

INTRODUCTION

Background Information

- The end result of fish production is the amount of fish gained at harvest which is dependent on the farmer's management and system of practice (Decline, 1999).
- The sustainability of aquaculture practice depends on the economic disposition and value it adds to the welfare of the farmer (Decline, 1999).
- The current rise in fish farming and aquaculture has resulted in an exponential increase in the use of agrochemicals which has made the researchers to view some of the chemicals as materials whose environmental fate is poorly understood (Dedeke et al., 2018).
- The use of agrochemicals, such as herbicides in farming and fish farming, most especially around ponds has raised a lot of questions as regards public health

INTRODUCTION

- Examples of chemicals with negative effects on target organisms and public health implications used in aquaculture include Copper sulphate, Malachite green, Formalin, Potassium permanganate (Alarape et al., 2013).
- *Clarias gariepinus*' exposure to copper sulphate resulted in necrotic ovaries, matted lamellae of the gills, and multifocal severe degeneration of the seminiferous tubules while those exposed to Malachite green resulted in disrupted and depleted seminiferous tubules, focal localized vacuolation of skin, and generalized fatty degeneration of liver (Adeyemo et al., 2011).
- Though, the use of pesticides is not targeted at the fish but can easily be washed into ponds and other water bodies by rain, altering the physiological parameters of the water and the chemicals could also build up in the fishes' systems, and this would pose a threat to public health in general.

INTRODUCTION

- Glyphosate is one of the common herbicides used as a non-selective herbicide and for aquatic weed control in fish ponds, lakes, canals, slow running water, which is said to be slightly toxic to mammals and fish (USDA, 1984).
- It is taken up by the foliage of plants and transported throughout the plant, resulting in plant death after several days.
- Glyphosate is the most extensively used herbicide worldwide and are major contaminants of rivers and surface waters (IFEN, 2007) as well as organisms, including humans, but also food, feed, and ecosystems (Acquavella et al., 2004).

INTRODUCTION

- In the past, glyphosate was considered a nontoxic herbicide because of its low LD50 (the concentration that caused 50% deaths); $> 4\text{g/kg}$ (WHO, 2001).
- Ayoola (2008) reported that glyphosate toxicity increased with increased concentration.
- According to Gill *et al.*, 2017, glyphosate's toxicity is not only observed in unicellular organisms but also shows its toxic effects on many multicellular organisms found on both soil and water.

METHODS

- Fifty pre-tested structured questionnaire asides from online Google forms were distributed to fish farmers to determine the usage of glyphosate chemicals on fish farms as well as the glyphosate brand commonly used.
- Seventy-five apparently healthy adult *Clarias gariepinus* (300 ± 0.5 g) were sourced from a local farmer.
- They were transported in a plastic keg to the Fish and Wildlife Laboratory at the Department of Veterinary Public Health and Preventive medicine that same day.
- The fishes were subsequently transferred into holding tanks for two (2) weeks acclimatization and were fed protein pellets daily at 5% body weight and later divided into four (4) groups by simple randomization.

METHODS

- There were four (T_1 , T_2 , T_3 and T_0) concentrations (0.15mls (0.003ml/L), 0.225mls (0.0045ml/L) and 0.3mls (0.006ml/L)) and a control of (0ml) respectively and three replicas of each concentration.
- Test solution was prepared according to Sani and Idris, 2016 with slight modification.
- The chemicals at different concentrations were added to a 50L mark tank of water respectively and aerated approximately one hour daily.
- Physical observation and behavioural changes were observed after the introduction of Force-Up. Fresh solutions were prepared every twenty-four hours while aeration and water quality parameters were repeated daily for five days.

METHODS

Sample Collection

- Blood samples were collected from the caudal veins and poured inside EDTA embedded bottles.
- The fish were euthanized using pithing method while organs (gills, liver, and kidney) were collected through dissection of the fish and placed in plain labeled bottles for histopathology, and preserved with Bouin's fluid for proper tissue preparation and slide production.
- After tissue sample collection, the fish were deeply buried in the ground and covered up with earth.
- This study's protocol was approved by University of Ibadan Animal Care and Use Research Ethics Committee (UI-ACUREC) with the assigned number UI-ACUREC019-0220/6

Results

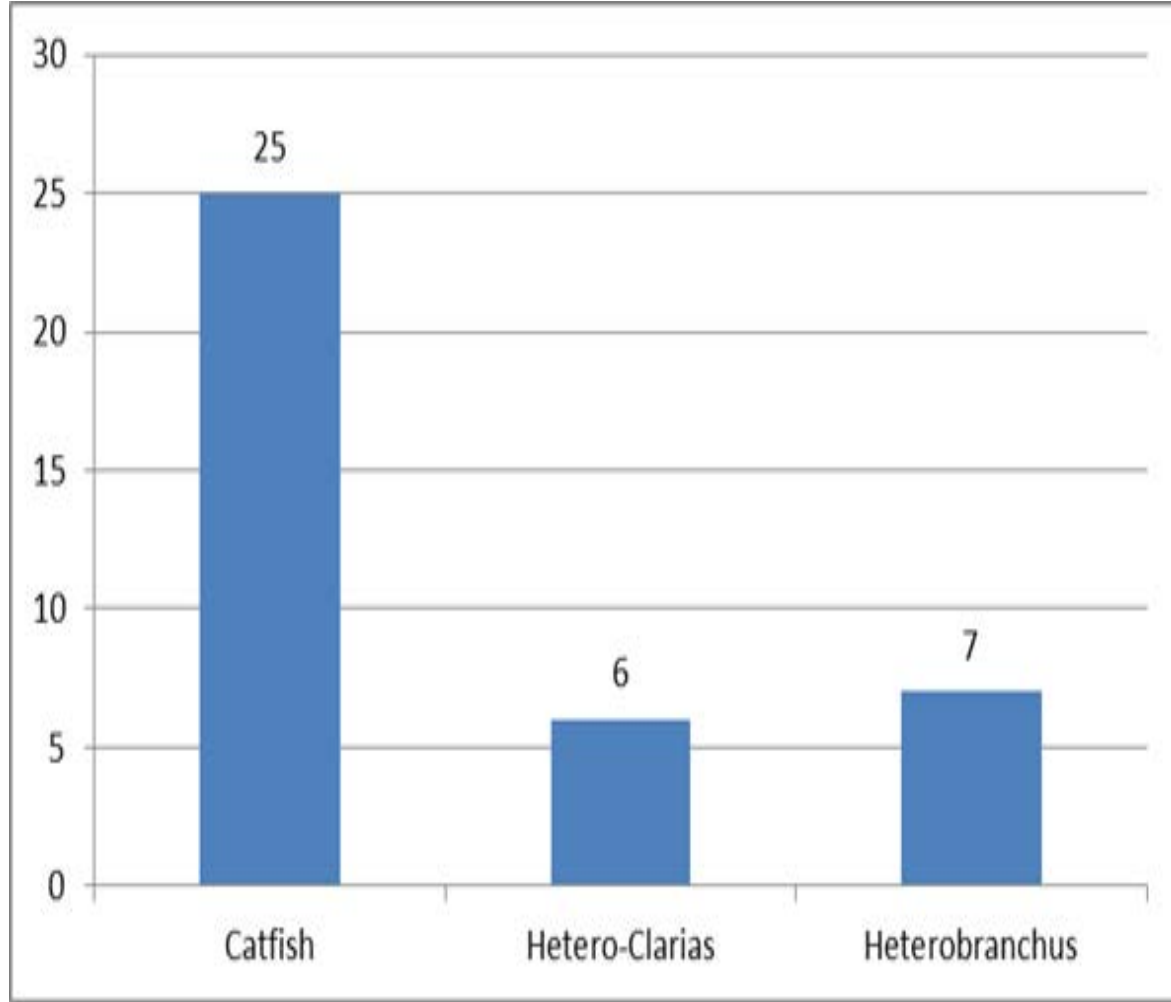


Fig. 1 showing Distribution of Cultured Fish

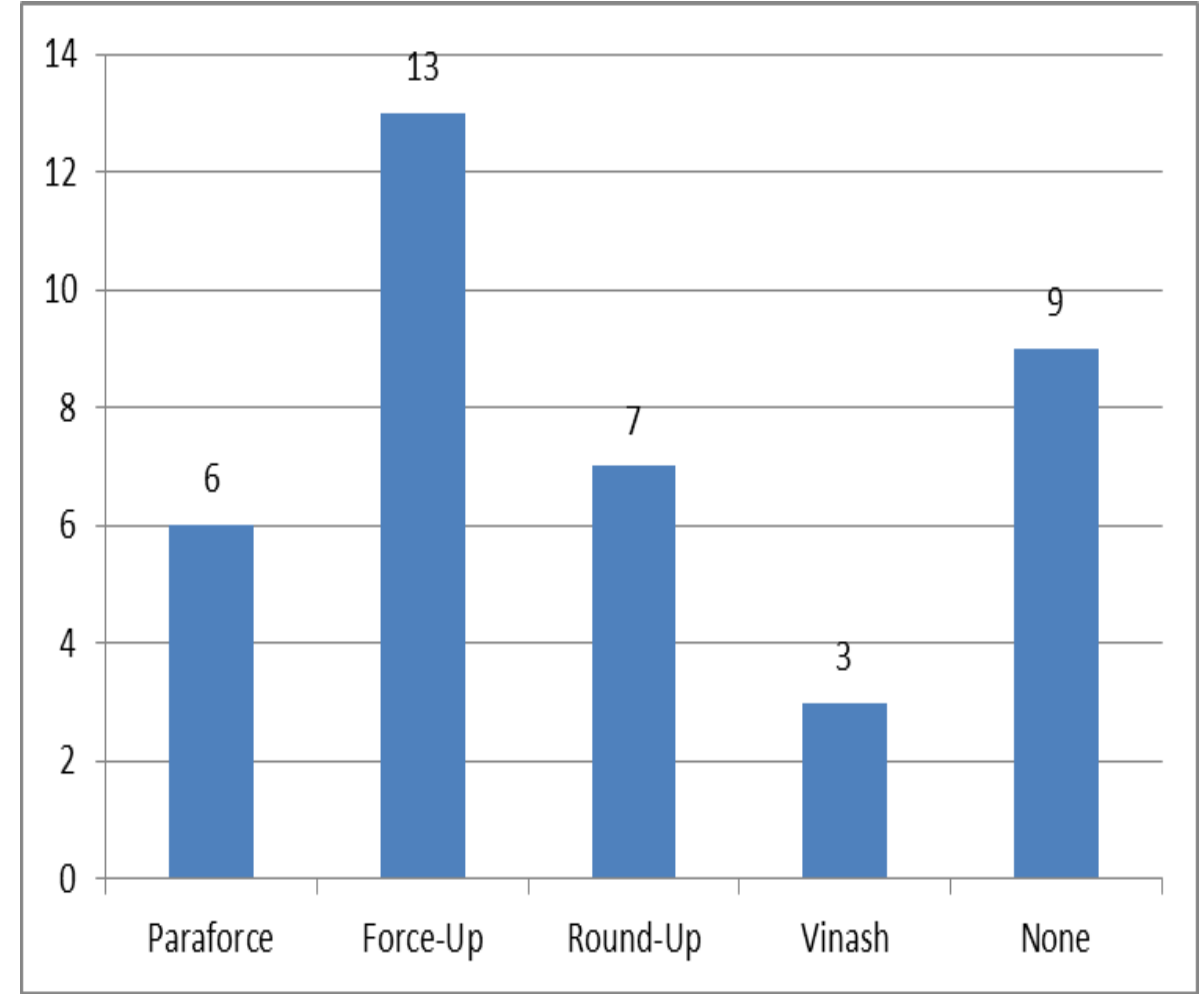


Fig. 2 showing Distribution of Glyphosate-based Herbicides use in Fish Farms

Results

Histopathological Lesions

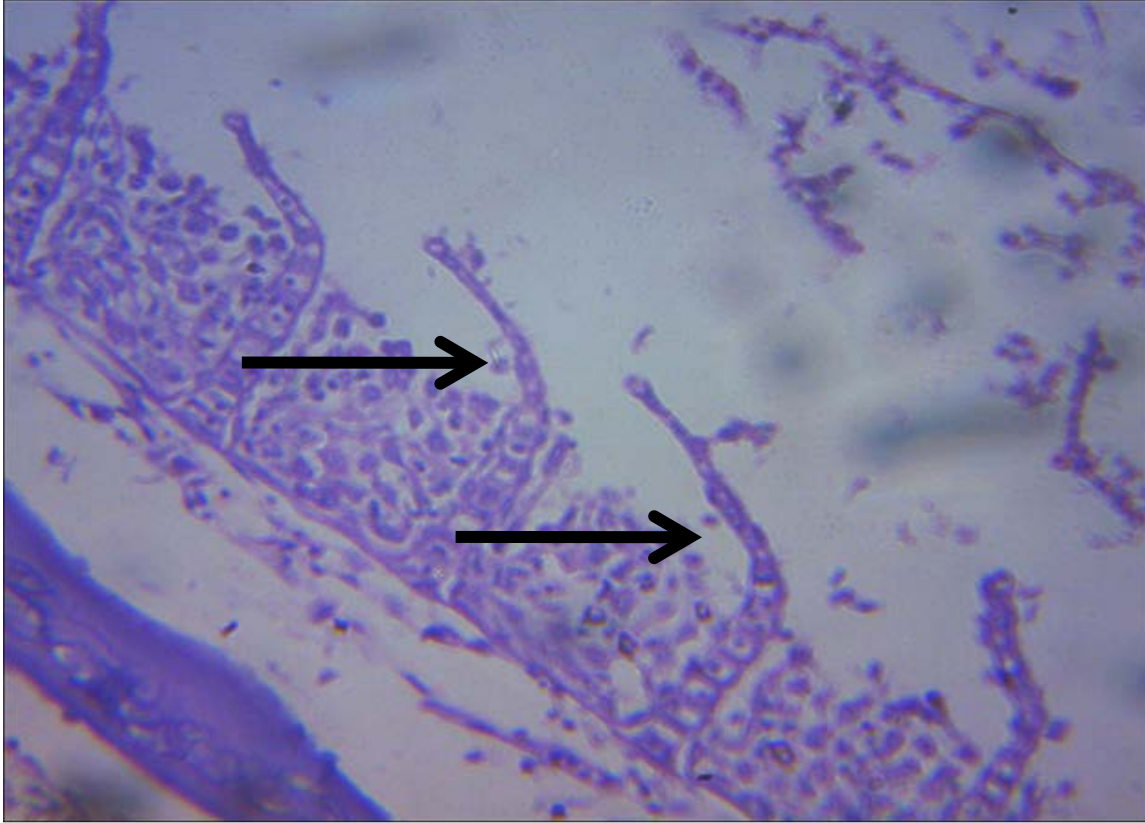


Fig. 3: Diffusely Stunted and Eroded Secondary Lamellae of the Gills (Arrows) at First treatment concentration (0.15mls) X400

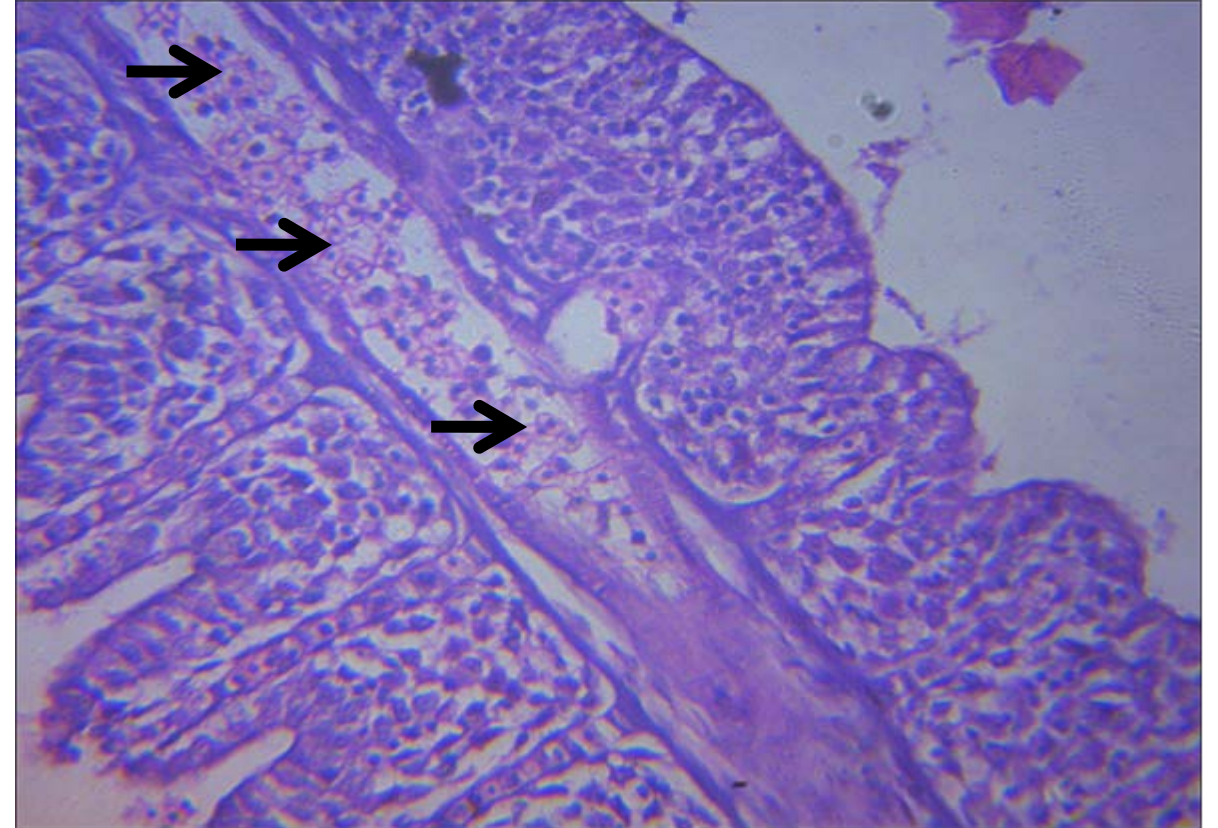


Fig. 4: Severe Congestion of the Blood Channel at the Core of the Primary Lamellae (arrows) at second treatment concentration (0.225mls) X400

Results

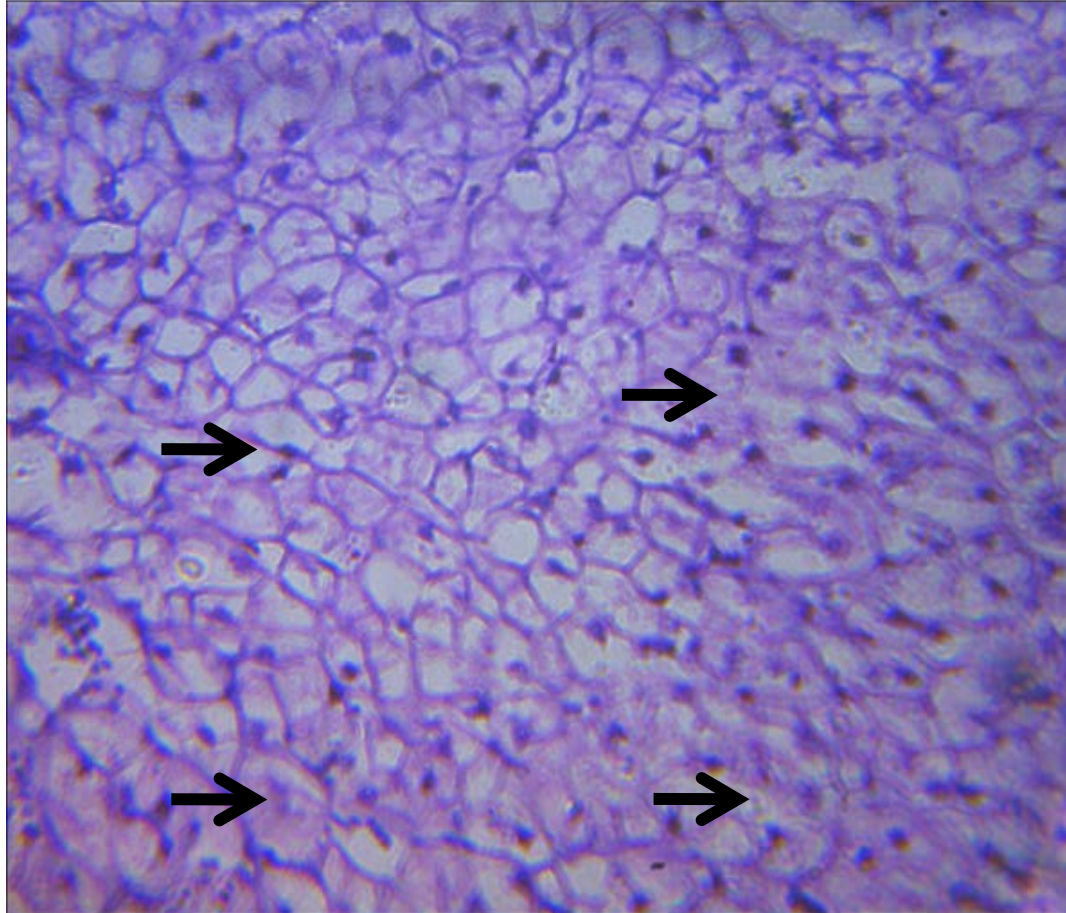


Fig. 5: Severe Diffuse Vacuolation of the Hepatocytes (Arrows) at First Treatment Concentration (0.15mls) X400

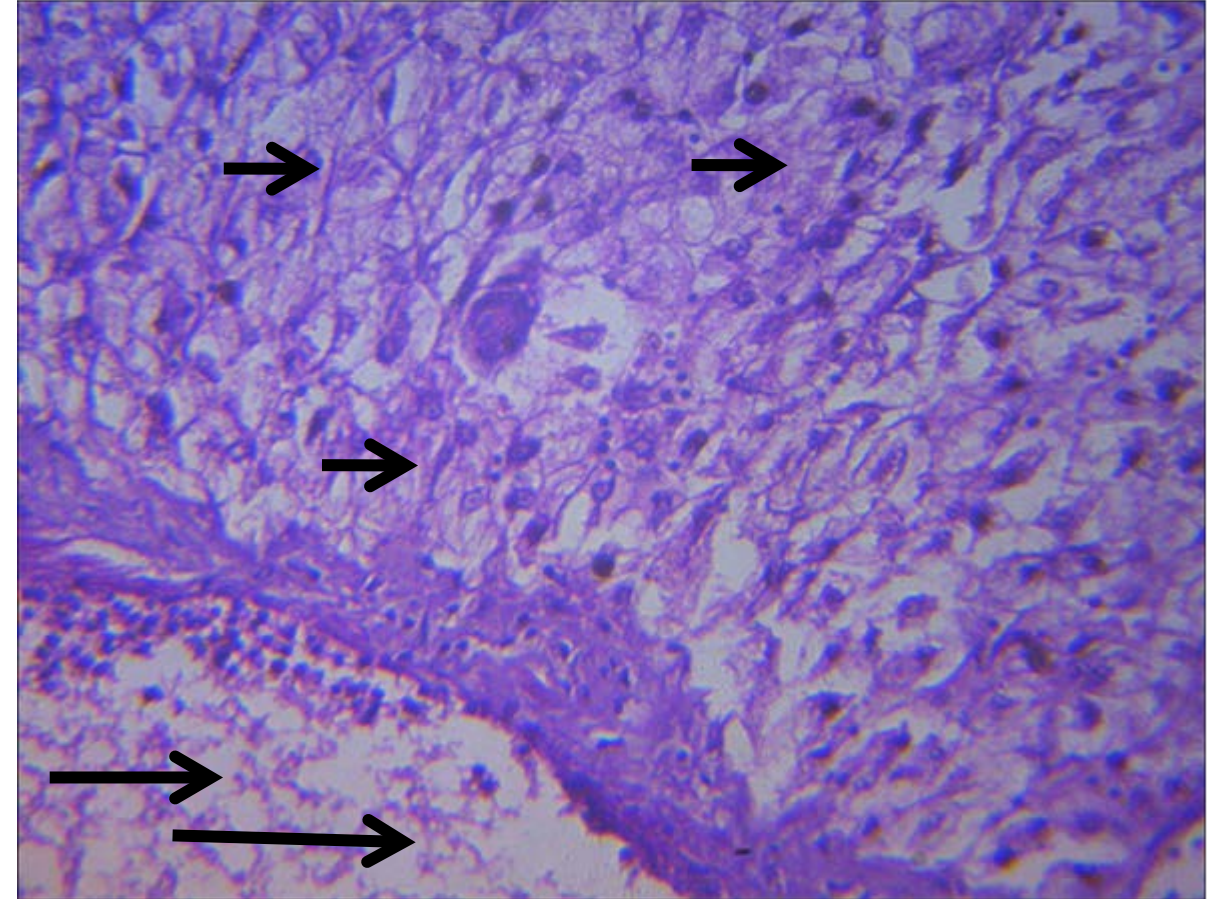


Fig. 6: Moderate to Severe Portal Congestion (long arrows) and Mild Diffuse Vacuolation of Hepatocytes (short arrows) at Second Treatment Concentration (0.225mls) X400

Results

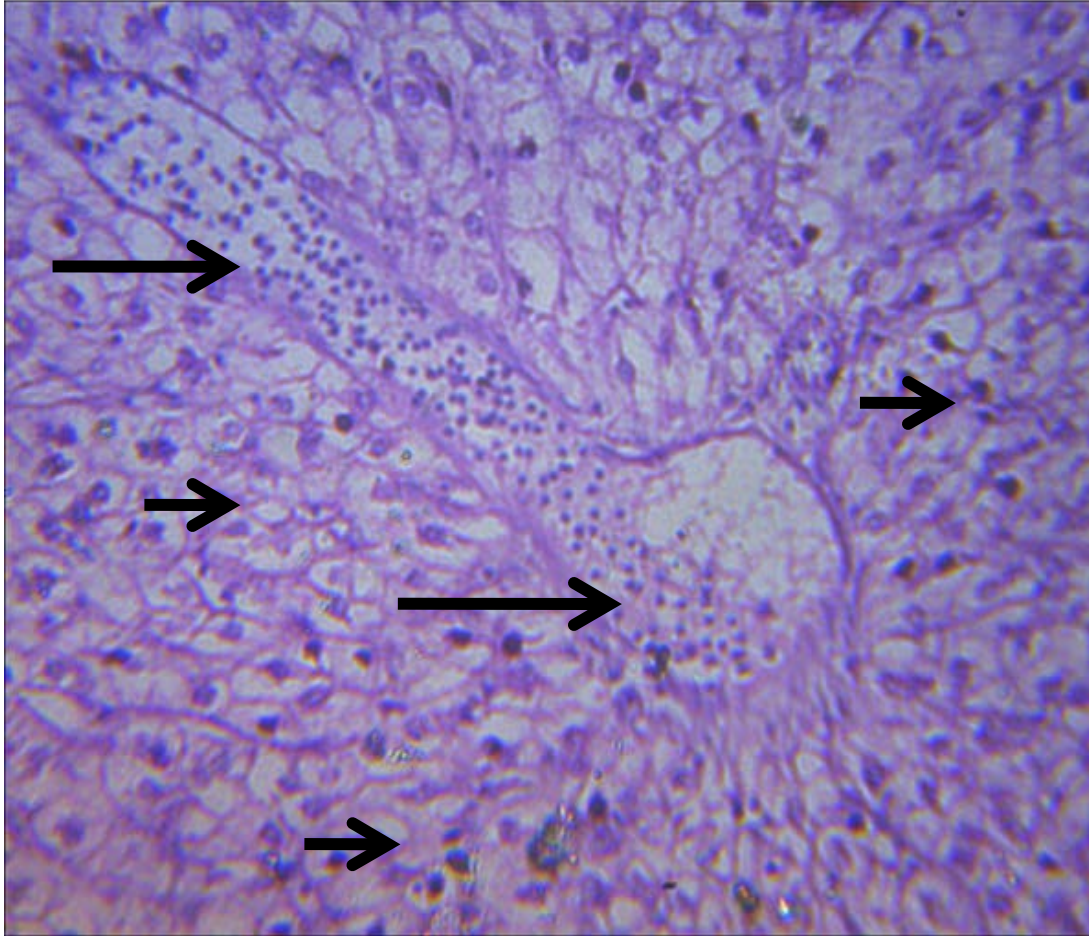


Fig. 7: Moderate Diffuse Vacuolation of Hepatocytes and Severe Portal Congestion at Third Treatment Concentration (0.3mls) X400

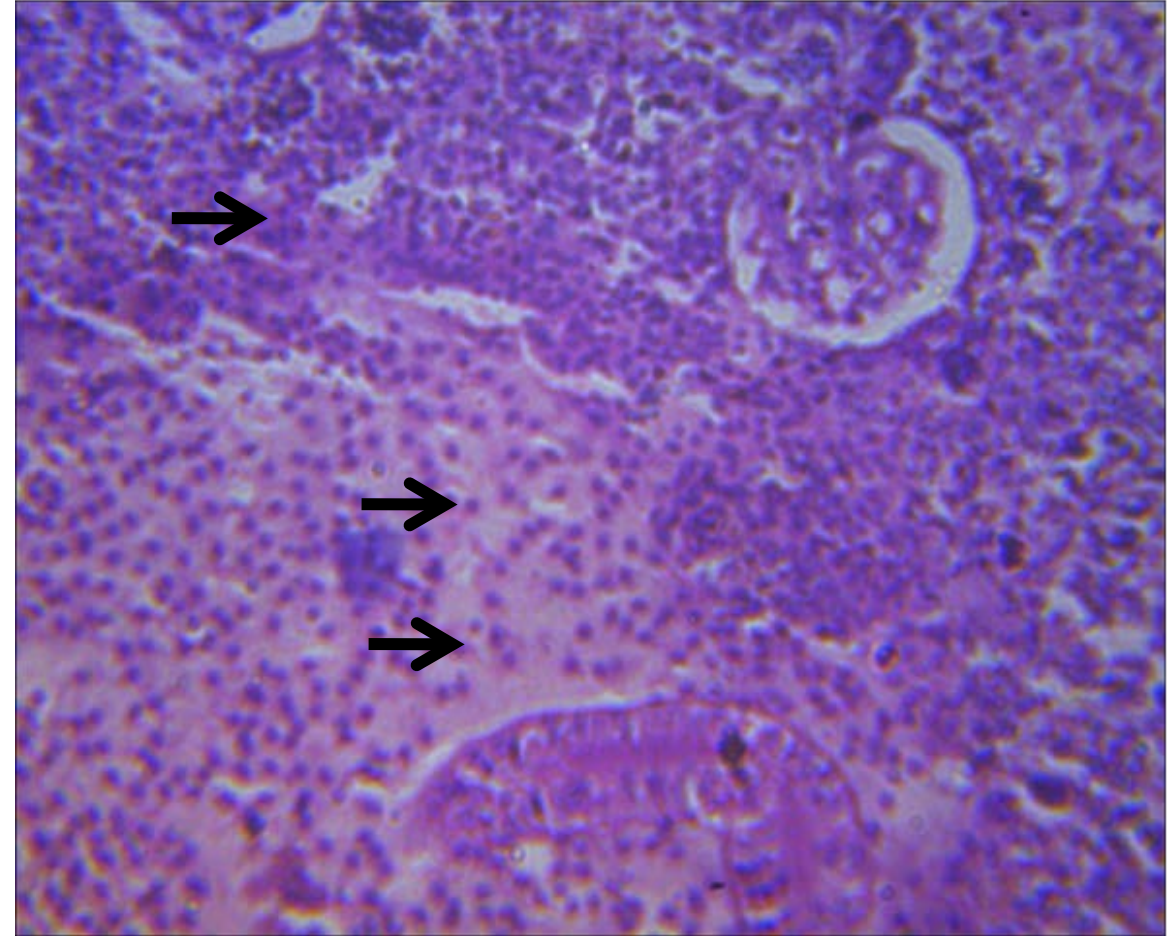


Fig. 8: Focus of Interstitial Oedema within the Parenchyma at Third Treatment Concentration (0.3mls) X400

Results

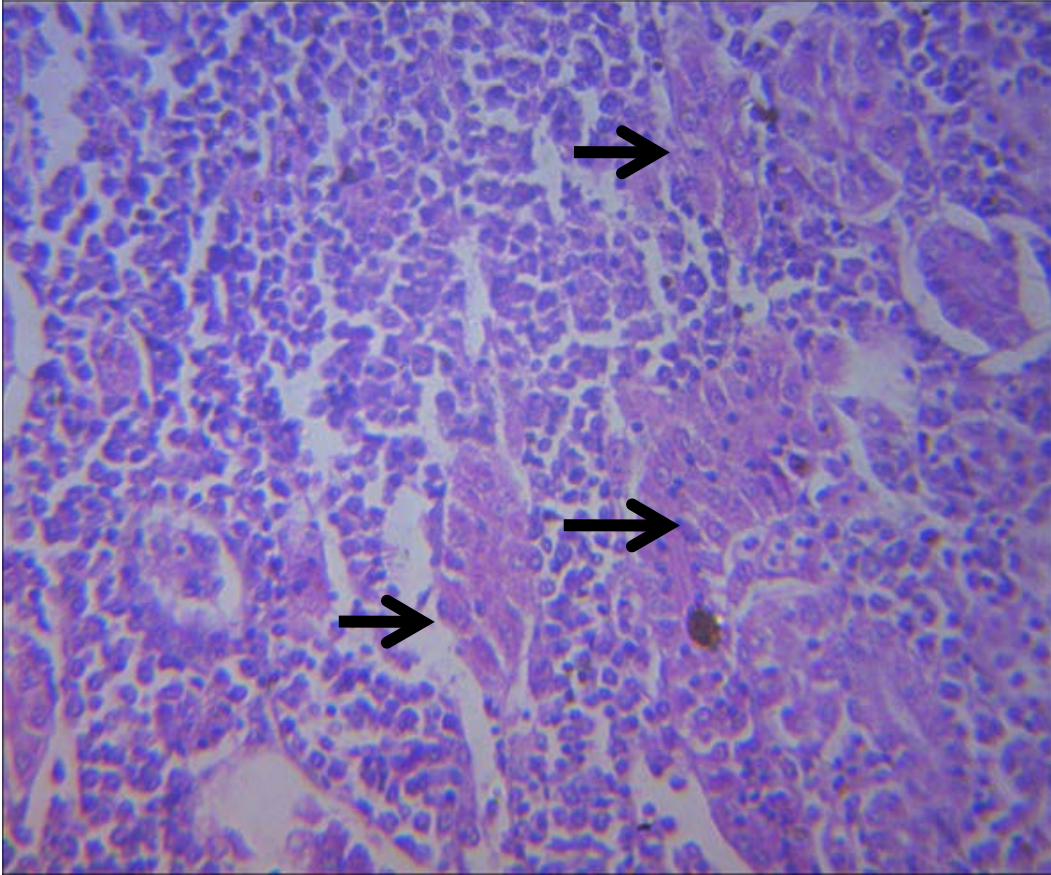


Fig. 9: Mild to Moderate Congestion of the Interstitium at Second Treatment Concentration (0.225mls) X400

Results

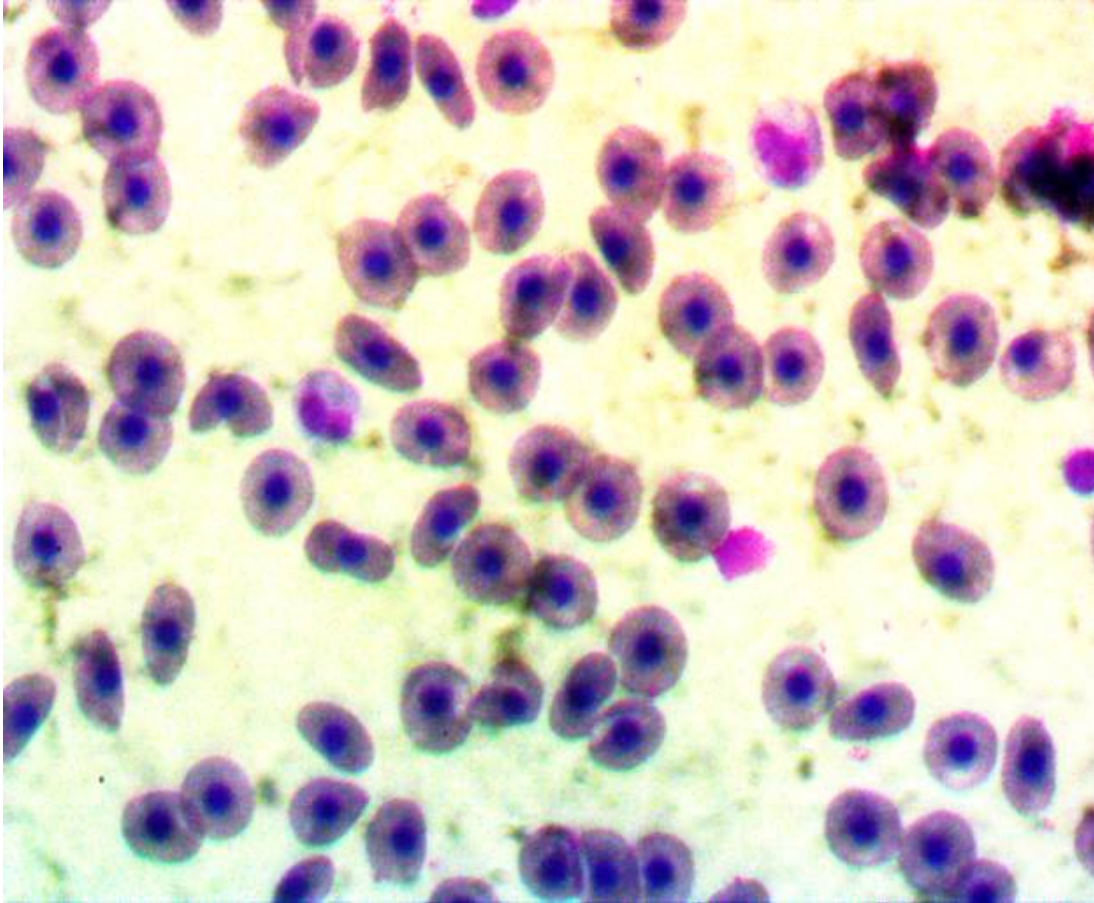


Fig. 10: Photomicrograph showing Normal Fish Nucleated Red Blood Cell (Giemsa x1000)



Fig. 11: Photomicrograph showing Micronucleus (red arrows) in the Fish Nucleated Red Blood cell at 0.225ml Treatment Concentration (Giemsa x1000)

Results

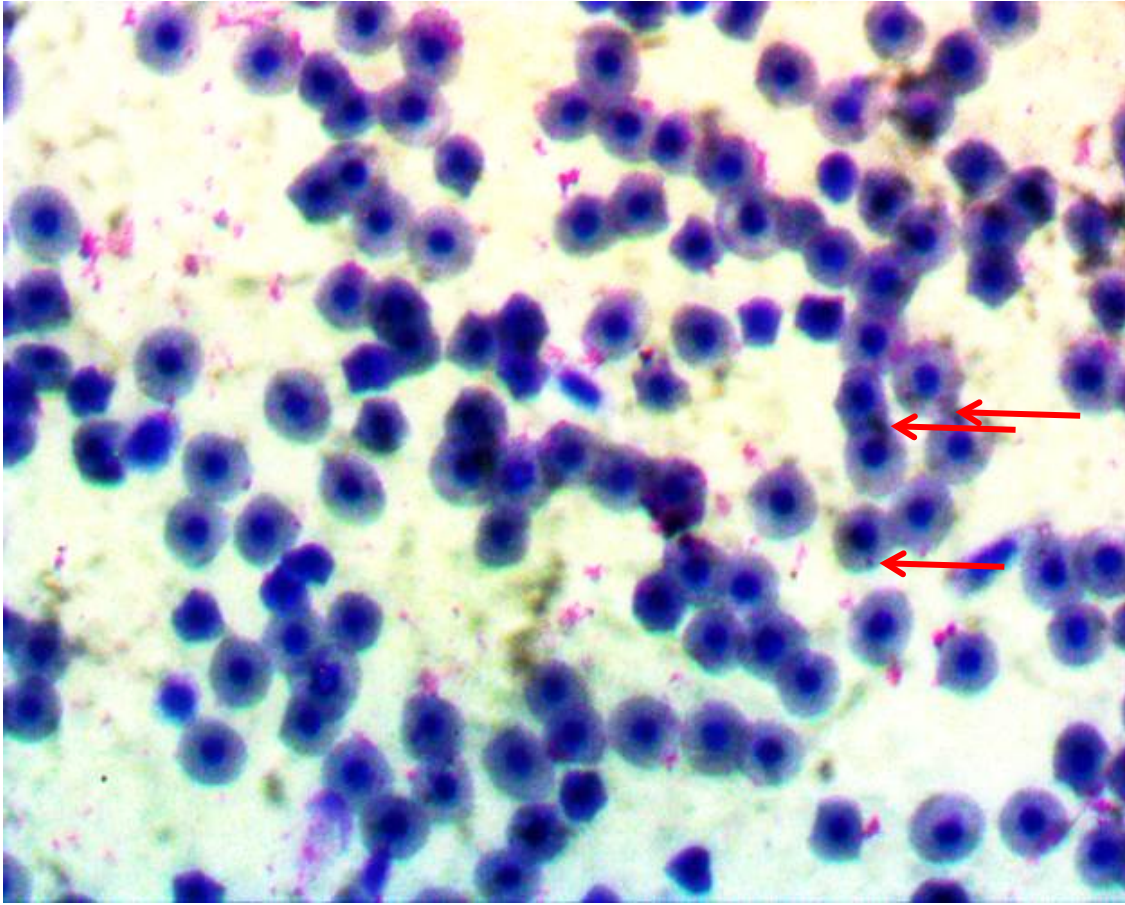


Fig. 12: Photomicrograph showing Micronucleus (red arrows) in the Fish Nucleated Red Blood Cell at 0.3mls Treatment Concentration (Giemsa

DISCUSSIONS

- 76.32% of the respondents were using one form of glyphosate or another in the control of weeds on the farm. This is corroborated by the report of (Valavanidis, 2018) where glyphosate-based herbicides were the most used agricultural pesticide worldwide.

PHYSICAL OBSERVATIONS

- Expectedly, Fish in the control experiment were calm and exhibited normal behavioural activities throughout the experimental periods
- Fish in the treatment groups showed erratic swimming, splashing, restlessness, movement from surface to bottom, sudden movement, and resting at the bottom of the container
- The observed behavioural signs were similar to the several previous reports by Aguigwo, (2002), Omoniyi *et al.*, (2002), Rahman *et al.*, (2002), Okayi *et al.*, (2010) and Sani and Idris, (2016).

DISCUSSIONS

HISTOPATHOLOGY

- Lesions observed in collected tissues from the fish were predominantly pronounced in higher dose treatments (T2 and T3) which are similar to the report of Ayoola, (2008) where he reported pronounced lesions at 96 hours exposure with accompanying mortality with an increase in the concentration of the glyphosate.
- Mortalities were observed at the highest concentration (2 and 5 mortalities at T2 and T3 respectively) of the herbicides which suggested that a threshold of toxicants is reached.
- This is in agreement with the observation of Fryer, (1977) which stated that when a threshold of toxicants is reached, there is no drastic survival of the animal. When below the threshold, an animal will be in a tolerance zone while above the tolerance zone is the zone of resistance.

DISCUSSIONS

- Livers and kidneys were mostly affected by the glyphosate toxicity compared to the gills. These findings were similar to the previous study reported by Ayoola, (2008).
- Presence of diffused, stunted, and eroded secondary lamellae of the gills coupled with severe congestion of the blood channel at the core of the primary lamellae reported in this study were in line with previous findings of Nowak, (1992), Neskovic *et al.*, (1996) and Ayoola, (2008).
- Observed mild to severe diffuse vacuolation of the hepatocytes and moderate to severe portal congestion of hepatocytes were similar to the report of Ayoola, (2008) where he reported that the most frequent types of degenerative changes encountered are vacuolization, hydropic degeneration, and focal necrosis.

DISCUSSIONS

- Risbourg and Bastide, (1995) also reported an increase in the size of lipid droplets and vacuolization in the liver of fish exposed to atrazine herbicide
- In the present study, the kidney of *Clarias gariepinus* exposed to Force-Up showed mild to moderate congestion of the interstitium and focus of interstitial oedema within the parenchyma. These lesions were similar to the reports of Oulmi et al., (1995), Omoniyi et al., (2002), Rahman et al., (2002).

MICRONUCLEUS ASSAY

- According to Osman et al., 2008 and Kumar et al., 2010, fish and aquatic invertebrates are excellent model for studying the toxic, mutagenic and carcinogenic potential of the water pollutants.

DISCUSSIONS

- They play different roles in the trophic web such as undergoing bio-accumulation of environmental pollutants, biotransformation of xenobiotics through cytochrome P450-dependent oxidative metabolism and response to mutagens at low concentration.
- The presence of micronucleus formation in the fish nucleated red blood cells at higher treatment (0.225mls and 0.3mls) concentrations in this study is also in support of a previous study carried out by Nwani et al., (2013).
- He reported micronucleus formation in erythrocytes of *C. punctatus* after exposure to carbosulfan (0.07, 0.13 and 0.20 mg L¹), glyphosate (8.1, 16.3 and 24.4 mg L¹) and atrazine (10.6, 21.2 and 31.8 mg L¹) for 96 hours.

CONCLUSION AND RECOMMENDATION

CONCLUSION

- Glyphosate is used extensively in aquaculture-related activities, and it's the world's most used herbicide.
- Findings in this study revealed that glyphosate formulations are menacing and unsafe to the aquatic environment and activities.
- Non-target use of the herbicides in aquatic environment can cause histopathological changes in different organs especially, at higher concentrations and particularly, in livers, kidneys, and gills.
- Despite the benefits derived from the use of glyphosate-based herbicides, the result of this work, like many others, portends that they can potentially harm the aquatic environment, human health and can even alter the food chain cycle.

CONCLUSION AND RECOMMENDATION

- Glyphosate residue could reach humans and animals through feed consumption and contact with or use of contaminated water.

RECOMMENDATIONS

- Farmers should be discouraged not to use high concentrations of herbicides around fish ponds.
- Most of the world's population depends on fish as another major alternative to a protein source, then the agricultural and aquaculture communities should therefore be conscious of the potential adverse effects of this pesticide and several others.

CONCLUSION AND RECOMMENDATION

- To protect the water quality and safety of aquatic animals, Government should therefore enact policies that will guide against the use of dangerous herbicides in the control of terrestrial and aquatic weeds.
- There is need for government to commence regulation of use of herbicides for farm activities in order to protect animal, human and environmental health.
- Weeding around and within the fish ponds and water bodies should devoid of use of herbicides.

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