

MUSHROOM PRODUCTION AND ITS ECONOMIC POTENTIALS IN NIGERIA

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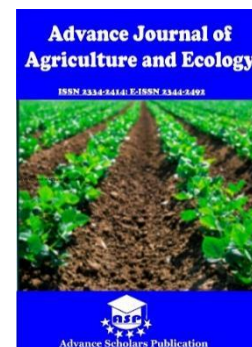
ABSTRACT: Mushrooms are widely held for their smoothness and savour. In several parts of the world, a variety of mushroom species are frequently consumed as a delicacy. They make great supplies of minerals, proteins, and vitamins. They are a wonderful source of vitamins, minerals, and proteins. Mushrooms can play a significant role in enhancing the human diet in nations with growing populations and food demand issues, where a major portion of the population is highly selective of food preference. It is the perfect method for recycling the plentiful agro-waste. The discarded compost from mushroom farms makes for higher biogas generation and is good organic manure. Utilizing agricultural waste as a growing medium efficiently is an additional benefit of mushroom farming. In some part of Nigeria today, edible mushrooms are utilized not only for medicinal purposes but they serve as food and vegetable.

Introduction

Agricultural productivity in the world and particularly in Africa is heavily dependent on the climatic condition; and the climate is no longer reliable due to the variability of the climatic elements (Elijah *et al*, 2020; Anarah *et al*, 2019; Ojemade *et al*, 2018). There's no silver bullet to address climate change, but experts are finding some solutions that are extraordinarily effective at mitigating environmental shifts (Osuafor & Ude, 2021). One game changer is the humble mushroom (Stamets, 2020). Mushroom production is a useful way of earning income when climate change makes farming less reliable. In order to increase revenue, ensure food security and

improve living conditions in the face of poor crop yields brought on by the effects of climate change (Osuafor *et al*, 2020), farmers can make an effort to grow protein-rich mushrooms. Mushroom is congenial for their flavour, economic and ecological values, and medicinal attributes for many years (Gupta *et al*, 2018; Sánchez, 2004). According to Miles and Chang (2004), mushroom is a macro fungus with a distinctive fruiting body which can be either epigenous or hypogenous and large enough to be seen with the naked eye and can be picked with hand. Adinya *et al* (2012) asserted that mushrooms belong to a group of living things called fungi; hence these terms will be used interchangeably in this study.

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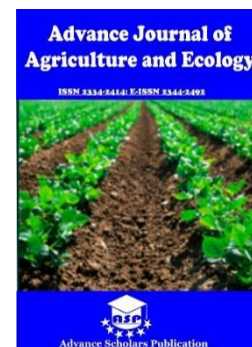
Fungi differ from plant and animals in the way they obtain their nutrients. This group of living things consists of heterogeneous organisms and includes moulds, mildews, rusts, smuts, and toadstools. Their sizes vary from extremely tiny microscopic forms to large bracket fungi and there are also variations in structure and texture. Mushrooms are extremely abundant and diverse worldwide. Oyedele *et al.* (2018) noted that there are hundreds of identified species of fungi which, since time immemorial, have made a significant global contribution to human food and medicine.

It is estimated that 14,000 species of mushrooms are now known in the world (Veena & Meera, 2012), with the most cultivated being the white button mushroom (*Agaricus bisporus*). Among these recognised species, about 7,000 (50%) are considered to possess varying degrees of edibility, out of which more than 3,000 are regarded as prime edible mushrooms (Okigbo & Nwatu, 2015). Elaine and Nair (2009) also opined that, although this contribution has historically been made through the collection of wild edible fungi, there is a growing interest in cultivation to supplement, or replace, wild harvest. Mushrooms are devoid of leaves, and of chlorophyll-containing tissues. They are also devoid of vascular xylem and phloem. Therefore, they are incapable of photosynthetic food production (Chang & Wasser, 2017). Siddiqui (2002) described mushroom as an edible vegetable which is delicious, nutritious and having medicinal value obtained scientifically from the spawn produced in the laboratory in a neat and clean environment.

The organic materials on which mushrooms derive their nutrition are referred to as substrates. Mushrooms possess microscopic spores, which serve as a means of reproduction. Chang and Philop (2004) noted

that mushroom may seem to sprout overnight, whereas it actually takes days or weeks for each to develop. Most of the growth of a fungus goes unnoticed because it occurs underground. The underground body of a fungus, called the mycelium, is made of moist thread-like filaments. When growing conditions are good, little knots of hyphae called primordia are formed. As individual primordia grow larger, the hyphae within them grow and develop into two parts. One part will become a mushroom's cap, and the other, its stem. When the primordium gets large enough, the stem elongates and pushes the cap up above the ground. As the stem elongates, the cap expands, a little like an unfolding umbrella (Joseph & Oku, 2016).

According to Chang and Wasser (2017), mushrooms process their food by secreting degrading enzymes that serve as the key to unlocking and decomposing the complex food materials present in the biomass where they grow to generate simpler compounds, which can be absorbed and then transformed into fresh new mushroom tissues. Mushrooms lack true roots. The vegetative parts of the mushrooms mainly consist of thread-like long, thin mycelia (Bashar, 2006), which colonize the substrates, degrade their biochemical components, and siphon away the hydrolysed organic compounds for their own nutrition. These substrate materials range from decomposing material in natural ecosystems, from the soil underlying forest floors to by-products and wastes from industry, households, and agriculture (Chang & Wasser, 2017). At present, three mushrooms namely, the button mushroom (*Agaricus bisporus*), paddy straw mushroom (*Volvariella spp.*) and oyster mushrooms (*Pleurotus spp.*) are cultivated in different parts of the world (Rana *et al.*, 2015).



Agronomy of Mushroom

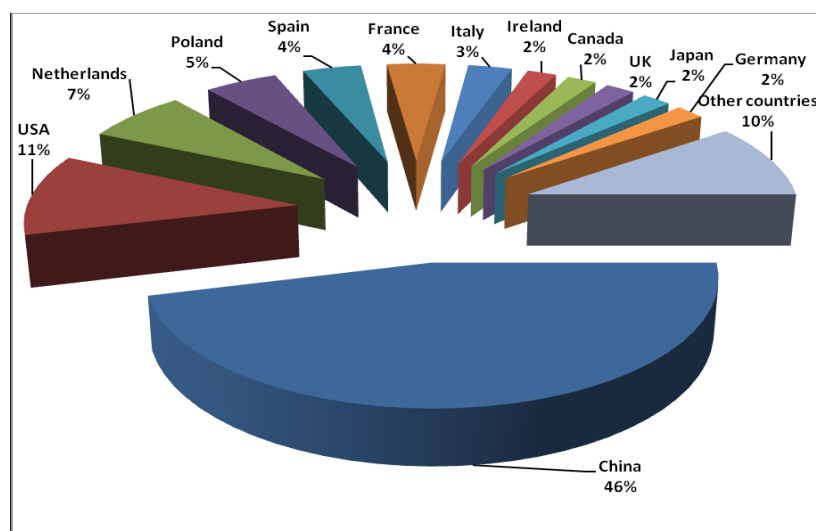
Obviously, mushroom cultivation is becoming increasingly successful in many regions of the world because of some of the following reasons; the prevailing external climatic conditions, short growing times, very low inputs requirements for production, and easy production technologies. Some other reasons may include; limited piece of land, especially where land is a limiting factor, low investment capital needed, and where agricultural residues are abundantly available (Rosmiza *et al*, 2016; Bradley, 2013; Marshall & Nair, 2009). Mushrooms have been considered one of the world's greatest natural resources since they have the ability to transform required input into nutritional substance and high protein food. In the event of large increase in population resulting in scarcity of nutritious food, the mushrooms offer a good source of nutrition due to being rich in minerals and vitamins (Rana *et al*, 2015). The realization of the nutritive therapeutic potentials of mushrooms has awakened interest in this regard and individuals, private companies and government are poised to cash in on this potential revenue earner (Usman & Osalusi, 2018).

In the Nigerian environment, agricultural wastes are predominant, which can serve as raw materials or substrates for organic mushroom production. The availability of these raw materials in conjunction with knowledge of simple and low cost techniques of mushroom cultivation could create a source of

income and improve nutritional base for the poor and rich. Mass production and subsequent export of such cultivated mushrooms could also be a source of foreign exchange earnings (Adinya, *et al*., 2012). Mushroom farming is one of the most economical agricultural practices with huge export value. Exportation of mushroom can generate a highly significant income base for the rural as well as urban farmers in the country.

In the developed countries, mushrooms have become one of the most important of all the horticultural crops. Commercial production of mushrooms is a rapidly growing industrial activity throughout the world (Tahir & Hassan, 2013). Supporting the foregoing, Arowosoge (2018) observed that there has been an increase in the world production of mushroom through cultivation at large, medium and low scale in more than 100 countries. In Malaysia, Mohdet *al*. (2015) noted that Mushrooms have been identified as one of the high-value commodities under Malaysia's National Agro-Food Policy (2011-2020). However, China has remained the leading world producer of mushrooms for many years since 2005 (Royse *et al*, 2017). USA is next to China in mushroom production, and then Netherlands, Poland, Spain, France, Italy, Ireland, Canada, UK, Japan, Germany and some other countries. The recent report of the world mushroom production in percentages is presented in figure 1.

Figure 1: World Mushroom Production in percent (Countries wise).



Source: Attri, 2019

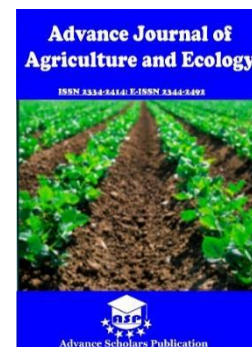
Mushroom production has a good potential in Nigeriadue to the cheap and availability of the substrates, man-power and ready market.Malnutrition is one of the critical problems facing the developing countries. Mushrooms with their flavour, texture, nutritional value and high productivity per unit area have been identified as an excellent food source to alleviate malnutrition in developing countries (Eswaran & Ramabadran, 2000). Mushroom as a delicacy is highly rich in protein relative to other type of food and as such recommended by Food and Agricultural Organization as a healthy food for bridging the protein malnutrition gap when mixed with soybean (Mala, 2018). In the recent years, several edible mushrooms have been identified in various communities. These have been found growing in several habitats including grass-land, forest floor, near termite hills, on dead and living trees, and in various waste dumps such as sawdust. They form part of the non-wood forest resources (Ekpo, 2001). Some

of the people in rural communities use edible mushroom for food and medicine. They are eaten mainly for their palatability.The addition of mushrooms to the diet can have beneficial health effects.

Benefits of Mushroom

Studies show that mushroom contains adequate amount of phosphorous, iron, protein, lipid, riboflavin and thiamine. For instance, oyster mushroom fresh fruiting body indicates a high quantity of moisture (90.8%). Whether as dry or as fresh, oyster mushrooms are rich in carbohydrate, protein, fibre, fat and ash with 345kcal energy value on 100g dry weight. The proteins of mushroom are considered to be intermediate between that of vegetables and animals; the amino acids essential for human body are present in oyster mushroom (Tolera & Abera, 2017). According to Onwubuya *et al* (2015) in Abia State, Nigeria, mushrooms are used for treatment of diseases for High blood pressure, pneumonia and urinary tract infection by Nigerian

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herbalists. Literatures also reveal that mushroom, particularly oyster mushroom contains 18 essential amino acids, such as; methionine, isoleucine, lysine, glutamic acid, cysteine, aspartic acid, phenylalanine, tyrosine, tryptophan, valine, arginine, histidine, alanine, glycine, serine and proline (Oni *et al.*, 2021). Iqbal *et al.* (2016) noted that the vitamins such as niacin, riboflavin and thiamine are found in oyster mushroom. In some parts of the world, mushroom is called 'vegetable meat' due to its taste and nutritious value.

Nevertheless, mushroom cultivation is not only a source for nutritious protein-rich food; it can also contribute to the production of effective medicinal products (Chang & Wasser, 2012; Wasser, 2014). Mushrooms have potential medicinal benefits and are also an ideal food for the diabetics as they are low-energy diet (Nagdeve, 2019), which is suitable for obese people. About 700 species are considered to possess medicinal properties (Wasser, 2014). Their medicinal values include wound-healing, immunity-enhancement, and tumour-retarding effects (Dai, Yang, Cui, Yu, Zhou, 2009). Their value has recently been promoted to tremendous levels with medicinal mushroom trials conducted for HIV/AIDS patients in Africa, which have been generating encouraging results (Chang, 2006). Oloke (2017) further affirmed explicitly that the *oyster* mushroom has been reported to provide relief to HIV patients, and it is currently being studied as a possible cure for the virus; the *button* mushroom can help in shedding off weight; while *shiitakes* are known to fight tumours.

Another significant aspect of mushroom cultivation is to help in the reduction and utilization of wastes in the environment. The utilization of waste is imperative for ecological sustainability, environmental safety, economic

stability and wellbeing of human society (Ghisellini *et al.* 2016). International concerns on the need to exploit potentials of waste materials for wealth generation is increasingly emerging. From developed to the developing economies, the focus on generating wealth from wastes have been on the increase in recent times (Ferronato & Torretta, 2019), because of the amount of wastes generated that are already posing environmental threats to the people. Mushrooms can be commercially grown both for local consumption and export market. They can be cultivated on a part time basis, and require little maintenance. Indirectly, mushroom cultivation also provides opportunities for improving the sustainability of small farming systems (Ayanfunke, 2019). Mushrooms can strengthen livelihood assets through the provision of income and improved nutrition. Successful cultivation has potential of earning and can be a good income generating activity for unemployed people (Shakil *et al.*, 2014).

In Nigeria, human population has continued to grow at a rate much faster than the rate of food production; meanwhile the recession in the national economy has resulted in wide spread poverty and low purchasing power of the citizenry. The ban on the importation of livestock products has further put the cost of animal protein beyond the reach of many, especially the rural population (Adinya *et al.*, 2012). Also, reduced income due to the increasing trend of unemployment, coupled with increased expenditure on escalating food prices in a country already facing stiff economic challenges has worsened the poverty situation. These scenarios have combined to keep the diets of the average Nigerians low in protein content and deficient in most essential minerals and vitamins (Akpet, Arikop, Agbogo & Ogbonnaya, 2005).

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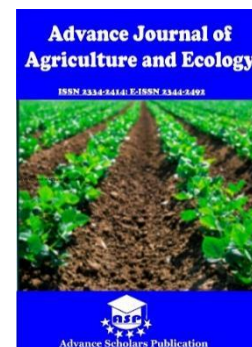
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These factors make it worthwhile for the average Nigerian to seek alternative and affordable meals with the necessary nutritional requirements. Furthermore, the cost of conventional livestock production is exorbitant. This also makes the Nigerian farmers anxious to develop an alternative source of protein with a high potential income generation. In such a situation, mushroom cultivation could be the potential solution to poverty alleviation.

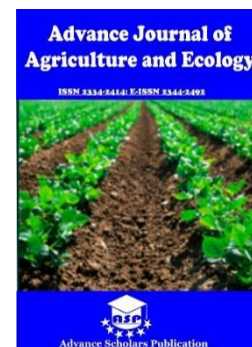
Correspondingly, Fewell and Gustafson (2007) asserted that mushrooms could become an important addition to farmers looking for a value-added product and a way to supplement farm income while making use of by-products or co-products from other crops. Wood, sawdust, straw, stalks, hulls, or meal will all support mushroom growth. The authors further noted that since mushrooms can be grown on nearly any type of agricultural residue, they are an ideal crop for rural areas with large amounts of cultivated acreage and residue from field crops. Mushroom provides an efficient and economically-viable biotechnology (Bradley, 2013), which can give consistent growth with high biological efficiency (Jonathan *et al*, 2012). Supporting this point of view, Zhang *et al*. (2014) noted that the rapid growth and market expansion of the mushroom business in China is a great example of rural development driven by bio-innovation and technological diffusion. They further said that it is an excellent example of rural economic development and poverty alleviation as well as typical recycle-economy and sustainable agriculture and forestry.

Mushroom is a high value niche product with great potential to contribute to enterprise diversification and poverty alleviation by utilizing agricultural wastes, thus providing an environmentally friendly disposal system

(Olujobi & Adeniji, 2021). Mushroom cultivation can help reduce vulnerability to poverty and strengthens livelihoods through the generation of a fast yielding and nutritious source of food and a reliable source of income (Marshall & Nair, 2009). Employment can be created for self and other persons by establishing mushroom cultivation unit. Cottage/small scale industry can be started with limited resources. This industry has very high employment generation and foreign exchange earning potential (Chauhan & Kumar, 2015). In consonance with the foregoing, Sharma and Gautam (2015) asserted that mushroom cultivation has become a profitable business with the produce fetching good return in the market because of the rise in demand for edible mushrooms. Edible mushrooms are highly tradable commodity.

More so, mushroom farming provides a diversification option, Marshall and Nair (2009) asserted that Mushroom cultivation is highly combinable with other traditional agricultural and a variety of domestic activities, and can make a particularly important contribution to the livelihoods of the disabled, of women and the landless poor who, with appropriate training and access to inputs, can increase their independence and self-esteem through income generation. This means that mushroom can provide income or food for households all year round. Mushroom cultivation does not compete with other crops, can be grown in homestead with the active participation of family members. The agricultural and other wastes can be used as substrates. Thus it can be produced in large quantity within a short time, provides more protein per unit area and can serve as income generating source in unemployed sector (Bashar, 2006).

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Among bioconversion processes, mushroom cultivation is an appropriate technology for management of agricultural and agro-industrial residues. Mushroom which is a fleshy saprophytic fungus are found growing in nature on damp rotten log of wood trunks of trees, decaying organic matter and in damp soil rich in organic substances. Cultivation of mushroom can be viewed as an effective way to extract bio resources left behind in agricultural residues and environmental protection strategy (Tsegaye & Tefera, 2017). Mushrooms are seasonal, commercial cultivation is therefore necessary to ensure constant availability. However, large scale cultivation and processing of mushroom requires a good knowledge of the growth requirements, and influence of the substrate on their growth rate and nutritional composition. Some researchers have already observed that the yield and the quality of oyster mushroom depend on the chemical and nutritional content of substrates (Tesfaw *et al.*, 2015).

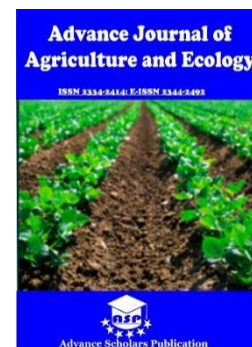
However, the low adoption of mushroom farming in Nigeria may have been caused by several factors. The first factor may be knowledge gap. Without clear understanding of the different steps procedures involved in mushroom production, farmers may find it difficult to commence mushroom farming. In addition, skills are important for one to perfect any activity (Kimole, 2012). Profitable cultivation of mushroom requires closer attention, experience and skill. If it is developed as a cottage industry in villages and on business lines, near towns and cities, the delicacy can become a common diet item to provide cheap source of proteins, vitamins and other nutrients. It is necessary to take proper steps to popularize and use edible mushroom as the

items of food and export (Tahir & Hassan, 2013).

Challenges and Way Forward

The desire for greater sustainability; improving food security by increasing diversity; and developing more reliable sources of income, suggests mushroom farming may be one of the viable options (Rahman *et al.* 2017). Singhet *al.* (2018) asserted that mushroom farming is highly remunerative enterprise with quick return in a short span of time. In the developed countries, mushrooms have become one of the most important of all the horticultural crops. Mushrooms could become an important addition to farmers looking for a value-added product and a way to supplement farm income while making use of by-products or co-products from other crops (Olujobi & Adeniji, 2021). Mushrooms are income generating and in most cases fast return on investment is possible. They have the economic advantage over other crop plants in their ability to grow on waste agricultural products like sawdust, straws, sugar-cane waste products and coconut waste products.

In fact, mushroom production cannot be trivialized in the development and growth of the nation's economy. Mushroom has the potentials of becoming one of the major export-driven agricultural produce in the nation. Many developed countries like the China, USA, UK, Canada, etc. have tapped into this nature's gift and are consistently generating export revenues from mushroom. Statistics from the Wakchaure (2011) reveal that there is still an increasing trend in export of mushrooms all over the world, whether as fresh or processed. This implies a high demand for mushroom in the market. Studies show that Poland is the highest exporter of mushroom in 2019, followed by Netherland, Ireland, China and Belgium. On the other hand, the countries that



are considered as heavy importers of mushroom in order of ranking are; UK, Germany, France, Netherlands, Belgium, Russia and Japan (Attri, 2019). It can be deduced that cultivation of mushroom can bring about profit making, diversification of income, generation of income from a limited land area and making income available throughout the year. In China, mushroom industry ranked fifth among the agricultural industries of China and it has been contributing to economic development of China (with total value of 24 billion USD in 2011) through foreign exchange earnings from exports and income generation (Zhang *et al.*, 2014).

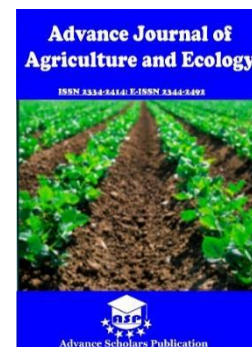
However, despite the huge benefits of mushroom production, it is quite startling that Nigeria is still at the infancy stage of mushroom production. Although, some Research Institutes in Nigeria such as Forestry Research Institute of Nigeria (FRIN); Institute of Agricultural Research and Training (IAR&T), Agricultural Development Programmes (ADP), as well as many non-governmental organisations (NGOs) have been training farmers on how to produce mushroom (Nurudeen *et al.*, 2014), yet abysmal outcome is still witnessed in the nation. Mushroom cultivation has not been given due importance in the nation; whereas, the nature has gifted favourable environmental conditions with a huge quantity of waste material required for obtaining beneficial food and efficient medicine through artificial cultivation of mushroom. Undoubtedly, some relevant and economical technologies have been developed to aid copious production of mushroom in the world, but the bulk of mushroom farmers still depend on the wild grown mushroom which has made the commodity to be scarce and expensive. The production of mushroom by

farmers would have helped to reduce food scarcity in the society, hence reducing the impacts of hunger and malnutrition.

Although, replete literatures regarding the subject of mushroom production have been made available by researchers, majority of the studies were carried out in the developed economies, such as USA, UK, China, etc. and other parts of the continent (Gutema, 2018; Chang & Wasser, 2017; Zhang, Geng, Shen, Wang & Dai, 2014; Kimole, 2012; Celik & Peker, 2009). Some of the few studies done in Nigeria (Onyema *et al.*, 2019; Adedokun & Okomadu, 2017; Onwubuya *et al.*, 2015; Adinya, *et al.*, 2012) focused on different aspects of mushroom production. Some focused on the impact of one substrate on the growth performance, some on the nutritional values, while some others have focused on mushroom production for food security (Joseph & Oku, 2016). Moreover, in view of the economic benefits accruing from mushroom production in other countries as shown in past studies, it therefore becomes justifiable to determine the economic returns on mushroom production in Nigeria while prioritizing the mushroom produced and identifying the problem militating against its production. This is because the decision to invest in any enterprise depends largely on its economic returns. There is available market for mushroom as its consumption is seasonal due to non-availability throughout the year in Nigeria (Nnodim & Enobong, 2018; Arowosoge, 2017).

Conclusion

Mushroom production has been found profitable. Therefore, more farmers should be encouraged to start mushroom production. More mushroom production on the long run would go a long way in providing employment while contributing to the economic



development of the country. Public sector production, processing, marketing, and export organisations should come forward. Diversification and year-round cultivation of diverse mushrooms should be prioritized, as should managed off-season cultivation of select important mushrooms. Finally, the researchers want to encourage more empirical studies on mushroom production in Nigeria.

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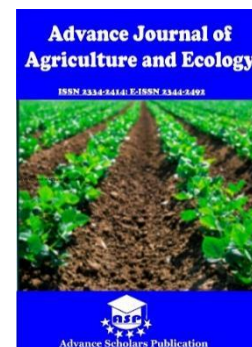
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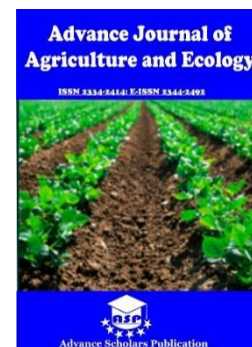


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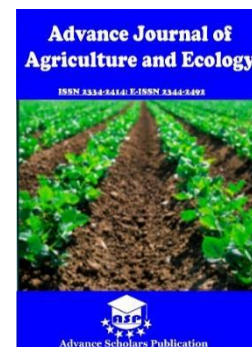
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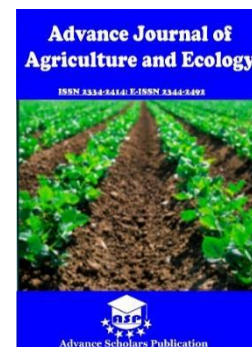
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