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Management of organic waste impacts on the environment: Utilization as fish feed

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Abstract

The paper examines the roles organic waste residues have played in the development of aquaculture in Nigeria. The increasing interest in the use of organic waste in fish culture is propelled by the desire to sustain the growth in aquaculture. One major problem limiting sustainable growth of the fisheries and particularly aquaculture industry in Nigeria is the limited availability of affordable quality feeds. The use of organic waste provide not only cheap alternative source of fish feed but also eliminates the problems associated with indiscriminate dumping of organic waste in the environment because of the associated air, water and soil pollution. Dried poultry manure can be used as substitute complementary fish meal to replace soybean meal in the diets of *C. gariepinus* advanced fry. Maggots and earthworms, which have high percentages of crude protein, can be cultured from organic waste in commercial quantities. Proper utilization of organic waste can therefore contribute significantly to enhancing fish production by reducing feed cost; protect the environment and contribute to the abatement of climate change by reduction of greenhouse gas emissions. In addition, these wastes constitute sources of pollutants and other toxic materials which may be detrimental to human health in terms of it's potential as a medium for humans to contact diseases. Furthermore, organic wastes that are not properly treated and disposed, constitutes a high level of nuisance to the environment. Therefore, there is the need to develop appropriate or local technology for treatment of these wastes to eliminate problems associated with their utilization for gainful purposes to man and reduction of their adverse impacts to the environment.

Keywords: Management; Organic waste; Impacts on environment; Utilization; Fish feed

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1. Introduction

Fish culture is the fastest growing food industry in the world, at an average rate of 11.0% since 1984 compared with livestock's 3.1% per year. In Nigeria, it has grown by over 100 percent in the past ten years and she is the second largest aquaculture country in Africa after Egypt. The growth is driven by dwindling supply from wild fisheries, increasing population and economic needs. According to Alam et al. (2009) fish feed and fertilizer play the key role for fish production in the conventional fish culture system, representing about 60-70% of production costs. At present, a large percentage of high quality fish feeds are said to be imported, with about 45,000 metric tons imported in 2010 (FDF, 2012). However, in most cases, farmers cannot afford to purchase the feeds and fertilizer round the year. As a result, the unsatisfactory fish feed and fertilizer management have contributed in widening the gap between target fish production and demand over the decades. With recent improvement in the supply chain in these products throughout Nigeria, it is expected that fish production would be boosted.

The use of conventional feeding stuffs such as grains and proteins of animal origin for aquaculture feeds are no longer economical because of increasing demand by humans and livestock industry. One major problem encountered by aqua culturists in Nigeria is therefore the limited availability of affordable quality feeds. The use of organic waste may provide not only an alternative source of cheap quality fish feed but also eliminates the problems associated with indiscriminate dumping of organic waste in the environment. Proper utilization of organic wastes can contribute significantly to reduce feed cost and turn waste into flesh (Table 1), protect the environment and climate by reduction of harmful gas emissions.

Table 1. Fish biomass production range from livestock manure

Manure Source	Fish biomass production range (Kg yr^{-1})
One dairy cow	100-200
One beef Cattle	90-160
One sheep	10-17
One laying hen	6-8
One broiler	3-4
One turkey	7-8

Source : Muller (1980)

Current waste management philosophy all over the world attempts to treat all wastes as resource material (starting material or product, not an end product) through recycling and conversion to other useful products as a means of achieving sustainable development (Baig et al., 2003; Hettiaratchi, 2007). It is therefore important that all potential and feasible unconventional sources of feed stuff or supplementary feed such as farm produce wastes be exploited to enhance the production of fish in Nigeria. Cost of fish produced utilizing such feed inputs will definitely be significantly cheaper compared to using the conventional feed ingredients. This will at the same time help to keep the environment relatively clean from these wastes that would have otherwise contributed immensely to the waste stream of generating localities at very little or no cost. The purpose of this paper is to therefore generally review the utilization of organic waste as a source feed in fish culture.

2. Surveys of organic waste in Nigeria

Good information on the types, amounts, and availability of different organic wastes that might be utilized in fish culture are lacking in Nigeria. The increasing cost of fish feeds and competing demand for conventional feed compounding ingredients by both humans and livestock make this information imperative. One problem associated with organic waste utilization is inability of generators to sort them. Great effort and education would be needed to prevail on generators of waste to sort them or categorize them.

However, Nigeria produces large quantities of organic wastes in the form of agricultural and agro-industrial by products (Oladeji, 2011), which could serve as alternatives sources of conventional feeds. About 60% of wastes collected in Nigeria are organic waste (Ogwueleka, 2009). An estimated 0.34Kg of waste per person is generated daily in Nigeria (Shridar, 2007). A city with an estimated one million inhabitants produces 50,000 tonnes of effluent water and 2,000 tonnes of waste material daily (Deelstra, 1989). However, differences in waste production between the industrialised and developing countries have been observed. Kano, a cosmopolitan city in Nigeria has on the average; 1.4 million persons generate about 450 tonnes of wastes per day (Lewcock, 1994), São Paulo (13 million) approximately 10,000t per day. Therefore, for Nigeria with a population of about 170,000,000 people, about 3 million tons of waste generated daily is a huge resource of enormous economic importance.

According to Parr et al. (1986), organic wastes can be grouped into 7; namely, (a) animal manures, (b) crop residues, (c) sewage sludge, (d) food processing wastes, (e) industrial organic wastes, (f) logging and wood manufacturing wastes, and (g) municipal refuse. Of these animal manure is of greatest importance in fish culture in Nigeria. Animal wastes include cow dung, poultry droppings, pig excreta and human excreta. Poultry and livestock industry in Nigeria generates about 932.5 metric tonnes of wastes produced annually (Adewumi et al., 2011). The use of animal manure in feeding fish is widely reported in literature including Tilapias (*Sarotherodon mossambica*) (Stickney and Simmons, 1977), channel catfish (*Ictalurus punctatus*) (Fowler and Lock, 1974; Lu and Kevern, 1975), the African catfish (*Clarias gariepinus*) (Oladosu et al., 1990) and gold fish (*Carassius auratus*) (Lu and Kevern, 1975).

Generally, organic wastes can be categorized into crop residues, animal manure, agro food organic wastes and by-products, organic wastes produced by shops, restaurants and households and those from sewage. Organic wastes common in Nigeria include plant matter such as plantain leaves, unripe and ripe fruits, pawpaw leaves, wet chaff from fermented milled or ground maize, palm kernel cake (by-product of oil processing), animal waste such as cow dung, poultry droppings, pig excreta and household waste among others (Oribhabor and Ansa, 2006).

Poultry droppings are very rich in nutrients. Several researchers have attempted complete or partial replacement of Fishmeal with poultry droppings or by-product meal with varying degrees of success (e.g. Stiffens, 1994). Table 2 shows the chemical composition of poultry droppings from different management systems.

Table 2. Percentage proximate constitution (dry matter) of chicken excrement (NACA, 1989)

Constituents	Raising above pond/cage	Ground raising	Dry grass/sawdust bedding
Moisture	11.4	12.3	15.5
Crude protein	26.7	21.9	22.3
Crude fat	1.7	1.7	2.3
Nitrogen-free extract	30.6	30.0	27.1
Crude cellulose	13.0	17.2	18.7
Minerals	16.5	16.9	14.1

The table show that Raising above pond/cage compared with Ground raising and Dry grass/sawdust bedding has by far the highest crude protein content (26.7, 21.9 and 22.3 respectively). Since the crude protein content of any feed stuff or ingredient is very critical to the growth of the organism being reared, it is therefore implied that Raising above pond/cage method should be encouraged as a deliberate source of generating animal feed from organic waste in Nigeria.

According to Panda (2013) "Organic waste from food sources includes vegetables, fruits, grains, meat, fish, and dairy products and constitutes some 18% of the typical municipal organic waste stream. An average of 1 kg per person per day of organic waste is produced, originating from households, wholesalers & processors, restaurants, and institutions" Waste utilization denotes multiple use of a given waste matter or material. The use of various kinds of organic waste has been integral part of sustainable agricultural practice in Nigeria (Ademoroti, 1996). Organic wastes are used as fertilizer and most times as composting substrates. According to Chopin et al. (2000), organic wastes have been used effectively as fertilizer for centuries for fish production in the far Eastern part of the world. Organic waste utilization is an ecologically safe and economically efficient method of waste management since it does not require spending money or disposal of waste in landfill that is likely to cause further pollution problems such as contaminating the ground water aquifer .

Despite the substantial availability of organic wastes and potentials of utilizing them to produce other products, management of waste are not well developed or effectively organized in Nigeria. However, current approaches may offer practical and cost effective solution to the problems of waste disposal faced in developing countries (Oribhabor and Ansa, 2006). Improvement on organic waste management and utilization could enhance fish production, and reduce greenhouse gas emission.

3. Methods of utilization of organic waste

Organic wastes have many useful applications; however, current level of utilization in Nigeria is very low. Organic waste is used for feeding livestock and poultry, fish and composting. Food wastes from restaurants are fed to dogs and other pets. The plant matter are used to feed snails, livestock and as composting and mulching materials, while the livestock and poultry wastes are used as manure for crops and fertilization of fish ponds. The microbial decomposition of livestock and poultry wastes enriches the water with nutrients for the growth of phytoplankton which forms the base of the food chain in aquaculture (Figure 1). The phytoplankton are consumed by zooplankton and ultimately fish (Aquaculture South Africa, 1999; Symoens, 1995). These organisms can supply 80% of nutrients required by fish for normal growth.

Lack of proper food item mainly zooplankton causes poor survival of spawned fishes (fry) in nursery ponds. Some organic wastes are particularly used in making supplementary feeds including crab meal, blood meal and bone meal (Bekibele et al., 1995). Livestock and poultry waste when appropriately treated represent valuable resource which can replace significant amount of inorganic fertilizer in fish production (Bowoan and Booji, 1998; Chan, 1998) and components of feed ingredients (Steffens, 1994). Organic waste is an asset in fish production. In China, about 40-50 kg of organic manure can produce 1 kg of fish (NACA, 1989)

In developing countries such as Nigeria, organic wastes serve as both food and fertilizer in an integrated approach to fish farming. Organic wastes are also used in maggots' production which can be fed directly to fish or used in making supplementary feed. Indirectly, maggots can be used as rich source of animal protein to replace fishmeal. Livestock and human wastes can be harnessed for energy production. Methane gas captured from anaerobic digestion of organic waste generates electricity which could be used to power aquaculture facilities. It is a well-established fact that one of the greatest challenges of successfully running and establishing re-circulatory aquaculture system in Nigeria like most developing nations where the energy supply is inefficient is limited or complete lack of adequate electricity to power such systems.

3.1. Integrated fish farming

Integrated fish farming is the combination of one or two agricultural practices with fish farming. Ayinla (2003) therefore observes that "Integrated fish farming is a diversified and coordinated way of farming with fish as main target". In integrated fish farming, many organic wastes are re-used as component of fertilizer

(Oribhabor and Ansa, 2006), composting substrate and compounded feed ingredient. The need to maximize food production at minimal production cost, concern for energy conservation (Mukherjec, 1995), competition for land and demographic increase appears to be driving this innovative approach of integrating fish farming system with either animal husbandry or crops. Though integrated fish farming system has long been practised in China and other Asian countries (Mukherjec, 1995), the concept is a recent development in Nigeria. Integrated farming activity leads to increased production per unit area at low input and better utilization of land. The use of livestock waste to fertilize fish ponds leads to greater fish yield as the manure provides active nutrients (NPK) that promotes the growth of plankton which is a natural food for fish (Ansa and Bashir, 2003). Some fish farmers build chicken pen over fish ponds where excess poultry droppings and chicken feed can be washed into the pond.

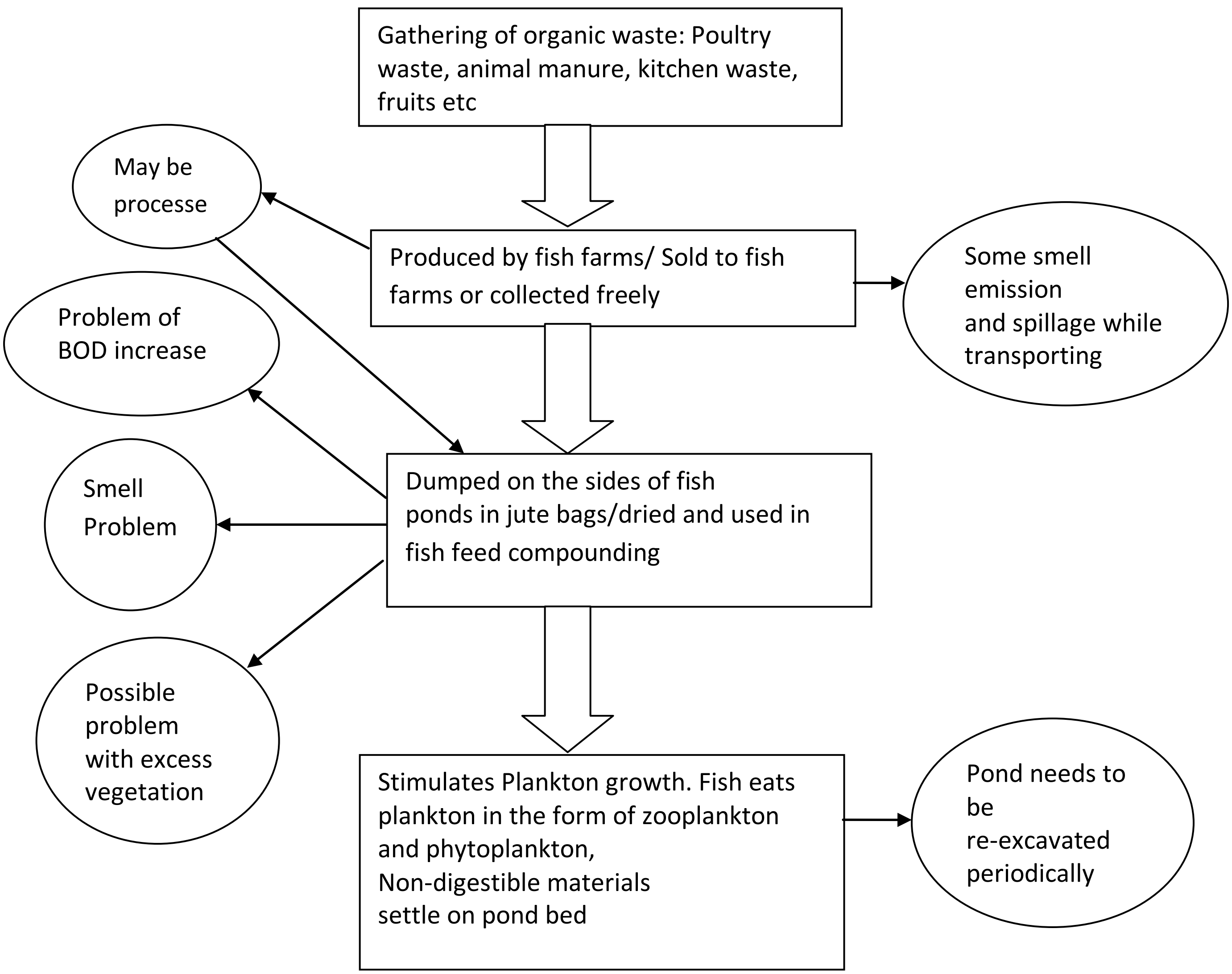

Figure 1. Impacts of Using Poultry Waste As Fish Feed

Examples of integrated fish farming include livestock-cum-fish, poultry-cum-fish and rice-cum-fish with fish as the main product.

3.1.1. Livestock-cum-fish

Different livestock production systems can be combined with fish production. The use of livestock waste to fertilize fish ponds leads to greater fish yield as the manure provides active nutrients (NPK) that promotes the growth of plankton which is a natural food for fish (Ansa and Bashir, 2003). This can reduce the cost of fish production considerably. Piggery pen may be built with flooring that allows waste to fall or swept directly into the pond. Pig excreta contain 70% digestible food and can therefore be utilized directly by fish as food. Pig fed with 16-17% protein mash produces manure containing 1.36- 2.0% nitrogen, 0.36- 0.39% phosphorous, potash and other secondary nutrients. Therefore pig manure acts as a good organic fertilizer which helps in producing phytoplankton and zooplankton in fish pond. A programme of integrated pig-fish farm totally eliminates the cost of application of extra fertilizer to fish pond and supplementary feeding to the cultured fish, thereby reducing the cost of fish production by as much as 50% - 60%.

According to Fasakin et al. (2000) animal waste may contain variable quantities of essential nutrients required by fish including non-digested feed, metabolic excretory products and residues resulting from microbial synthesis. These can be utilized to replace reasonable part of foodstuff used in conventional fish feed thereby causing decrease in fish feed production cost. Research to determine the proximate composition of dried pig excreta and their use in graded levels in fish feed formulation must be encouraged.

3.1.2. Poultry-cum-fish

This is the commonest type of integrating fish farming systems. Some fish farmers build chicken pen over fish ponds where excess poultry droppings and chicken feed can be washed into the pond. Adewumi and Adewumi (1996) reported that a layer produced an average of 161 g of droppings/bird day. Typically, poultry droppings contain 2.1% nitrogen, 64.3% phosphorous, 5.31% calcium, and 2.11% magnesium (Odoemena, 2005). Since the digestive tract of a chicken is very short, measuring just six times its body length, some of the eaten foodstuffs are excreted by the chicken before being fully digested (Abdul-Mohsein and Mahmoud, 2015; Adewumi et al., 2011). According to Akinwumi et al. (2011) only 80% (dry weight) of ration fed to fish is utilized and digested by the poultry, making 20% available to the fish in an integrated fish cum poultry culture system. Up to 10% of the food fed to chickens is lost but drop directly into the pond for fish consumption (Adewumi et al., 2011). Two birds per square meter are recommended for this system; otherwise the water quality will deteriorate. Obasa et al. (2009) converted poultry manure to fish flesh by successfully replacing up to 60% of soybean meal with dried poultry manure in the diets of *C. gariepinus* advanced fry.

Ducks are aquatic birds and they are well suited for integration for fish farming in terms of utilizing their droppings as supplementary ingredients. Though, they prey on the fishes and eat fry or fingerlings. About 100 to 200 ducks per hectare may be kept in the fish ponds providing each about 50 to 100 square metre for movement and feeding.

3.1.3. Rice-cum-fish

This is an old practice in many rice growing regions of the world including Nigeria. It involves raising fish in irrigated rice fields. Traditionally various species of wild fish which enter into the flooded rice field are trapped in the rice fields and grow along with the rice and are cropped at the time of harvesting the rice (Mukherjee, 1995). Over the past several decades, various species of fish are now intentionally introduced into rice fields. The operating principle is that waste product from one enterprise or system serves as input in another. Herbivorous species benefit from the system by feeding on weeds whose growth is stimulated by fertilizers applied to the rice field. *Clarias* spp catfishes, Tilapia, Bonytongue and Heterotis are suitable candidates for rice-cum-fish integrated system. Rahman et al. (2012) found that farmers in Bangledesh earned about 3 times higher profits from the rice-cum-fish culture than the rice-mono culture. The system ensures more economic utilization of land because fish and rice are obtained from the same piece of land. According to Ahmed et al. (2007) and Nhan et al. (2007) the benefits of integrating fish culture with rice farming includes improvement on diversification, intensification, productivity, profitability, and sustainability. Giap et al. (2005) and Dugan et al. (2006) suggest that "integrated rice-fish farming is ecologically sound because fish improve soil fertility by increasing the availability of nitrogen and phosphorus". We suggest that this system should be encouraged in rice growing belts of Nigeria and it is envisaged as a panacea to rural poverty. Suitable fish species adapted to life in rice field condition have to be identified.

3.2. Utilization of organic waste through maggots production

Maggots production using organic waste like livestock manure, brewery spent, cow blood, abattoir wastes, wheat bran etc. as a substrate media is another strategy for utilization of organic waste (Figure 2). Maggot used in fish culture is the larvae of the domestic fly (*Musca domestica)* which are produced through aerobic fermentation process of organic waste (Nzamujo, 2010). Maggot is produced to supplement fish feed. It provides a source of nutrient for fish and other livestock including pigs and poultry. According to Alao and Sonaiya (1991), Foo (1999), Fasakin et al. (2003) and Idown et al. (2000), maggots have been found to be very good protein source. Teguia and Beynen (2005), Larish (2003), and IDPH (2005) supported this by stating that the common housefly (*Musca domestica)* is the most efficient breeder of maggots with high protein content. The use of maggot protein for poultry and fish production has been widely reported (Atteh and Adedoyin 1993; Shepperd et al*.,* 2002*)*. The biological value of maggot protein has been found to be close to that of fish meal and superior to that of groundnut cake and soybean meal.

However, Atteh and Ologberia (1993), Teguia et al*.* (2002) reported different nutritional values for maggot meal due to variation in species, age, source of maggot (substrate) and method of processing. Crude protein content of maggot meal have been found to vary between 43.3% and 47.12% (Atteh and Ologbnla, 1993; Gado et al., 1982; Fasakin et al*.,* 2002; Aniebo and Oweu, 2008) depending on the drying method. Therefore, maggot meal is a good protein source and a solution to the high cost of feed in fish and livestock production since the standardized crude protein requirement of fish is between 35% - 45%.

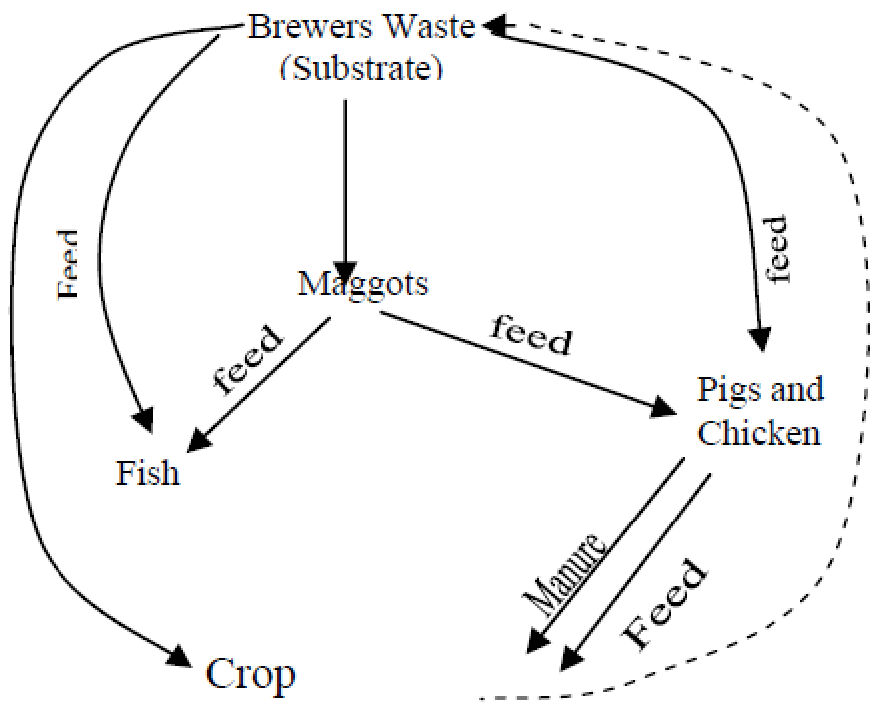

Figure 2. Utilization of Chicken Manure in Maggot Production (Source: Adapted from Oribhabor and Ansa, 2006)

About 1-2 tonnes of maggots could be produced in a month in a 20,000 hen- laying house. Such maggots could be dried for sale as stable source of income (Onuoha et al., 2001), Many researchers have tried to substitute maggot meal for high fish protein with variable degrees of success.

3.3. Artificial breeding and utilization of earthworm

Earthworms are a good food fish. They are used as baits. Fresh and dried earthworms have been reported by (NACA, 1989) to contain about 8–10 and 56–66 per cent protein, respectively with effective energy content of 2920 cal/kg and nutritional value equivalent to that of fish meal. Chakrabarty et al. (2010) obtained higher average weight and total *Oreochromis mossambicus* yield when vermicompost was applied to culture waters than those of the mixed fertilizer and Single Super Phosphate treatment because the vermicompost served as a direct feed for the fish and also acted as pond fertilizer for autotrophic and heterotrophic production of natural fish food organisms. Vermiculture research should be encouraged in Nigeria to benefit the catfish industry. Their diversity in Nigeria should be documented and meals from the different species compared in feeding trials and substitution for fish meal. In the natural earthworm is good food for the clariids.

Earthworms are very prolific. Earthworms are hermaphrodites and capable of regeneration of lost segments and multiplying at least 200 times/year under natural conditions (Sharma et al., 2005; NACA, 1989). However, with proper management, an earthworm can reproduce 1000 times/year. The culture of earthworms for various purposes including improvement and maintenance of soil fertility, conversion of organic waste into manure,and production of earthworm based protein diet (earthworm meal) for fish and livestock, (Paoletti, 1991) and bait for fish market (Ghosh, 2004). Nitrogen rich substrate such as fermented cow dung, pig manure, weeds, legumes and rank grass from the integrated fish farm mixed with the proper amount of silt are good fodders for earthworms (NACA, 1989; Sharma et.al., 2005).

3.4. The utilization of organic waste through direct supplementary feed

Fish farmers across Nigeria have access to different agricultural by – products depending on locality at little or no costs. These are used as feed supplements but do not provide complete fish nutrition. These wastes are always available in large quantities, to the point of constituting environmental nuisance. These feedstuffs can be used as direct supplementary feed. For example, a fish farmer in Nigeria has access to groundnut cake (by-product of groundnut oil processing), palm kernel cake (by – product of oil processing), wheat bran, rice bran, maize bran, livestock blood, (blood meal), fish wastes like bones, heads and guts. These can be chopped up and fed as supplement to fish including livestock; moreover, they are inexpensive (David and Jonathan, 2007). Nonetheless, some of these materials is bagged and sold throughout the country for use as livestock feed.

3.5. Utilization of organic waste as a feed compounding ingredient

Some of the organic waste, for instance, groundnut cake, livestock blood, palm kernel cake, wheat bran, and maize bran can be utilized as feed compounding ingredient. The production of fish feed is one of the most profitable ways of utilizing these wastes. According to Adeniji et al. (2014) "The feed route represents the highest immediate cash return" because the demand for fish feed is high and stable and the technology involved is not sophisticated.

Whereas shrimp meal is by far the richest in crude protein level (Table 2) when compared to other organic wastes listed, it is not commonly available. It should therefore be used where available. Also other ingredients listed in the Table 2 are therefore suggested to be used either wholly or in combination with shrimp meal in ratios that would boost their crude protein contents where possible.

3.6. The use of wood ash and charcoal

There is increasing use of charcoal and wood vinegar in animal husbandry and fishery since the 1980s. Incorporating bamboo charcoal into feed have been proved to result in significantly better weight gain, growth rate and condition factor in farmed tilapia when compared with those fed on diet without bamboo charcoal, thereby enhancing the efficiency of aquaculture. (http://www.thefishsite.com/fishnews/9555/bamboo-charcoal-can-boost-fish-growth/). Charcoal powder containing wood vinegar is used in the aquaculture of eel and fish to keep water clean. Feeding eels and tilapia with feed containing ground wood charcoal and wood vinegar improved fish growth and the feed conversion rate and boosts the fish's immunity against diseases. Quaiyum et al. (2014) fed bamboo charcoal to *Pangasius hypoththalmus* fingerlings and found that the material has stimulating effects on intestinal villi, improved growth performance and water quality by decreasing concentration of ammonia. Moe et al. (2010) found that feed supplemented with charcoal enhanced the growth and body composition of juvenile Japanese flounder, *paralichthys olivaceus.* This is an area of organic waste utilization for fish feed or general animal rearing that is yet to be explored in Nigeria and most developing countries of Africa. It is therefore an area with a lot of potential for managing this type of waste economically. Utilizing carbonized charcoal in particular for water quality management in Nigeria, such as filtration units is highly needed, especially as lack of power is a major limiting factor filtration system. Carbonized oil palm bunches could provide alternatives to bamboo and should be tried out in Nigeria to determine their efficacy in growth enhancement, impartation of immunity and water purification. Maintenance of water quality and elimination of waste is a primary concern in aquaculture and the use of these carbonized organic wastes must be encouraged

Table 2. Nutrient composition of various organic wastes

Ingredient	Nutrient Concentration				
	Dry Matter	Protein	Lipid	Crude fiber	Ash
Brewers yeast	93.0	25.0	15.04	21.9	4.7
Shrimp meal	91.0	55-66.0	6.0	4.0	23.1
Cotton seed cake	93.0	35.9	6.7	7.1	5.8
Sun flower cake	94.0	21.0-25.0	5.5	39.6	5.0
Wheat bran	-	14.0-18.0	6.5	16.0	4.0
Maize bran	93.0	10.0-15.0	4.4	11.6	3.2

Source: Adapted from David and Jonathan, 2007

4. Significance of waste utilization in aquaculture

In the conventional fish culture system fish feed and fertilizer constitute major cost components of the total cost of producing either fish seeds or table size fishes for consumption. Consequently, high of feed in particular is a major constraint to intensive fish production in Nigeria and most developing nations of Africa where access to finance is not only difficult, but interests rates on borrowed capital is very high . According to Falaye (1992), feed cost constitutes about 60% of production input. Olvera–Nova (1996) also reported that feed alone has been estimated to account for 40 – 70% cost of intensive aquaculture operations. Thus high operational input can be sharply reduced by judicious utilization of organic waste. It also reduces groundwater contamination and encourages integrated fish farming and upgrades the quality of fishery product through efficient resource utilization including labour, feed, land spaces, reduction in investment risk through diversification of income generation, family food source, conservation of the environment due to its waste management potentials.

5. Problems associated with organic waste utilization in fish culture

One of the problems of organic waste; particularly livestock waste that have attracted attention is their potential as pollutants in water courses which results in the destruction of aquatic organisms, (University of Nevada, 2005). Organic wastes could also constitute nuisance through environmental pollution, principally the liquid component which seep into the aquifers (underground geological formation, which is the natural reserviour of portable groundwater that can supply wells or springs). According to Button and Tuner (2003), organic waste, like animal manure, is not only a source of valuable nutrients but can also a source of pollution and a threat to aquifers and surface water.

Pollution of surface water may occur if poorly managed, especially by improper or inappropriate application of manure and receiving untreated effluent from ponds or streams, development of sludge banks in the ponds usually have high nutrient loading leading to deleterious effect of cyanobacterial bloom. According to Osuji et al. (2003), cyanobacterial bloom is undesirable in aquatic food base, because they are poor producers of oxygen in pond water with undesirable growth habit, some species produce unpleasant odour that impact undesirable flavour to the culture fish. Others produce compounds that are toxic to aquatic organisms.

Eutrophication is a very critical phenomenon in surface waters that leads to depletion of dissolved oxygen in water. It arises as a result of excessive enrichment of water bodies from organic waste stream channelled into such eaters either on purpose or as a result of uncontrolled run offs from agricultural estates and effluent discharges. The putrefactive impacts generally associated with it are highly undesirable both in terms of distorted environmental aesthetics of the polluted water and poor organoleptic qualities of cultured fish species.

6. Management of problems associated with organic waste utilization in fish culture

One of the effects of heavy load of organic waste in fish culture facilities is the rapid depletion of dissolved oxygen. As a result fish will swim to the surface to gulp air. When these signs are observed, fertilization must be immediately suspended and fresh water added to the pond to enhance the dissolved oxygen content of the water and by extension revive the fish. You may also drain water from the bottom of the pond where the oxygen levels are lowest. Another method is by keeping tracks of the phytoplankton, this can help in preventing oxygen depleted problems. There should be regular monitoring of the culture medium turbidity. Sechi – disc gives readings of the range of phytoplanktons density that is present in a particular water body that is fertilized using organic wastes in particular. Reading from 20cm or below indicates that the phytoplankton or algal bloom content of the water is too high and would therefore be checked to avoid dissolved oxygen problems. The problems associated with poor dissolved oxygen in water occasioned by organic waste nutrient enrichment could be avoided by controlled and careful application of wastes into ponds, by filling porous bags with wastes and placing them in different points of the ponds (Oribhabor and Ansa, 2006) and routine secchi disc readings of such waters. Prompt application of such measures does not only ensure avoidance of fish mortality due to asphyxiation, but also ensures optimum growth and development of the cultured fish due to reduction of various diseases incidence burdens within the culture medium.

7. Conclusion

Organic waste have been applied in aquaculture as fertilizer for centuries to boost pond productivity of plants and animals (Ansa and Jiya, 2002). Efficient utilization of organic waste in aquaculture reduces dependence on outside input and increases income, while at the same time serving a very good purpose in efficient and effective waste management for a cleaner and healthier environment.

8. Recommendations

Based on the preceding review, it is hereby recommended as follows:

a) One of the ways of achieving these goals of judicious utilization of organic waste is to develop training and sensitization programmes in integrated aquaculture with an objective, so that the uninformed fish farmers will embrace the practice.

b) Feeding techniques utilizing organic waste should be adequate researched into as a means of reducing feed cost, obtaining faster growth and high yield of farm animals generally and fish in particular.

c) Extension service geared towards dissemination of information in respect of the use of organic waste as fish feed among fish farmers in particular and general animal husbandry should be intensified.

d) Based on the report of Oribhabor and Ansa, (2006), that lack of appropriate processing technologies have limited the utilization of many available plant and animal by-products in the feed industry, it is therefore, important to encourage advancement in technology of waste processing for animal/fish feed and manure.

e) Neighbourhoods and industrial estates where organic waste management constitutes a serious challenge to achieving clean and healthy environment, should adopt organic waste utilization as fish feed as a key channel for managing their wastes.

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