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Proclivity to Use Poultry Waste for Productive and Environmentally Safe Management Among Poultry Farmers in Oyo State Nigeria

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Abstract

The study investigated the proclivity to use poultry waste for productive and environmentally safe management among poultry farmers in Oyo State, Nigeria.

A total of one hundred and twenty-five (125) poultry farmers were selected using a multi-stage random sampling technique. Data were analysed using percentages, mean and standard deviation. The mean age of respondents was 58 ± 11.7 years, with 64% male and 80.8% being married. The majority (97.6%) had formal education and made an average monthly income of ₦340,000.00K \pm 95,185. Respondents had a high level of awareness (76.8%), had high level of perception (57.6%) and a high proclivity to use poultry waste for productive and environmentally safe management. Labour scarcity ($\bar{x}=1.73$) was the major impediment to the use of poultry waste for productive and environmentally safe management. Educational status,

awareness level and perception to use poultry waste for productive and environmentally safe management influence proclivity to use poultry waste for productive and environmentally safe management. The respondents are willing to use poultry waste for productive and environmentally safe management. Younger people should be encouraged to take up poultry production as a profession and engineers should develop small equipment that can be used to dispose wastes.

Introduction

The poultry industry is arguably one of the world's largest and fastest-growing agro-based industries due to the rise in demand for poultry meat and its products because of their nutritional values (Nwokoma, Mayeen, Kolo and Bradley, 2020). The increase in demand for poultry meat could also be as a result of its acceptance by most societies and its relatively low cholesterol content. The production of poultry results in colossal waste such as hatchery waste, manure (bird excrement), litter (bedding materials: sawdust, wood shavings, straw etc.), farm mortalities and processing wastes (offal, feathers, entrails and organs of slaughtered birds, processing water and bio solids) (Akporube, et al. 2023). Most of these by-products can provide organic and inorganic nutrients that are of value if managed and recycled properly, regardless of flock size. Poultry farm waste can also be a source of elements, chemicals, veterinary drugs, pathogenic microorganisms, pest- and vermin-carrying insects, as well as other toxins that are harmful to both human health and the environment (Akporube, et al., 2023). Improper waste management is detrimental to human health, leading to potential pollutants affecting water and air qualities and in some cases, the environment by depleting the ozone layer when burnt, thereby increasing the impact of climate change (Ayilara, Olanrewaju, Babalola and Odeyemi, 2020).

Specific concerns that were well documented include degradation of nearby surface and or groundwater resulting from increased loading of nutrients such as nitrogen, phosphorus and potassium in some locations. Hydrogen sulphide and other volatile organic compounds are emitted into the atmosphere as pollutants from the metabolic breakdown of poultry waste products, generally under low oxygen conditions causing offensive odours. According to Akporube, et. al., (2023) wastes produced from poultry houses and products contaminate the air thus affecting air quality as ammonia, hydrogen sulphide, dust particles and other volatile organic compounds (VOCs) emitted are associated with health disturbances and nuisance odorants in individuals living near these poultry farms. Greenhouse gas emissions and health effects associated with nuisance odours are also emerging and/or relevant issues, owing to global climate change and increasing human population near poultry production operations.

The continuous application of both chemical Nitrogen fertilizers and organic manures including poultry waste to the soil in most cases exceeds the amounts for crop growth requirements leading to Nitrogen loss, this significant amount of Nitrogen in soil may be lost to the environment as ammonia (NH₃) and other gaseous emissions (NO₃ or

N₂O) which has major consequences on global human and environmental health (Mahmud, Panday, Mergoum, and Missaoui, 2021). Most poultry manure and litter are dumped to land near poultry production farms in most developing countries including Nigeria. This often leads to nutrient imbalance and adverse environmental or health effects when land application of the nutrients exceeds crop utilisation potential.

Similarly, if poor poultry waste management practices were deployed, it may result in nutrient loss due to soil erosion or surface runoffs during rain that contaminates surface and underground water by potential pollutants, or pathogens contained in the manures, or litter particularly if drinking water supply is affected. The issue is increasingly complex owing to the trend of producing meat and eggs under the intensive system that requires the production of large quantities of poultry per unit area of land which leads to the production of more poultry waste.

There has been a significant increase in the production of poultry wastes due to an increase in poultry farming (Ali, Khadija and Mahe, 2020). According to (Gbigbi, 2020), the estimated daily poultry waste generation in most poultry farms is between 0.09kg and 0.18kg, depending on the farm size and considering the large numbers of bird production in Oyo State shows that the volume will be enormous. However, there is no accurate data on the actual quantities of waste production in the state.

The environmental issues of pollution of poultry waste in certain areas of concentrated farms have become so great that poultry farm owners are beginning to understand the enormity of the problem.

Hence, many different poultry waste management practices have been developed over the years to address these problems most of which have been deployed in Oyo State. Such management practices include land application of poultry wastes or litter as an organic fertilizer, closed loop system, composting, direct combusting to generate electricity, biofuel and anaerobic digestion (Chia, Chew, Le, Lam, Chee, Ooi and Show, 2020); Tait, Harris and McCabe, 2021). Other disposal management practices used were, as fish feed and as cooking fuel.

Meanwhile, poultry waste in Nigeria has not been properly managed owing to several factors including ignorance, lack of technical knowledge, high cost of management, unavailability of appropriate technology and lack of policy initiatives. However, friendly policies have received low compliance among poultry farmers. Hence, the physical and economic development of the host communities is affected resulting in huge private and social costs for the individual and the entire nation. This is arguably the most powerful cause of soil and air pollution in most cases.

Furthermore, Akporube, et. al., (2023), noted that existing disposal methods for poultry waste in Nigerian cities are neither cost-effective nor environmentally friendly. Therefore, issues relating to the environment, human health, potential income gain and the quality of life for the poultry farmers as well as the people living near and far

from poultry production operations, particularly in urban areas make waste management a critical consideration for the long term growth and sustainability of poultry production (Gbigbi, 2020) given the large volume of poultry waste generated on the farms and the need for their disposal. Therefore, it is against this backdrop that the study investigated the proclivity to use poultry waste for productive and environmentally safe management among poultry farmers in Oyo State, Nigeria. The following specific objectives were assessed:

1. assess the level of awareness of the respondents on alternative ways of disposing of poultry waste for productive and environmentally safe management,
2. evaluate the respondents' perception of the use of poultry waste for productive and environmentally safe management,
3. examine the constraints faced by the respondents in disposing of waste for productive and environmentally safe management,
4. ascertain respondents' proclivity to use poultry waste for productive and environmentally safe management.

Hypotheses

1. There is no significant relationship between respondents' level of awareness of alternative ways of disposing of poultry waste for productive and environmentally safe management and their proclivity to use poultry waste for productive and environmentally safe management.
2. There is no significant relationship between respondents' perceptions of the use of poultry waste for productive and environmentally safe management and their proclivity to use poultry waste for productive and environmentally safe management.

Methodology

The study was conducted in Oyo state. It lies between latitudes 7°2" and 9°1" North of the Equator and between longitude 2°5' and 4°3" east of Greenwich meridian and its capital at Ibadan (Fadairo, Adeleke and Olowofoyeku, 2019, Okonta, et al., 2023). Oyo state has 33 local government areas. The study was conducted in Oyo state because of the fairly high concentration of poultry production in both the urban and rural areas of the state. The population of the study consists of poultry farmers registered with the Poultry Farmers Association of Nigeria, Oyo state chapter, Nigeria.

Multi-stage sampling procedure was employed for the study. The first stage involves the purposive selection of three Poultry Farmers Association zones out of the five in the state due to the high concentration of poultry farmers in the areas. The zones selected were Ibadan 1, Oyo and Ogbomosho poultry zones. The list of registered poultry farmers was obtained for each zone and fifty (50%) of the registered farmers were randomly selected from the zones to make a total of 125 respondents for the study. Primary data were collected using a well-structured questionnaire and administered to the farmers through trained extension agents in the respective zones. The level of awareness of the respondents on alternative ways of disposing of poultry waste for productive and environmentally safe management was measured by listing

nine (9) ways of disposing poultry waste for productive and environmentally safe management with the response options of aware with a score of 1 and not aware with a score of 0. The minimum and maximum scores of 0 and 9 were obtained respectively. The mean score (4.76) was obtained and used to categorise respondents as having high level of awareness on alternative ways of disposing poultry waste for productive and environmentally safe management for values between 4.76 and 9 and low for values below 4.76.

Respondents' perception of the use of poultry waste for productive and environmentally safe management was measured by providing twelve (12) perception statements on the use of poultry waste for productive and environmentally safe management and their responses were captured using the 5- 5-point Likert-type scale of strongly agreed, agreed, undecided, disagreed and strongly disagreed with a scores of 5,4,3,2,1 respectively for positively worded statements and the reverse order of scoring for the negatively worded statements. The minimum score was 12 and the maximum was 60. The mean score was computed and used to categorise respondents as having a high level of perception for values between the mean (28.57) and 60 and low for values below the mean (28.57).

The list of ten (10) constraints facing the poultry farmers was presented to the farmers and asked to rate the constraints in terms of their severity on three (3) a point scale of not a constraint with a score of 0, mild constraints with a score of 1 and serious constraint with a score of 2. The constraints with the highest weighted means were considered the most severe constraints confronting the processors in disposing of poultry waste for productive and environmentally safe management in decreasing order.

The proclivity to use poultry waste for productive and environmentally safe management was measured with fourteen (14) management practices of poultry waste for productive and environmentally safe goals presented to the respondents with the following response options of willing with a score of 1 and not willing with a score of 0 assigned. The minimum and maximum scores of 0 and 14 were obtained respectively. The mean score was obtained and used to categorise respondents as having a high level of proclivity to use poultry waste for productive and environmentally safe management for values between the mean (6.63) and 14 and low for values below the mean (6.63). The data were analysed using a social science statistical package (SSSP) and the results were organised into percentages, means, standard deviations and some inferential statistics.

Results and Discussion

Awareness of Respondents on Alternative Ways of Disposing Waste for Productive and Environmentally Safe Management.

Table 1 shows that the majority (83.3%) of the poultry farmers were aware of the use of poultry waste as soil conditioner and organic fertilizer, 80.8% were aware of turning of poultry waste into feed ingredients and 78.4% were aware of the application of poultry waste on arable land. Ayilara, et al. (2020), confirmed that the application of compost from organic waste including poultry waste increases agricultural productivity and the organic matter content of the soil. This result implies that poultry farmers were aware that poultry waste can be used to enhance soil nutrients.

Level of Awareness on Alternatives Ways of Poultry Waste for Productive and Environmentally Safe Management

Table 1 reveals that 76.8% of the respondents had a high level of awareness of alternative ways of disposing of poultry waste for productive and environmentally safe management. This result is expected as the majority of the poultry farmers had one form of education or the other. Education helps an individual to have a critical analysis of problem at hand through reading wide and gaining knowledge on the subject matter to arrive at a better way to solve the situation. This could probably be the reason for the high level of awareness of alternative ways of disposing of the waste. According to Izuogu, et al., (2023), farmers' awareness of a new technology like certified rice seeds is the take-off point of their adoption of the technology and it will also influence their rate of adoption of the innovation. The level of awareness of the poultry farmers on different ways of disposing of poultry waste is also likely to influence their proclivity to adopt some of the environmentally friendly management practices that may be novel at that time and possibly put them to use.

Table 1: Awareness of alternative ways of disposing of poultry waste for productive and environmentally safe management

Variables	Awareness (%)	Mean/SD
Application to arable land	78.4	
Livestock feeding	74.4	
Buried in the soil method	74.4	
Burning after sun dried	76.0	
Turn to feed ingredients	80.8	
Used as soil conditioner and organic fertilizers	83.2	
Burning through biological means	61.6	
Use as cooking fuel	67.2	
Sold to biogas to power generators	24.0	
Level of awareness		
Low (< 4.76)	23.2	4.76±0.42
High (4.76-9)	76.8	

S/D=Standard deviations

Perception of Poultry Farmers on the Use of Poultry Waste for Productive and Environmentally Safe Management

Table 2 reveals that the perception of the poultry farmers on the use of poultry waste for productive and environmentally safe management was; that poultry waste can be applied to the land ($\bar{x} = 5.0$), selling of poultry waste as manure to generate additional income ($\bar{x} = 4.2$), use of poultry waste to generate biofuel ($\bar{x} = 4.00$), used as a pathogenic killing agent ($\bar{x} = 4.0$), used as feeds for livestock ($\bar{x} = 4.0$) and recycling the poultry waste for effective management ($\bar{x} = 4.0$). The result implies that poultry waste can be used in a productive and environmentally safe management manner to enrich the soil for agricultural productivity, generate additional income for the farmers and be used to produce useful products such as biofuel, and pesticides and incorporate in formulating animal feeds. All these perceived uses of poultry waste as identified by the respondents are essential to influence the farmers' perception of viewing the poultry waste as a serious threat to their profession but rather see the poultry waste as another money-making enterprise and as such influence their perception of the poultry waste and their willingness to adopt environmentally safe management practices.

Level of Perception of Poultry Farmers to Use Poultry Waste for Productive and Environmentally Safe Management

Regarding their level of perception to use of poultry waste for productive and environmentally safe management, Table 2 reveals that the poultry farmers had a high level of perception (57.6%). The result is in tandem with the findings of Nwaobiala, et al., (2022) show that farmers had a favourable perception of innovative technology like cassava-maize intercrop technologies of the Sassakawa Glogal 2000 project. This indicates that many of the respondents have a favourable perception of using poultry waste for productive and environmentally safe management. The reason for this could be that poultry waste has been constituting a nuisance to them and the need to address the problem hence affecting their perception to use the waste more productively and safely to make the environment healthy. To achieve this, the poultry farmers will have to be innovative and be willing to try new things that might have informed their perception to use poultry waste for productive and environmentally safe management.

Table 2: Perception of the use of poultry waste for productive and environmentally safe management

Statements	Mean/SD	
Use on arable land	5.0 ± 1.0	
Use to generate biogas	4.0 ± 1.1	
Use for improving soil nutrient content for plant growth	4.0 ± 1.0	
Used to reduce environmental pollution	3.0 ± 1.5	
Use as feed for livestock feed	4.0 ± 1.4	
Selling poultry waste as manure to generate additional income	4.2 ± 1.0	
Use as raw materials for other farm enterprises	4.0 ± 1.2	
Use poultry waste to kill pathogenic organisms is a good practice	4.0 ± 1.1	
Use to prevent spending extra cost in treating infection	4.0 ± 1.0	
Use as soil conditional and organic fertilizer	4.0 ± 1.1	
Use for treatment of heavy metal contaminated water	4.0 ± 1.3	
Recycling for effective management	4.0 ± 1.3	
Level of perception		
Low (<28.57)	42.4	28.57±0.49
High (28.57-60)	57.6	

S/D=Standard deviations

Constraints Faced by Poultry Farmers in Disposing Poultry Wastes for Productive and Environmentally Safe Management

Table 3 reveals that the prominent constraint faced by poultry farmers in disposing of poultry wastes for productive and environmentally safe management was lack of labour (\bar{x} =1.73). This was followed by inadequate disposal facilities (\bar{x} =1.4) and poor pricing of poultry waste with weighted mean scores of (\bar{x} =1.4). Lack of labour is expected because of the small household size that would have assisted in the day-to-day running of the enterprise. The cost of labour is an important factor that makes labour a constraint in the disposal of waste. Having a larger household size could have helped to reduce the cost of labour, thereby making poultry production more profitable. Also, the hazardous nature of the waste and the offensive odour oozing out of the waste might have been some of the reasons for this finding since most people would not be willing to work in such an enterprise. In addition, waste disposing facilities that could be used for disposing waste are not available which makes disposing of the waste more stressful and difficult at times with serious consequences on the available labour.

Table 3: Constraints faced by poultry farmers in disposing poultry wastes for productive and environmentally safe management

Statement	Severe constraint (%)	Mild constraint (%)	Not constraint (%)	Mean
Labour scarcity due to irritation	80.0	12.8	7.2	1.73*
Insufficient fund	37.6	50.4	12.0	1.26
Lack of extension service	56.8	22.4	20.8	1.36
Low demand for manure from farmers	45.6	39.2	15.2	1.30
Lack/inadequate knowledge on poultry waste management	48.8	28.8	22.4	1.26
Lack of means of transport and high cost of hiring	41.6	34.4	24.0	1.18
Poor pricing of poultry manure	54.4	30.4	15.2	1.40
Inadequate waste disposing facilities	48.0	43.2	8.8	1.40
Difficult to burn during raining seasons	44.0	43.2	12.8	1.31
Bad attitude of farm workers	42.4	38.4	19.2	1.23

Proclivity to Use Poultry Waste for Productive and Environmentally Safe Management

Table 4 shows that the majority (94.4%) of the poultry farmers were willing to use poultry waste for productive and environmentally safe management during land preparation followed by 88.8% who were willing to use poultry as feeds to 85.6% were willing to manage poultry waste to prevent spending extra cost in treating infections 84.4% were willing to use poultry waste to enhance plant growth and 84.0% each were willing to sell poultry waste to generate additional income as well as to use environmentally safe poultry waste management. The proclivity of poultry farmers to use poultry waste for productive and environmentally safe management might be because poultry waste has been a persistent issue over time and the use of poultry waste for productive and environmentally safe management was probably the possible way to address it. The study shows that poultry farmers are now more aware of many possible ways to use poultry waste for productive, economic and environmental friendly and as such are willing to adopt new technologies to harness all the benefits associated with it. Gbigbi, (2020) observed that re-using poultry waste can be beneficial and economical if managed properly by farmers.

Level of Proclivity to Use Poultry Waste for Productive and Environmentally Safe Management

With regards to the level of proclivity to use poultry waste for productive and environmentally safe management, Table 4 reveals that 63.8% of the poultry farmers had a high level of proclivity to use poultry waste for productive and environmentally safe management. The result implies that majority of the poultry farmers are willing to put poultry waste into productive and environmentally safe management to gain additional income or to help solve the menace caused by poultry waste in the environment. The inherence benefits that have been identified such as poultry waste enhanced soil fertility, being incorporated into feed mills to feed livestock, and sold to

make more income could be part of the reasons that motivated the poultry farmers to be willing to practice the new innovations

Table 4: Proclivity to use poultry waste for productive and environmentally safe management

Statements	Willing (%)	Mean/SD
Use poultry waste during land preparation	94.4	
Use poultry waste to generate biogas	81.6	
Use poultry waste to enhance plant growth	84.8	
Use poultry waste as a raw materials for another enterprises on the farm	77.6	
Use poultry waste as a fish feed	88.8	
Use poultry waste to feed livestock	80.8	
Sell poultry waste to generate additional income	84.0	
Use poultry waste in environmentally safe management is high	84.0	
Use poultry waste to kill pathogenic agent in poultry waste	72.8	
Managing poultry waste to prevent spending extra cost in treating infection	85.6	
Use composting because it is environmentally acceptable	74.4	
Selling poultry waste out to ensure best practice of poultry waste	83.2	
Use poultry waste for treatment of heavy metal contaminated water	65.6	
Recycling waste in an effective manner	75.2	
Levels of proclivity	36.2	
Low (< 6.63)	63.8	6.63±0.48
High (6.63-14)		

S/D=Standard deviations

Relationship between Level of Awareness and Perception and Proclivity to Use Poultry Waste for Productive and Environmentally Safe Management.

Table 5 shows that there existed a significant relationship ($r=0.40$) between poultry farmers' level of awareness of alternative ways of disposing of poultry waste and proclivity to use poultry waste for productive and environmentally safe management. This implies that the more the respondents were aware of alternative ways of disposing of poultry waste, the more they were willing to use poultry waste for productive and environmentally safe management. The farmers now know the inherent benefits and better ways of disposing of the waste and they are also less bothered about the problem in the past of how to dispose poultry waste, hence they will be willing to use the waste in a more productive and environmentally friendly.

Table 5 shows that there was a significant relationship ($r=0.47$) between poultry farmers' level of perception to use poultry waste for productive and environmentally safe management and proclivity to use poultry waste for productive and environmentally safe management. This implies that the higher their perception of using poultry waste, the higher their proclivity to use poultry waste for productive and environmentally safe management. The respondents have a favourable disposition to use poultry waste for productive and environmentally safe management.

Table 5: Relationship between level of awareness on alternative ways of disposing and level of perception to use poultry waste for productive and environmentally safe management and proclivity to use poultry waste for productive and environmentally safe management

Variables	r-value
Awareness level of alternative ways of disposing poultry waste	0.40**
Perception level to use poultry waste for productive and environmentally safe management	0.47**

**p≤0.05

Conclusion and Recommendations

Respondents were willing to use poultry waste for productive and environmentally safe management and the only constraint to use it for the purpose was the lack of labour in the study area. Higher education status, increase in household size, increase in the numbers of birds reared and increase in the level of awareness can enhance the proclivity to use poultry waste for productive and environmentally safe management.

Youth should be encouraged by all stakeholders to take up poultry farming as a profession in their various empowerment programmes in the state through incentives such as soft loans or giving poultry equipment as start-off grants. Simple implements like scrappers to scrap and pack the waste in the poultry houses should be developed by the engineers to carry out tasks of disposing of poultry waste since labour was scarce. Government should provide waste disposal facilities for them or give them soft loans to assist them in acquiring some machines that can be used for poultry waste disposal because of labour scarcity.

References

- Akporube, K.A., Kalu E. Ikpendu C. and Edward I.G. (2023). Poultry waste management in Nigeria: a neglected sector. *Journal of Sustainable Veterinary and Allied Sciences*. Vol 4, Issue 2: 137-141.
- Ali, A, Khadija, G.and Mahe M. (2020). Poultry waste management options and opportunities: A short review. *Journal of Natural and Applied Sciences Pakistan*, 2 (2), 472-484.
- Ayilara, M.S, Olanrewaju, O.S, Babalola, O.O and Odeyemi O. (2020).Waste Management through Composting: Challenges and Potentials. *Sustainability*. 12 (11), 4456. doi:10.3390/su12114456.
- Chia W.Y, Chew, K.W, Le, C.F, Lam, S.S, Chee, C.S.C, Ooi M.S.L and Show, P.L. (2020).Sustainable utilization of biowaste compost for renewable energy and soil amendments. *Environmental Pollution*, 267. Available at <https://doi.org/10.1016/j.envpol.2020.115662>.
- Fadairo, O. S, Adeleke, O. A and Olowofoyeku B. O. (2019). Perceived effect of livestock waste on wellbeing of farm workers and residents within farm catchment area in Oyo State, Nigeria. *Agricultura Tropica et Subtropica*, 52 (:3–4), 139–147. DOI: 10.2478/ats-2019-0016/ats-20190016.
- Gbigbi, T. M. (2020). Contributing Factors of the Choice of Poultry Waste Management Practices: Evidence from Nigeria. *International Journal of Environment, Agriculture and Biotechnology*. 5 (3), 790.

- Izuogu, C.U., Nwokpoku, J.O., Orugbala, M.A., Azuamairo, G.C., Njoku, L.C., Agou, G.D., Olesin- Ibrahim, S., Inyang, P.J., Chinaka, I.C (2023) Awareness, access and utilization of certified seeds by rice farmers in Ebonyi State. *Journal of Agricultural Extension* 27(4), 80. <https://dx.doi.org/10.4314/jae.v27i4.8>.
- Mahmud, K, Panday, D, Mergoum, A and Missaoui, A, (2021). Nitrogen losses and potential mitigation strategies for a sustainable Agro-ecosystem. *Sustainability*. 13 (4), 2. <https://doi.org/10.3390/su13042400>
- National Population Commission, (2006:2010), National Population and Housing Census. A Publication of Federal Republic of Nigeria, Abuja, Nigeria.
- Nwaobiala, C. U, Igwe, C. O. K, Kalu, U and Akwada, S. N. 2022. Determinants of Farmers' Adoption of Sasakawa Global 2000 Cassava-Maize Intercrop Technologies in Abia State, Nigeria. *Journal of Agricultural Extension*. 26 (4), 15.
- Nwokoma, O.C, Mayeen, U.K, Kolo, M.T and Bradley, D.A. (2020). Metal uptake in chicken giblets and human health implications. *Journal of Food Composition and Analysis*, 85.. Accessed online from <https://doi.org/10.1016/j.jfca.2019.103332> on 9th September, 2022.
- Okonta, O.W., Ajala, A.O., Kolawole, E.A., Ogunjimi, S.I., Adejumo, A.A. (2023). Willingness to Adopt Organic Farming Practices among Arable Crop Farmers in Oyo State, Nigeria. *Journal of Agricultural Extension*. 27 (3), 43.
- Tait, S, Harris P.W and McCabe, B.K. (2021). Biogas recovery by anaerobic digestion of Australian agro-industry waste: A review. *Journal of Cleaner Production*. 299, 1-2. Available at <https://doi.org/10.1016/j.jclepro.2021.126876>.