African Journal of Tropical Hydrobiology and Fisheries 16: 48-50 (2018)

Commercialisation of Alternative Livestock Feeds Could Save Fish Stocks in Lake Victoria

SIYA AGGREY[*], DONALD R. KUGONZA[*], VINCENT MUWANIKA[*]

[*]*College of Agricultural and Environmental Sciences, Makerere University, P.O. Box 7062, Kampala, Uganda*

Corresponding author's email address: siyaggrey@gmail.com

Abstract

Increasing livestock production in East Africa requires increased use of fish meal as a source of protein, some of which comes from the Silver Cyprinid (*Rastrineobola argentea*) in Lake Victoria, which could result in its over-exploitation and affect the survival of other organisms in the lake. The crude protein content of cockroaches (38-76% CP depending on the age) and of other insects is similar to that of fish meal (61.24% CP) and could be a substitute for it, if these insects can be domesticated and used as animal feeds. Non-conventional feeds such as cockroaches, houseflies, termites, earthworms and carabid beetles are used on a small scale by farmers in Uganda who would be willing to use them more if they could be produced on a large scale. There is therefore a need to promote large scale insect breeding so that these alternative protein sources can be integrated into farming systems.

Keywords: Alternative protein sources, Fishmeal, Insects, Poultry

Introduction

The world's human population is predicted to reach 9.7 billion (34% higher than today) by 2050 (United Nations, 2013) and this growth will mainly be in developing countries) such as those around Lake Victoria. By this time, about 70% of the population will be urban compared to 49% today (FAO, 2009; Angel *et al*., 2011). This increase in human population calls for an increase in food production and it is estimated that it will have to increase by 70% to feed the population in 2050 (FAO, 2009). This increase in food production will consequently have impacts on water bodies like L. Victoria since agriculture is a major source of pollutants and sedimentation in lakes (Moss, 2008; Donohue and Garcia Molinos, 2009).

Livestock production has evolved in response to the demand for animal products, which will double by 2050 causing, amongst other things, a significant increase in anthropogenic greenhouse gases (Herrero *et al*., 2009; Thornton, 2010). There will also be an increased demand for fish meal (Torstensen *et al*., 2008) that has and will continue to cause unsustainable pressure on fish resources (Asche *et al*., 2013). Around Lake Victoria the small cyprinid fish *Rastrineobola argentea* is mostly used for livestock feed, especially chicken production (Sharpe *et al*., 2012). In some parts of Africa, the demand for fish meal for both human diets and livestock feeds has affected the price of stock feeds (Ayantunde *et al*., 2014).

The continued increase in the human population calls for commercialization of alternative unconventional protein-rich feeds for livestock, including these feeds with fish meal (Burr *et al*., 2012). Some of these potential livestock feeds are eaten in the wild; for example, free range chicken feed on various insects and earthworms (Józefiak *et al*., 2016) but these alternative sources have not been adopted because the technologies of production have not been developed (EFSA Scientific Committee, 2015).

The consequences of climate change, such as severe flooding, are likely to increase the siltation of rivers and lakes (Xu *et al*., 2005) and could affect fisheries productivity in freshwater bodies including Lake Victoria (Bates *et al*., 2008). Insects, such as cockroaches have proved to be resistant to the harsh climatic conditions likely to be imposed by climate change since they are able to survive at extreme temperatures with limited food and water and can survive on food wastes (Brenner, 2002).

Rapid urbanization is currently reducing the availability of land for agriculture (Tiffen, 2003). Consequently, marginal lands and wetlands are increasingly being converted for agriculture; and the loss of wetlands around Lake Victoria could adversely affect fisheries productivity (Thenya *et al.*, 2006). Insect farming such as the rearing of cockroaches (e.g. *Blaptica dubia*), for instance, requires a smaller land acreage for its production and has been found to emit fewer greenhouse gases than livestock (Oonincx *et al*., 2010).

Methods

The Kawempe division of Kampala was selected for this investigation since it has many modern poultry farms (Benson and Mugarura, 2013) and is in the Lake Victoria basin. A total of 60 poultry farmers were interviewed to assess their attitudes towards the use of cockroaches as a substitute for fish meal. Consent from the respondents was sought before interview with each respondent having signed a prior consent form (Van Deventer, 2009). These key informant guides also took into consideration what farmers currently use as substitutes for fish meal and the challenges in poultry farming.

The literature was reviewed to determine the feed ingredients in fish meal relative to insect protein sources, which included crickets, cockroaches, carabid beetles and houseflies. The nutrient concentration of the different feed sources was determined in relation to fishmeal mainly used by the farmers. The crude nutrient content for each of the feed sources was evaluated in relation to the nutrient requirements of poultry.

Results and Discussion

Most (75%) poultry farmers were willing to use cockroaches as a substitute for fishmeal and alternative protein sources used by the farmers included carabid beetles, earthworms and houseflies. More than two thirds (69%) of the poultry farmers improvise alternative feeds by methods such as piling up chicken droppings so that carabid beetles, housefly maggots and other insects can grow in them and then be eaten by the chickens. This is not seen as a substitute for fish meal and the farmers complained about the lack of technologies to produce these alternative feeds in sufficient quantities to sustain poultry farming.

The crude protein concentration of carabid beetles, cockroaches and houseflies was 77%, 62% and 79% respectively (Finke, 2013) compared to 61% crude protein in fish meal (Quartararo *et al*., 1998; Soares *et al*., 2015). Soybean (plant protein source) was also evaluated and compared with the crude protein concentration in fishmeal. Soybean averaged at 63.07% crude protein, CP (Soares *et al*., 2015) which is fairly equivalent to that of fish meal. The small differences between the crude protein concentration in fish meal and other protein sources suggest that these alternative sources could replace fishmeal. If these sources could be produced on a large-scale substitution might reduce pressure on fish stocks, while increasing the quantity of fish available for human consumption.

However, in order to tap into this potential, there is need to train farmers on the use and production of these alternative feeds. Policies to encourage the use of alternative feeds for poultry need to be instituted and the development of technologies for large-scale production developed. There is also a need for research on ways of ensuring safety in the production of these alternative feeds.

Acknowledgements

My heartfelt thanks go to the Lake Victoria Management team who recognise the value of sharing knowledge about Lake Victoria.

References

Angel, S., Parent, J., Civco, D.L., Blei, A. and Potere, D. (2011). The dimensions of global urban expansion: estimates and projections for all countries, 2000-2050. *Progress in Planning* **75**:53–107.

Asche, F., Oglend, A. and Tveteras, S. (2013). Regime shifts in the fish meal/soybean meal price ratio. *Journal of Agricultural Economics* **64**:97–111.

Ayantunde, A.A., Blummel, M., Grings, E. and Duncan, A.J. (2014). Price and quality of livestock feeds in suburban markets of West Africa's Sahel: case study from Bamako, Mali. *Revue d'élevage et de médecine vétérinaire des pays tropicaux* **67**:13-21.

Bates, B.C., Kundzewicz, Z.W., Wu, S. and Palutikof, J.P., eds. (2008). *Climate Change and Water*.

Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva: 210 pp.

Benson, T. and Mugarura, S. (2013). Livestock development planning in Uganda: identification of areas of opportunity and challenge. *Land Use Policy* **35**:131-139.

Brenner, R.J. (2002). Cockroaches (Blattaria). *In*: G.R. Mullen and L.A. Durden (eds) *Medical and Veterinary Entomology*. Academic Press. pp. 29-44.

Burr, G.S., Wolters, W.R., Barrows, F.T. and Hardy, R.W. (2012). Replacing fishmeal with blends of alternative proteins on growth performance of rainbow trout (*Oncorhynchus mykiss*), and early or late stage juvenile Atlantic salmon (*Salmo salar*). *Aquaculture* **334-337**:110–116.

Donohue, I. and Garcia Molinos, J. (2009). Impacts of increased sediment loads on the ecology of lakes. *Biological Reviews* **84**:517-531.

EFSA Scientific Committee. (2015). Risk profile related to production and consumption of insects as food and feed. *EFSA Journal* **13**(10): 60 pp.

FAO. (2009). How to Feed the World in 2050. Proceedings of the expert meeting on how ro feed the world in 2050, 24-26 June 2009, FAO Headquarters, Rome.

Finke, M.D. (2013). Complete nutrient content of four species of feeder insects. *Zoo Biology* **32**:27–36.

Herrero, M., Thornton, P.K., Gerber, P. and Reid, R.S. (2009). Livestock, livelihoods and the environment: understanding the trade-offs. *Current Opinion in Environmental Sustainability* **1**:111-120.

Józefiak, D., Józefiak, A., Kierończyk, B., Rawski, M., Świątkiewicz, S., Długosz, J. and Engberg, R.M. (2016). Insects - a natural nutrient source for poultry - a review. *Annals of Animal Science* **16**:297-314.

Moss, B. (2008). Water pollution by agriculture. *Philosophical Transactions of the Royal Society* B **363**:659-666.

Oonincx, D.G.A.B, van Itterbeeck J., Heetkamp M.J.W., van den Brand, H., van Loon, J.J.A. and van Huis, A. (2010). An exploration on greenhouse gas and ammonia production by insect species suitable for animal or human consumption. *PLoS ONE* 5 (12): e14445 DOI: 10.1371/journal.pone.0014445.

Quartararo, N., Allan, G.L. and Bell, J.D. (1998). Replacement of fish meal in diets for Australian snapper, *Pagrus auratus*. *Aquaculture* **166**:279–295.

Sharpe, D.M.T., Wandera, S.B. and Chapman, L.J. (2012). Life history change in response to fishing and an introduced predator in the East African cyprinid *Rastrineobola argentea*. *Evolutionary Applications* **5**:677–693.

Soares, M, Fracalossi, D.M., de Freitas, L.E.L., Rodrigues, M.S. Redig, J.C., Mouriño, J.L.P., Seiffert, W.Q. and Vieria, N.V. (2015). Replacement of fish meal by protein soybean concentrate in practical diets for Pacific white shrimp. *Revista Brasileira de Zootecna* **44**:343-349.

Thenya, T., Wassmann, R., Verchot, L. and Mungai, D. (2006). Degradation of the riparian wetlands in the Lake Victoria basin - Yala swamp case study. *In*: E. Odada, D.O. Olago, W. Ochola, M. Ntiba, S. Wandiga, N. Gichuki and H. Oyieke (eds) *Proceedings of the 11th World Lakes Conference, Nairobi, Kenya*, Volume 2. International Lakes Environment Committee, Shiga, Japan: pp. 483-492.

Thornton, P. K. (2010). Livestock production: recent trends, future prospects. *Philosophical Transactions of the Royal Society* B **365**:2853–2867.

Tiffen, M. (2003). Transition in sub-Saharan Africa: agriculture, urbanization and income growth. *World Development* **31**:1343–1366.

Torstensen, B.E., Espe, M., Sanden, M., Stubhaug, I., Waagbø, R., Hemre, G.I., Fontanillas, R., Nordgarden, U., Hevrøy, E.M., Olsvik, P. and Berntssen, M.H.G. (2008). Novel production of Atlantic salmon (*Salmo salar*) protein based on combined replacement of fish meal and fish oil with plant meal and vegetable oil blends. *Aquaculture* **285**:193–200.

United Nations. (2013). World population projected to reach 9.6 billion by 2050. *World Population Prospects: The 2012 Revision, Press Release (13 June 2013): "World Population to Reach 9.6 Billion by 2050 with Most Growth in Developing Regions, Especially Africa"* (June), 4 pp.

Van Deventer, J.P. (2009) Ethical considerations during human centred overt and covert research. *Quality and Quantity* **43**:45-57.

Xu, C., Widén, E. and Halldin, S. (2005). Modelling hydrological consequences of climate change - progress and challenges. *Advances in Atmospheric Sciences* **22**:789–797.