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Review Article

Review on Contribution of Diversified Food Production for Improved Human Nutrition

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Abstract

Diversified food production is about producing foods from various sources that are rich in all the essential micronutrients, available in sufficient quantities and accessible to people all year round. It serves as a tool to improve human nutrition by ensuring food and nutrition security. Furthermore, it plays also a great role by alleviating peoples from the problem of hunger and malnutrition either by increasing their dietary diversity or by enhancing level of their economic status. There are different food groups namely; Cereals, legumes, vegetables, fruits, animal products and fats which have a synergistic relationship with human nutrition. However, over reliance on each one of the food groups only may lead to poor health and nutritional status. Combined production of all these formerly mentioned food groups could improve health and nutritional status of peoples through enhancing their dietary diversity or being served as a source of income. Therefore, this paper is aiming to address the role of diversified food production for ensuring food and nutrition security.

Introduction

Background

Diversified food production is about producing foods from various sources that are rich in all the essential micronutrients, available in sufficient quantities and accessible to people all year round [1,2]. Promoting diversified food production is required for achieving improved human nutrition. Human nutrition deals with the provision of essential nutrients in foods, which are necessary to support human life and good health [3]. Human nutrition can be improved by ensuring both food and nutrition security so in order to achieve both food and nutrition security diversified food production is a vital tool, which needs to be implemented. A lot of efforts have been made to enhance food security situation of smallholder farmers by enabling them to adopt diversified crop production [4,5]. Showed that farm production diversification can improve the dietary diversity of households in the developing world. In addition diversified food production could also improve level of dietary diversity in households by enhancing their economic status [6]. Highlights the case study in tanazania, showing that households in poverty can have high risk of inadequate dietary diversity. Alleviating households from poverty leads to increased access of diversified food item as a result their nutritional status also improved. Hunger and malnutrition remain major global problems despite progress in recent years. According to the Food and Agriculture Organization of the United Nations [7], More than two billion people in the world are estimated to suffer from micronutrient deficiencies. Approximately 11% of the world population suffers from poverty and lack of access to sufficient nutritious food necessary for human health. The estimated number of people who suffer from chronic hunger declined by 17% from 1990-92 until 2015, but according to the most recent reports global hunger is on the rise again, affecting 815 million people in 2016. There has been a major growth in food production in the past decades. Almost one billion people, however, still have no access to sufficient nutritious food necessary for human health [8]. Although production of diversified food item is the best alternative to alleviate from the problem of hunger and malnutrition, still most of the peoples in developing countries are dependent on production and consumption of specific food item. Diversified food production away from over-reliance on a particular food group is an essential part of progress towards achieving sustainable food and nutrition security. It plays a pivotal role by improving the nutritional status of peoples in developing countries through enhancing their dietary diversity and serve as source of income. Therefore the aim of this paper is discussing the contribution of diversified food production as a means to ensure food and nutrition security.

Literature review

Role of diversified food production for improved human nutrition

The production of variety food items is a tool to improve the nutritional status of people living in developing countries. Many people in developing countries like Ethiopia are becoming self-sufficient in food production but diet remains poorly diversified [9]. This indicated that food production sufficiency is not a grantee for nutrition security. Therefore, diversifying and increasing food production through collaboration of people working in different disciplines such as agriculture, fishery, forestry, small animal husbandry and nutrition is the key element for promoting nutrition security. Among aforementioned sectors the agriculture sector plays a significant role in improving the nutritional status a farming family. Most of smallholders farmers often rely on own farm production to meet the household dietary requirements. Therefore Improving farm productivity is likely to enhance the food security situation of the household [10,11]. Farm productivity can be improved by implementing different activities like mixed cropping and integrated farming system, small livestock raising, promotion of underexploited crops and home gardening. These activities could enable to ensure dietary diversity. Diversified production can be used as a means to increase farm income, generate employment and alleviate poverty and it is considered as an important strategy to overcome many of the emergencies faced by developing countries [12]. Generally the contribution of diversified production for alleviating households from hunger and malnutrition can be seen into two perspectives; the one is by increasing their dietary diversity and the other is as a source of income by selling different produced commodities.

Role of diversified food production for dietary diversity

Dietary diversity is one of the outcomes of diversified food production and it can be defined as the number of different



kinds of foods consumed over a given reference period. It is often used as a food security proxy in nutrition surveys, and it generally has been found to be closely correlated to both caloric adequacy (the amount of kilocalories consumed) and anthropometric outcomes [13,14]. Crop and livestock production diversification have found varying effects on nutrition through increasing households access to nutritionally rich crop and animal products [15]. For the purposes of improving dietary diversity and nutritional outcomes, it therefore suggested that diversified production interventions need be implemented alongside with social investment programs in health and education. Most of the peoples in developing countries rely on consumption of cereal based products (diet rich in energy). These have been linked to a decrease in the intakes of iron and in turn a greater incidence of iron deficiency anemia being observed in the sub-Saharan countries [16]. Therefore promotion of diversified food production strategies could increase the access of acquiring a variety of food items rich in different essential nutrients as a result the health of the consumers can be kept well.

Role of diversified food production as a source of income

Food production diversification strategies have been pursued worldwide as a way to improve household income in less-developed countries [17]. Crop diversification is one of diversification strategies it is based on the facts that: crop rotation has beneficial effects for the soil, guaranteeing environmental protection and it increases food security by offering farmers access to sufficient, nutritious and diversified food in areas where markets are not available [18]. Furthermore crop diversification enables the farmers to shift their consumption pattern by enhancing their ability to purchase other food items in the market. As previous works in sub-Saharan Africa and in other developing countries show up, subsistence farms rely on their farm production to satisfy the household consumption requirements [15]. Subsistence farmers also purchase some food items from the market [19,20]. Argue that the consumption of high value crops by the producing farm households is often uncommon. For instance, farm households can sell high value crops, and in return, can purchase cheap food items to meet the calorie requirements of their members. This requires a joint food consumption model that combines food production and purchase of food stuffs. Diversified food production enables households to alleviate from food poverty. Despite the varied definitions the existing literatures incline to agree that food poverty (food insecurity) is a situation when one doesn't meet his (her) nutritional requirements. Food poverty is often measured within its extremes as a form of undernourishment. Food poverty exists "when caloric intake is below the minimum dietary energy requirement" [21]. The practice of diversified production enhances food purchasing power of households by selling high value crops as a result they can satisfy their caloric requirement. The study in Tanzania showed that the food diversity index and food purchase proportion are slightly lower for the households in food poverty. Conversely, food secure households in Tanzania have higher levels of production diversification compared to households in food poverty [22].

Contribution of different food groups for human nutrition

There are a number of food groups' classifications containing five, six, seven and eleven across over different regions of the world according to different literatures. The food group system by [23] classified the 206 foods and 32 beverages reported in the Oxford WebQ into 93 groups (79 food and 14 beverage groups) belonging to 15 main food categories (13 food and 2 beverage categories). But all of these food groups can be merged into condensed form. The information adopted from FAO showed that food groups are classified into six on the basis of mainly nutritional needs of the population group namely; Cereals, legumes, vegetables, fruits, animal products and fats. Each of these food groups contributes their own role for achieving improved human nutrition by providing essential nutrients and micronutrients. Promoting production of this entire food item is required for achieving major nutritional improvement. This requires multidisciplinary collaboration like agriculture, industry, marketing, communications, women's participation, home economics and nutrition. The wide application of proven technologies and approaches in these fields, as well as the development of new concepts, will contribute towards solving nutritional problems. The results of research must be transmitted to farmers, and efforts must be made to build on farmers' indigenous knowledge. Greater and more sustained yields from the farming system will increase the potential access of the household to an adequate diet [24]. Similarly, farming practices that improve the regular flow of a variety of different foods into the household throughout the seasons enhance food security for its members. Among the farming practices; Promotion of mixed cropping and integrated farming systems, introduction of appropriate new crops into the agro-ecology, Promotion of underexploited traditional foods and home gardens, Small livestock raising, Promotion of fishery and forestry products are the major ones.

Animal products

Animal diversity also plays an important role in human nutrition and dietary diversity, mainly in terms of dairy products, eggs, meat and offal, fish and seafood [13]. Foods derived from animals are an important source of nutrients [25]. According to a recent FAO report on livestock in food security [26] 'Livestock contribute around 12.9% of global calories and 27.9% of protein directly through provision of meat, milk, eggs and offal.' Livestock kept by the poor can produce a regular supply of nutrient-rich animal source food (ASF) that provide a critical supplement and diversity to staple plant-based diets [27]. This can help mitigate the effects of often-large seasonal fluctuations in grain availability. There is a synergistic relationship between livestock production and human nutrition. Keeping livestock influences human nutritional and health status through numerous multiple-link causal chains [28]. In one chain, owning animals increases the amount of Animal Source Food (ASF) available, which can increase ASF consumption, dietary intake, and nutritional status. Other chains indicate that animals owned increase animal production, animal and livestock product sales, and household incomes. Income from the sale of livestock products can be used to purchase ASF or other foods, and allow more or better quality healthcare services or products to be purchased by the household. Animal Source Foods (ASF) contribute a significant proportion to the food intake of Western societies [29], but also play an increasingly role in developing countries. Although global average production has increased, the problem of malnutrition remains a large problem for those without access to animal source food and with food insecurity [30]. Increased access to affordable ASF could significantly improve nutritional status, growth, cognitive development and physical activity and health for many poor people [31].

Aquaculture and fisheries

Aquaculture and fisheries are both seen as key to the future of food production, health, and nutritious food systems [32]. Aquaculture is an increasingly important source of fish, including in less developed countries [33]. Currently, fish provide approximately 3.2 billion people with almost 20 percent of their average per capita intake of animal protein and these values are still on the rise [7-10]. Fish is one of functional food types that have the potential to minimize medical care costs while improving health and wellness, and giving consumers greater control over their health by providing a convenient form of health-enhancing food. Functional foods are food products specifically designed to deliver nutritionally valuable component (essential macronutrient or micronutrient) able to amend body functions and decrease the risk of certain diseases [34,35].

Vegetables and fruits

Vegetable and fruit production and consumption have the potential to provide ample amount of micronutrients for the body and antioxidants and phytochemicals that may protect people against non-communicable diseases [36]. While at the same time creating employment and generating income in the developing world [37]. A survey in Kenyan provides detailed information on the incomes of a sample of workers in the fruit and vegetable sector and comparative data for a control group of people not involved [38]. The figures indicate that fruit and vegetable producers are much better off than non-horticulture smallholders, with a mean income that is four times larger. The consumption of vegetables and fruits globally remains below the expected minimum of 400g of fruit and vegetables per day (excluding potatoes and other starchy tubers), with sub-Saharan Africa lagging behind [39]. The annual fruit and vegetable consumption in Africa is less than 100 kg per person, which equals around 250 gram per capita per day [8]. That's why most of the peoples are suffer from micronutrient deficiencies. Therefore production and consumption of fruits and vegetables has a milestone contribution in improving nutritional status and assuring food security peoples. The survey by [40] in Uganda showed that fruit and vegetable production is beneficial for food security and ultimately anaemia status of individuals in particular, women of childbearing age. Nutritionally, fruits and vegetables are energy-dense foods containing vitamins, minerals, fibre and other bioactive compounds [41]. Thus production of fruit and vegetables could enable to access the essential macro and micronutrients as a result the problem of micronutrient deficiencies can be solved. In addition consumption of fruit and vegetable guarantees a paramount health benefit among them improved mental health and better cardiovascular health [42], reduced risks of some cancers and weight management [43]. Although fruits and vegetables are an important source of essential nutrients for maintaining optimal human health, they are produced and consumed to unsatisfactory level in less developed countries. Therefore, a lot need to be done in order to meet the recommended daily intake of fruits and vegetables for households in different regions of the world. Every individual should grow fruits and vegetables in their garden or farmland so as to get essential



nutrients and maintain healthy life.

Fats

Most of the fats in the human diet can be obtained from animal or plant (oil bearing crops) sources. Oilseeds are important crops for low-income families in the semi-arid tropics as they contribute 40% of the total calorie intake in their diet [44] and they are regarded as a major source of vegetable oil with a large amount of oil yields when compared to other crops [45]. These crops are cheap, readily available and grow in various soils. Seed oils from flax (linseed) and castor bean are used for industrial purposes [46]. Globally, oilseeds are being modified for high nutrition, improved oil quality, and composition. The oil contains polyunsaturated fatty acid which is beneficial to human health and industrial application. Seed oil is Cultivation and production of oilseed crop is on the increase due to its numerous properties and roles in human and industrial application. According to the report by [47] the global production of oilseed has shown a steady increase since the beginning of 2013, reaching a peak of 209 million metric tons in 2019/2020. The most common vegetable oil types include palm oil, soybean oil, canola oil and sunflower oil. In the 2020/2021 crop year, soybeans were the leading type of oilseed in the world. That year, around 362 million metric tons of soybeans were produced worldwide. The oilseed meals contain the most concentrated form of protein. Consumption of soybean protein reduces protein energy malnutrition in infants, reduces body weight and lowers plasma cholesterol [48]. Oilseeds are also best known for their high content of fat. They are predominantly made up of Polyunsaturated Fatty Acids (PUFA) with high contents of linoleic acid [49]. The oils are made up of a large amount of omega-6 fatty acids. Some oil seeds contain omega-3 Polyunsaturated Fatty Acids (PUFA), which possess the most potent immunomodulatory activities. They have a positive effect on human health due to their ability to reduce the risk of cardiovascular diseases in humans [50]. Oilseeds consist of active compounds such as phenolic compounds which contribute to the antioxidant properties of the crop. Polyphenols have antioxidant, anti-inflammatory, and anti-cancer activities that can protect the human body [51,52]. Most oilseeds consist of flavonoids which has paramount health significance [53]. As reported by the presence of flavonoids in Sesame seed oil also accounts for its use in inhibiting the replication of human colon cancer cells.

Cereals

Cereals are crucial to human survival and are the main components of human diets [54]. They provide a major source of energy, protein, and dietary fiber in human nutrition. For instance, wheat can provide more than half of the calorie requirements in a healthy daily diet [55]. Some cereals have been staple foods both directly for human consumption and indirectly via livestock feed since the beginning of civilization [56]. Cereals are the most important sources of food. Cereal based foods are a major source of energy, protein, vitamins B and minerals for the world population [57]. As well as containing a range of phytochemicals which may provide some of the health benefits seen among populations consuming diets based on plant foods [58]. Cereal and cereal based products are main parts of meal in the most parts of the world. They play an important role in the diet and are the main source of many nutrients for both children and adults. The dietary guidelines accompanying the Balance of Good Health encourage 'plenty of foods rich in starch and fiber [59]. Therefore to achieve healthy life style it is advisable to involve cereal based products in our diet. Africa is the center of origin and also a major producer of several cereals like sorghum, pearl millet, finger millet, teff and African rice [60]. Despite the fact that Africa is center of origin for different cereals but still most of people in this continent suffer from hunger and malnutrition problem. In order for Africa to survive the enormous ever increasing food demand and be able to feed herself and even export, it is must to learn and adopt appropriate and adequate farming practices. [61] noted that reliance on a smaller number of crop species and varieties not only results in erosion of genetic resources but can also lead to an increased risk of diseases when a variety is susceptible to new pests and diseases. In this regard, mixed or rotation cropping of cereals with other crops is one of the farming practice which enable individuals to obtain diversified food item [62].

Legumes

Legumes are plants belonging to the family leguminosae which is a large family with over 18,000 species of climbers, herbs, shrubs and trees of which only a limited number is used as human food [63,64]. Legumes are believed to be one of the first crops cultivated by mankind and have remained a staple food for many cultures all over the world [64]. These seeds are valued worldwide as an inexpensive meat alternative and are considered the second most important food source after cereals. Legumes are nutritionally valuable, providing proteins with essential amino acids, complex carbohydrates, dietary fibre, unsaturated fats, vitamins and essential minerals for the human diet [65]. The

consumption of legumes has also been reported to be associated with numerous beneficial health attributes [66] such as hypocholesterolemic, antiatherogenic, anticarcinogenic and hypoglycemic properties [67]. Legumes have proven to be a cheap source of nutrients as well as a potential source of income for subsistence farmers who cultivate legumes at household level. It is advisable to increase the utilization of legumes and to introduce new legume based products to low-income groups as a way to reduce poverty and alleviate malnutrition. Protein-energy malnutrition (PEM) is affecting over 170 million preschool children and lactating women in developing Africa and Asian countries [63]. The prevalence of PEM can be attributed to many factors such as the high price of animal protein (eggs, meat and milk), the staple cereal-based diet and the ever-increasing price of food commodities becoming unaffordable to the lower income groups. The nutritional demand of legumes is increasing worldwide because of increased consumer awareness of their nutritional and health benefits. Legumes are particularly important in vegetarian diets as they are the chief source protein, provide vitamins and minerals [68]. They play an important role in many diets all over the world and are especially important in developing world continents in Africa, Latin America and Asia. Legumes have been labeled the 'poor man's meat' and this statement seems to hold some truth as observed in the consumption distribution in different regions, with an inverse relation between legume consumption and income being observed [66]. Therefore, by taking all the nutritional benefit of legumes into consideration it is good to grow them in combination with other staple crops.

Summary

The problem of food insecurity, malnutrition and micronutrient deficiency are among the critical challenges in the developing world. Diversified food production plays a critical role for mitigating aforementioned problems either through diversifying the diet or by improving the economic status of the peoples. There are different food groups including fruit and vegetables, legumes, cereals, animal source foods and fats that can provide several nutritional and health benefit. Thus, production of those food groups in combination or in rotation can improve nutritional status of households and ensure food security. Year round production of only a particular food group could not satisfy the nutritional need of a given society rather it could expose them to the problem of hunger and malnutrition. Although diversified food production is one of the key strategies to overcome nutrition related problems, it is not well introduced into different regions of the world. Therefore every countries should incorporate the principle of diversified food production as a strategy to ensure food and nutrition security of their people.

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