

## **CGIAR FS4HD Reduce postharvest losses of vegetables for healthier urban consumption**

### **Deliverable 1: Tomato as selected vegetable for impact assessment of intervention to reduce postharvest losses.**

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#### **Summary**

The most interesting vegetable to select for analysis of postharvest losses in Nigeria is the tomato. Tomatoes are widely consumed in major cities in Nigeria and consumption can increase even further. Tomatoes are also produced on a wide scale in Nigeria. Tomatoes have a relatively good nutritional value compared to many other vegetables. The estimates of the postharvest losses in Nigeria are high, so improvements can be made.

#### **Consumption and production of vegetables and tomatoes in Nigeria**

##### ***Consumption***

Vegetables are an essential part of the daily meals in Africa (Gubben et al., 2014). Differences in consumed vegetables between countries and regions are large, due to differences in historical backgrounds and agro-ecological conditions. According to Gubben et al. (2014), the most important market vegetables in quantity and value are tomatoes, onions, and hot peppers, because they are used daily. Okra, African eggplant, cabbage, eggplant, pumpkins, and carrots are also important products. Leafy vegetables as a whole are the most important in quantity and are consumed almost daily. Important leafy vegetables are amaranth, celosia (Lagos spinach), jew's mallow, roselle, gboma eggplant, African nightshade, spiderplant, bitter leaf, and the leaves of pumpkin, cowpea, cassava, sweet potato, and cocoyam. Salad vegetables such as cucumber and lettuce, are becoming increasingly important for urban consumers.

In Nigeria, over 90% of interviewed consumers in the cities of Lagos and Ibadan indicated to consume tomato, onion, small sweet pepper, hot pepper, carrot, and green leafy vegetables (Raaijmakers et al., 2017). Over 70% of these consumers indicated to consume bell peppers, cucumber, okra, baby corn, cabbage, and garden egg. Furthermore, Nigeria's population is predicted to grow at over 2.5% annually.

Adeoye et al. (2016) found that 93.3% of 150 consumers interviewed in Ibadan purchased tomatoes on the urban market. Of these consumers, 91.3% purchased fresh tomatoes, 6.7% tomatoes in sachets, 1.3% dried tomatoes, and 0.7% canned tomatoes. Respondents prefer the fresh tomato varieties UC82B (62% of respondents) and Roma (32%), as well as large tomatoes (56%) and medium sized tomatoes (42%). Tomatoes were bought during all seasons, but the expenditure on tomatoes was higher during the low season. About 55% of respondents purchased tomatoes twice a week in the peak season, whereas this was 48% in the low season. However, compared to neighbouring and other African countries consumption of tomatoes in Nigeria is fairly low, showing ample room for increased tomato consumption (Coffey, 2013).

Demand for tomatoes in the south of Nigeria, particularly Lagos, is very (Coffey, 2013). In the months January to April consumption of fresh tomato is high, because of the seasonality in production (Ugonna et al., 2015). Although some supply of fresh tomatoes remains in the other months, it drops and the gap in demand of tomatoes is filled by dried and canned tomatoes (paste, concentrates). Of these, about 80% is imported and about 20% is coming from tomatoes produced in Nigeria (Ugonna et al., 2015).

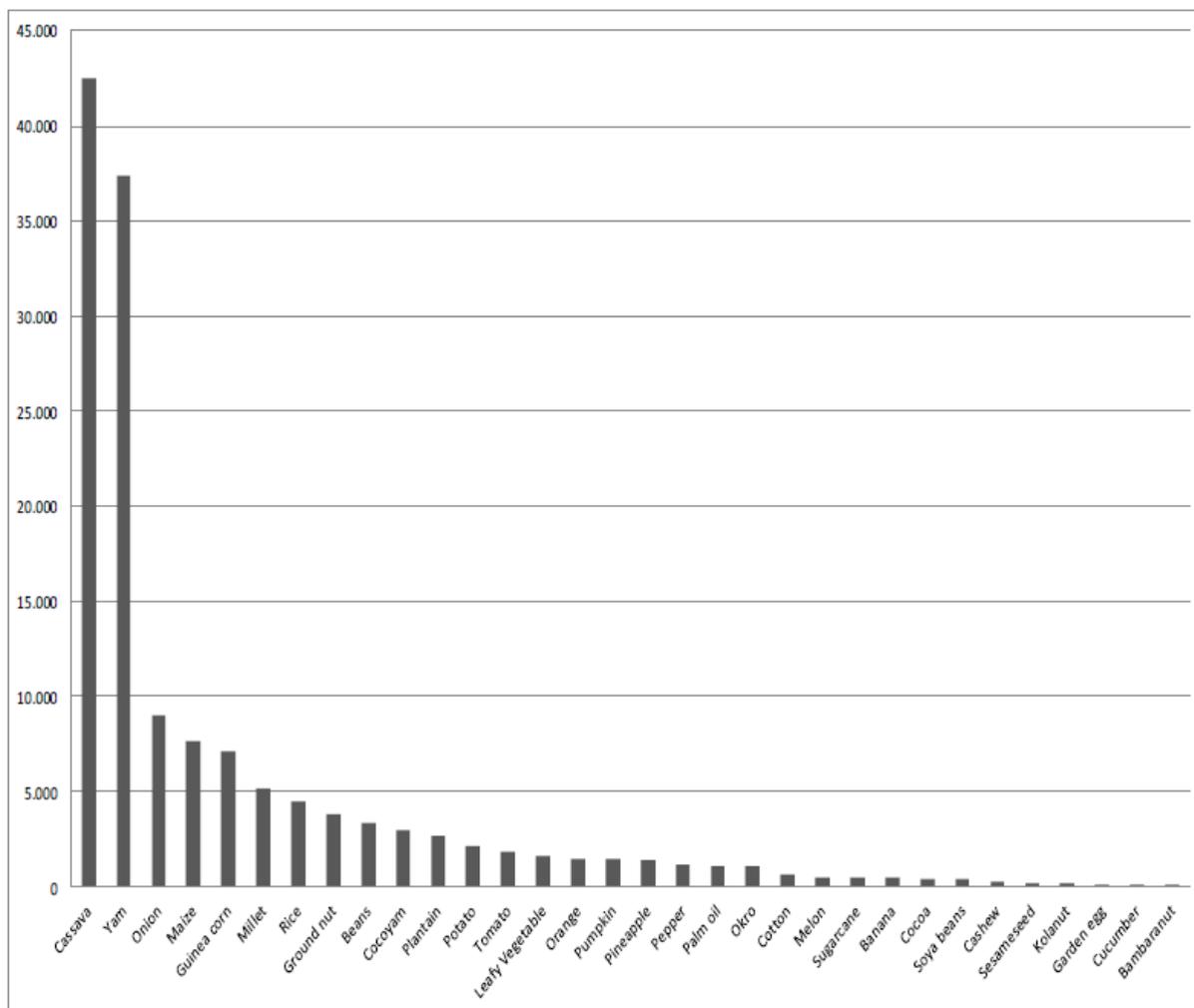
From a consumption viewpoint, tomatoes, onion and peppers are the most interesting vegetables to select.

### ***Production***

Figure 1 provides the most important horticultural crops produced in Nigeria in 2011. The products with the highest production volume are staple foods, such as cassava and yam. The most produced vegetables were onions (18.0 million metric tons) and tomatoes (3.6 million metric tons), followed by leafy vegetables, pepper, and okra. From 2012 to 2014, the average annual production of tomatoes in Nigeria was estimated at over 2.0 million tonnes (FAOstat). This was around 1.2% of the total world production. The production of tomatoes exceeded that of okra (just under 2.0 million tonnes), potatoes (1.1 million tonnes), onion (0.9 million tonnes), chilli peppers (0.7 million tonnes), and carrots and turnips (0.2 million tonnes) (FAOstat).

About 60% of the tomatoes produced in Nigeria are produced by small holders, 30% by medium sized farmers, and 10% by large farmer (Ugonna et al., 2015). Often, tomatoes and onions are grown in mixed systems with each other and other vegetables (van der Waal, 2015). They are grown on seasonally irrigated flood plains in the northern savannahs in Nigeria. This means a large distance between the areas of production (in the North) and areas of consumption (in the south) of almost 1,000 km, which could take up to several days including hold-ups. Production of tomato in Nigeria shows a seasonal pattern, with high supply of fresh tomatoes from January through April.

From a production viewpoint, onions and tomatoes are the most interesting vegetables to select.



**Figure 1: Most important horticultural crops produced annually in Nigeria in 1,000 metric tons (source: Van der Waal 2015, based on NASS 2011 survey).**

### **Nutritional value**

It is not easy to get an accurate idea of the quantity of micronutrients that vegetables contribute to the nutritional value of the daily meal (Gubben et al., 2014). To compare the nutritive value of vegetables and other foods, g dry matter is a more appropriate denominator than g fresh product, because the water content of vegetables is high and highly variable. The water content also has an impact on the amount of vegetables needed to consume to reach recommended nutritional intake levels. Leafy vegetables (e.g. amaranth, kale, nightshade) generally have a lower water content than non-leafy vegetables (e.g. tomato, carrot, eggplant, cucumber). This means that a person has to consume more weight of non-leafy vegetables to reach the recommended nutritional intake of a nutrient than of leafy vegetables.

At the macronutrient level, most vegetables have a remarkably high protein content per g dry matter (Gubben et al., 2014). Leafy vegetables are even as rich in protein as legumes. However, vegetables contain less carbohydrates than staple foods and fruits. Vegetables are rich in structural tissue (protein and fibre) and ash, which goes together with a high content of micronutrients (minerals, vitamins, and other bioactive compounds). The high dietary fibre content of vegetables is important for the healthy functioning of the gastrointestinal tract and the prevention of dietary induced chronic diseases, such as cardio-vascular diseases, various forms of cancer, diabetes and obesity. Vegetables are also an important part of the diet in order to avoid micronutrient deficiencies such as vitamin A, zinc, and iron (Gubben et al., 2014). Vegetables differ in their nutrient level per g dry matter. Leafy vegetables generally contain

higher amounts of nutrients per g dry matter than non-leafy vegetables. Within the group of non-leafy vegetables described by Gubben et al. (2014) carrot, lettuce, pumpkin, and tomatoes have an above-average nutrient content per g dry matter.

Tomatoes are a good source for consumers of mineral elements, such calcium, iron, magnesium, manganese, phosphorus, potassium, sodium, sulphur, and zinc (Olaniyi et al., 2010; Ugbaja et al., 2017). Ugbaja et al. (2017) described that such mineral elements also play important roles in health and disease states of humans: potassium increases iron utilization, calcium and phosphorus are required by children, pregnant and lactating woman for bones and teeth development, magnesium is a constituent of bones, teeth and an enzyme cofactor, iron is required for the formation of haemoglobin, and zinc, sulphur, and manganese are required for building immune system, regulation of cellular growth, act as a co enzyme for carbohydrates, protein and nucleic acids metabolism, and regulation of blood sugar level and production of energy.

Tomatoes are a rich source of vitamin A, vitamin C, and vitamin E (Adebisi et al. 2014, Ugbaja et al. 2017). Ugbaja et al., (2017) describe that vitamin A helps to maintain good sight and prevent certain diseases of the eye, vitamin C promotes wound healing, strengthens resistance to infections by boosting the immune system and improves absorption of iron, and vitamin E helps maintain cell membrane, red blood cell integrity and also involved in immune function.

Tomatoes are high in phytochemicals (Ugbaja et al.,2017), such as carotenoids, flavonoids, alkaloids, lycopene, cardiac glycoside and quercetin. Phytochemicals play a crucial role in maintaining optimal immune response, such that deficient or excessive intakes can have negative impact on health (Prakash et al., 2012). Lycopene is a very good antioxidant that is associated with reduction in the risk of prostate cancer (Basu and Imrhan, 2007).

Tomatoes also contain anti-nutritional values, such as tannin, oxalate, and saponin (Ugbaja et al., 2017). These anti-nutrients could be toxic when consumed in an unprocessed food. However, at the present concentration they may not constitute major danger, provided the fruits are cooked before consumption (Enechi and Odonwodu, 2003).

Additional availability of fruits and vegetables may help decrease the incidence of stunting, which affects million children worldwide and can lower lifetime earnings by up to 22% (Rockefeller Foundation, 2013). Stunting (also stunted growth or nutritional stunting) is a reduced growth rate in human development. It is a primary manifestation of malnutrition (or more precisely undernutrition) and recurrent infections. Stunted growth in children has the following public health impacts apart from the obvious impact of shorter stature of the person affected ([https://en.wikipedia.org/wiki/Stunted\\_growth](https://en.wikipedia.org/wiki/Stunted_growth)):

- greater risk for illness and premature death
- may result in delayed mental development and therefore poorer school performance and later on reduced productivity in the work force
- reduced cognitive capacity
- Women of shorter stature have a greater risk for complications during child birth due to their smaller pelvis, and are at risk of delivering a baby with low birth weight
- Stunted growth can even be passed on to the next generation (this is called the "intergenerational cycle of malnutrition")

The impact of stunting on child development has been established in multiple studies. If a child is stunted at age 2 they will have higher risk of poor cognitive and educational achievement in life, with subsequent socio-economic and inter-generational consequences. Multi-country studies have also suggested that stunting is associated with reductions in schooling, decreased economic productivity and poverty. Stunted children also display higher risk of developing chronic non-communicable conditions such as diabetes and obesity as adults. If a stunted child undergoes substantial weight gain after age 2, there is a higher chance of becoming obese. This is believed to be caused by metabolic changes produced by chronic malnutrition, that can produce metabolic imbalances if the individual is exposed to excessive or poor quality diets as an adult. This can lead to higher risk of developing other related non-communicable diseases such as hypertension, coronary heart disease, metabolic syndrome and stroke.

From a nutritional viewpoint, leafy vegetables, carrot, lettuce, pumpkin and tomatoes are the most interesting vegetables to select.

## **Postharvest losses in the vegetable supply chains in Nigeria**

Reducing food loss and waste can contribute to food security and sustainability (Schuster and Torero, 2016). They state that measuring food loss and waste, identifying where in the food system it occurs, and developing effective policies along the value chain are essential first steps toward addressing the problem.

### ***Definition***

Post-harvest losses refer to the losses of horticultural crops after the harvest and at all stages of the onward supply of produce to markets (the post-harvest chain) (Hodges, Buzby & Bennet, 2010; Buzby & Hyman, 2012). The term post-harvest loss (PHL) is often used as reference to the quantitative loss of food that was originally intended for human consumption, particularly in the context of food security in developing countries. But also qualitative losses occur in crops between harvest and consumption. The measurement of these qualitative losses such as loss in edibility, nutritional quality, caloric value, and consumer acceptability of the products, is however much more difficult to assess than quantitative losses (Kader, 2005). Methodologies for analysing PHL mostly focus on measuring quantitative losses.

### ***Size***

As for many countries accurate data on post-harvest losses in Nigeria's vegetable chains are scarce and are mostly based on estimations. Field data of registered losses of vegetables between harvest and market are absent and as a result hamper the evaluation of costs and benefits from intervention that will reduce these losses. Researches performed on postharvest losses in vegetable chains in Nigeria reveal some of these 'guesstimates', but generally keep a wide range within the estimations of losses in the postharvest chain from 30 to 50% (or more for specific crops) (Bolarin & Bosa, 2015). Ugonna et al. (2015) estimated the annual losses of tomatoes produced in Nigeria at 45% of production (750,000 tonnes). In their policy and strategy document Nigeria's Federal Ministry of Agriculture and Rural Development reported post-harvest loss rates up to 60% for all perishable crops (FMARD, 2016). For tomato production the reported losses of product harvested but left unsold accounts for little more than 40% (equal to 750MT), although this was not accounted for a specific year. An assessment by Olayemi et al. (2012) of postharvest losses of vegetables (including tomatoes), based on a survey among 450 farmers in 8 different areas showed a reported average loss of 33%, although in this research it was not made explicit to which parts of the supply chain these losses apply. In Ethiopia, Kasso and Bekele (2016) estimated postharvest losses of tomatoes at 45%, of potatoes at 37%, of onion at 25% and green pepper at 23%.

In their review on the dilemma of postharvest losses in ensuring food security Bolarin and Bosa (2015) concluded that the 'estimation of production losses in developing countries such as Nigeria is hard to judge'. Nevertheless, given the available documented research on postharvest losses in the tomato supply chain the average figure of 40% is judged to be rather accurate. It is safe to assume that the incurred postharvest losses will show variations between crops, chains, regions and seasons. After all, the available data are an average for the entire country and for a variety of crops. It is, however, clear that the levels are generally high and leave ample incentive for intervention to reduce these losses.

From a postharvest losses viewpoint, tomatoes are the most interesting vegetable to select.

### **Conclusion**

Based on the consumption, production, nutritional value and postharvest losses viewpoints, the most interesting vegetable to select for analysis in Nigeria is tomato.

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