

The Role of Fungi in Converting Waste to Wealth in Kogi State, Nigeria

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Abstract

This paper focuses on the role of fungi in waste to wealth initiatives in Kogi State, Nigeria. Kogi State is home to a largely agrarian and industrial population which has a rich biodiversity of fungi which can convert various forms of waste into usable products and resources. The research was conducted using a qualitative approach to conduct interviews and surveys with key stakeholders, policy makers, industry experts and residents of the region. The results of the study indicate that fungi can play a key role in waste to wealth conversion in Kogi State. The byproducts of fungi cultivated on agricultural and industrial waste can be used to produce various items such as medicines, food supplements, animal feed, bioplastics and electricity in the form of biogas. Additionally, fungi may be used to enhance the fertility of soil and improve the productivity of crops, thereby increasing income of farmers and reducing the amount of waste produced in the region. The findings of the study show that fungi can play an important role in waste to wealth conversion in Kogi State. Therefore, it is important for government, industry, and stakeholders to collaborate to ensure the potential of fungi is leveraged to promote sustainable development in the region. The paper concludes with a set of recommendations for the promotion of fungi-based waste to wealth initiatives in Kogi State.

Keywords: Fungi, Waste, Wealth, Kogi State

Introduction

Overpopulation and overexploitation of ecosystems leads to the depletion of natural resources and food security in our local society as large proportion of waste is been generated based on daily anthropogenic activities, these have a lot of problems which have created economic and ecological injustice that results to changes in the physical, chemical and biological components of the atmosphere. The use of fungi has the potential to meeting the nutritional, health and economic needs of poorer nations which are often rich in biodiversity but lack resources to be able to conserve and exploit their own resources (Ryan, McCluskey, Verkleij, Robert and Smith 2019). There are about 200 species of edible fungi which have low carbohydrate and fats but are excellent sources of essential amino acids, protein, vitamins, minerals and energy making them excellent source of human food, about 700 species of fungi have been found to have therapeutic properties (Reshetnikov, Wasser and Tan, 2001), making them a good source of biologically active compounds for use in the pharmaceutical industry. In Nigeria a lot of fungi species found in the wild have served edible and medicinal purposes (Ayodele and Okhuoya 2007; Ukoima et al., 2009). Fungi play significant role both in nature and in

the human economy as they could be used as supplementary medicine and food sources both functional and supplementary (Slusarczyk, Adamska and Czerwik-Marcinkowska, 2021). Indigenous of various environment and cultures are aware of the mushrooms that are edible and have medicinal values around their environment in Nigeria, but no significant attention has been given to this indigenous knowledge about edible and medicinal mushrooms among the different tribes in Nigeria (Akpaja *et al.*, 2003).

Waste and wealth

Dictionary definition of Waste is any unwanted or unusable material or any substance discarded after primary use or worthless, defective and of no use material. A byproduct, by contrast is a joint product of relatively minor economic value. Any unavoidable material resulting from domestic activity or industrial operation for which there is no economic demand and which must be disposed of is waste (Sridhar 1996). Wastes are being generated across the world and all too often no solution is in place to reuse or recycle this waste. The concept of waste to wealth which is the transformation of waste from an exhausted utility to valuable commodity as a mechanism for effective solid waste management is yet to be properly utilized in Delta State (Egun 2012; Vaksmaa, *et al.*, 2023). Deposition of waste in unauthorized landfill is a common practice in Nigeria that is injurious to the ecosystem worldwide and this action brings about the alteration of the ecosystem and this has become a treat to the society (Etaware, 2021).

Wealth on the other hand is an abundance of valuable possession or measures the value of all the assets of worth owned by a person, community, company or country, total market value of all the physical and intangible assets owned by them subtracting all debts. Waste to wealth is converting unwanted or unusable materials to valuable possessions that will improve the economic, health and nutritional value of an individual, society or nation lead to sustainable growth of such a nation.

Fungi impacts on waste-to-wealth generation

Fungi are described as group of eukaryotic organisms; these organisms are grouped into moulds, mushrooms and toadstools, rusts, smuts, mildews and yeast. They are typically found in the soil and plant matter and have significant impacts on man and his environment. Different fungi causes different diseases, some of such fungi as recorded by NIAIDS (2022) *Candida* is yeast that causes candidiasis, *Cryptococcus* fungi causes Cryptococcosis, *Aspergillus* is a common mold that causes aspergillosis, *Coccidioides immitis* and *C. posadasii* are fungi that causes Coccidioidomycosis, Histoplasmosis is caused by the fungus *Histoplasma capsulatum*, Blastomycosis is an infection caused by the fungus *Blastomyces dermatitidis*, Pneumocystis pneumonia, called PCP, is caused by the fungus *Pneumocystis jirovecii* which causes a lot of waste and losses especially in the agricultural sector of crop and animal production, although there are a lot of hazards, if fungi is put to proper use it will create an avenue for waste-to-wealth generation processes, ranging from economy improvement to resource conversion.

Fungi and its products are very important channel of bringing about change towards a more sustainable future of the society as they are capable of transforming raw materials and wastes into valuable commodities, thereby providing economic benefits and they are specialized in breaking down plant materials as such have been found to produce biodegradable compounds which can aid in waste decomposition. Apart from improving food, one of the essential points in relation to production of mushroom in Nigerian is the conversion of ordinarily valueless or toxic wastes of different sources to value added products through a permaculture system (Okhuoya, *et al.*, 2010). Moreover, fungi can be

used to extract and transform metals and organic molecules, allowing for the better use of resources in a circular economy, it can also be used to reduce hazardous waste generation, thereby improving human health and environmental protection. In industry such fungal products can be brought in use for converting bio-waste and agricultural crop residues into bioenergy, biomaterials, biochemicals, biofertilizer etc (Sridhar and Hammed, 2014).

They play a major role in recycling the dead and decayed matter. The mushrooms species which are cultured are edible and are used as food by humans. There are many fungi that are used to produce antibiotics and to control diseases in humans and animals. Penicillin antibiotic is derived from a common fungus called *Penicillium*. Fungi are involved in exploiting insects, other small worms and help in controlling pests. Spores of fungi are used as a spray on crops. Fungi play a major role in recycling organic material and are also responsible for major spoilage and economic losses of stored food. In composting fungi colonizes a mixture of heterogeneous substrates such as a municipal solid waste and cattle manure with straw, many fungi can grow on solid substrate and secretes extracellular enzymes that break down various polymers to molecules that are reabsorbed by the fungal colony (Cohen and Hadar, 2009). Different edible and medicinal mushrooms abound in different ecological zones in Nigeria. For instance, *Tricholoma* Spp and *Schizophyllum* Spp are predominantly found in the forest region while *Rusula* Spp and *Lactarius* Spp are commonly found in the grass land in Nigeria (Okhuoya, 1997). Fungi can play a key role in waste to wealth conversion in Kogi State as the byproducts of fungi cultivated on agricultural and industrial waste can be used to produce various items such as medicines, food supplements, animal feed, bioplastics and electricity in the form of biogas, fungi may be used to enhance the fertility of soil and improve the productivity of crops. It is therefore important to explore the key roles of fungi in waste to wealth initiative examining their potential to generate value for the environment and society.

Objectives of the Study

- 1) To identify role of fungi in waste to wealth conversion initiatives in Kogi State
- 2) To document the indigenous knowledge and uses of various fungi by people of Kogi State.
- 3) To identify the level of people's awareness of potentials of fungi role in waste to wealth

Materials and Methods

The method of Okigbo RN, Nwatu CM. 2015 and Akpaja, E.O., Isikhuemhen, O.S. and Okhuoya, J.A. (2003) was used in the study area which involved the use of a well-structured questionnaire to obtain vital information from the respondents.

Study Area

The area to be covered is all the senatorial zones (Kogi West, Kogi east and Kogi central) which consist of 18 Local Government areas, made up of Yoruba, Igala and Ebara speaking respectively. The area rich in both forest and savanna vegetation is home to a vast collection of plants (including Fungi) upheld in folklore as having useful medicinal applications as well as other uses. The vegetation of the area is typical of the derived savanna. The area is characterized by a mean annual rainfall of about 1,260mm. Rainfall begins in April and ends in October and dry season from November to March. Rainfall has two maxima, July and September. Within the dry season, harmattan sets in. The average annual temperature is 27⁰ C.

Sampling Frame

The respondents to questionnaires were from the three senatorial district of Kogi State, Nigeria. Four hundred and fifty (450) respondents were interviewed by way of serving those questionnaires or

interview for the non-educated respondents using questions on the questionnaires. The choice of selecting Kogi State was because the area consists of a lot of forest and savanna vegetation that supports fungal growth and in addition, the people had similar cultural and traditional beliefs.

Sampling Procedure

Administration of Questionnaire

A well-structured questionnaire was designed to assist in obtaining crucial information from the people in the study areas. One hundred and fifty (150) questionnaires were randomly distributed to each senatorial district making a grand total of four hundred and fifty (450) questionnaires used in this survey. The questionnaire was constructed to get vital information as follows:

- 1) Respondents' Age
- 2) Types of fungi found in the wild and around the homes
- 3) Traditional uses of the identified fungi among the people
- 4) Perception of other fungi that does not belong to mushroom
- 5) Whether the people are aware that some edible mushrooms can be cultivated
- 6) Whether the people are aware of potentials of fungi role in waste to wealth
- 7) Whether the people have knowledge of waste to wealth initiative in relation to fungi

Result

The age of the respondents ranged from 30 to 80 years old. The highest number of respondents fell between 61 to 70 years followed by 51 to 60 years, few elderly people 71 – 80 were found. Although the questionnaires were randomly distributed, it was those that had the knowledge of fungi and were ready to fill or answer the questions on the questionnaire that provided the data and it was discovered that it is the age group of 55 and 75 that have better knowledge of indigenous importance of fungi.

The respondents interviewed provided vital information on the indigenous uses of Fungi especially those of edible and medicinal mushrooms identified.

Fungi	Number	Percentage
Moulds	21	27.27
Mushrooms and toadstools	45	58.44
Rusts	3	3.90
Smuts	1	1.30
Mildews	6	7.79
Yeast	1	1.30

77 different species of fungi were identified in this study as shown on Table 1. Mushrooms (Edible and non-edible) has the highest identification 58.44%, followed by mould 27.27%, then Mildew 7.79%, Rust has 3.90% and the least percentage is Yeast and Smut 1.30% respectively.

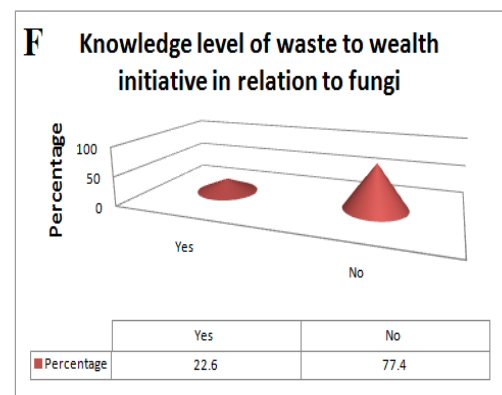
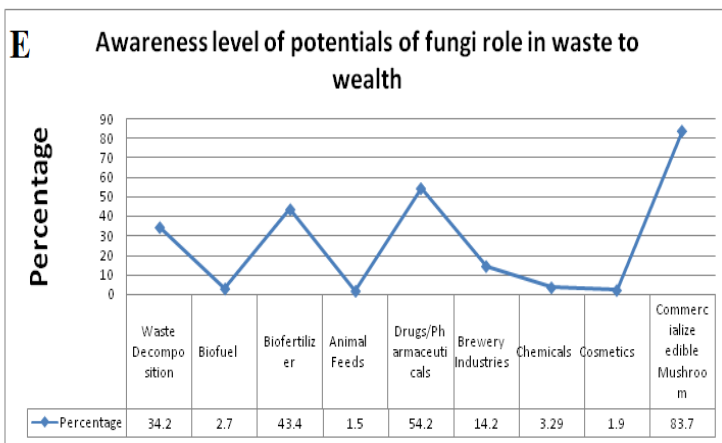
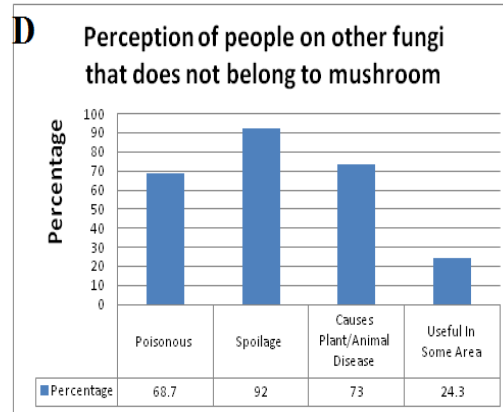
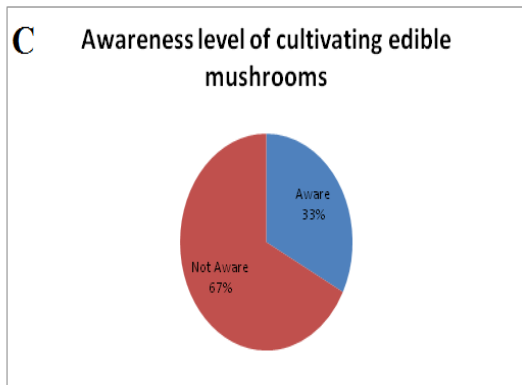
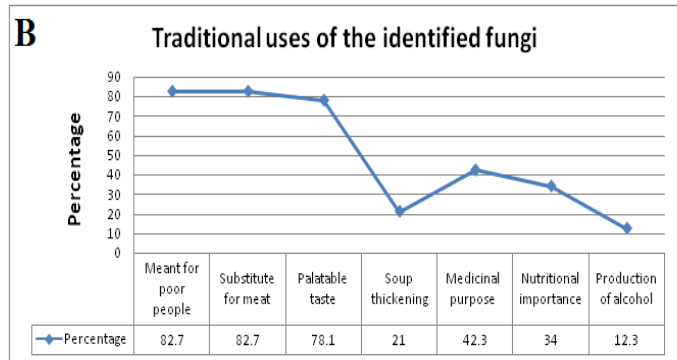
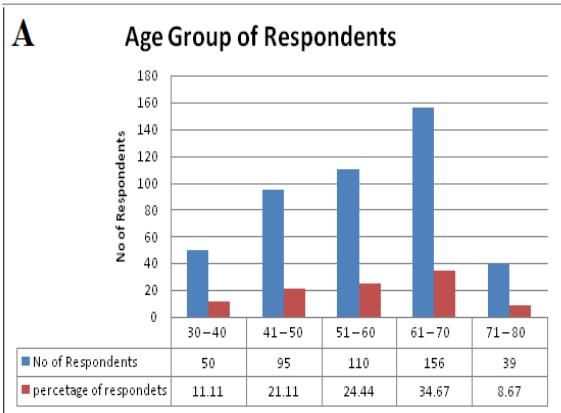


Fig A - F:
 A. Age of respondent
 B. Traditional uses of the identified fungi
 C. Awareness level of cultivating edible mushrooms
 D. Perception of people on other fungi that does not belong to mushroom
 E. Awareness level of potentials of fungi role in waste to wealth
 F. Knowledge level of waste to wealth initiative in relation to fungi

Various reasons were given why edible mushrooms were consumed in the study areas, these reasons

include majority of the people (82%) believed that it is meant for poor people as it can stand as substitute for meat, others (78.1%) agree that the taste is palatable, about 42.3% of the respondents agreed with the use for medicinal purposes, it seem that the educated ones are those that consented to the nutritional values and very few (21%) agreed with its use for soup thickening.

Majority of the people (67.4%) are not aware that some edible mushrooms can be cultivated; this could be as a result of its abundance in wild were they are collected freely during its season.

People's Perception of other fungi that does not belong to mushroom from the data collected shows that apart from edible mushroom all other group and species of fungi are almost useless to the society and that in fact they cause harm rather than good and as such should be destroyed or eliminated from the ecosystem . 68.7% of the respondents sees them as poisonous, 92% agreed that the cause spoilage to their farm products and food, while 73 % believed they causes plant/animal disease, only a few (24.3%) believed that they could be useful in some area.

The people's awareness on potentials of fungi role in waste to wealth is very low as they believed that apart from edible mushroom and those that serve medicinal purposes all other species of fungi are treat to human existence, this can be deduced from their percentage of agreement; Waste Decomposition (34.2%), Biofuel (2.7%), Biofertilizer (43.4%), Animal Feeds (1.5%), Drugs/Pharmaceuticals (54.2%), Brewery Industries (14.2%), Chemicals (3.29%), Cosmetics (1.9%), Commercialize edible Mushroom (83.7%) respectively.

Their knowledge of waste to wealth initiative is also very low; this could be as a result of their lack of awareness on the various potentials of the role fungi fungi can play in waste to wealth generation.

Discussion

Various form of fungi are found to abound in Kogi state, in this study 77 species are identified especially mushrooms and moulds, these are essential in transforming Kogi State by improved food, nutrition, health and economy towards a more sustainable future and valuable economy as they are capable of converting raw materials and wastes into essential properties through specialized action in breaking down plant materials as such have been found to produce biodegradable compounds which can aid in waste decomposition, this agrees with Okhuoya, *et al.*, 2010 who reported that apart from improving food, one of the essential points in relation to production of mushroom in is the conversion of ordinarily valueless or toxic wastes of different sources to value added products through a permaculture system .

In the study area people sees fungi especially mushroom to be vital for its commercial, nutritional and medicinal value although majority of the people (82%) believed that edible fungi (Mushroom) is meant for poor people and can stand as substitute for meat, others about 42.3% of the respondents agreed with the use for medicinal purposes, it seem that the educated ones are those that consented to the nutritional values. Majority of the people (67.4%) are not aware that some edible mushrooms can be cultivated; this could be as a result of its abundance in wild were they are collected freely during its season. People's Perception of other fungi that does not belong to mushroom from the data collected shows that apart from edible mushroom all other group and species of fungi are almost useless to the society and that in fact they cause harm rather than good and as such should be destroyed or eliminated from the ecosystem . This could be as a result of harm they cause to their farm produce

The people's awareness on potentials of fungi role in waste to wealth is very low as they believed that apart from edible mushroom and those that serve medicinal purposes all other species of fungi are treat to human existence, this can be deduced from their percentage of agreement. Their knowledge of

waste to wealth initiative is also very low; this could be as a result of their lack of awareness on the various potentials of the role fungi can play in waste to wealth generation.

Conclusion

Fungi can play a key role in waste to wealth conversion in Kogi State which is an Agrarian environment. The byproducts of fungi cultivated on agricultural and industrial waste can be used to produce various economically valuable items such as medicines, food supplements, animal feed, bioplastics and electricity in the form of biogas, fungi may also be used to enhance the fertility of soil and improve the productivity of crops, thereby increasing income of farmers and reducing the amount of waste produced in the region.

Recommendation

It is recommended that:

- The indigenous people be educated on the various potentials of fungi especially those seen to have caused wastages in the waste to wealth generation
- People should be enlightened on different initiatives on the role of fungi that could lead to waste to wealth generation in the State
- Government, industry, and stakeholders should collaborate to ensure the potential of fungi is leveraged to promote sustainable development in the region.
- Various species of fungi and their traditional uses should be properly documented

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