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Assessing the Associated Challenges in the Use of Animal Manure in Plant Growth

Tunde Ezekiel Lawal and Olubukola Oluranti Babalola*

Department of Biological Sciences, Faculty of Agriculture, Science and Technology, North-West University, Mafikeng Campus, Private Bag X2046, Mmabatho 2735, South Africa

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ABSTRACT The use of animal manure is of course a significant componentas it enhances the growth of crops and invariably improves the yields from such crops. In addition, there is the clamour for organic farming and green vegetation. Such clamour engages or underscores the importance and relevance of animal manure. Besides, the use of chemical fertilizers has been discouraged because of the various disadvantages. However, care must be taken in the use of animal manure as well because it has its challenges. This write up attempts tothrow light on these challenges which, among other things, include microbial pathogens present in animal manure and effects of such pathogens; antimicrobial drugs in animal manure; existence of heavy metals and pesticides and mycotoxins and hormones in animal manure. This review suggests some management practices and technologies that will reduce the prevalence of these impediments in animal manure and thereby enhance its use.

INTRODUCTION

Concerns and worries about the effects of pathogens, anti-microbial drugs, heavy metals and pesticides that are present in animal manure on environments and consequently, human beings health is fast gaining attention in recent times. Animal manure can be a veritable source of important plant nutrients when appropriately managed. It enhances the nutrient contents of the soil, biological and physicochemical properties of the same. Moreover, manure has some shortcomings when juxtaposed with chemical fertilizers. Manure contains minimum nutrients and high volume and that makes it uneconomical to move to a distant place from its production site (St-Pierre and Wright 2013). Manure releases its nutrients at times when plants are not actively growing to use them. This leads to having untapped nutrients being left in the soil and such nutrients can be washed into streams, lakes or rivers via erosion, runoff or probably leached into groundwater. Environmental Protection bodies of nations have identified bacteria and some other micro-organisms as prominent causes of water quality pollutants in lakes, streams, and rivers. There are more than 170 organisms that can spread infection from animals to humans through contamination or pollution. Many of these organisms can be found in animal manure. They include viruses, protozoa and bacteria such as *Escherichia coli*, *Salmonella*. Animal manure serves as a veritable source of plant nutrient, but, apart from this, it can also be a pollutant as it harbours heavy metals, remnants of pesticides and viruses (Pindozzi et al. 2013). Often, animal manure carrying some pathogenic bacteria have been said to be associated with pollution of streams, rivers and estuaries. About 145 organisms have been confirmed to have potential of spreading infections animals to man causing zoonotic diseases (Table 1). Meanwhile, some of the causative agents have been located in animal manure. Use of uncomposted manure on crops encourages the spread of pathogens and pollution of the environment. Possibly, in manure, it is likely to also find contaminants like residual pesticides, antibiotics, hormones and some heavy metals apart from the mentioned disease organisms. Public health becomes negatively affected if pathogen in the faeces gains entrance into surface water and there are potential hosts in the water to accommodate the pathogens this can lead to formation of infective dose and if man takes the infec-

**Address for correspondence:*
Dr. Olubukola Oluranti Babalola
Department of Biological Sciences
Faculty of Agriculture
Science and Technology
North-West University
Mafikeng Campus
Private Bag X2046
Mmabatho 2735, South Africa
Telephone:+27183892568
Fax:+27183892134
E-mail: olubukola.babalola@nwu.ac.za

Table 1: Some diseases and parasites from animal manure to humans and possible symptoms

Diseases	*Organisms*	*Symptoms*	*References*
Bacteria			
Salmonellosis	*Salmonella spp.*	Diarrhoea, fever, abdominal pains and headache	(Sumner et al. 2004)
Tuberculosis	*Mycobacterium avium; Mycobacterium tuberculosis*	Fever, fatigue, pains in back and chest, cough	(Anguelov et al. 2014)
Tetanus	*Clostridium tetani*	Heavy muscle spasm, difficulty in breathing	(Livingston et al. 2013; Pirazzini et al.2013)
Brucellosis	*Brucellamelitensis*	Fever, sweating, headache and general body weakness	(Asaad and Alqahtani 2012)
Colibaciliosis	*Escherichia coli*	Diarrhoea and persistent production of abdominal gas	(Kim et al. 2011)
Anthrax	*Bacillus anthracis*	Pneumonia, cough, headache and fever	(Moayeri and Leppla 2009)
Erysipelas	*Erisipelothrixrhusiopathiae*	Headache, vomiting, sweating and fever	(Radakovic et al. 2013)
Viruses			
Foot and mouth		Fever and sore throat	(Tildesley et al. 2012)
Psittacosis		Pneumonia	(Pirazzini et al. 2013)
Fungi			
Histoplasmosis	*Histoplasmacapsulatum*	Cough, joint pains, fever muscle ache	(Mohammed et al. 2012)
Coccidioidycosis	*Coccidioideaimmitus*	Headache, cough, sweating, fever	(Song et al. 2013)
Protozoa			
Coccidiosis	*Eimeria*spp.	Diarrhoea, abdominal pains	(Akpo et al. 2012)
Cryptosporidiosis	*Cryptosporidium* spp.	Weakness, dehydration, Diarrhoea	(Robertson and Chalmers, 2013)
Toxoplasmosis	*Toxoplasma* spp.	Seizure and headache	(Delhaes et al. 2013)
Giardiasis	*Giardia lamblia*	Nausea, headache, fever, diarrhoea	(Lal et al. 2013)
Parasite			
Ascariasis	*Ascarislumbricoides*	Bloody sputum, fever, cough, skin rash	(Kitvatanachai and Rhongbutsri 2013)

tive dose via consumption of aqua cultural or agricultural produce (Dai et al. 2013).

ANIMAL MANURE PATHOGENS AND LAND PREPARATION FOR AGRICULTURAL PURPOSE

Useof animal manure for the enrichment of soil fertility is one of the best ways of reducing environmental degradation. Notably, this has also been observed to have some demerits becauseit has the potential of emitting nitrogen through the process of volatilization (Wu et al. 2011). Livestock and poultry manures naturally contain a wide range of bacteria, viruses and protozoa. Many of these are renowned for their ill effects on humans. Bacteria known to be human pathogens include certain strains of *E. coli*, *Salmonella* spp., *Listeria*, *Streptococcus* spp. and *Campylobacter* spp. Examples of such protozoa are: *Giardia* and *Cryptosporidium*. However, many of the viruses located in animal manure do not endanger human life. Spread of these pathogens in manure depends considerably on livestock species. For instance, *E. coli* can be located in the manure from all species. Though it is most common in cattle manure, but it has also been located in the manure of other mammals. *Salmonella* is popularly located in poultry (turkey, domestic fowls, geese and pigeon) manure. *Campylobacter* is popularly found in manure of all poultry species. *Listeria* is found in manures of all species of cattle and sheep. In addition, *Cryptosporidium* can be found in cattle manure and it may also be found in manures of pigs and sheep (Abdel-Monaim and Abo-Elyousr 2012). It also suffices to state that green yard wastes can be contaminated as a result of pet droppings.

It is important to take precaution to prevent the spread of pathogens on farmland as this will reduce the multiplication of livestock-linked pathogens (Nicholson et al. 2007). It has been reported that when animal manure is applied on farmland, it will result to movement of pathogens through the pores and the movement will be both vertical and horizontal. The rate or speed of movement will definitely determine the possibility of the pathogens reaching ground surface waters. It follows that peradventure the water is used for agricultural purpose like irrigation, then the tendency to pose health risk for the consumer of the produce from that operation is high (VanderZaag et al. 2011). Venglovsky et al. (2006) opined that factors that determine the horizontal movement of pathogens are: soil type, soil water content, amount and intensity of rainfall, temperature, nematodal activity surface charge and size of microorganism, transport through plant root and soil pH. The workers further submitted that factors that determine the vertical movement of pathogens include the amount and intensity of rainfall, closeness of the pollutant source, agricultural activities weather and the season of application. The activities of pathogens is determined and influenced largely by the availability of water. Besides, temperature is also a very important factor. High temperature inactivates pathogens. Existence of the pathogens is also influenced by the specie of the organism. Bacteria that form spores endure for longer time than the ones that are non-spore forming (Babalola and Akindolire 2011). When pathogens are covered with the soil or incorporated into the soil, they tend to have higher survival than when they are exposed.This may be due to the fact when buried in the soil, they are protected from exposure to ultraviolent rays from light or sun or the direct high temperature. Notably also, it suffices to state that, possibly, when the pathogens are also buried, they are likely to be consumed by the predators and this will as well reduce the survival. Jamieson et al. (2002) opined that pH will also influence the survival of pathogens in the soil. Application of fresh manure has been of concern because it has higher possibility of spreading pathogens to waters; especially the surface water and when agricultural produce are cleaned or washed with such waters, there will be contaminations and eventual poor food security. In works of Islam et al. (2004), *E.coli* contaminated lettuce and carrots when uncomposted animal manure was applied on soil as fertilizer.

Survival of Pathogens in the Animal Manure

Poultry litter or manure is generated in millions of tonnes every year from poultry farms. A considerable part of the manure is spread or used for the fertility of the farmland. Survival of pathogens in manure depends on several factors but prominent ones are the temperature and moisture content of the materials. In addition, other conditions that can determine survival of pathogens include: oxygen level, pH level and ammonium content level.

When the temperature in the manure increases and the storage time of the manure also increases, the possibility of pathogens survive reduces. Most pathogens have brief survival time when in dry environmental conditions. It has been reported that *Salmonella* sp. and *E. coli* can survive for 4-6 months when the temperature is between 1-9^{o}C and this is more than 50 times longer when compared with what is obtainable at temperature between 40-60^{o}C. Admittedly, *Campylobacter coli* thrive in slurry and dirty water for three months. When composting is properly carried out, it can, to a large extent minimize the population of pathogens in manure. One of the essentialconditions in composting is to have temperature above 55ºC for at least 4 days even during aeration (Bustamante et al. 2012).

Another composting method named windrow system needs turning with equipment that moves the materials from the surface to the base of the windrow and this will expose the materials to higher temperatures. This needs to be done repeated so as to ensure that all materials are exposed to minimum of 3 consecutive days of high temperature. It is often suggested that windrows keep a constant temperature of 55ºC for 17 days with at least 4 turnings. Owing apparent need for good churning, mixing and regular high temperatures, pathogen population in windrow composting has been found to be effective than the in-vessel systems. However, some microorganisms are "tough" and highly resistant than others and temperatures must therefore be constantly monitored in order to make sure that expected temperatures are in place.

Pathogens and Compost Tea

Compost teas are prepared by inserting a small quantity of mature or aged compost in a bag with holes into water and permitting it to steep or brew. The tea solution that evolves can be applied to plants as source of nutrients for crop foliage. However, compost teas can only be produced with fully mature compost in order to kill pathogens (Mc Carthy et al. 2011). Notably, addition of sugar during steeping has the potential of increasing the occurrence of pathogens in the compost tea. In addition, compost tea must be well ventilated in the course of "steeping" and applied fast. This becomes important in an attempt to reduce the chances of pathogen contamination. Farmers are enjoined not to apply compost teas to edible parts of the crop and it should not be applied when harvesting phase is near.

It is to remember that manure tea is produced using composted manure and may still contain some pathogens. It is therefore suggested that it must not be applied directly to crop plants. It is suggested that farmers must wait for at least four months after application before harvesting the crops (Chaney 2012).

Antimicrobial Drugs in Animal Manure

Use of antibiotics in production of animals has been beneficial i the sense that it has assisted in improving feed quality, feed efficiency and subsequently growth rate of farm animals. As a result, this has led to reduction in the cost of food production and void of nutrients via manure; hence minimizing the environmental pollution. Findings on the use of antimicrobial drugs have been primarily focused on their beneficial and adverse actions on animals and humans. Of late, the need to study the effect of these drugs on their environment and influence on the plants that take them up from manure has come to the fore (Thien Thu et al. 2012). Unknowingly, consumers may possibly be taking traces of some of these drugs when they eat crops from manure treated farmland (Mc Carthy et al. 2011). Antibiotics are generally administered for two reasons: 1. Therapeutically to treat diseases and 2. Sub therapeutically for increasing feed efficiency and prevent diseases. Sulfa drugs, coccidiostatics, antibiotics and antimicrobial drugs are basically commonly used in poultry and swine farming. It is worth notingthat some antibiotics are not well used by the animals and considerable quantities are passed into the urine and manure. Importantly, this has become a source of concern to the public because some of these unabsorbed drugs found in the urine and manure may found their way into surface water and if such waters get to crops possibly via irrigation, it can contribute to antibiotics resistance developments and elicit allergies (Husfeldt et al. 2012).The chemical structure determines the activities of these drugs as they transform during metabolic activities via digestion. The veracity of the drug in the excreted dungs, droppings or urine of animals, depends on humidity, pH and the processing method of the manure. Potentially, some of these drugs form chemical complexes with elements like calcium and this action makes them insoluble and unabsorbed in the animal's body. In some cases, drugs traces analyzed in the manure are physiologically inactive. In the works of Christian et al. (2003), it was reported that manure samples from cattle farm and cattle and piggery farm that had different tanks had quantities of drugs especially antibiotics in considerable quantitiesthat can be as high as 20 $mgkg^{-1}$can be found in manure. It was further reported that farmland fertilized with swine and cattle manure sulfadimidine was also observed at the first 20cm layer of the farmland three months after its application to the soil. However, tetracycline was not detected in the manured soil in considerable concentrations and the authors opined that this may be due to the ability of tetracycline to bind strongly with soil particles.McEwen (2006) suggested that the prudent use of antimicrobial drugs and growth promoting drugs cannot be overemphasized as their effect onthe animal and human health can be both positive but if carelessly administered or managed, their effect can be deleterious. Notably, the bacteria may become resistant; once resistance becomes prevalent and gets to a certain level; reversal of the resistance may become another big task (Arriaga et al.2011).

Bacteria from Animal Manure can Develop Resistance

The continuous use of antibiotics will lead to resistance and reduction in effectiveness of such antibiotics when administered for treatments in both humans and animals. Undoubtedly, disease-causing organisms (Table 1) are definitely the most diverse and numerous organisms on earth. They are different in their environmental adaptation, habitat and system of reproduction. They do have short life span but high rate of multiplication. Combination of these attributes foster resistance development. (Wilson and Cotter 2013) Overtime, there have been reports about the development of resistance to antibiotics used for both livestocks and human beings. There are four established means by which antibiotics can terminate the susceptible bacteria : through the disruption of microbial cell wall synthesis, prevention of DNA replication, prevention of protein synthesis and inhibition of cell division, development and differentiation. Resistance results if and when the targeted bacterium develops another way for its cell functions and processes such that the antibiotic will no longer be able to hinder or prevent it. The most renowned source of antibiotic resistance is the one carried out through the instrumentality of genetic modification. Most of the drug resistant microorganisms came up owing to single or multiple gene mutation. Besides, there is also the possibility of having resistance when an organism acquires a foreign gene from another microorganism or assesses an unengaged gene source from the environment through a process referred to as transformation. (Singh et al. 2012). There is specificity in the resistance strategy by a particular bacterial specie to a particular antibiotic and possibly a particular resistance mechanism may be restricted to a particular environment. In addition, there have been reports about the possibility of observing similar genes in unrelated bacteria and that indicates that such resistance genes can be transferred among bacteria (Rizzo et al. 2013).

ANTIBIOTICS AND SOIL ENVIRONMENT

It is observed that about 30-80 percent of antibiotic dose given to livestock as growth promoters may be egested as part of faeces or droppings owing to poor absorption. When manure that has a considerable quantity of antibiotics is applied to farmlands, such antibiotic in the manure has the possibility of getting into the edaphic material and finds its way into lakes, streams or rivers. Antibiotics permeate the environment either as part of the unabsorbed waste or as part of excretion of absorbed antibiotic residues and their metabolites by urine and faeces of the livestock animals (Liu et al. 2013). The popular route through which antibiotics are released into the environment is through application of manure in arable soil and in fisheries production. Possibly, an integral part of feed having the active ingredient may not be consumed by the livestock and will therefore get to the sediment directly without any transformation. After the consumption of antibiotics, it is also possible that it can be voided partly as metabolized compounds and this will also get to the sediment. Residues of antibiotic remaining in the animal manure undergo degradation or leaching and this is a function of the chemical properties of the manure as at that time. During grazing, animals do urinate and the metabolized drugs in the urine can be washed into the pool of waters nearby. However, it seemsthat most of the drugs voided through urine can easily dissolve in water. In contrast, drugs voided through faeces or droppings are mostly less water soluble. Antibiotics, which are admitted purposely to terminate disease causing microorganisms-bacteria, most especially broad spectrum antibiotics, can also do havoc on microbial settlements in the edaphic system.Antibiotics could disturb the important biological works in soil. As a result, this could lead to development of antibiotic-resistant bacteria that could affect human beings, animals, wildlife, fish and other aquatic animals (Gao et al. 2012; Gong et al. 2012). Notably, after the introduction of antibiotic laden feed ingredients to the animals as part of the feed, antibiotics not metabolized by the livestock will be voided and become part of the environment. In fish farming, antibiotics are given as part of the feed which will be thrown into the ponds; approximately 72 to 85% are directly released into the water. Antibiotic residues with notable antibacterial tendencies have been reported in the water from fish ponds. Penicillin, tylosin, momensin and tetracycline are some of the most commonly used antibiotics and that are traceably found in the manure of beef, swine and poultry. In addition,concentration of these listed antibiotics differs. It can be as high as 218 mg/l in manures depending on the animal and the metabolism ability of such animals. Often, these antibiotics do remain inactive or passive during manure storage. Water and soil pollution resulting from manure application has been reported. Furthermore, it has been noted that residual amounts of antibiotics in soils can almost be equated to the level that is as similar as that of pesticides. Such pollution by antibiotics endangers livestock and human beings to regular challenge of consequences owing to availability of pockets of low contents of antibiotics in the environment. This development reduces both human and animal health by reducing the success of antibiotic effectiveness when administered for treatment. Antibiotic resistant genes from microorganisms in the environment can be transferred directly to humans. Antibiotics from manure-fertilized lands are undermining the quality of drinking water in the sense that they are parts of the pollutants and they thereby reduce quantity of drinkable water available to both livestock and human beings. However, side effects of long time cumulative exposure to low concentrations of antibiotics soon become apparent and the threats coming from veterinary antibiotic contamination to human and livestock health cannot be thrown into the trash (Cytryn 2013; Fernández-Calviño and Bååth 2013).

How Long Can Antibiotics Stay in the Soil?

There are multiple factors that can influence the degree of persistence of antibiotics in the soil. These include, among other things, availability of water, types of microorganisms, Photolysis and ability to bind to soil particles via the process of adsorption. The antibiotics possibly combine with soluble organic materials and having solubilized, they are easily moved and they can thereby pollute waters while still maintaining the potency (Martinez 2009). Some antibiotics namely: virginiamycin, ciprofloxacin andofloxacin do break down slowly and may endure in soil still maintaining its original potencyto 32-83 days but other antibiotics like tylosin and erythromycin absolutelybreak down within one month at temperatures from 22-32^{0}C. Antibiotic residues in animal manure often remain unchanged during storage until its application to agricultural farmlands. We need to collect precise data on antibiotic use in animal farming, aquaculture and agriculture and the potential reservoir for residual antibiotics in the terrestrial environment in the country (Han et al. 2012). There is still paucity of information on the kinetics of breaking down and potentials of different antibiotics in soils, manures and aquatic bodies. This is important because it will enhance and foster better understanding of eco-toxicological impacts of different antibiotic residues in the vicinity.

EXISTENCE OF HEAVY METALS OR MINERALS IN ANIMAL MANURE

Owing to increase in the cost of inorganic fertilizers, there is an upward demand for the use of animal manures for the improvement of soil fertility. This has provided a cheaper means or way of amending agricultural field with plant nutrients and organic matter. Be that as it may, this has the tendency of increasing the levels of heavy metals proportions in soil. It suffices to state that some of the heavy metals are advantageous to plants and animals when they are available at trace proportion or at the needed levels because they pose threat when they accumulate in higher levels (Tak et al. 2013).

Accumulation of heavy metals in agricultural soils may lead to dangerous challenges if the bearable level is exceeded. Overtime, the soil becomes the residence of heavy metals if there is persistent and consistent application of animal manures that contain such metals. Agricultural soils that have been amended by animal manure tends to be high in organic matter and this often affect the level of aggregation of soil particles, minimizes bulk density and heightens soil porosity (Inyang et al. 2012). Unhindered or unrestricted application of animal manure on the soil increases the heavy metal quantities in the soil (Anikwe and Nwobodo 2002). Thus,this demandscarefulanddeeper scientific knowledge when applying the manure. Kidd et al. (2007) agreed that metals sourced from waste biomass are known to bind organically and therefore be less available for plant use. In addition, soils on which animal manures are unabatedly applied have propensity for accumulation of heavy metals thereby reducing the functionality of such soil, reducing the quality of crops that come from such soil and becoming health threat to humans.

Possibility of having accumulation of minerals in animal manure is gaining prominence of late. This is possible when a high level of minerals is given to animals (calcium and phosphorus in layers, copper in broilers and young poultry, and copper and zinc in pigs). Presence of heavy metals such as lead, mercury and cadmium has been reported in animal manure. They are not commonly found in poultry droppings but, they are amply found in beef manure and the toxicity of Lead is a function of chemical structure of the compound and this determines its usability by the body. It was reported that due to the rapid development of intensive animal farms in China, animal manure production is about $32x10^8$ tonnes annually and that animal manure is being used to enhance the fertility of agricultural land. It further informsthat this practice has resulted into serious environmental problem such as nitrate and phosphate contamination of surface water. It was also noted in their work that the use of animal manure has led to accumulation of heavy metals as manure has metals like: Arsenic (As), Cd, Copper (Cu), Pb, Hg, Molybdenum (Mo), Nickel (Ni), Selenium (Se) and Zinc (Zn). In addition, the work of Canget al. (2004) reported heavy metals pollution in poultry and livestock feeds and manures under intensive farming in Jiangsu Province was investigated and 97 feed and manure samples were sampled from 31 farming plants in 10 major cities of Jiangsu. Moreover, 14 metals, including Zn, Cu, Pb, Cd, Cr, Ni, Mo, Mn, Ba, Co, Sr, Ti, As and Hg, were analyzed after samples acid digestion. The results indicated that most feed samples contained high concentration of metals which exceeded National Hygienical Standard for Feeds.

In addition, it was found that Cu, Zn, Pb, Cd and Cr concentrations in animal manures were also high. For instance, Cu concentration in a manure sample reached as much as 1726.3 mg/kg. Heavy metals can be accumulated in surface soils as a result of long-term agricultural use. This can lead to metal migration through leaching and runoff. Li et al. (2007) reported that the content range of Cd in pig manure ranged from non-detectable (ND) to 129.76mg/kg dry matter in Beijing and Fuxin. They further noted that mean Cu content in manures from Beijing was 887 mg/kg in grower-finisher pig manures. However, heavy metal residue displayed diversity in content in different part of China. For instance, Canget al. (2004) reported that average Cu in pig, cattle and chicken manures from Jiangsu province was 399, 46 and 89 mg/kg dry matter. The heavy metal content of animal manure is traceable to their content in the feed ingredients and the efficiency of feed conversion by the animals. Zhang et al. (2007) reported that in the Northeast China, small farms are widely located in suburban areas and that heavy metal additives were in feeds because of lack of thorough supervision by government officials and ignorance of the feed millers. Hence, arbitrary application of Cu additives to compounded feeds lead to rise in Cu content in manures from small piggeries. They also reported that feed additives containing heavy metals were generally applied in intensive animal husbandry in Northeast China and the abuse of additives with heavy metals was predominant in both big and small farms. Li and Chen (2005) submitted that addition of As additives to animal feeds led to possibility of having As in manure and that in England and Wales, the mean contents of As in pig, layer and cattle manure were 1.68, 1.46 and 0.44 mg/kg. Besides, Sager (2007) stated that the mean contents ofAs in pig and cattle manure was <1.0mg/kg in Austria.

ANIMAL MANURE AND PESTICIDES RESIDUES

Manure from non-organic farms may possibly contain pesticide residues. These pesticides include: aldrin, heptachlor, lindane, chlordane, DDT, endrin, methoxychlor, dieldrin, toxaphene and many others. The reason for this is not farfetched; some farmers do spray manure piles with pesticides in order to kill fly larvae. They are also used for ectoparasite control; endoparasite control (oral or parentheral); treatment of feed or bedding prior to or during manufacture; spraying manure, litter or the entire environment for pest control; spraying or treating crops by insecticides and herbicides and many other applications on farms and in the feed industry and other activities related to farming (Vittoria Pinna et al.2012). However, the level of pesticides is often more in cattle fed conventional feed ingredients than in cattle fed poultry litter or other animal wastes. This is possibly because the use of pesticides in agriculture is widespread, and high levels may often occur in forage, feed and crop residues and when the straw is used for bedding; this will increase the level of pesticides locatable in the litter or in the tissues of livestock given such animal wastes. Pesticides remains in livestock carcass may lead to food insecurity to humans if it is left uncontrolled. In the works of (Zhao et al. 2013) the residual levels of 8 organochlorine pesticides (OCPs) and 15 priority polycyclic aromatic hydrocarbons (PAHs) were studied in pig, chicken, and cow feed and manure samples collected from feedlots in Jiangsu province, China. The average residuals of OCPs ranged from 25.35 to 65.62 ng/g in feeds and from 33.46 to 90.89 ng/g in manures. Among 4 hexachlorocyclohexanes (HCHs), α-HCH was the most prominent compound with a high occurrence above 80% in all kinds of animal feeds and manures. In the case of dichlorodiphenyltrichloroethanes (DDTs), the predominance of p, p2 -DDE and p, p2 -DDT of total DDTs was also clearly observed. Composite profiles of HCHs and DDTs in feeds indicated that the residuals of lindane and DDTs could be attributed to new inputs in the past several years. Furthermore, average residuals of all of the PAHs varied from128.94 to 389.66 ng g^{-1}in manures. The mean concentrations of seven carcinogenic PAHs in manures varied from 16.80 to 79.70 ng g^{-1}. These informthat of the 15 priority PAHs, phenanthrene was the most dominant PAH species and accounted for approximately 50% of the total PAHs in all animal manures. They concluded that the distribution of PAHs with different rings showed that PAHs with 3 rings were the primary components in the tested manures. Even though law against the use of OCPs has been promulgated in China, 3200 t of lindane was still been used until the year 2000 for the extermination of forest pests. Besides, DDT was also manufactured for production of other pesticides like dicofol. Furthermore, Chinese government and the United State Environmental Protection Agency have identified sixteen PAHs and seven of them already declared as being carcinogenic. Therefore, monitoring of PAHs in the environment, feed and food is very important so as to ensure that human health is not endangered. The persistence, bioaccumulation and toxicity of OCPs and PAHs is generating concerns because they are found in manures traceable to their use as pesticides and find their to be part of the feed, hay and grasses that animals consume (Dai et al. 2013). Sizeable HCH and DDT isomers and metabolites can be found in pigs, chicken and cow feed and manure samples in the environment where they are still been used as pesticides.

Fate of Pesticides Residues in Composts

It is very important to ask the question about the fate of pesticides remains in compost. This is so because even at very low level, pesticides can cause dangers to the environment. For instance, it has been reported that at concentrations of parts per billion (ppb), diazion and pendimethalin are dangerous to fish wellbeing (health). So, if composts are to be directed into the fish ponds, the pesticides availability must be gauged. However, pesticides do lose their potency during composting. But, there are some exceptions and examples of such exemptions are DDT metabolites and chlordane (Yoshizaki et al. 2013). Most countries have banned these two pesticides but they still persist in some environments. In addition, investigations have revealed that most of the pesticides are broken down either by chemicals or microorganisms in the process of composting. Of late, it was discovered that an herbicide named Clopyralid remains in the composts at levels that may inflict negative impacts on growth of some crops. It is important to say that pesticides are broken down in the composts through pathways. Mostly, they are lost through mineralization or degradation to CO_2. Besides, it has been reported that pesticides may also be volatilized into the atmosphere and this is aided by the rise in temperature in the compost. In addition, it is also possible that the pesticides will leach from the compost when and if it rains (Marchal et al. 2013). Moreover, some pesticides residues become part of organic matter of the compost owing to their metamorphosis into forms that is chemically at variance to their original form and they remain inactive. It is not good that the pesticides should remain untransformed in the process of composting. Persistence of a pesticide called Clopyraliddespite composting is widely gaining attention. Generally, it is used in controlling broadleaf weeds. The challenge is that Clopyralid is “unbreakable” even in composts or during composting process. (Hough et al. 2012) So, when such composts are used for improvement of soil fertility, it affects some crops, especially, crops that belong to the leguminosae, solonaceae and the compositae families. Such crops can be stunted even if the level is as low as 10 parts per billion. Findings have shown that tomato planted with compost with residues of Clopyralid make the leaves of such plants look cupping and that leaves of pepper plants grown on such pesticides show atypical leaf growths. Furthermore, beans planted on soil with remnants of Clopyralid show shoot bad formation. In addition, agricultural produce can also lose their value via contamination owing to conspiracy between Clopyralid and Picloram. When cattle feeds on Clopyralid or Picloram in the course of grazing on the field where they have been applied, the pesticides also pass through the gastro intestinal tracts unchanged or untransformed. This has become a source of worry for organic farmers. This is so because they depend mostly on composts and manure for soil fertility (Bernard et al. 2012).

Mycotoxins and Hormones in Animal Manure

The quality of animal wastes can be seriously influenced by mycotoxins and other metabolites of fungi; most especially *Aspergillus* and *Penicillium* species. These fungi can be located in large quantities in animal manure or in bedding materials. These microorganisms produce aflatoxin and other mycotoxins. Mycotoxins are toxic secondary metabolites produced by fungi. There is the possibility of being toxic to human beings and animals that take in the mycotoxins. The effect of toxicity can be seen in skin lesions, death or symptoms like nephrotoxicity, hepatotoxicity and genotoxicity. Apart from the above expressions, mycotoxins could also be carcinogenic or mutagenic and develop negative effect on the immunity of the affected beings (Nardone et al. 2010). Manure can be an important carrier of pathogenic microbes and microbial toxins. Microorganisms have the potential of growing on livestock wastes and bedding materials and when these materials are consumed they may have direct effects on digestive tract, nervous and blood systems. In the same vein, the genera of *Stachybotrys* and *Pithomyceschar-terum* because, they are saprophytes can also grow on dead organic matters like: straws, bedding materials, animal manure and cellulosic material when the moisture content is between 25 and 40%, produce toxins dangerous to all species (Holler 2012). In addition, *Clavicepspur-purea*, which is popular in temperate regions, produces alkaloids and histamine. Of course, drying and other processing of manure stop the growth of microorganisms, but the inactivation of the actual toxin can be partially eliminated by microbial processes, although the mode of action is unknown. A large number of thermophilic and mesophilic fungi which are pathogenic or toxigenic to animals and plants are normally present in feedlot surface manure. Examples of such thermophilic fungi are *Mucorpusillus and Chaetomium thermophile* and examples *of such* mesophilic fungi are *Mucor, Rhizopus, Absidia and Mortierella* and they are mostly present at lower temperatures and in fresh faeces. The moisture content appears to be a factor responsible for the degree of infestation: it was observed that A. *flavus and Fusarium solani* were found in increased numbers when moisture of the feedlot waste increased. Effect of mycotoxins in animal manure is comparable to that of mycotoxins in feed. The presence of mycotoxins in animal manure creates problem at the period of waste collection, when the biotop changes (Collett 2012; Gadd et al. 2010). Drying, ensiling or other processing is therefore encouraged to be used immediately after disposal of manure. Scientists are also concerned about the environmental impacts of hormone residues that are found in cow manure. Examples of such hormones are: diethylstilbestrol (DES), estrogens, testosterone and estradiol.When manure is excreted, these hormones can contaminate surface and groundwater thereby harming local ecosystems. Aquatic ecosystems are particularly vulnerable to the negative impacts of hormone residues; recent studies have demonstrated that exposure to hormones has a substantial effect on the reproductive capacity and egg production of fish. Fishes are particularly exposed to the negative influence of hormone residues. Recent studies have shown that exposure to hormones has a substantial effect on the reproductive capacity and egg production of fish. It has been reported that the use of growth hormones in food animals sparks a risk to consumers' health.Hormone residues found in meat from theseanimals can disrupt the consumer's hormone balance, bring about developmental challenges, negatively affect the reproductive system and can lead to cancer. However, kids and pregnant women are most probable victims of these negative health effects. Consumption of hormone residues in animal or fish is also possible to cause the early onset of puberty in girls. Bad enough, this puts girls at risk of having breast cancer and other types of cancer (Cairns et al. 2012; Chassy 2010).

PANACEA TO CHALLENGES ASSOCIATED WITH ANIMAL MANURE

Application of animal manure should be regulated to prevent unwarranted accumulation of heavy metals in the soil. Contamination of water by pesticides can be averted by avoiding storing pesticides near wells, ditches or bodies of water. Farmers are encouraged to choose a mixing site of pesticides that is not too close to a water source. It is important not to mix the pesticides during a windy time. Besides, pesticides should not be applied during or before heavy rainsas the pesticides may be washed into waters as part of the runoff waters. Monitoring of heavy metals in agricultural soil is very important owing to the fact that metals do bio-accumulate and also bio-magnify from one soil level to the other (Troy et al. 2013).

Majority of human pathogens located in animal manure have evolved or adjusted to living in the intestine; therefore, they find it difficult to survive in soil and manure. Therefore, the most effective and efficient 'weapon" in exterminating pathogens from manure in practice and economic view, is time. It follows that if manure is allowed to remain unprocessed or unaided in storage or in soil, the quantity or concentration of pathogens will nosedive with time because they die out, overtaken or consumed by native microorganisms (Powell et al. 2013).

1. Manure should not be applied to wet or saturated soils.
2. Liquid manure should not be left unburied into the soil on the day of its application.
3. Apply manure only to land not susceptible to flooding (land with less than a 4% slope).
4. Apply and bury liquid manure in locations with a limestone landscape, which topography with caves and rivers or streams).
5. Apply manure on lands that are not prone to erosions because it can be washed into water via the runoffs during rainfall or heavy irrigations.
6. Hygienic management at the storage sites is very important in order to reduce the possibility of spreading the attendant pathogens.

CONCLUSION

Meanwhile, the most economical method of handling animal manure that resultsin the elimination of these impediments need to be embraced in order to make the use of this manure safer to enhance production of higher, more efficient crop yields and a healthier population of consumers. Good management of manure which demands good timing of application and burial can take care of the above mentioned concerns. Therefore, among other things, application of uncomposted manure directly on crops either as preplant or side dress fertilizers on vegetable crops is discouraged.

RECOMMENDATIONS

To prevent the spread of dangerous food-borne diseases from animal manure from spreading to the environment and negatively affecting human, livestock and aquatic animals' health should be embraced as a welcomed development. In an attempt to prevent the contamination, it is advisable that manure be applied in about 55 days before the harvest of vegetables to beconsumed without cooking. As much as possible, farmers are advised to apply manure before planting and avoid the use of manure from cats and dogs whether composted or not because many parasites found in humans are also found in them. All agricultural produce from manure treated farms should be washed thoroughly before consumption. It is therefore suggested that the pet droppings be composted and be applied with care when planting food crops.

High temperature aerobic composting has been encouraged and recommended as a way of exterminating diseases causing organisms and thereby minimizing risk associated with human health. In addition, composting will reduce the volume of the manure and this will make it a lot easier to convey from one place to another. So, regulated temperature, good moisture content of 55-60%, proper aeration and mixing are all criteria to be fulfilled in order to ensure formation of good compost that will have terminate pathogens.

It is found that bacteria pathogens can survive for longer time in animal manures when the environment is appropriate. The appropriate environment includes: low temperature, moistened and low or no aeration depending on the organism.

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