INTRODUCTION
Hunger and malnutrition remain amongst the most devastating problems facing the world poor and needy. Almost a billion people (the poor, especially those in rural areas in the developing countries) still suffer from hunger, (FAO, 2012). The most reliable source of protein for many is fish, yet millions of people who depend on fish are faced daily with the fear of food shortage (World Fish Center, 2003) due to limited supply from the wild. However, rearing fish in pond requires basic input such as quality feed and fertilization with value between 40 to 70% of the cost of production of the fish (Kubitza, 2000), therefore the use of integrated aquacultural system proffers some solutions which make aquaculture venture less expensive, easy to manage and increase income.

Animal waste (droppings, dungs and sewage obtained basically from cattle barns, stables, farmyards, biogas slurry and sewers) is used in aquaculture as feed and to fertilize fishponds (Dhawan and Toor, 1989). Raw poultry dung for instance contains 2.1% nitrogen, 64.3% phosphorous, 5.31% calcium, and 2.11% magnesium (Odoemena 2005), therefore it act as a good fertilizer which helps in producing fish feed i.e. phytoplankton and zooplankton in fish pond. So application of extra fertilizer to fish pond for raising fish is not needed. This cuts the cost of fish production by 60%. In one year 25-30 birds can produce 1 ton dip litter and based on that it is found that 500-600 birds are enough to fertilize 1 ha water spread area for good fish production (IIRR, 1996). Therefore integrating fish with various systems of livestock (e.g. fish-cum-chicken, fish-cum-duck, fish-cum-buffalo, fish-cum-dairy cattle, fish-cum-pig, fish-cum-sheep) use up regular animal waste supply (Eyo et al., 2006). The recycling of animal wastes through fish culture, as manure, can abate organic pollution and keep the environment clean and healthy. The economic benefit of integrated fish farming cannot be over-emphasized since the integration is varied and diversified in nature. It is one of the most viable, reliable and profitable of any farming enterprise because meat, eggs and fish can be produced simultaneously from the same venture. (Dhawan and Kaur, 2002). It contributes immensely to the economic empowerment of many families especially in the rural communities and enables the farmer to be productive all the year round and fully maximize their production. By practicing the pond based farming systems programme, farmers could be able to utilize their resources judiciously and effectively as Fish feed directly on the animal excreta (Gabriel et al., 2007) Numerous parasites have been identified with livestock-fish integration, however little is known about its link to the deadly Avian influenza virus. According to Nyaku et al., (2007) livestock-fish integration may have various diseases and infections associated with them, however the means of transmission of these viruses as well as the practice of using poultry manure (chicken, duck and other poultry feaces) in agriculture and aquaculture in untreated form may set up major new reservoirs of avian influenza infection, hence this paper aims to provide information for consciousness and safe practice in the light of growing interest in integrated aquaculture.

Key words: Bird flu, Poultry manure, Zoonotic infection, Integrated fish farming.

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Abstract
The integration of fish production with animals is a model farming system for full utilization of local resources, waste recycling, saving energy, and for maintaining ecological balance and circulation. The mode of transmission of the Avian Influenza virus puts practitioners of fish cum-poultry integrated fish farming at high risk; this paper therefore details current knowledge of the virus with an aim to enhance safer practice of integrated poultry cum fish farming in the light of zoonotic transmission of the disease.

Key words: Bird flu, Poultry manure, Zoonotic infection, Integrated fish farming.
Avian influenza
Avian influenza is an infection caused by avian influenza viruses. These influenza viruses occur naturally among birds. Wild birds worldwide have flu infections in their intestines, but usually do not get sick from flu infections. There are three types of Influenza viruses, categorized as A, B and C types (Lee et al. 2006) within the Influenza virus genus and Orthomyxoviridae family. Only type A is capable of causing severe infections and pandemics in human populations although type B can cause severe morbidity and mortality particularly in children (Webster et al. 2006). The central core of influenza A viruses contain eight single-stranded RNA gene segments surrounded by the surface glycoproteins hemagglutinin (HA) and neuraminidase (NA) (Figure 1) (Lee et al. 2006).

Bird flu A type virus has multiple sub-types, these being defined by combinations of the two proteins. (HA and NA) existing on the surface of the virus. The HA protein has 15 different subtypes, the NA nine subtypes (ICTV 2002). The combination formed by one HA and one NA protein is used to name the virus sub-type but only three HA (H1, H2, H3) and two NA subtypes (N1, N2) are widely present in humans (Horimoto and Kawaoka 2001). Bird flu is known as H5N1 virus, being a combination of HA 5 and NA 1 proteins. Avian Influenza viruses are also classified by their level of pathogenicity, or virulence. Highly pathogenic avian influenza (HPAI) has a high mortality rate in poultry; capable of killing between 90 and 100 per cent of infected chickens. Low pathogenic avian influenza (LPAI) causes less severe symptoms; in many cases no illness may occur in infected chickens (Webster et al. 2006). But LPAI viruses can evolve into HPAI viruses, requiring that both be monitored should outbreaks occur (ACIAR, 2009). However, avian influenza is a very contagious disease among birds and some of these viruses can make certain domesticated bird species, including chickens, ducks, and turkeys, very sick and result into death. HPAI H5N1 virus does not normally infect man (WHO, 2007).

Humans are naturally protected from avian influenza viruses because we lack certain receptor binding sites (α 2-3 receptors) in our respiratory tracts that are required for infection to occur. Humans possess α 2-6 receptors, which are binding sites for human influenza viruses (e.g., H1N1, H3N2) but typically not susceptible to avian influenza viruses. Pigs however are susceptible to both human and avian influenza viruses because they possess receptors for both avian and human influenza viruses (α 2-3 receptors and α 2-6 receptors, respectively), and therefore can serve as an ‘intermediate host’ (i.e., mixing vessel). Antigenic shift results from the re-assortment of two distinct influenza A viruses (e.g., avian and human influenza viruses) within a single host (e.g., pigs) and represents a major change in viral composition which result in the formation of novel viruses (Tambyah and Leung 2006). Therefore, the variability of influenza A viruses depends on the evolution of the virus through point mutations (antigenic drift) and genetic re-assortment (antigenic shift) (Horimoto and Kawaoka 2001) These point mutations occur often resulting in annual variations in the human influenza strains circulating the globe. It is these changes that require the production of new human seasonal influenza vaccines each year (Jennings and Read 2006)

MODE OF TRANSMISSION
Avian Influenza (Bird Flu) is a zoonotic disease that potentially threatens millions of people. Effective detection and improved animal health are important aspects of controlling this disease. Increasing population in rural areas is leading to more humans living in closer proximity to livestock and to each other. This proximity can cause problems when diseases occur, creating increased opportunities for transfer from animals to humans and within humans. Both livestock and domesticated animals can carry such diseases (ACIAR, 2009). Two zoonotic diseases have been the subject of widespread outbreaks, namely Avian Influenza (bird flu) and Severe Acute Respiratory Syndrome (SARS) (ACIAR, 2009) hence the need to create more awareness as integrated aquaculture becomes wide spread.

Outbreaks of bird flu amongst poultry have been confirmed in Cambodia, China including Hong Kong, Indonesia, Japan, Laos, Pakistan, South Korea, Thailand and Vietnam. In Africa, eight (8) countries have reported cases of bird flu. They are Burkina Faso, Cameroun, Cote d’Ivoire, Djibouti, Egypt, Niger, Nigeria and Sudan. Zoonotic transition from poultry to humans has been reported in Asian countries such as China, Vietnam, Cambodia, Thailand and Indonesia. Human cases have also been reported in three African countries namely Egypt, Djibouti and Nigeria. Though there is no evidence to date of sustained human-to-human transmission - like the ordinary flu. However, the world is concerned that H5N1 could adapt and become easily transmitted among humans and once this adaptation occurs, it will no longer be a bird virus but a human influenza virus, which could cause a pandemic but infection in humans so far has been zoonotic in nature (Jennings and Read 2006).

Basically Wild birds worldwide have flu “A” infections in their intestines, but usually do not get sick from flu infections. However, avian influenza is very contagious among certain domesticated bird species, including chickens, ducks, and turkeys (Karafistant, and Arik-Colacoglu 2005). This virus is often passed on through
contact with the droppings of wild birds and from sharing a source of drinking water or food (Capua et al., 2002). Infected birds can shed influenza virus in their saliva, nasal secretions, and faeces. Susceptible birds become infected when they have contact with contaminated secretions or excretions or with surfaces that are contaminated with secretions or excretions from infected birds. Infection with bird flu in domestic poultry causes two main forms of the disease that are distinguished by low and high extremes of virulence. The "low pathogenic" form may go undetected and usually causes only mild symptoms of bird flu, which may include ruffled feathers and a drop in egg production. The highly pathogenic form of bird flu spreads more rapidly through flocks of poultry. This form may cause disease that affects multiple internal organs, and it has a mortality rate that can reach 90 percent to 100 percent, often within 48 hours (Capua and Alexander 2002).

Symptoms of Infection in Birds
The signs of avian influenza in birds vary and can be affected by the existence of other diseases, the age of the birds, the environment and the severity of the virus itself. In very severe forms the disease appears suddenly and birds die quickly, sometimes without showing clinical signs of the disease. Signs may include:

1. Quietness and depression
2. Loss of appetite
3. Decrease in egg production
4. Production of soft-shelled or shell-less eggs
5. Profuse watery diarrhea.
6. Combs and wattles may be swollen and become blue
7. Swelling of the face, and skin under the eyes
8. Reddening of the legs
9. Laboured respiration
10. Coughing, sneezing - nasal discharge
11. Nervous problems - uncoordinated gaits
12. Haemorrhages on the hock
13. Sudden death without clinical signs

Mass mortalities may start with a few deaths which may be followed by an outbreak, killing hundreds or thousands of birds each day (Timothy, 2008).

Symptoms of infection In Humans
As at 6 February, 2007, 272 human cases of Avian influenza were reported in eleven countries with 166 deaths. Most of these cases have resulted from people having direct or close contact with H5N1-infected poultry or H5N1-contaminated surfaces (WHO, 2007). The cases were confirmed by the Egyptian Central Public Health Laboratories, a National Influenza Center of the WHO Global Influenza Surveillance Network, hence our fear for practitioners of integrated aquaculture. However, so far, there is no evidence that properly cooked waterfowl (or domestic poultry) can sicken people (Aamir, 2009). Initial Avian Influenza symptoms in humans include:

1. High fever, usually with a high temperature and influenza-like symptoms.
2. Diarrhoea
3. Vomiting
4. Chest pain
5. Bleeding from the nose and gums

There is currently no effective vaccine to protect humans against H5N1. However, some anti-viral drugs can help limit symptoms and reduce the chances of the disease spreading (Timothy, 2008).

Practice of Integrated Aquaculture in the risk of infection with the Influenza virus.
Nyaku et al., (2007) reported that the widespread practice of using poultry manure (chicken, duck and other poultry faeces) in agriculture and aquaculture in untreated form as fertilizer and as food for pigs and fish may set up major new reservoirs of zoonotic infections. If the chickens providing the manure are infected themselves with Avian influenza virus (Feare 2006), zoonosis becomes highly likely. Birds infected with viruses excrete viruses in their faeces hence untreated faeces move from infected birds into fish ponds providing a potential source of infection and risk to individual practitioners. Although recognized as early as 1988, the risks of this practice for spreading influenza viruses remain little investigated (Suarez et al., 2004). Where untreated poultry manure is collected, transported and sold, this could be a highly effective way of spreading the bird flu virus over long distance (Bird Life, 2006). The risks of integrated fish farming in relation to outbreaks of avian influenza, especially human pandemics, were recognized over a decade ago (Scholtissek et al., 1988) Although some scholars doubted that avian influenza pandemics is likely not generated from Integrated Fish Farming on the basis that pigs, usually regarded as necessary “mixing vessels” for the re-assortment/re-combination of poultry viruses are rarely reared with both poultry and fish (Little et al., 2003). However, this constraint has now been removed with the ability of the current HPAI H5N1 to pass directly from poultry to humans probably due to recombined genes (Webster et al., FAO/OIE/WHO (2005) identified the use of poultry manure in fish farming as one of the risk factors in the spread of HPAI H5N1. In relation to other diseases, FAO (2005) considered the use of raw chicken manure in aquaculture to present risks of Salmonella and various parasites being transmitted to man. In response to these concerns, FAO (2004) recommended that the feeding to farmed fish with poultry manure/poultry litter, poultry meat, bone meal or feather meal, should be banned in countries affected by or at risk from avian influenza and where industry standards are not followed; however where small enterprise holders depend upon this system for pond fertilization and also cannot afford expensive fish meal for feeding fish, there is little likelihood of any such bans being effective or practicable (FAO, 2004).

In conclusion, integration of fish and poultry farming may clearly present new opportunities for the dissemination of HPAI H5N1 viruses through poultry faeces either by direct feeding or by incorporation into feed for export which could provide opportunities for long distance spread of the virus, more so, wild infested bird on transit may transfer the virus by virtue of contact of the saliva with pond water while drinking from the pond or searching for food in a pond. Awareness of the health hazard of these should be
more emphasized while research should be intensified on how best to use poultry manure without being exposed to the risk of avian influenza infection. However to prevent integrated Aquaculturists from any risk of zoonotic infection from poultry birds, the following are advised:

i. Always wash your hands with soap after touching any poultry, eggs or bird meat.

ii. Do not slaughter, use or cook sick or already dead poultry or birds for human or fish consumption.

iii. Closely monitor and report to the nearest veterinary authority any cases of sick or dead poultry or birds in your locality.

iv. Cook poultry and eggs thoroughly before eating.

v. Use protective coverings such as long cloaks, nose and mouth mask when handling both live or dead birds.

vi. Free range production tanks can be covered using appropriate netting material to reduce the vulnerability of these ponds to contact with wild birds.

vii. Once it is observed that wild birds have drank, from your source of water, it is adviseable to empty and disinfect the container immediately.

viii. Keep children away from sick or dead animals especially poultry and birds.

Reference


World Fish Centre (2003). ‘Fish an issue for every one’: A concept paper for fish for all Summit. p.10.

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