green</td>
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<tr>
<td>Area harvested (Ha)</td>
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<td></td>
<td></td>
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</tr>
<tr>
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<td>Production (tonnes)</td>
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<td></td>
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</tr>
<tr>
<td>Tomatoes</td>
<td>81.3 Fc</td>
<td>3.683.600</td>
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<td></td>
</tr>
<tr>
<td>Area harvested (Ha)</td>
<td>45.300 F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production (tonnes)</td>
<td>3.683.600 F</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Yields of tomatoes and onions in selected countries.

Source: FAOSTAT 2015

The Netherlands is also one of the largest exporters of tomatoes, with 14% of the world total. If we take a look at the yields, the differences are striking. In the Netherlands, the yield for open air onions is about 45 t/ha. For tomatoes it is a striking 483 t/ha. One could ask if there is not an error in the FAO data, but no, the yield is indeed 48 kg/m². The explanation is that tomatoes are not an open air product, but produced year round in greenhouses, which are heated and artificially lit. So the growing conditions are optimized 365 days per year. Of course this requires a very high level of technical sophistication and a great deal of energy input in the winter. However, more and more use is made of heat stored in the soil during the summer, to be used in the winter. The tomatoes are not grown in soil, but on glass wool substrates and drip irrigated, while fertilizer is added with irrigation (fertigation). Pests and diseases are carefully controlled. Insects are easily kept out of the greenhouses and if there are any, they are combated with predator insects, so that very little pesticide is used. So the comparison is not fair, as Nigeria will not have the same conditions.

Spain is another important producer and exporter of tomatoes, providing 12.4% of the world total exports (FAO data). The production system is different, and tomatoes are mainly grown in the open field, Spain being a Mediterranean country. Here yields of over 80 t/ha are achieved. To understand the Mediterranean system better, we quote (Tello 1998):

"Taking Spain as an example, since 30% of its production is in fresh tomatoes and 20% is exported, the "Mediterranean system" is different from the "Dutch system" in its more natural cultural practices, favoured by more favourable climatic conditions. The Spanish tomato production system has a certain technological dependence on the "Dutch system" and a great heterogeneity in productive structures.

The basic elements of the Spanish system are: field cultivation, or cultivation in soil under plastic or mesh-covered greenhouses without temperature or atmospheric control. Varieties exist for cultivation in sand-covered soils. Soilless cultivation is done on a small scale.

Mediterranean production in the last few years has undergone an important modernization programme. Outstanding changes include the adaptation of plastic greenhouses, the introduction of a localized irrigation system, the utilization of soluble fertilizers, varietal reconversion, automation of the packaging line, and the incipient automation of the irrigation system. A great part of these innovations were generated in the EU, especially in Holland. The adoption of suitable hybrid cultivars, requiring less pesticide input and “long-life” varieties with longer shelf life and transportability, proved to be the most important.

Similarly, the onion yields in the Netherlands are very high, with 45 t/ha, whereas Spain with a warmer climate, achieves even better yields.

Nigeria achieves an average yield of about 6 t/ha for tomatoes and about the same for onions, which is in stark contrast. However, it is also a strong hope that with the right input of measures and investments, as mentioned here for Spain, the use of hybrids, the use of plastic tunnels, drip irrigation and fertigation, it must be fully
possible to increase the yields considerably, and hence use the scarce land much more efficiently. That will lead to a shift in the production function, where the yield is a function of land, investment and labour. The yield is now low, with low values of investment and high costs of land and labour. This is not very motivating for the producers and especially not for young people. Intensifying the production will shift the production function to higher investment and lower land and labour requirements.

5.4.4 Plantains

Cooking bananas (including plantains, (Musa spp., AAB genome)) are among the major commodities used in Sub-Saharan Africa to combat food insecurity. The production in Nigeria is estimated at 5,351,000 metric tonnes and the distribution over the States as shown in Figure 13 (NASS 2012) [National Bureau of Statistics 2012 #599]. It is estimated that about 70 million people in West and Central Africa derive more than 25% of their carbohydrates from plantains, making them one of the most important sources of food energy throughout the African lowland humid forest zone. “The consumption of plantain has risen tremendously in Nigeria in recent years because of the rapidly increasing urbanization and the great demand for easy and convenient foods by the non-farming urban populations. Besides being the staple food for many people in more humid regions, plantain is a delicacy and favoured snack for people even in other ecologies. A growing industry, mainly plantain chips, is believed to be responsible for the high demand being experienced now in the country.” (Akinyemi et al. 2008).

**Production of Plantain in Nigeria**

![Map of Nigeria showing production of plantain](image)

The plantain is ranked third among starchy staples, after cassava and yam. It is often intercropped with cocoa, where the plantain serves as a shade crop. This is common in Western Nigeria, where cocoa is mostly produced. Plantain is also intercropped with cassava and yam. Then there is the forestry production, where trees, such as teak are the most important and plantains generate income during the infancy of the
trees. Production around the house also exists, but the highest increase has been from plantation-style production. However, a lack of technical know-how has limited its development.

Post-harvest problems are rife, with high losses reported. It is interesting to note that up to the 1980s, the transport was often done by train, but with the demise of the rail system, this practice has come to an end (Akinyemi et al. 2008).

Production of Starches in Nigeria, 2011

![Map showing the relative production of starchy crops in Nigeria.](image)

**Figure 14 The relative production of starchy crops in Nigeria.**

“In Nigeria, all stages of the fruit (from immature to overripe) are used as a source of food in one form or another. The immature fruits are peeled, sliced, dried and made into powder and consumed as ‘plantain fufu’. The mature fruits (ripe or unripe) are consumed boiled, steamed, baked, pounded, roasted or sliced and fried into chips. Overripe plantains are processed into beer or spiced with chili pepper, fried with palm oil and served as snacks (‘dodo-ikire’). Industrially, plantain fruits serve as a composite in the making of baby food (‘Babena’ and ‘Soyamusa’), bread, biscuits and others. Though fruits are produced all year round, the major harvest comes in the dry season (November to February), when most other starchy staples are unavailable or difficult to harvest. It therefore plays an important role in bridging the hunger gap as well as providing farmers with cash at hand through sales of plantain. In Nigeria, plantain peels are used as feed for livestock, while the dried peels are used for soap production. The dried leaves, sheath and petioles are used as tying materials, sponges and roofing material. Plantain leaves are also used for wrapping, packaging, marketing and serving food.” (Akinyemi et al. 2008).

The plantain is grown in small family gardens and small plots. The cultivation is not difficult, as it requires only abundant rainfall and fertile soils, for which reason the production is found in the South, in the rainforest/Guinean agroecological zone. The only pest that is seriously menacing the plantain, is a fungus known as Black Sigatoka. It kills the leaves and causes a sharp reduction in yield. The International
Institute for Tropical Agriculture (IITA), in Ibadan, did much research and development to develop resistant plantain varieties for the benefit of the Nigerian farmer. However, as one scholar puts it “Many laudable and sound scientific results have been churned out by research into plantain and banana innovation systems, the climax of which was the king Bauduin of Belgium award to IITA in 1994 for an outstanding achievement in breeding plantains for Black Sigatoka resistance and advances in Musa genetics. Sadly however, many of these sound scientific results are still sitting on the shelf of the Institute. Research agendas were formed without recourse to the farmer’s priority, this mostly led to rejection of research results or low adoption of disseminated innovations in plantain and banana innovation systems. A case study is the cooking banana dissemination efforts of 1990 - 1994 which was rejected because farmers lacked utilization knowledge of cooking.” (Faturoti et al. 2007). This provides important feedback for researchers, that care must be taken that innovations are relevant and desired and done with the participation of the beneficiaries.

Sigatoka disease was first found close to the town of Sigatoka (Fiji), after which the disease is named, and causes a sharp decrease in yield.
It is estimated that more than 30% of the banana production is lost after harvest. The losses are mostly due to the rapid ripening of the fruits, poor handling, inadequate storage and means of transportation and poor knowledge of food processing options. Processing the fresh fruits into food products with a longer shelf life can provide a major outlet to use surpluses and to exploit a greater number of marketing options. In this paper, we provide ingredients and recipes for food products produced by the International Institute of Tropical Agriculture (IITA) from its improved hybrids of cooking bananas to decrease post-harvest losses, diversify the industrial potentials of bananas and add value to farmers’ products. Some of these processing methods can be used by farmers and rural entrepreneurs in their communities to ensure food security and raise their incomes, or upgraded by the private sector in a value chain approach to curb production losses in bananas (Ferris et al. 1999).

The farmers and traders cited the availability of credit, the state of the roads and poor market access as the major constraints to the sector (Adeoye et al. 2013). Processing of plantains into plantain flour can be an attractive strategy to reduce food spoilage, bridge the seasonality gaps and improve marketing (Adeniji et al. 2010).

5.5 Traders and markets

5.5.1 Wholesalers and retailers

The traders play an important role in the distribution of the produce to the cities. “The Nigerian domestic food system presents a fascinating case where debates concerning the moral economy are played out with huge implications for the well-being of millions of people in poverty. Considering the difficult business conditions with no recourse to legal systems, a corrupt and ineffective police force, minimal banking infrastructure, poor communications and a highly degraded transport infrastructure, the movement of food from over 70 million food producers to over 60 million urban consumers is a feat of ingenuity” (Lyon & Porter 2009).

It is no easy task to move perishable produce from an area like the Plateau to urban centres, over long distances under difficult circumstances. Traders manage to do this. They provide an intermediary service for both farmers and consumers. However, there are also reports of exploitative behaviour and the formation of cartels. (Smith & Lutrell 1994).

There is a wide difference in margins recorded by traders in different crops. Tomatoes seem to yield better margins than bananas. “The majority of the traders lack basic formal education. This hinders marketing efficiency, due to the fact that they do not keep records of day to day financial activities. This also prevents them from obtaining loans from financial institutions. Traders in the study areas mainly got their initial start-up capital from personal savings, friends and local lending agents. Capital is not readily available for further expansion. The lack of good and cheap means of transportation has posed a serious threat to the traders. This is due to frequent fuel scarcity, long distances from the point of production, poor roads and the dilapidated condition of existing roads. Recommendations include training marketers on simple preservation techniques, introducing uniform and standard weights as well as the provision of storage facilities, in a bid to minimize variations in the prices of fruits” (Ajani 2007).

A survey was held among 42 wholesalers and 56 retailers at the two local fruit markets of Ibadan, Oyo state. Most of the wholesalers where men (88%), perhaps because of the physical nature of the work, while retailers were mostly women (93%). The majority of the wholesalers (55%) and retailers (58%) where aged 31-40 years, so in the active age group. 95% of the traders were married and 67% of the wholesalers and 79% of the retailers had completed primary education.

The study also revealed that 69% of the wholesalers had acquired 11-15 years of experience while 50% of the retailers had only 6-10 years of experience. This
suggests that more people tend to stay longer in the tomato wholesale business possibly due to rewarding economic returns. The majority of wholesalers (71%) buy the product directly from farmers, while some buy through agents. Female retailers buy predominantly from wholesalers, as is to be expected.

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<td>Female</td>
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<td>31-40</td>
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</table>

Table 3 Socio-economic characteristics of tomato traders in Ibadan markets. Source: (Adeoye et al. 2009)

Respondents considered the tomato trade as their main occupation and source of income.

Generally, rough handling during unloading caused the most damage. Stacking of baskets holding tomatoes, high temperatures and exposure to sunlight are also main factors.

For different cultivars, the economic losses ranged from 34% for UC82B to 85% for Roma, 79% for the Ibadan local variety and 94% for the VT563-JM94-47 cultivar (Adeoye et al. 2009). The result is not unexpected, as the UC82B (developed at the Tomato Genetics Resource Centre, University of California Davis, [grc.ucdavis.edu](http://grc.ucdavis.edu)) is a processing-type tomato with higher firmness and lower water content, but not intended per se for fresh consumption.
Another survey was conducted among 60 tomato traders in Delta State. The objective was to learn more about the marketing efficiency of tomatoes. It is known that the absence of cold storage and refrigerated transport systems force farmers to harvest tomatoes at the point of being vine-ripe. At this moment, the product needs to be sold quickly, giving 2-4 days marketing time. This negatively affects the price and it worsens the transportability of the crop. It is acknowledged that tomatoes could be harvested at the green mature stage, be sold, transported to the market and then be ripened according to consumer demand. By introducing some form of storage, the marketing time would increase to some 12-15 days, which buffering would make the market more efficient, reduce losses and improve prices (Odemero & Ngozi 2014).

Lowering the transport and storage temperature to 15-20 °C would already increase the shelf life enormously and reduce food losses. The presence of vibrations and compressions, due to the sometimes poor road conditions, do not seem to be equally destructive as too high transport and storage temperatures (Sugri et al. 2011).

**Transport**

Research was carried out in ten different markets across the countries and questions were posed to 100 people usually involved in the transport of fruits and vegetables. Various questions were tackled, such as the routes generally taken, the current obstacles experienced, the packaging systems employed, the type of vehicles used, the ownership and transit times. A ride was taken on a tomato transport from Kano to the South. More than 80% of the respondents had been more than 15 years in the activity, so there was a good source of knowledge. The major types of vegetable being handled were tomato, pepper and onion. These vegetables constitute the major North-South trade. The major fruits handled included orange, pineapple and banana. The fruits are produced in the South and transported to the urban centres.

Movement from Kano to Lagos takes two days on average. Another 2-3 days are spent on source markets. The cargo owners do not own the vehicles. They are rented at the market where the fruits or vegetables are purchased. The preferred truck is a 7.5 – 9 tonner, known colloquially as “911” after the famous Mercedes “short bonnet” truck, known for its robustness and adaptability to African conditions (the load size and good ventilation are also mentioned). However, this vehicle is not always available when needed, and traders need to take recourse to any other available kind of vehicle, even passenger buses. There are also reports of consignments being tied to fuel tankers. Wooden planks are put between baskets of tomatoes, in order to prevent compression. Onions in bags are stowed in bulk.

The price for the transport of a basket of tomatoes or a bag of onions is reported at 200 naira (€ 0.95) for a 36 kg basket, the distance being 990 km. It was reported that 14% of the
produce was spoilt during the transport (Idah et al. 2007).

This boils down to approximately € 0.03 per ton-km, compared to about € 0.06 per ton-km in Europe. It has to be noted that in Europe, this price includes proper refrigeration, as well as state-of-the-art trucks, and a higher salary level. The efficiency of the market for finding backloads is also of high importance. The vehicle operating costs on a like-for-like basis are in Africa higher than in Europe. The average age of the truck fleet in Nigeria is unknown, but may be well over 10 years (see Figure 19). The relatively high cost of transport is not only related to the poor infrastructure. In spite of it, the high average age of the fleet and the low utilization (in terms of numbers of kilometres travelled each year), transport operators seem to be able to make good returns and transport is in many cases a seller’s market. This has more to do with the structure of the market, the ease of access, the existence of oligopolies and formal and informal barriers (Raballand & Macchi 2008).

The recommendations for reduction of these economic and food losses are simple: organize the value chain by using better packaging, provide refrigerated transport and storage facilities, invest in the training of farmers and traders and improve roads and market structures. Markets also need to be better organized from a hygiene perspective. The market in the picture above was closed down because of the prevailing unhygienic conditions (inadequate toilets and washing facilities, inadequate use of refuse collection etc. – see Sun News 23 January 2013). The food safety aspects will be discussed in paragraph 5.6.2.

5.5.2 Retail, food service, industry

The food retail sector in Nigeria is split into three sectors: the open air traditional markets discussed previously, comprising 65% of all food sales, the convenience stores and small groceries comprising 34% and the formal supermarkets, comprising only 1% of the total sales (Nzeka & Rondon 2011).
The structure and needs of the omnipresent open air markets have already been described in the previous paragraphs. The role of the convenience stores and small groceries is less clear. More can be said about the role of the formal supermarkets. Even though these comprise only 1% of the total sales, they are an important segment because they cater for an upmarket clientele. The requirements placed on quality, assortment and presentation of the fresh fruit and vegetable category are much higher. In that sense, they provide an important incentive for upgrading the chains. The same can be said of upmarket hotels, restaurants and airline catering companies that are serviced by food service operators, or need to put in significant time to source their products. The leading supermarket is Shoprite, with currently 11 stores in the country. They sometimes source fresh fruits and vegetables in South Africa, Kenya and Ethiopia, due to the wide range of produce, the quality is up to international standards thanks to the presence of international export oriented farms and, importantly, the ease of ordering. However, many products, including many foodstuffs, are on an import ban list. Shoprite has expressed that it wants to source as much as possible locally and set up a local distribution centre. This will provide opportunities for local businesses. Less dependence on imports also protects against a devaluation of the naira.

Another supermarket is the Netherlands-based Spar International, that opened a shop with the most important local supermarket group Park-n-Shop (Artee Group) in 2010. They currently have six stores.

The South African Massmart also opened a shop. Massmart is owned by Walmart (USA). French retailer Carrefour will open stores in Nigeria and elsewhere in Africa, in collaboration with the trading company CFAO.

Gloo.ng is the country’s leading web grocery.

The Oxford Business Group reports that “besides a handful of locally-based fast-moving consumer goods producers, including Nestlé, Unilever, P&G and Cadbury, most of the products on the shelves of Nigerian retailers are imported. Locally sourced fresh items, such as fruits and vegetables, often spoil by the time they arrive at retail outlets due to the congested and underdeveloped national road network.” (http://www.oxfordbusinessgroup.com/)

Similarly, processing industries such as Nestlé and Unilever prefer to source locally, but are confronted with issues of reliability of supply, quality and food safety issues.
5.5.3 Export markets

Nigeria is largely absent on the export markets for fruits and vegetables. Eurostat does not report any significant import of fruits and vegetables into the European Union.

It has been noted that Nigeria’s neighbours succeed in exporting sizeable quantities of fruits and vegetables to Europe and elsewhere. Notably Cameroun and Ghana are successful with bananas and pineapples. Also Togo and Benin are active in smaller export programmes, mainly of pineapples.

5.6 Consumers

5.6.1 Consumer preferences and buying power

Fruits and vegetables on the one side and starch sources on the other are important food items. It is clear that Nigerians spend a relatively large proportion of their income on food. It is expected that as disposable income grows, this proportion will decrease, while at the same time the awareness of consumers of quality, health and hygiene will increase. There is therefore an important issue to meet the growing expectations of Nigerians in terms of safety, supply reliability and affordability. Reducing wasted food and controlling the use of pesticides is therefore of paramount importance.

5.6.2 Food safety

The food safety risks can be split into three groups: the risk of contamination with chemicals used for crop protection, the risk of chemical contamination with waste water effluents downstream from industries (such as tanneries, mines) and the risk of microbiological contamination due to the use of bacteriologically and parasitic contaminated irrigation or washing water and contamination by unhygienic handling conditions during harvest, transport and marketing.

Chemical contamination with pesticide residues

In spite of the situation described earlier where producers have little understanding of the right application and dosage of pesticides, only a few studies report significant contamination of fruits and vegetables with pesticides. Bempah & Donkor (2011) reported from Accra that contamination with persistent organochlorine compounds existed in over 70% of fruit and vegetable samples taken, and that the levels were in 30% of the cases in excess of the maximum residue level. This shows that there is a risk of accumulation of these dangerous chemicals when eating vegetables, even though there may not be a direct risk for illness.

Another study reported contamination with organophosphorous chemicals (insecticides) in vegetables in Borno State. Various insecticides, viz. dichlorvos, diazinon, chlorpyrifos, and fenitrothion were determined in some vegetables (spinach, lettuce, cabbage, tomato and onion). The study also pointed to the accumulation of these compounds in the soil. The levels of contamination were well above the European Maximum Residue Levels and daily consumption would constitute a health risk (Akan et al. 2013). It is expected that should more research be done in other growing areas, similar results will be found.
The fact that pesticide residues are not under control is not only a health risk for the national population, but also makes it impossible to think about export. It is for this reason that ColeACP has been charged with the Pesticide Insecticide Project, aimed at educating ACP farmers to comply with the Good Agricultural Practice norms, which are required for entry into the European market.

**Chemical contamination with heavy metals**

Tomatoes grown around Kano were reported to contain high levels of lead, chromium and cadmium. The irrigation water in this case was taken from the Challawa river on which a large cluster of leather tanneries is situated further upstream. These tanneries polluted the water with tanning chemicals. The heavy metal contents were higher than the approved maximum levels set by the Food and Agriculture Organization of the United Nations and the European Union (Abdullahi et al. 2007). Similar results were reported for vegetable gardens in and around Kano by Audu & Lawal (2006).

A sampling on Lagos markets found no alarming levels of heavy metals, with the exception of lead in various fruits and vegetables, possibly caused by polluted irrigation water, farm manure or traffic exhaust particles (Sobukola et al. 2010). Fruits and vegetables should be treated before reuse as irrigation water and tested for microbiological safety.

Producers and trader should be trained in Good Agricultural Practices, especially personal hygiene, hygienic use of packaging, cleanliness of markets etc.

Microbiological contamination

Microbiological contamination of fruits and vegetables may be the greatest concern for the health of consumers. Various bacteria, fungi, yeasts and parasites have harmful effects on consumers’ health when ingested.

(Adamu et al. 2012) reported how enteric helminthic parasites were present on average in 3.5% of 1130 vegetable samples taken on Maiduguri market.

A sampling done of vegetables sold in Jos showed worse results: of 1250 samples analysed, 450 showed the prevalence of intestinal parasites, with cabbage being affected in 64% of the cases and tomato in 20% of the cases (Damen et al. 2007). A study conducted in South Western Nigeria showed similar results (contamination with parasites in 68% of cases) (Ogbolu et al. 2009). This shows how fruits and vegetables considered to be a healthy part of the diet, turn into highly dangerous foodstuffs, especially if not prepared properly. The cause of the contamination is probably the use of night soil, contaminated irrigation water (open sewer - (Audu & Lawal 2006) and the handling of vegetables in markets without observing personal hygiene, as discussed in paragraph 5.3.2. Really important work needs to be done in training farmers and traders to work hygienically.

An especially alarming report was made by (Muhammad et al. 2004) who checked tomatoes marketed in Sokoto for the presence of harmful fungi. Aspergillus spp fungi were found on rotten tomatoes in the market. These are not only highly pathogenic for the fruit, but also harmful in case of human consumption. Eight different Aspergillus fungi were detected and after heating the tomatoes at 121°C for 15 minutes, carcinogenic residues of the fungi (aflatoxins) could still be detected. The danger here is that if tomatoes are used for processing, there is a chance that the final product (juice, paste) is contaminated with aflatoxins. Indeed, a sampling of sixty packaged, heat-treated Nigerian fruit juices were tested and 17-27% of the samples contained heat-resistant Aspergillus fungi (Obeta & Ugwuanyi 1995).

**5.6.3 Food security and undernourishment**

The scope of this study does not allow to delve deeply into the food security aspects of the fruit and vegetable industry. It has already been noted that vegetables and fruits play an important role in the quality of the diet. They add minerals and vitamins to the diet that are required by the body to remain healthy. They are especially important for children and adolescents when they are growing up.
In 2005, a nationwide survey was done to establish the vitamin A status of children under five years of age. A total of 6480 households were surveyed. The proportions of children with vitamin A deficiency (VAD) differed among the agroecological zones; incidences were 31.3% in the dry savanna, 24.0% in the moist savanna, and 29.9% in the humid forest (Maziya-Dixon et al. 2006). VAD is a serious health problem in all the ecological zones. VAD causes growth retardation and compromises the human immune system, making children and adults more susceptible to infections. Complementing the diet with sufficient vitamin A is important and fruits and vegetables can play an important role. Certain fruits and vegetables contain a high level of (pro-)vitamin A and can be easily included in the diet if they are culturally acceptable. Examples are the leaves of cassava, mango, certain varieties of plantains and bananas.

When 204 school children in Osun State were assessed for their daily intake of vegetables and their blood retinol levels were assessed, it was found that vitamin A levels were generally sufficient, especially thanks to the consumption of red palm oil. However, malnutrition (stunting) was observed in more than 60% of cases (Adelekan et al. 1997).

The consumption of vegetables is influenced by price and tradition. Leafy vegetables are widely used in soups. The amount consumed depends on the season, the availability and the price. In order to boost the consumption of vegetables and fruits, the pricing, availability and the local eating customs must be taken into account (Hart et al. 2005).

The issue of VAD is very important though. There would be much merit in the identification and promotion of vitamin A rich foods, in a way that is close to the current eating habits and the current food production and trade patterns. A vitamin A rich banana could blend in well in the eating pattern and increase the health status of children under 5 years of age. Other deficiencies, such as iron and zinc, also play a role. A balanced diet with fruits and vegetables is important to remedy these.

5.7 Support structures

The National Horticulture Sector Survey has shown that farmers face obstacles that prevent their development. A number of obstacles have already been mentioned, such as the absence of infrastructure, notable proper rural roads, but also the Credit institutions.
The National Horticulture Sector Survey shows that farmers mainly use their own financial means to invest in horticulture. This picture is also confirmed by other data sources. There is here a clear observation by the farmers for the need to have an adequate supply of electricity. This greatly reduces the costs for irrigation, which is more costly utilizing motor pumps than if operated electrically. It is also noted that farmers mention the lack of funds as a bottleneck. If farmers have better access to credit and it is noted that the majority of their capital requirements are covered by personal savings, they will be more likely to invest in equipment, fertilization and better planting material. This will increase the yields from scarce land resources and also place fewer demands on the labour force. It has been observed that increased technification of horticulture also reduces the employment of children. Instead of working on the land, they can go to school, something that is very important for many reasons. For the horticulture industry, it has been shown that the general level of education is very low, both of the producers and the traders, whereas the requirements of modern society only increase. It is of primary importance in order to feed the growing population, to improve productivity, by improving economic efficiency, agronomic practices and trade, and for all of this, the development of human resources is highly necessary. Increasing the level of literacy and calculus skills among farmers and traders will increase the sustainability of the business. It will also make the provision of credit and extension services more efficient.

In the same NASS it is mentioned that lack of finance prevents farmers investing in modern equipment and farm inputs. It is mentioned as the largest obstacle. In different tones of voice, the same concerns are expressed time and again: poor infrastructure, poor credit, lack of enforcement of contracts, theft of equipment and adulteration of inputs. With regards to the latter, the establishment of reference laboratories will be important so that agricultural inspection services can easily carry out controls on markets and perform quality assessments of pesticides, fertilizers and other inputs, as well as assess the quality of fruits and vegetables. Such a service is also of the greatest importance if the country wants to become an exporter of horticultural products. The Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) requires that third parties, such as
exporting countries, maintain a system of sanitary and phytosanitary controls of equal quality as those in force in the EU. The EU has always maintained a strong body of legislation related to consumer health and safety in the area of foodstuffs. The EDES programme of ColeACP, funded by the EU, envisages helping governments of third countries to implement these systems (www.coleacp.org/edes).

5.7.1 Agricultural colleges and universities

One of the elements that has been mentioned before as being important is the provision of extension services. All of the States have Agricultural Development Projects, which provide agricultural infrastructure and the main vehicle for agricultural extension. Most of the States have universities which in many cases have an agricultural faculty. They provide research for development. The current study shows that much useful research is done at these institutions, in many cases with limited means, but often of high relevance. The trick will be to turn the research into policy and practice, so that research leads to development.

The National Horticultural Research Institute is located in Ibadan and is part of the Agricultural Research Council of Nigeria (http://www.arcnigeria.org/).

Ibadan hosts the International Institute for Tropical Agriculture (IITA), a CGIAR branch, focusing mainly on food staples, such as maize, rice, yam and cassava, but also on plantain and banana.

Table 4 lists the most important Nigerian universities with agricultural colleges and schools, as well as the major research institutes.

<table>
<thead>
<tr>
<th>University/College</th>
<th>Place</th>
<th>State</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal College of Horticulture</td>
<td>Dadin Kowa</td>
<td>Gombe</td>
<td><a href="http://services.gov.ng/horticultural-college-gombe">http://services.gov.ng/horticultural-college-gombe</a></td>
</tr>
<tr>
<td>Landmark University</td>
<td>Omu-Aran</td>
<td>Kwara</td>
<td><a href="http://lmu.edu.ng/">http://lmu.edu.ng/</a></td>
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<tr>
<td>Ahmadu Bello University</td>
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<td>Kaduna</td>
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<td>Ibadan</td>
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<td>Kano</td>
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<td>Ibadan</td>
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<td>Ebonyi</td>
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<td>Imo</td>
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<tr>
<td>Ladoke Akintola University of Technology</td>
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<td>Oyo</td>
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<tr>
<td>Michael Okpara University of Agriculture</td>
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<td>Abia</td>
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<tr>
<td>Modibbo Adama University of Technology</td>
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<td>Adamawa</td>
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<tr>
<td>Obafemi Awolowo University</td>
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<td>Osun</td>
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<td>University of Nigeria</td>
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<td>National Horticultural Research Institute (NIHORT)</td>
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<td>Agricultural Research Council of Nigeria</td>
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<td>FCT</td>
<td><a href="http://www.arcnigeria.org/">http://www.arcnigeria.org/</a></td>
</tr>
</tbody>
</table>

Table 4 Nigerian Universities with Agriculture Colleges and Research Institutes
An important agenda for research could be the further study of the relation between different interventions or strategies for improved production, yields, quality and hence food security. While there are ample studies into the effect of single improvement strategies, such as fertilizer application, there are limited studies where the relation between more than one are taken into account, like e.g. fertilizer and irrigation, or irrigation and improved seeds use. Horticulture is a multi-factorial production system, where inputs are complimentary: The absence of one factor may render useless the increase of another factor (Takeshima 2011).

### 5.7.2 Extensions services

It has already been mentioned in paragraphs 5.4.1 and 5.4.2 how important extension services are to improve the quality and productivity of the horticultural production. Farmers get advice on the use of fertilizer and pesticides from dealers, but this is not always the right advice and some bias may be involved. Also the well-considered use of scarce water resources needs guidance. Farmers benefiting from good extension achieve better returns.

Agwu et al. (2008) give us some valuable advise on how extension and outreach by researchers should stimulate innovation among rural farmers. The basic message is that if the current low productivity and performance of the agricultural sector is to be improved, leading to better availability and lower food prices, it is important to adopt a systematic approach making sure that all the different factors affecting adoption by farmers of performance enhancing technologies and approaches are coherent and are all pulling in the same direction. The opposite is what often happens, viz. that extension is a simplex broadcast effort, which for lack of a coherent approach and receptive dynamics by the market, is doomed to failure.

In Nigeria, there are 18 National Agricultural Research Institutes (NAER), under the responsibility of the Federal Ministry of Agriculture. There is an Extension and Research Liaison Service (NAERLS) linked to the Ahmadu Bello University in Zaria (Kaduna), which is the largest university in Nigeria, and the second one in size in Africa South of Cairo.

### 5.7.3 Enabling environment

It is well known that the Government of Nigeria has an ambitious plan to encourage the agricultural sector, called New Nigerian Agricultural Policy (2001). The Policy encompasses a number of important measures to create an enabling environment, such as zero duty on agricultural machinery, tax exemptions on the agro-processing industry, import prohibition of frozen foods and juices, to mention a just few. The policy intends to achieve food self-sufficiency and even a surplus for export. It also particularly focuses on the cotton, groundnut, palm oil and cocoa sectors. The Policy contains many valuable initiatives and shows a good coherence of the different factors.

One factor needs to be emphasised especially in view of the export of horticultural products. This is the need to have a favourable tax regime for export, and especially and easy reclamation of local taxes paid, such as Value Added Tax, on inputs such as cardboard boxes, pallets and other farm inputs. Not being able to deduct these costs, will lead to an uncompetitive starting position on the international market, where Nigeria has to find its place. An alternative to reclamation with some susceptibility for fraud, is the establishment of an export subsidy financed by local taxes paid on exported goods, such as is done in Peru, a country with a great track record in horticultural exports.
6 Export

As we turn to export opportunities, it is good to review everything that has been stated before. The starting position of the Nigerian horticulture is not a strong one. The production is scattered, of low yield, inconsistent, lacks good agricultural practices and hence has low quality, insufficient food safety, it is low input, low investment, dependent on rain or artisanal irrigation, highly labour intensive and hence unattractive to young educated people. It suffers from a failing infrastructure, notably bad roads, vagaries of the roads, insufficient power supply, absence of credit and finance provision, lack of market organization, lack of training of traders and retailers, relatively high prices due to shortages, irregular supply due to all these difficulties and a lack of policy coherence.

We will now turn to the export side and evaluate where the opportunities for horticultural export are and which measures must be taken to realize the potential.

In doing so, we use a simple, practical methodology. Export is international trade, and international trade is making the link between countries producing something and countries buying something. The reason for countries buying is that they cannot make it themselves or that other countries have advantages so that they can produce the good better or more cheaply, including the costs of transport. In the case of export of horticulture, it is clear that we have to look for products that are in demand in overseas countries. So, tropical products are a logical choice to be exported to temperate countries, as they cannot grow there. Also, products which are highly labour intensive can come into the picture, as they can benefit from low labour costs. Then it is necessary to be able to bring these products in a cheap and efficient way to the export destinations. If there is no logistics, there is no trade. Of course, logistics can follow the trade, but given the high capital intensive nature of logistics, horticulture trade flows need to have sufficient scale to allow logistics to follow. What we will do in this study, is start with a small overview of the current horticulture exports in Africa and how they were developed. Then start with the current logistic options that Nigeria offers and that can be utilized. Having a market is more important than a mill and having logistics to that market is equally important as starting to produce something. So we will start with charting the logistics, since, in our experience, we consider this to be the bottleneck and then see if we can find combinations of a market and a crop that can use these logistics to be commercialised profitably.
6.1 The current horticulture exports of Africa

The following table (Table 5) shows the export volumes of the most important fruits and vegetables from sub-Saharan countries to the European Union.

<table>
<thead>
<tr>
<th></th>
<th>South Africa</th>
<th>Cote d’Ivoire</th>
<th>Cameroon</th>
<th>Ghana</th>
<th>Kenya</th>
<th>Senegal</th>
<th>Zimb-abwe</th>
<th>Swaz-iland</th>
<th>Namibia</th>
<th>Total EU imports</th>
</tr>
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<tbody>
<tr>
<td>Pineapple</td>
<td>799</td>
<td>24.969</td>
<td>9.781</td>
<td>35.328</td>
<td></td>
<td></td>
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<td></td>
<td>862.845</td>
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<tr>
<td>Other citrus</td>
<td>343</td>
<td>3</td>
<td></td>
<td>4.268</td>
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<td></td>
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<tr>
<td>Avocado</td>
<td>48.376</td>
<td>80</td>
<td>5</td>
<td>17.078</td>
<td>489</td>
<td>218</td>
<td></td>
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<td>216.444</td>
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<tr>
<td>Banana</td>
<td>224.943</td>
<td>213.868</td>
<td>50.691</td>
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<td>Lemon</td>
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<td>64</td>
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<td>Strawberry</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>38.561</td>
</tr>
<tr>
<td>Kiwi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28.694</td>
<td></td>
</tr>
<tr>
<td>Lime</td>
<td>212</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>97.759</td>
</tr>
<tr>
<td>Litchi/passion</td>
<td>4.044</td>
<td>10</td>
<td>701</td>
<td>541</td>
<td></td>
<td>493</td>
<td></td>
<td></td>
<td></td>
<td>28.485</td>
</tr>
<tr>
<td>Mango</td>
<td>681</td>
<td>15.245</td>
<td>259</td>
<td>847</td>
<td>20</td>
<td>6.197</td>
<td></td>
<td></td>
<td>229.674</td>
<td></td>
</tr>
<tr>
<td>Melon</td>
<td>1.473</td>
<td>11.336</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>344.108</td>
</tr>
<tr>
<td>Orange</td>
<td>393.743</td>
<td>265</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.221</td>
<td>12.005</td>
<td></td>
<td>809.176</td>
</tr>
<tr>
<td>Papaya</td>
<td>100</td>
<td>41</td>
<td>336</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>27.819</td>
</tr>
<tr>
<td>Watermelon</td>
<td>504</td>
<td></td>
<td></td>
<td>8.320</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>183.199</td>
</tr>
<tr>
<td>easy peeler</td>
<td>69.723</td>
<td>21</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td>753</td>
<td></td>
<td></td>
<td>315.159</td>
</tr>
<tr>
<td>Plantain</td>
<td>0</td>
<td>9</td>
<td>617</td>
<td>238</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>72.948</td>
</tr>
<tr>
<td>Pear</td>
<td>86.409</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>224.032</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>74.367</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.360</td>
<td>8.455</td>
<td></td>
<td>347.167</td>
</tr>
<tr>
<td>Apple</td>
<td>119.801</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>495.340</td>
</tr>
<tr>
<td>Plum</td>
<td>33.504</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>49</td>
<td></td>
<td></td>
<td>77.406</td>
</tr>
<tr>
<td>Grapes</td>
<td>160.402</td>
<td>12.070</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>567.454</td>
</tr>
<tr>
<td>Garlic</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>71.041</td>
</tr>
<tr>
<td>Asparagus</td>
<td>26</td>
<td></td>
<td></td>
<td>173</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>37.910</td>
</tr>
<tr>
<td>Aubergine</td>
<td>2</td>
<td>11</td>
<td>211</td>
<td>23</td>
<td></td>
<td>1.297</td>
<td></td>
<td></td>
<td></td>
<td>8.654</td>
</tr>
<tr>
<td>Mushroom</td>
<td>44</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.788</td>
</tr>
<tr>
<td>Courgette</td>
<td>274</td>
<td>11</td>
<td>20</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>43.944</td>
</tr>
<tr>
<td>French Beans</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>37.855</td>
<td>5.299</td>
<td>220</td>
<td></td>
<td></td>
<td>169.362</td>
</tr>
<tr>
<td>Onion</td>
<td>600</td>
<td>3</td>
<td>99</td>
<td>798</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>228.649</td>
</tr>
<tr>
<td>Peas</td>
<td>21</td>
<td>1</td>
<td></td>
<td>1</td>
<td>5.327</td>
<td>2.686</td>
<td></td>
<td></td>
<td></td>
<td>22.335</td>
</tr>
<tr>
<td>Pepper</td>
<td>8</td>
<td>4</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>207.480</td>
</tr>
<tr>
<td>Early potato</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>321.500</td>
</tr>
<tr>
<td>Tomato</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9.547</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>441.150</td>
</tr>
<tr>
<td>Total vegetables</td>
<td>981</td>
<td>12</td>
<td>213</td>
<td>39</td>
<td>44.775</td>
<td>15.785</td>
<td>2.909</td>
<td>1</td>
<td>0</td>
<td>1.563.813</td>
</tr>
</tbody>
</table>

Table 5 Horticulture exports from Sub-Saharan Africa to the EU.
Source: Fruitrop (2013)
Countries with export volumes below 10,000 t/yr have not been included. This is why countries like Mali and Burkina Faso are not included, even though they export quantities of mangoes and French beans. Likewise, Ethiopia is not represented as the volumes are still below the threshold.

From the table, it becomes clear that there are a number of regional champions. In the whole of Africa, South Africa is clearly leading with important exports of citrus, apples and grapes. The country is competitive due to its infrastructure that is unrivalled in Africa: excellent road system, good rail network, a coherent government policy and all the supporting structures in place, including finance, quality systems and a perishables export controls board (http://www.ppecb.com), which carefully controls the quality of the exported produce so as to protect the country of origin reputation, something which is very important in fresh fruit and vegetables.

The West-African countries of Cote d’Ivoire and Cameroon have been successful in exporting bananas to Europe. They have been able to do this by attracting French investors who have planted banana farms and organized their own shipping with reefer ships.

Today, a significant portion of fresh bananas from West Africa are also shipped in refrigerated containers. Driven by the success of the banana, Cameroun and Cote d’Ivoire also started to export pineapples by boat. Ghana is a relative newcomer which started to benefit from the crisis in Cote d’Ivoire and now boasts an important pineapple and banana export industry. Ghana has become the main exporter of MD2 “Golden” pineapple that are most prized in the European and Mediterranean markets.

Further to the right in the table, Kenya shows it is active as exporter of avocados and French beans. It is especially known for the latter crop. Though the volumes may look modest, the value of the crop is impressive: an estimated € 130 million per year. The volumes of the fresh beans are almost exclusively exported by air. Kenya has been able to develop this business thanks to the availability of unused air cargo space and the high per unit value of the commodity. It may be a misconception that cargo planes come specifically to pick up the cargo. The art of air cargo and horticulture exports is to find suitable back loads so that air cargo operators can use both legs for paid cargo. Every cargo then only needs to pay the one-way cost. If this is not possible, the two-way cargo has to be charged, which makes the cost extremely high. This is only possible if the value of the cargo is very high and the urgency justifies air freight. Generally, the urgency of horticulture crops is high, but the value is not. Labour intensive products like French beans, mangetout and peas are generally higher value and hence justify the air freight. Besides, these products do not tolerate the transit times in refrigerated containers well, even though experiments are being done in Senegal (benefiting from only 5 days ship transit times to Europe). So, the thing to look for is whether it is possible to find refrigerated transport to the market with a short transit time, allowing enough time to market and shelf life in the retail shops. In practice, a transit time of 14-20 days is workable for many crops. Alternatively, if the volumes are big enough, a refrigerated ship can be chartered, but then the volumes must be sufficient to load weekly volumes of 3500-5000 tons of cargo.
A commodity that is very high value and has traditionally been carried by airplanes, are flowers. The flower import in Europe has grown tremendously over the past years, even though with the crisis, it seems to have evened out (Rabobank 2015).

The next table gives an overview of the African countries most active in floricultural exports and the export values this generates.

<table>
<thead>
<tr>
<th>Volume (t)</th>
<th>Ethiopia</th>
<th>Kenya</th>
<th>Tanzania</th>
<th>Zimbabwe</th>
<th>Cote d'Ivoire</th>
<th>Zambia</th>
<th>Ghana</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>6.448</td>
<td>103.000</td>
<td>2.814</td>
<td>11.091</td>
<td>524</td>
<td>5.997</td>
<td>2.832</td>
<td>132.706</td>
</tr>
<tr>
<td>Belgium</td>
<td>12.622</td>
<td>819</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.441</td>
</tr>
<tr>
<td>Germany</td>
<td>1.344</td>
<td>2.367</td>
<td>396</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.007</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2.547</td>
<td>2.278</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.836</td>
</tr>
<tr>
<td>EU28</td>
<td>20.884</td>
<td>110.685</td>
<td>5.093</td>
<td>11.495</td>
<td>6.414</td>
<td>6.008</td>
<td>2.832</td>
<td>163.211</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value (EUR)</th>
<th>EU28</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.038.601</td>
<td>44.761.678</td>
<td>3.028.876</td>
</tr>
</tbody>
</table>

Table 6 Import volumes and values of floriculture crops. (G06) into EU 28 from African countries in 2014. Source: Eurostat 2015.

It is once again shown how countries with good airline connections have initially been able to benefit from the export of high-value agricultural crops. Again, it is Kenya that is the most successful with a staggering 110,000 tons of flowers (mainly roses) and an export value of almost € 45 million. But also Tanzania and Ethiopia have been
able to capture these markets thanks to a developed tourist circuit in Tanzania, whereas Ethiopia has developed Addis Abeba as a hub for inter-African and transcontinental travel, allowing the horticulture and floriculture business to develop starting with belly cargo (cargo carried in the holds of passenger planes). The State-owned airline company Ethiopian Airlines played an important role in making this development possible (Gebreeyesus & Iizuka 2012).

In Kenya, the links between Kenyan-Indian families with agribusiness and their foreign contacts proved to be equally important (English et al. 2004).

6.2 Logistics

We have already established the importance of adequate logistics. We will now evaluate the Nigerian outbound logistics situation, before turning to the internal logistic situation which has already been touched upon earlier.

6.2.1 Air cargo

Thanks to the oil industry, Nigeria is well served by a number of passenger and cargo airlines with regular flights to Lagos, Abuja, Kano and Port Harcourt. In fact, one of the catalysts for this study was the AFGEANs (Agricultural Fresh Produce Growers and Exporters Association of Nigeria) contact with the air cargo operators and the mutual quest to see if cargo can be found for the return leg to Europe.

There are a number of commercial airlines offering cargo services from and to Europe, or the Middle East. Air France is bringing in a B777 (103 ton) cargo twice weekly, serving Lagos and Port Harcourt. Cargolux has two rotations per week with a B747 (113 ton). DHL /European Air Transport is flying daily with a 60 ton A300 on Lagos from Leipzig, with Lagos serving as a hub for its West-African network. The airlines are bringing in a variety of goods, such as oil equipment, consumer goods, electronics, pharmaceuticals. The backload is more difficult to organize, as there is a lack of exportable products from the country. DHL is feeding pineapples, mangoes and other fruits and vegetables from countries like Cameroun and Cote d'Ivoire, to load on its intercontinental service to Leipzig. What is clear, is that there is a great deal of empty cargo space available and that can be purchased at attractive rates. This makes Nigeria in principle a competitive country for high-value horticulture/floriculture exports, and because of the large number of dedicated cargo services and availability of many airlines with belly cargo space, perhaps more competitive than countries like Kenya and Ethiopia and certainly more than its neighbours in the region.

Figure 25 The cargo terminal of Murtala Mohamemd airport, Lagos.
Picture: JWH van der Waal
6.2.2 Sea freight

We have seen that the larger volumes of horticulture exports travel by sea. There are a number of shipping lines serving the West-African region. Most of them offer refrigerated containers. An obstacle is that the Nigerian ports are part of a loop and usually they do not have the shortest transit times to Europe, because of the lack of available cargo space. The ports of Douala and Abidjan have a far better cargo offering and are therefore served last, assuring the shortest transit time to Europe.

A quick search into the possibilities shows that there are a few shipping lines offering containerized refrigerated cargo to Europe. Maersk Line have a weekly service with a transhipment in Algeciras (Spain), reaching Rotterdam from Lagos (Apapa Port/Tin Can Island Port) in 21 days and from Onne in 35 days. Hapag Lloyd links Lagos with Antwerp with a weekly service with transhipment in Tema, in 29 days. MSC has the best service and has a direct service from Tin Can to Rotterdam in 17 days. The practice shows that anything over 20 days is likely to cause problems with the cargo (bananas, pineapples, mangoes). A transhipment is also a major source of problems (delays, cold chain rupture etc.).

<table>
<thead>
<tr>
<th>shipping line</th>
<th>origin</th>
<th>destination</th>
<th>transit time</th>
<th>frequency</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maersk Line</td>
<td>Onne</td>
<td>Rotterdam</td>
<td>35</td>
<td>irregular</td>
<td>transshipment Algeciras</td>
</tr>
<tr>
<td></td>
<td>Apapa</td>
<td>Rotterdam</td>
<td>21</td>
<td>(bi)weekly</td>
<td>transshipment Algeciras</td>
</tr>
<tr>
<td>Hapag Lloyd</td>
<td>Apapa</td>
<td>Antwerp</td>
<td>29</td>
<td>weekly</td>
<td>transshipment Tema</td>
</tr>
<tr>
<td>MSC</td>
<td>Tincan</td>
<td>Rotterdam</td>
<td>17</td>
<td>weekly</td>
<td>direct</td>
</tr>
<tr>
<td></td>
<td>Tincan</td>
<td>Genoa</td>
<td>13</td>
<td>weekly</td>
<td>direct</td>
</tr>
<tr>
<td>Cosco</td>
<td>Apapa</td>
<td>La Spezia/Genoa</td>
<td>20</td>
<td>weekly</td>
<td>direct</td>
</tr>
<tr>
<td>UASC</td>
<td>Apapa</td>
<td>Algeciras</td>
<td>22</td>
<td>weekly</td>
<td>direct</td>
</tr>
</tbody>
</table>

Table 7 Shipping connections from Nigeria to Europe 2015.

Table 7 shows the current shipping connections to Europe. Other destinations have been left out as they have prohibitive transit times. The transit times mentioned here are already quite high. In fact, the best service is the 17 days direct MSC service to Rotterdam.

6.2.3 Port operations

A separate issue to be considered is the efficiency of sea ports and airports. African ports are among the most inefficient in the world, with low productivity (only the ports of Durban and Abidjan come anywhere close to the number of container moves per hour that are achieved in the developed world), extremely high costs due to ageing equipment, underutilization and inefficient import and export operations. One of the major headaches is the large backlog of containers that accumulate in the ports and fail to be collected by the consignee for failure to pay the import duties and/or demurrage. West-African ports risk losing their advantage of having access to sea and, in practice, become landlocked countries, according to (Palsson et al. 2007). The operation of the airports also needs to be smooth and uninterrupted at all times. Export customers have no consideration for delays and can choose to terminate their contracts if the supply is unreliable.

6.2.4 Farm to port logistics

Having an airport and a plane or a seaport and a ship is nice, the goods must also reach the port. With the major port being Lagos, it is important to be able to reach the airport and the seaports fast without delay. This may be a problem in Lagos during the daytime. At the ports, there are facilities needed to keep cargo refrigerated until departure. This can be installed relatively easily. It goes without saying that it will not be easy to bring perishables from the north to the port, given the distance and the transport challenges (time, road blocks, accidents, breakdowns, theft). It is interesting
to learn from the experiences from Cote d'Ivoire. As can be seen in Table 5, this country exports a significant quantity of mangoes. These all come from the North. They are mainly transported by train in refrigerated containers that are loaded directly onto the ship. So the cold chain is uninterrupted from the packing station where the mangoes are sorted, washed, packed and pre-cooled to a temperature of 10°C, are stuffed in the container and only opened upon arrival at the warehouse of the customer in the Netherlands or elsewhere.

A container terminal, operating with a reach stacker that was able to take containers on and off railway carriages, was built on the railway line. The operation of the railway line was entrusted to a French private company, that assured two daily trains in every direction between Abidjan and the Burkina Faso capital of Ouagadougou. For the mango season, they provided dedicated train consists, capable of carrying 11 refrigerated containers that were centrally powered by a large 175 kVA diesel generator, supervised by a refreer technician. The advantage of the railway line was not its speed, but the steady operation of the system. It was very stable, no vibrations or shocks and, once it was rolling, it ran uninterrupted from station to station, not being held up by traffic congestion, administrative issues, police road blocks and such like. And most importantly, it offered direct access into the city, without congestion, directly onto the container quay.

The rehabilitation of the Nigerian railway system is now well under way. The Western railway line Lagos - Agege - Ifaw - Ibadan - Ilorin - Minna - Kaduna - Zaria - Kano is being reconstructed and new rolling stock has been acquired. New standard gauge lines are constructed (Abuja-Kaduna) and more developments are under way. The challenge will now be to keep the reconstructed lines well maintained and achieve and keep high levels of serviceability and reliability. When operated efficiently, the Western line will be an important backbone for the haulage of foodstuffs, staples, fruits and vegetables, frozen fish from the coast and live cattle from the North, and can be an important backbone for horticulture development.

Figure 26 The dedicated consist with generator in Ferkessedougou, Côte d’Ivoire. The green container is the generator that supplies the power. Picture: JWH van der Waal
6.2.5 Inland waterways

The discussion of the inland to port logistics would not be complete without mentioning the unique opportunity offered by Nigeria’s waterways. The Rivers Niger and Benue are navigable over long distances (a total of 8,600 kms) and present cost effective and environmentally friendly means of bulk transportation. The lower parts of the rivers have recently been dredged. Chukwuma (2014) has made a thorough analysis of the potential and obstacles, and notes that investment in river ports is necessary. Investment in regulation of the transport on the rivers, providing security in remote areas by policing and communication systems are equally important.

6.2.6 Conclusion

From the logistics point of view, the air cargo corridor provided by cargo planes that return empty to Europe or the Middle East, provide a unique opportunity for the development of an export oriented horticultural sector. This can be either fresh produce, flowers or cut produce (fruit salads). The sea head needs to be developed, and a start can be made, but there is no competitive advantage over the regional peers.

6.3 Export opportunities

We now turn to the commodities that could be successfully marketed. We therefore have to turn to the demand side of the equation, before we look at the supply side. “A market is more than a mill” and market-led innovation and production is of paramount importance if costly failures are to be avoided. To examine export opportunities, we look at tropical fruits, counter season vegetables, speciality products and floricultural products (ornamentals). The following table (Table 8) shows the production figures of a wide range of agricultural commodities. It shows that cassava and yam are the
most important in terms of tonnage. There is a significant production of vegetables, fruits, including citrus, sweet potatoes, mangoes, papayas and so forth. To select crops for export, it is misleading to look at the production figures. Even though the production of citrus fruits is reported as 3.9 million tonnes, higher than South Africa, this does not mean that there is a chance of becoming an exporter. The production of citrus is geared to the needs of the local market. Farmers have planted cultivars that they believe are best suitable for their land and responds best to the need of the local market. The needs of an export market are usually very narrowly defined and almost never match with the local availability and offering of produce. A good example is the mango production in Burkina Faso. This was estimated at 140,000 mt/yr (FAOSTAT). Unfortunately, when an export project was started with an investment in packing lines exceeding 2 million Euros, it turned out that no more than about 600 t/yr was of varieties and qualities suitable for export. In response, a mango pulp factory was built also destined for export, but this project failed because of an unattractive production cost structure that could not compete on the world market.

### Production (Megatonnes)

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Production (Megatonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citrus</td>
<td>3.9</td>
</tr>
<tr>
<td>Mango</td>
<td>0.85</td>
</tr>
</tbody>
</table>

On top of the quality and varietal requirements for export, actors need to be aware that export requires a great deal of organization and quality management that very few people have experience with. The production needs to be carefully controlled. Every single farm needs to have full traceability, full control of inputs and pesticide applications. The whole farm or group of farmers must be governed by a Good Agricultural Practice quality system and any shipment of fruits with pesticide residues exceeding the maximum residue levels set by the EU or containing quarantine pests (insects, especially fruit flies) will be destroyed. The prices paid for export products are set in a very competitive landscape with existing players keen to defend their position. A newcomer has to really fight its way into the arena and come with a very attractive product, with excellent quality, perfect traceability and quality management, super reliable supply and a competitive price. This requires organizational skills and human resources that go much farther than just buying produce, packing it and sending it overseas.

#### 6.3.1 Tropical fruits

It is therefore important to look for crops that are already produced with the right varieties, or where varietal conversion can be achieved easily and quickly.

Existing crops like citrus (3.8 million t/yr production) and mango (850,000 t/yr production) are generally not suitable for export. The citrus is planted for local consumption and the climate in the primary production State Benue is not favourable for suitable export quality (the fruit does not turn orange, the acid/sugar balance is not good). Citrus can be processed into juice. The Teragro factory is doing this. The local markets will be the most suitable, as the international market is dominated by Brazil, where the quality is very high and the price/quality ratio very advantageous, with good shipping rates to anywhere in the world.
The same goes for mango. The varieties requested are Kent and Keitt and to our knowledge these are not widely available in Nigeria. Besides, the fruit fly is causing much damage to the mango, which is an enormous problem all over West Africa. Varietal conversion requires replanting of trees and a crop can be expected after no less than 5 years. The north of the country will supply the best quality of mangoes that could probably match the quality of Mali. The availability of air lift capacity from Kano is an opportunity. Sea exports would be possible from this region, if care was taken of suitable logistics (see paragraph 6.2.4). The demand for mango is still growing in Europe. Modern, well managed, high density plantations would be a requirement for export. Small farmers could be grouped around such a nucleus farm and benefit from technical assistance, quality management, financial and packing services.

Pineapples are produced in Ghana and Cameroun and both countries are suffering from decreasing exports due to the dominance of Costa Rica on the market. There are smaller productions in Benin and Togo also of organic pineapple.

Avocado is also a product for which the market is growing in Europe. Investment in avocado plantations could make sense if the right varieties are selected and the pricing would be attractive.

An undersupplied market is that of papayas. Papayas are very sensitive and relatively difficult to transport by refrigerated container. For this reason, the best papayas are airlifted. The crop cycle is short. The availability of cheap air cargo combined with a fast crop cycle could make interesting opportunities for papaya export, if the right varieties and supply windows are identified.

The same is valid for other tropical fruits, such as dragon fruit, that can be planted if not yet available.

### 6.3.2 Counter Season Vegetables

Again in Table 5, it can be seen that some countries have been successful in vegetable exports. Kenya, Zimbabwe, Ethiopia and Zambia, but especially Kenya, have been exporting large quantities of French beans, sugar snaps, mange tout and bimi, whereas Senegal has had some success in the export of cherry tomatoes. Senegal is currently also exporting French beans, grown by a Dutch group. Kenya is also processing French beans by canning and deep freezing. Their industry is sophisticated and able to pack directly for European super market chains in their private label packaging.

It is thought that the export of haricot type vegetables such as in Kenya could be very possible in the off-season and that the climate of the Plateau is suitable, as it is comparable to Kenya (1300 m altitude). Of course further study is necessary to find out if the cost price structure is competitive, but the presence of attractively priced air cargo is an advantage. It remains to be seen how the labour component affects the cost price: as can be seen in Figure 28, vegetable export is labour intensive and the low labour costs in Kenya (combined with exactly the right support from the Government of Kenya, a country that cannot boast oil reserves) are the key to their success.
6.3.3 Speciality Products/Super Fruits

Another angle from which opportunities can be assessed, is the issue of vitamin A deficiencies. Production of certain fruits and vegetables especially rich in vitamin A or betacarotene, could be important for the local market, but could also be interesting for export to regional markets, as well as overseas export. For the plantain growing areas, the introduction of a foreign variety of plantains and bananas high in vitamin A (not the genetically modified cultivar) could be interesting as they are probably easily adopted by farmers as they know the culture of bananas and fit in the consumption pattern of people. Small quantities of speciality types of bananas can be interesting for export by air.

There is currently much interest in fruits and vegetables with interesting attributes, especially health advantages. In that respect, there is certainly an opportunity to explore crops that are perhaps not so obvious to export. Consider, for example, Bambara beans, which have an excellent protein composition and can grow under difficult growing conditions. It has to be acknowledged that the exported volumes of such products are likely to remain low, but if it is done well, they could be important ambassadors for the country and help create an innovative and positive “country of origin” image.

6.3.4 Ornamentals

What has been said for vegetables by air from Kenya, can be said for ornamentals. In fact, if the assumption is right that the Plateau offers similar growing conditions as the Kenyan highlands, then the production of ornamentals, such as T-hybrid roses, offers potential. Again, the availability of cheap return air cargo will be an important asset. Again, the cost of labour and other costs in the production function need to be more carefully analysed. It is not advisable to start in a market that is saturated. It looks like the ornamentals market is still offering growth perspective, even though the crisis in Europe and the devaluation of the rouble has changed the fundamentals of the market. Nevertheless, the flower market is more international than the vegetable market, with flowers from Kenya ending on tables in the USA or Japan, all transiting through the Netherlands. The Netherlands is the largest hub for flowers, with the Flora Holland flower auction being the central hub. Flowers from Kenya are cut on day one, trucked to Nairobi in the evening, to catch the overnight flight, arrive on day 2 early in the morning, are sold on the auction the same morning, transhipped to another flight e.g. to the USA, to arrive day 2 in the evening. A further evaluation of the agronomic conditions of the Plateau will be required. Also the sociological and ecological situation must be evaluated, especially given the high pressure on the land and the requirements for the local food supply.
7 Suggested Interventions

The idea of this study is to be as specific and practical as possible. Before we turn to the action agenda, we will sketch the pillars for a horticultural agribusiness in Nigeria. They are based on the issues that have been highlighted in the previous sections. A recent agribusiness study performed by Unido (Yumkella 2011) identifies seven pillars that we will elaborate on with a special emphasis on the horticultural sector.

7.1 Enhancing productivity

It has been stated in paragraphs 4.6 and 5.2 that the yields of the crops grown are low and that they need to be increased. Soil management and better water management are of paramount importance, as is the well-considered use of fertilizer (given the fragile status and limited absorption capacity of many soils). Hence the production function should change from labour and land oriented towards capital oriented so that less land is necessary for the same production and the nature of labour becomes more skilled and hence more attractive to young people.

7.2 Upgrading value chains

Value needs to be added to the product. This is not the same as processing, though this can also be a direction. Adding value is making sure that a customer pays a higher price for a service or product. Supplying trusted, reliable, guaranteed safe fresh fruit and vegetables, is an added value that a group of customers such as hotels, airline caterers, supermarkets, is willing to pay more for than for produce from a local market which risks to be contaminated. Processing of produce can be value addition, but can also be value destruction: turning fresh mangoes into puree is not value addition, but destruction as the product now becomes an anonymous commodity for which (low) world market prices are the rule.

To upgrade the value chains, the transformation must be made from a highly scattered flea market like network of a) open air produce markets, with arm’s length trading relations between a multitude of actors (traders, transporters, producers, wholesalers and retailers) that are all limited by the absence of financial means to grow, and b) of produce that is relatively expensive due to the low yields and high wastage along the chain and for which the origin, the manner of production and the quality (hygiene, food safety) cannot be traced, into integrated “farm-to-fork”, more capital intensive, well managed value chains that cater for the needs of the population for reliable, safe, inexpensive produce. Barriers to these value chains need to be removed.

7.3 Exploring and exploiting demand

All development should start with the market. The market demand can be explored and exploited. There is no doubt that there is a vast demand for horticultural produce in Nigeria with its large population. It has been shown that there is a demand for fresh produce and floricultural products. This has to be carefully analysed. The question is whether to go for bulk volumes or start with specialization. In any case, the reputation of the country of origin has to be built up. This requires careful control of the quality. The government should not allow its export chances to be spoiled by allowing substandard produce to leave the country.

7.4 Strengthening technological effort and innovation

An intensification of the production and processing has to be pursued. The use of improved seeds, composting facilities, the use of urban waste for producing fertilizers, investment in water management and irrigation, the use of plastic greenhouses to protect crops against rain during the rainy season and conserve moisture during the
dry season and protect against excessive sun, refrigerated warehouses and transport should all be encouraged.

7.5 Effective and innovative financing

To make it possible to achieve intensification, it is necessary to be able to satisfy the requirements for capital. This means provision of investment and working capital. The traditional banks are careful with financing perishable crops and informal systems with relatively low returns. Well-tailored micro-finance facilities and cooperative banking organizations can provide working capital and fulfill the investment requirements for small and medium sized farmers. The government could provide guarantees for larger investment projects to be financed by commercial banks. A good system of accompanying measures, like land rights and effective legal enforcement of contracts by the judicial system are important side measures that make financing possible and more efficient.

7.6 Stimulating private participation

The role of the government should be to stimulate and create a conducive environment, provide financial guarantees and invest in infrastructure and power provision, as described below. If these public goods are provided, which the private sector cannot provide, then the private sector can take initiatives to start farms, invest in cold stores, upgrade the value chains and innovate. It can work very well in promoting private initiative by helping the horticultural sector to be exposed to modern developments. Visiting importing countries like the Netherlands can widen the scope and generate ideas. Visits or learning exchanges for entrepreneurs and professionals to other developing countries with a strong export sector, such as South Africa, Chile, Peru or Costa Rica, or closer to home, such as Kenya, Côte d’Ivoire and Cameroun, can be very instructive and encouraging experiences.

7.7 Improving infrastructure and energy access

Infrastructure and energy provide the backbone of the industry. With the improvement made to the rail system, by investing in interurban and rural roads, removing obstacles from the road facilitating trade, it will only require proper management and intermodal innovation to get things moving. Operational excellence of the rail system will be a condition for being able to service the requirements of the perishable sector. Putting in place cold stores, but also the rural use of electrical pumps for irrigation, requires the reliable provision of power. It cannot be stressed enough how primordially important this is to the development of the sector and to food safety and security. Putting in place refrigerated cold stores at the Lagos airport (and other airports, especially Abuja and Kano) is very important and will make it interesting for entrepreneurs to start an export business. A well-run phytosanitary service and a 24/7 presence of customs officials providing smooth and fast export clearance are very important.

Apart from stimulating private participation, the role of the Government is not expanded on in the seven pillars. So we call this the 8th pillar. Putting in place a Sanitary and Phytosanitary Service as necessary for export and beneficial for the local market. ColeACP’s EDES programme has been put in place to help countries achieve this goal.

Protecting the country of origin reputation is a task for the government. This can best be done in a public private partnership where the private sector is involved in setting the standards for export as they know best what the market demands. Giving a private body a public task is the usual way to do this, as is shown by the South African experience. The experience in Côte d’Ivoire is also very interesting.

The government should also act as a “director” of the sector, without taking on the responsibilities of the private sector. The “director” role concerns the implementation
and scheduling of policy. It makes no sense to invest heavily at this time in agricultural extension if the advice given by the services cannot be implemented because there is no access to credit, or no power supply or evacuation of the crop remains complicated due to poor rural infrastructure. It is also suggested that there be a national policy, but that the execution can be decentralised, so as to tailor it to the needs of the State. It would be advantageous to start in a State with a high potential, try to kick-start a development towards intensification and modernization and be able to present the results as a model that can be followed and replicated in other States, with the necessary local adaptations.

Organizing incoming missions directed towards the horticulture sector can be especially useful. The intervention of the Netherlands Africa Business Club (NABC), as well as specialized agencies can be very useful.
8 Annex: Crop Production and Productivity Maps

Production of Bambaranut in Nigeria, 2011

Production in metric tons
- < 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 2
- No production

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Production of Banana in Nigeria, 2011

Production in metric tons
- < 25
- 25 - 50
- 50 - 75
- 75 - 1000
- No production

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Production of Cashew in Nigeria, 2011

Production in metric tons
- < 5
- 5 - 250
- No production

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Production of Cassava in Nigeria, 2011

Production in metric tons
- < 1000
- 1000 - 2000
- 2000 - 3000
- 3000 - 4000
- No production

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Production of Cocoa in Nigeria, 2011

Production in metric tons
- < 25
- 25 - 50
- 50 - 75
- 75 - 100
- No production

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Production of Okro in Nigeria

Production in metric tons
- < 25
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 125
- No production

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Production of Onion in Nigeria

Production of Orange in Nigeria
Production of Palm oil in Nigeria

Production in metric tons
- < 25
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 150
- No production

Production of Pepper in Nigeria

Production in metric tons
- < 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 250
- No production

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Production of Pineapple in Nigeria

Production of Plantain in Nigeria

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Production of Potato in Nigeria

Production in metric tons

- < 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 1000
- No production

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Production of Pumpkin in Nigeria

Production in metric tons

- < 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 300
- No production

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Production of Rice in Nigeria

Production of Sesame seed in Nigeria
Production of Soya beans in Nigeria

Production in metric tons
- < 30
- 30 - 60
- 60 - 90
- 90 - 120
- No production

Production of Sugarcane in Nigeria

Production in metric tons
- < 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- No production

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Production of Tomato in Nigeria

Production in metric tons

- < 25
- 25 - 50
- 50 - 100
- 100 - 200
- 200 - 500
- No production

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About the author

Hans-Willem (J.W.H.) van der Waal (1970) studied Process and Food Technology at The Hague University and Technology Management at the Hanze University (Groningen). He completed a Masters degree in Economics at UNISA (Pretoria). After his studies he worked on an agricultural development project with a focus on fruits (apples, pears, berries) in the Southern Highlands in Tanzania. Back in the Netherlands, he worked for almost five years as a management consultant and completed a post-doctoral management consulting course at Sioo (Utrecht). He has been working again in the fruit and vegetable industry since 2004. For first four years establishing and managing a fresh mango export company in Burkina Faso, exporting by sea to Europe. Since 2008 he is the managing director of fresh fruit importer Agro Fair Europe. He is also responsible for the activities of Agro Fair’s consultancy organization TASTE, which aims at making the experience of fresh fruit and vegetable value chain development available to other countries. Since 2012 he is vice-chairman of ACP horticulture import-export association ColeACP (Paris/Brussels). In recent years, he has completed executive education courses at INSEAD (Fontainebleau), Rotterdam School of Management (Rotterdam) and Babson College (Greater Boston, USA). He has written a number of papers on value chain development in Burkina Faso, Sudan and Latin-America, as well as papers about organic post-harvest issues. He has presented at several Cool Logistics conferences (Rotterdam, Cape Town and Hong Kong).