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Review Article

Role of Horticultural Crops in Food and Nutritional Security: A Review

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Abstract:

Horticultural crops perform a very important role in both food and nutritional security more especially in developing countries. Fruit and vegetables have high content of both nutritional and health promoting compounds which consist mostly of essential vitamins, minerals and anti-oxidant that is not present in major staple food crops. Fruits and vegetables supply a large constituent of human nutrition, as they are vital sources of minerals, vitamins, nutrients, dietary fiber, ant-oxidant and phytochemicals that are easy to produce and have short production cycle. A diet rich in fruits and vegetables can help in reducing high blood pressure, lower the risk of heart disease and stroke, provide protection against most types of cancer, reduce the risk of eye and digestive problems, and have a significant effect controlling blood sugar levels which serve as appetite booster. The higher the amount of daily intake of fruits and vegetables, the lower the risk of developing cardiovascular diseases. Fruits and vegetables also contain fiber that assist in bowel movements and can relieve or prevent constipation. Eating fruits and vegetables can also keep eyes healthy and may help prevent two common eye diseases like cataracts and macular degeneration. The FAO, IFAD, UNICEF, WFP and WHO report on state of World food and nutrition security for the year 2021 painted a gloomier picture. The report estimated that between 720 and 811 million people in the world faced hunger in 2020 with close to 2.37 billion people did not have access to adequate food in 2020. Thus the need to encourage the production of horticultural crops can help in enhancing food and nutritional security since it is an enterprise that maximizes small space in terms of value and health benefits.

Key words: corn; onions; red kidney beans; crunchy snacks; flour; storage

1.Introduction

The contributions of fruit and vegetable to food and nutritional security is dependent on the fact that fruits and vegetables are important sources of vitamin A, vitamin C, folate, anti-oxidant and phytochemicals (Mintesnot, 2016). Although minerals are less bioavailable in plant foods, fruits and vegetables provide a large proportion of minerals such as iron and calcium consumed in rural populations in developing countries. According to Padhy and Behera (2015) fruits and vegetables contributed 38% of vitamin A, 35% of vitamin C, 30% of calcium and 17% of iron consumed by rural women. In the same populations, all vegetable accounted for up to 33% of folate consumed (Padhy and Behera 2015). The amount of fruits and vegetables consumed was found to be the best predictor of over-all nutrient adequacy across multiple nutrients (Padhy and Behera 2015).

2. Horticulture

The word 'horticulture' is obtained from two Latin words 'hortus' (garden) and 'cultura' (cultivation), which connotes garden cultivation (Rajani and Joshi, 2017). Horticulture is therefore the scientific cultivation of garden crops which involve the production of fruits, flowers, ornamental plants, plantation crops, spices, tubers, vegetables, medicinal and aromatic plants. Horticultural crops are the major source of healthy diet, the nutrients obtainable from fruits and vegetables by the human beings are water, carbohydrates, fats, proteins, fiber, minerals, organic acids, pigments, vitamins, antioxidants and others (Chadha and Patel, 2019).

Generally speaking, fruits and vegetables are produced all year-round comprising wide range of produce consisting of different varieties, taste, colour, flavour and aroma. They can also be processed into different products using either hot or cold processing methods (Rajani and Joshi, 2017). Horticulture comprises diverse cropping systems in all agro-climatic zones, provides healthy and nutritious food, and generates employment and income for smallholder farmers, including women who are often the main primary producers (Paloma et al., 2020).

Benefits from horticultural development include improved nutrition for children and families, increased income from sale of horticulture products, and improved status and confidence of women farmers (Paloma et al., 2020). In many cases, horticulture can generate substantial income from smallholdings that would not be profitable if planted with cereal crop staples (Peter, 2015). In addition, women typically use the income

generated from horticulture to invest in family health and education, which multiplies the benefits by increasing social capital. Fruits and vegetables availability and intake are well below WHO recommendations in most countries (FAO, IFAD, UNICEF, WFP and WHO, 2021).

Globally, insufficient intake of fruit and vegetables has been linked to 2.7 million deaths per year (FAO, IFAD, UNICEF, WFP and WHO, 2021), due to associations between fruits and vegetables intake and: micronutrient intake, risks of is chaemic heart disease and stroke as well as risk of type 2 diabetes mellitus (Chadha and Patel, 2019). Vegetables and fruits contribute considerably to improving the quality of diet, income, human food and nutritional security. These crops are excellent sources of Vitamins A and C, iron, calcium, carbohydrates and proteins as observed earlier. Some vegetables have a higher protein content than rice and legumes when expressed in dry matter content, as such nutrient deficiencies can be corrected using selected vegetables and fruits and may also be the means of ensuring food security for households (Chadha and Patel, 2019).

Horticultural crops are mostly vegetables and fruits that function as a natural source of micronutrients and bioactive compounds such as vitamins and minerals which are essential for the proper metabolism of the human body (Bowman, 2013; Peter, 2015; Davies and Bowman, 2016; Paloma et al, 2020). These essential compounds must be augmented through the diet. Fruit and vegetable production at the household and community level has the potential of enhancing food and nutritional security through the supply of fresh, quality and readily available produce throughout the year, thereby improving their consumption, increasing, dietary diversity and bettering their standard of living as observed by Anon. (2014); Peter (2015).

Horticulture has come into view as a potential agricultural venture that can assist in the promotion of food and nutrition security, and economic growth of most developing countries (Rajani and Joshi, 2017). Mintesnot (2016) argued that, it also offers a means of wide range of options to the farmers for crop diversification, but in addition provides a means for supporting large number of agro-allied industries, which can create huge employment opportunities for the rural populace. Similarly, Motswagole (2021) pointed out that diversification of horticulture is the best means of enhancing nutritional and food security, generating employment opportunities, increasing farm income, optimum use of natural resources and above all, promoting agro-industrial development. According to Padhy and Behera (2015); Modak (2020); Motswagole (2021), the evolving tendency globally is to pay more attention on nutritive sensitive agriculture that focuses on the dietary needs of the people and enhanced the income for farmers thus further drive the demand for more horticultural produce.

Currently there are more than 300 million people that are malnourished, and millions of others below the poverty line, there is urgent need for improving quality of life through ensuring food and nutritional security by embarking on large scale production of horticultural crop by small holder farmers since they are the major producers of food in the developing countries (Rajani and Joshi, 2017; Chadha and Patel, 2019). In 2021, the FAO, IFAD, UNICEF, WFP and WHO (2021) reported that the state of World food and nutrition security is far below the minimum level required to meet the fast growing human population. The report further estimated that between 720 and 811 million people in the world faced hunger in 2020 with close to 2.37 billion people did not have access to adequate food in 2020. In addition, no region of the world has been spared. The report further stated that high cost of healthy diets and unrelenting high levels of poverty and income disparity continue to keep healthy diets beyond the reach of about 3 billion people in every region of the world. Moreover, new analysis in the report revealed that the increase in the unaffordability of healthy diets caused by higher levels of moderate or severe food insecurity. To address this problem there is the need to encourage the production of horticultural crops which it can help in enhancing food and nutritional security since the enterprise can utilise small space to produce valuable and health benefits food crop even in the urban areas.

Fruits and vegetables are high-value crops that can play an important role in helping to enhance global food and nutritional security as described by International Society for Horticultural Science (ISHS, 2012; Davies and Bowman, 2016). Bowman (2013), recounted that, horticultural crops form part of the specialty crops which represents 50% of the farm-gate value of all crops produced in the US and the author further conveyed that, unlike cotton, corn, rice, soybean, and other staple crops, they receive little government subsidy despite the vital role it played in human food and nutritional security. While staple cereal crops are needed for their starch and calories, they do not supply the vitamins and minerals found in fruits and vegetables (Modak, 2020).

Horticultural crops provide opportunities for increasing food production and consumption of diet rich in vitamins and micronutrients that could help in enhancing food and nutritional security of any country (Peter, 2015; Motswagole, 2021). Then there is also economics of scale that a smallholder farmer can be commercially successful growing high-value horticultural crops under small acreage in rural, peri-urban or urban environments, compared to the large hectares are required to farm cereals commercially (Bowman, 2013; Chadha and Patel, 2019; Paloma et al., 2020).

According to Wilson (2014); FAO, IFAD, UNICEF, WFP and WHO (2021) by the middle of the 21st century, the world population will increased by 30% to be more than 9 billion. They further estimated that by 2030, 60% of the population will live in urban areas, and this figure will reach 70% by 2050. As such food production will need to increase by 70% to meet the ever increasing demands. The numbers do not add-up and without concerted effort the world cannot realistically meet the ever increased demand for food with a limited natural resources. This called for redirecting attention toward production of horticultural crop that require less space and give more nutritive food per hectare.

Increases in crop productivity can be achieved through the utilizing of recent advances in science and technology such as biotechnology, genetics, agronomy and horticulture to meet the world food demand despite resource limitations and constrains to the global food system (Davies and Bowman, 2016). As rightly observed by University of California Davis (UC Davis, undated) that a diet rich in fruits and vegetables can supply the needed micronutrients that cannot be found in staple grains, meat or dairy. Horticultural crop production holds the key for a swift attainment in food and nutritional security in the face of ever increasing human population since little space is required for its production even in urban areas and have a shortest production cycle than most staple crops.

3. Food Security

Food security refers to the availability of food and one‘s access to it (Devaux et al., 2020). A household is considered food secure when it occupants do not live in hunger or fear of starvation (Louhichi et al., 2020). Riesgo et al. (2020) postulated that, food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security doesn’t mean availability of food only but it involve four dimensions i.e., availability, access, use and quality, and stability (Devaux et al., 2020).

Peter et al. (2020) reported that at the last World Summit of Food Security in 2009, this definition was reconfirmed, the concept was extended and specified by adding that the “four pillars of food security are availability, access, utilization, and stability” and stated that “the nutritional dimension is integral to the concept”. The FAO Committee on World Food Security has also combined these four different elements and states that “Food and nutrition security exists when all people at all times have physical, social and economic access to food, which is safe and consumed in sufficient

quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life" (Mintesnot, 2016; Paloma et al., 2020).

Similarly, according to Chadha and Patel (2019) the World Bank Policy Study on food security in 2006) defined food security as "access by all people at all times to enough food for an active healthy life". So food security involves not only food availability through storage, and trade but also more importantly food access through domestic or home production (Peter et al., 2020). It is therefore important for a sustainable food security, food supplies must keep pace with increasing population and urbanization (FAO, IFAD, UNICEF, WFP and WHO, 2021). As such, according to the joint UN agencies (FAO, IFAD, UNICEF, WFP and WHO, 2021) report, addressing agriculture and population growth is vital to achieving world food and nutritional security. These are overwhelming food, nutritional security, human health, economic and political stability issues. The shortest route to attain food and nutritional security is through the production of horticultural that has short production cycle and the ability to adopt to small plot sizes for the supply of nutritive food even in the urban areas.

To buttress the importance of horticultural crops in enhancing both food and nutritional security, the International Potato Center (CIP) in Nairobi has develop a series on the "Shamba Shape-Up" TV show to teach the public and smallholder farmers the benefits of using highly nutritious Orange-Fleshed Sweet Potatoes [OFSP)] (Bouis and Islam, 2012). The series includes nutritional importance of OFSP (high beta-carotene, to combat vitamin A deficiency), field preparation, propagation, planting, production, harvesting, post-harvest handling, and storage, and ideas on better ways to prepare and cook OFSP (Bouis and Islam, 2012).

It is a known fact that fruits and vegetables perform a number of crucial roles in human health (Davies and Bowman, 2016). They are primary source of antioxidants such as vitamin A, C and E that are important in neutralizing free radicals (oxidants) known to cause cancer, cataracts, heart disease, hypertension, stroke and diabetes (Chadha and Patel, 2019). Mintesnot (2016) further documented that horticultural agriculture plays an important role in increasing food availability and incomes, supporting livelihoods and contributing to the overall economy, and a key factor to improve food and nutrition security.

The recent renewed interest in urban, vertical and controlled environment agriculture will provide added impetus in providing solution to the problem of rapid growth of the urban population, the low nutritional levels of the urban poor and the rise of cost for foods as observed by Peter (2015); Paloma et al. (2020); the Bangladeshi Food Planning and Monitoring Unit (FPMU, 2020). Thus tackling the problem of food and nutritional insecurity. This will also help to increase the development of urban agriculture in many countries of both the developed and developing nations as one of the strategies to address the urban challenges (Modak, 2020). Urban agriculture provides a substantial contribution to food security and enhance the nutritional level for the urban poor in many developing countries (Chadha and Patel, 2019).

4. Nutritional Security

Nutrition is most absolutely necessary for normal body functions and we can obtain this nutrition through chemicals found in food. Just like our body, food is a combination of chemicals, some of which are essential for normal body functions (Chadha and Patel, 2019). These essential chemicals are called nutrients. A nutrient is defined as a chemical whose absence from diet for a long enough time results in a clearly defined change in health (Padhy and Behera, 2015; Modak, 2020).

We therefore need nutrients for normal body growth and development, for the repair and replacement of cells and tissues, for fuel to do physical and metabolic processes. Foods provide six major classes of nutrients viz., carbohydrates, lipids, proteins, minerals, vitamins and water (Paloma et al., 2012; Motswagole, 2021). The first five are called essential nutrients while carbohydrates, protein and fats are called macronutrients because our bodies need large quantities of them (Devaux et al., 2020). Our body requires comparatively small amounts of vitamins and minerals, so they are called micronutrients (Wilson, 2014; Peter, 2015; Devaux et al., 2020; Paloma et al, 2020) which mostly supplied by fruits and vegetables.

According to Padhy and Behera (2015), aside from nutrients, there are many other chemical substances which do not fit the classical definition of a nutrient present in fruits and vegtables. These include dietary fiber, enzymes and phytochemicals. The latest development in the field of nutrition is research on phytochemicals (plant chemicals), popularly called as antioxidants that are abundantly found in fruits and vegetables and play vital role in reducing the risk of many chronic diseases including cardiovascular, cancer, and diabetes, macular and neurological degeneration (Padhy and Behera, 2015)

However, researches also suggested that certain forms of malnutrition such as hidden malnutrition or obesity are less responsive to both agricultural and economy-wide growth (Riesgo et al, 2020; FAO, IFAD, UNICEF, WFP and WHO, 2021). In addition to inclusive economic growth additional measures are required to tackle the underlying causes of malnutrition, which may be health or diet related, or to several other factors (FAO, IFAD, UNICEF, WFP and WHO, 2021). Despite the multi-dimensional nature of malnutrition horticultural approach can still play an important role in remediating it.

Many researchers have reported that fruits, nuts, and vegetables play a significant role in human nutrition, especially as sources of vitamins (C, A, B 6, thiamine, niacin, E), minerals, and dietary fiber (Quebedeaux and Bliss, 1988; Quebedeaux and Eisa, 1990). Their contribution as a group is estimated at 91% of vitamin C, 48% of vitamin A, 27% of vitamin B 6, 17% of thiamine, and 15% of niacin in the U.S. diet. Fruits and vegetables also supply 16% of magnesium, 19% of iron, and 9% of the calories. Legume vegetables, potatoes, and tree nuts (such as almond, filbert, pecan, pistachio, and walnut) contribute about 5% of the per capita availability of proteins in the U.S. diet, and their proteins are of high quality as to their content of essential amino acids (Bowman, 2013; Davies and Bowman, 2016).

Bowman (2013); Davies and Bowman, 2016) further chronicled that nuts are a good source of essential fatty acids, fiber, vitamin E, and minerals. Other important nutrients supplied by fruits and vegetables include folacin, riboflavin, zinc, calcium, potassium, and phosphorus. Several reports have also revealed that adequate intake of fruits and vegetables regularly form significant component of a healthy diet and low fruit and vegetable intake make a person liable to risk factor for chronic diseases such as cancer, Coronary Heart Disease (CHD), stroke and cataract formation (Padhy and Behera, 2015; Mintesnot, 2016).

Scientific evidences prove that frequent consumption of fruits and vegetables can prevent oesophageal, stomach, pancreatic, bladder and cervical cancers and that a diet high in fruits and vegetables could prevent 20% of most types of cancers (Crawford et al., 1994; Padhy and Behera, 2015).

5. Role of horticulture in enhancing food security

Horticulture has the mechanism to combat world hunger, nutritional and food security (UC Davis, undated) it also has the potential to develop a horticulture-driven food and nutritional security initiatives to help smallholder farmers and people under the threat of hunger (Peter et al., 2020). Eating fruits and vegetables is part of a healthy diet (Chadha and Patel, 2019). Fruits and vegetables are not only sources of many vitamins and minerals, but eating them reduces the risk of disease Modak, 2020). In fact, the World Health Organization (WHO) has identified low fruit and vegetable intake as a top risk factor for global mortality (FAO, IFAD, UNICEF, WFP and WHO, 2021).

Specific fruits and vegetables can be used to target particular nutrient deficiencies for example, orange-fleshed sweet potatoes have been proven effective for alleviating Vitamin A deficiencies (Bouis and Islam, 2012). Perhaps more importantly, these whole foods also provide an array of phytonutrients and antioxidants that have a variety of beneficial health impacts (Peter, 2015). A diet rich in fruits and vegetables provides necessary micronutrients that cannot be found in staple grains, meat or dairy (UC Davis, undated). Dietary diversity shows how many food groups a person routinely eats, this can be used as a proxy for the nutritional adequacy of a diet. Eating a variety of fruits and vegetables is key to achieving dietary diversity and meeting daily micronutrient needs (Peter, 2015).

Horticulture has the added advantage of utilizing small space for the production of varied fruits and vegetables (Rajani and Joshi, 2017). This could be achieved through sustainable and intensive usage of urban and peri-urban environments, it can efficiently grow high-value horticultural crops vertically, in synthetic media under protected culture i.e Controlled Environmental Agricultural systems (CEAs), from hoop-houses to modified greenhouses and buildings (Davies and Bowman, 2016). To support the increase in the population of the developing and developed world, niches are needed of commercial smallholder and large-holder farmers producing in peri-urban and urban environments (Bowman, 2013; Abraham and Pingali, 2020).

6. Role of horticulture in enhancing nutritional security

There is a double burden of malnutrition because of diets shift in developing countries, malnutrition can include both people who are undernourished and people who are overweight (FAO, IFAD, UNICEF, WFP and WHO, 2021). Under nutrition and over nutrition can co-exist, even in the same household. Increasing fruit and vegetable consumption is one of the few dietary strategies that can help improve both situations (Mintesnot, 2016). Vegetables play an important role in human nutrition as fruit and vegetables are packed full of goodness, and often contain a number of essential vitamins and minerals that cannot be found in other types of foods or they may contain higher levels of these nutrients than other foods (Padhy and Behera, 2015).

Vegetables and fruits play a significant part in enhancing human food and nutritional security, as they are important sources of nutrients, dietary fiber, and phytochemicals (Peter, 2015). A diet rich in vegetables and fruits can lower blood pressure, reduce risk of heart disease and stroke, prevent some types of cancer, lower risk of eye and digestive problems, and have a positive effect upon blood sugar which can help keep appetite in check (Abraham and Pingali, 2020).

The higher the average daily intake of fruits and vegetables, the lower the chances of developing cardiovascular diseases as reported by Peter (2015). Fruits and vegetables contain indigestible fiber, which absorbs water and expands as it passes through the digestive system (Mintesnot, 2016). This can calm symptoms of an irritable bowel and, by triggering regular bowel movements, can relieve or prevent constipation. Eating fruits and vegetables can also keep eyes healthy, and may help prevent two common aging-related eye diseases (cataracts and macular degeneration) (Padhy and Behera, 2015)

According to Davies and Bowman (2016), Successful programs in enhancing food and nutritional security through horticulture involve the evolution of collaboration with horticulture and other disciplines to focus on nutritional sensitive production of fruits and vegetables. This thriving programs addressing societal issues, such as health, obesity, and nutrition. Some 2/3 of all deaths are diet-related: obesity, hypertension, heart disease, diabetes, etc. (Bouis and Islam, 2012; Davies and Bowman, 2016). Furthermore, in the developing world, treating HIV patients is compounded when they have diet-related diseases, plus malnourishment, which limits effective treatment and a nutritious diet of fruits and vegetables enhances the efficacy of HIV treatments (Weller, 2014).

7. Contribution of Horticultural Produce to Food and Nutritional Security

Fruits and vegetables are an important source of vitamins, minerals, fiber, vegetable protein, anti-oxidants and phytochemicals (Padhy and Behera, 2015). Leafy vegetables such as amaranth, Indian spinach, water spinach, colocasia, drumstick and jute leaves are excellent sources of iron, beta carotene (pro vitamin A), calcium and folic acid as reported by FPMU (2020); Modak (2020). Horticultural production, especially the production of fruits and vegetables can enhance household food and nutritional security through home gardening which can also contributes to women's empowerment, increasing their income and community participation (Mintesnot, 2016).

8. Recommendations

The following recommendations are therefore made for improving food and nutritional security through horticultural crops:

- Farmers should practice nutrition sensitive agriculture where they would be encourage to grow fruits and vegetables, and feed on they produce.
- Farmers should be assisted in growing fruits and vegetables so that they can earn significant income even from small plots and consistently higher prices than those growing cereal crops. That additional income can allow farmers to spend more on other food purchases.
- Support should be extended to women farmers since they make up a majority of horticultural farmers in many countries and are often responsible for feeding their households and making nutrition choices, they should be encourage to increase their capacity to ensure their households' food and nutritional needs.
- Regions and communities where farmers grow and market horticultural crops they should be provided with transport, storage and modern refrigeration facilities to have greater access to fruits and vegetables markets and also to reduce postharvest losses. As more fruits and vegetables enter the market, prices may decrease which can make these nutritious crops more available and cheaper to consumers.

9. Conclusion

Fruits and vegetables are major sources of abundant, cheap source of fiber and several vitamins and minerals. In general, they have the highest nutritional value when eaten fresh. Similarly, production of horticulture specialty crops provide an opportunity to reduce malnourishment, hunger, and poverty, and to generate employment, create niche market opportunities for smallholder farmers on small acreage, and generate income for women. It has the advantage of utilizing small spaces and short production cycle unlike field crops which require larger land availability for economies of scale, horticulture can be profitable under reduced acreage.

Food and nutritional security can be achieved through the role of horticultural crops in improving the food and nutritional security of a nation and its role in development. This would help the world to make substantial progress in attaining both Sustainable Development Goal (SDG) Target 2.1, which strive to ensure access to safe, nutritious and sufficient food for all people all year round and also SDG Target 2.2, which seeks to eradicate all forms of malnutrition. World food security situation can be improved tremendously if nations employ nutrition sensitive agriculture anchored on the production of horticultural crops. When this is put in place, all people, at all times would have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs.

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