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SUSTAINABLE WATER MANAGEMENT FOR CASSAVA (*Manihot esculenta*) PRODUCTION IN NIGERIA

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ABSTRACT

Nigeria is the largest producer of cassava with annual output of 34 to 60 million tons of tuberous root. Cassava production has been increased for the past 25 years in area cultivated and yield per hectare, almost all the cassava produced is used for human consumption with less than 5% as industrial raw material.
Compare to other crops, cassava is more tolerant to poorly fertile soil and resistant to

Introduction

The middle belt agro-ecological zones in Nigeria which include Benue typify the tropical environment that favours a wide spectrum of crops, especially roots and tubers Kalu (2003), popularly referred to as the "Food Basket of the Nation" on the basis that agriculture is the main economic activity, Benue state has an estimated population of 2.8 million people made up of 413159 farm families, majority of whom are ruralizes and are directly involved in subsistence agriculture characterized by small farm holdings with an average farm size of 1.5 – 2.0 ha NPC (1996). Benue and Kogi state in the North Cantral Zone are the largest producers of cassava (IITA, 2004)

Production of Cassava, 1000 metric tons, Benue is the top region by production of cassava in Nigeria. As of 2005, production of cassava in Benue was 3,548 1000 metric tons that accounts for 11.08% of Nigeria's production of Cassava. The top 5 regions (others are Kogi,Taraba Imo and Cross River) account for 44.05% of it. Nigeria's total production of cassava was estimated at 32, 015.4 1000 metric tons in 2005. (Knoema 2019). Cassava (*Manihot*

drought. The water requirements for cassava production is relatively low owing to the fact that cassava is tolerant to drought, it can therefore strive well under green water supply depending on the nature and terrain of the arable land. Net water consumption can expressed volume of water per unit output. During the overall cropping season, both green and blue water supply is required at different stages of production and in different proportion. Cassava also responds well to irrigation (Blue water), drip irrigation with its ability of small and frequent water application have created interest in view of decreased water requirement, possible increased production, and better product quality.

Keywords: Sustainable Water Management, Cassava *(Manihot esculenta)*, Production, Nigeria, Irrigation.

esculenta) roots are cultivated largely in the tropical countries, it is considered as a crop that can boost rural industrial development raise income for producers, processors and traders (Echebiri & Edaba, 2008). Cassava is the chief source of dietary food energy for most people living in the lowland tropics, and much of the sub humid tropics of West and Central Africa. Cassava production has been viewed as a means of attaining household food security and increasing food availability (Lebot 2009). Global food demand is expected to double by 2050, this causes significant rise in freshwater consumption consequently posing challenges to the United Nations (UN) water sustainability goal, clean water and sanitation, aquatic and terrestrial life (Smilovic *et al.*, 2019). Optimizing use of water through irrigation could support both food and water security, this involve managing both timing and special distribution of water (Smilovic *et al.*, 2019). Water management is highly relevant in agriculture sector, there pressure exerted on the water environment from water withdrawal and pollution while water shortage can adversely affect its overall requirements, hence, adopting technologies to increase production and reduce environmental impacts may allow water sustainability (Hess *et al.*, 2014).

Starch is produced by all green plants as an energy store and is an important energy source for humans (Abbas *et al.*, 2010). It is found in potatoes, wheat, rice and other foods, and it varies in appearance, depending on its source. Starch consists of two main components: mainly linear amylose and highly branched amylopectin and is stored as discrete semi crystalline granules in higher plants. Among carbohydrate polymers, starch is currently enjoying increased attention owing to its usefulness in different food products (Abbas *et al*., 2010). In the unmodified form, starches have limited use in the food industry. In general, native starch produces weak-bodied, cohesive, rubbery pastes when heated and undesirable gels when the pastes are cooled (Adzahan, 2002). That is why, the food manufacturers generally prefer starches with better behavioral characteristics than those provided by native starches. Modified starches have been developed for a very long time and its applications in food industry are significant nowadays. The purposes of modification are to enhance its properties particularly in specific applications such as to improve the increase in water holding capacity, heat resistant behavior, reinforce its binding, minimized syneresis of starch and improved thickening (Adzahan, 2001; Miyazaki *et al., 2006).*

CASSAVA PRODUCTION IN NIGERIA

According to Adeniji *et al.,* (1997) & Ikuemonisan *et al.,* (2020), Nigeria is the largest producer of cassava with annual output of 34 to 60 million tons of tuberous root. Cassava production has been increased for the past 25 years in area cultivated and yield per hectare, almost all the cassava produced is used for human consumption with less than 5% as industrial raw material (Adeniji *et al.,* 1997). Compare to other crops, cassava is more tolerant to poorly fertile soil and resistant to drought, however, financial and land tenure system challenges are militating against sustainable cassava production, this could affect Nigeria household by increased demands due to expanding agro-allied firms and industries (Ikuemonisan *et al.,* 2020).

Processing cassava in Nigeria has been mainly traditional and labour intensive, but application of improved processing technologies with reduced processing time and less laborious is currently gaining ground (Adeniji *et al.,* 1997). Industrial utilization of cassava as raw material is also increasing with low levels application of modified cassava products such as starch; this is associated with low levels of mechanization automation and insufficient processing capacity (Akpa & Dagde 2012). In foods and pharmaceutical industries, starch is used to control such characteristics as texture, moisture, consistency and shelf life, it can be used to bind or disintegrate, expand or density, clarify or opacify, to attract or inhibit

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moisture, to produce smooth or pulpy texture, soft or crispy coating (Akpa & Dagde 2012).

Packaging of the products could be achieved by standards methods using different type of presentation and quantification depending on the intending/target destination, also transportation of the product could be by road, air or water transport system which are all realizable in Benue State, Nigeria.

WATER USE IN CASSAVA PRODUCTION

Water is an indispensable component of the photosynthetic pathway, which is necessary for building plant biomass, it can be used more or less efficiently but can never be replaced (Lundqvist & Steen, 1999). According to Lundqvist & Steen, (1999), the production of plant biomass in natural and man-made systems require water, crops completely rely on soil water in the root zone which can extend to about 1 meter deep. Net water consumption can expressed volume of water per unit output (Hess *et al*., 2013). An estimated 67% of world's crop production comes from rain-fed agriculture where crops take rainwater that is stored in the soil to subsequently transpire most of it (Hoekstra 2019). Natural sources of water such as rainfall water, ground and surface waters provide the basic water supply for agricultural activities. Green water supply refers to the use of rainwater in the soil whereas blue water use is related to ground water and surface water supply (Clothier 2010: Hoekstra 2019). The water requirements for cassava production is relatively low owing to the fact that cassava is tolerant to drought, it can therefore strive well under green water supply depending on the nature and terrain of the arable land, however, there will still be need for supplementary water supply in order to achieve maximum cassava yield.

WATER FOOTPRINT

Net water consumption can expressed volume of water per unit output (Hess *et al*., 2013). During the overall cropping season, both green and blue water supply is required at different stages of production and in different proportion (Green water, 2014). Green water could be collected as rainwater harvest (RWH) and be used onward as blue water supply given adequate facilities for collection and storage (Hoekstra 2019). For bulking purposes, cassava requires 200mm of rainfall in the first month of planting, equivalent to 808m^3/acre/month, whereas for production phase, planting occur normally under green water supply, however, if rain do not fall within a week of planting, 20 mm of water equivalent to $162m^3$/acre/month is needed (Green water, 2014). For processing of cassava into flour, 1.2 L of water is needed/kg of cassava equivalent to $18m^3$/acre (Green water, 2014). All water footprints are determined based on the sum of beneficial water consumption (T) and non-beneficial water consumption (E), this is because measurement of water footprint intends to show total water consumption related to the production which includes the waste fraction of consumption, that is unproductive evaporation from the soil and water used in spraying (Hoekstra 2019). The grey water which will be introduce in the general WF formula of Mekonnen and Hoekstra (2011) is not taken into consideration because it is not a physical quantity of water use, but associated to water pollution.

POTENTIAL ENVIRONMENTAL IMPACTS OF WATER USE IN CASSAVA PRODUCTION

Widespread and drastic reduction of water in areas downstream of dams and other points of extraction are the most serious consequences of expanded irrigation system, lowering of the ground water table, increased cost of developing additional water resources are other effects of expanded irrigation (Lundqvist & Steen 1999).

WATER MANAGEMENT

Cassava also responds well to irrigation (Blue water), drip irrigation with its ability of small and frequent water application have created interest in view of decreased water requirement, possible increased production, and better product quality (Connor *et al.* 1981; Mohammed *et al.* 2006). Edoga and Edoga (2006) reported that drip irrigation the soil is maintained continuously in a condition which is highly favourable to the crop growth. As the applications are located close to the plant zone, the losses caused by through drainage or by wetting inter-rows and ridges are minimized. The report stated that drip irrigation generally compare favourably with other types of irrigation both in terms of crop yield and conservation. Drip irrigation has proved to be a success in terms of water and increased yield (Bhardwaj 2001).

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