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# Effects Of Maize Cob On Fish Feed Floatation, Nutrient Utilization And Growth Performance Of African Catfish (*Clarias gariepinus*) Fingerlings

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**ABSTRACT**

*This study was carried out to determine the effects of maize cob on fish feed floatation, growth performance and nutrient utilization of Clarias gariepinus fingerlings as a replacement for wheat bran. Triplicate groups of 30 fish per treatment were stocked in 3 plastic bowls each containing 15 litres of water. The initial average weight of fish was 2.43± 0.01. The fish were fed with 5 different test diets. The control contained 100% wheat bran (treatment 1). The wheat bran was partially replaced with 10%, 20%, 30% and 40% maize cob in treatment 2, 3, 4 and 5 respectively. The treatments were fed to each group of experimental fish at 3% body weight. The feeding trial lasted for six weeks and the growth performance were recorded weekly.*

*There were significant differences in most of the growth performance measured. The mean weight gain of the fish fed treatment 1, 2, 3, 4 and 5 were 1.54g, 1.75g, 2.15g, 1.24g and 1.22g respectively. The fish fed treatment 3 had the highest percentage weight gain (PWG) value of 88.48% while those fed treatment 5 had the lowest value of 50.21%. The highest specific growth rate (SGR) was also observed in fish fed treatment 3 (0.47), followed by treatment 2(0.33), treatment 1(0.23), treatment 4(0.15) and treatment 5 (0.10) respectively.*

*Fish fed treatment 3 had the highest protein efficiency ratio (PER) of 0.038 and the lowest was observed in treatment 5(0.026). The feed conversion ratio observed in treatment 5 was significantly higher than those fed with other treatments and the lowest was observed in treatment 3. There were significant differences in the nutrient utilization amongst the treatments at P < 0.05.*

*Treatments 1 and 3 had 20% floatability at the end of 10 minutes while treatment 2 had 10% floatability, treatment 4 and 5 had 0% floatability at the end of 10 minutes.*

*This experiment shows that 20% inclusion level of maize cob has a greater potential as a partial replacement for wheat bran. This was because fish fed treatment 3(20% inclusion) had the highest growth parameters followed by treatment 2, treatment 1, treatment 4 and treatment 5 respectively. However fish fed treatment 3 and treatment 2 were observed to have better growth indices than the control treatment while the fish fed treatment 5 performed poorest. This further confirmed the better potential of maize cob over wheat bran which is commoner in Nigerian market.*

**Keywords**: *Clarias gariepinus*, maize cob replacement, floatability and growth parameters.

## INTRODUCTION

The increase in human population and reports of large numbers of undernourished or starving people, especially in the developing countries, has made the need for food production a major worldwide issue of concern. There are three main groups of activities that contribute to food production: agriculture, aquaculture and fisheries. Recent knowledge shows that the world's natural stocks of fish and shell fish, though renewable, have finite production limits, which cannot be exceeded even under the best management regimes. For most of our lakes, rivers and oceans, the maximum sustainable fishing limit has been exceeded (FAO 2000e). Therefore, fish production will depend on aquaculture to bridge the gap of fish supply (Tacon, 2001).

Fish is an important source of both food and source of income to many people in developing countries. In Africa, as much as 5% of the population, some 35 million people depends wholly or partly on the fisheries sector for their livelihood (FAO, 1996a). It is estimated that by 2050, when world population is projected to be over 9 billion, Africa will have to increase food production by 300%, Latin America by 80% and Asia 70% to provide minimally adequate diets for the projected population of 2 billion, 810 million and 5.4 billion people in the respective regions (Anon, 1997).

Nutritionally, fish is one of the cheapest and direct sources of protein and micro nutrient for millions of people in Africa (Ben and Heck, 2005). Good nutrition in animal production systems is essential to economically production of a healthy and high quality product.

In fish farming, nutrition is critical because feed represents 40-60% of the production costs. Fish nutrition has advanced dramatically in recent years with the development of new, balanced commercial diets that promote optimal fish growth and health. The development of new species-specific diet formulations supports the aquaculture (fish farming) industry as it expands to satisfy increasing demand for affordable, safe, and high-quality fish and seafood products. In culturing fish in captivity, nothing is more important than sound nutrition and adequate feeding. If the feed is not consumed by the fish or if the fish are unable to utilize the feed because of some nutrient deficiency, then there will be no growth. An undernourished animal cannot maintain its health and be productive, regardless of the quality of its environment.

The production of nutritionally balanced diets for fish requires efforts in research, quality control, and biological evaluation. Faulty nutrition obviously impairs fish productivity and results in a deterioration of health until recognisable diseases ensue. The borderlines between reduced growth and diminished health, on the one hand, and overt disease, on the other, are very difficult to define. There is no doubt that as our knowledge advances, the nature of the departures from normality will be more easily explained and corrected. However, the problem of recognizing a deterioration of performance in its initial stages and taking corrective action will remain an essential part of the skill of the fish culturist.

**Aquaculture Development in Africa**

Aquaculture is the husbandry of aquatic organisms. It is the rearing and breeding of fish under controlled conditions. It involves raising fish in ponds, tanks or enclosures for food. It could also be refer to the growing practice of farming fish and plants in both salt and freshwater environments. It is becoming an increasingly popular market as shown by the rise of Australia produce in recent years with more than 60 species now being humanely farmed including pearl oysters, mussels, salmon, algae and even crocodiles.

Aquaculture development in Africa is insignificant compared to the rest of the world (Changadeya *et al.*, 2003). According to Hetcht (2000) the entire continent contributed only 0.4% to the total world aquaculture production for the period 1994 to 1995. In the year 2000 it contributed a mere 0.97% of the total global aquaculture (FAO, 2003). Although the history of aquaculture is relatively recent in Sub-Saharan Africa compared to Asia, and some other parts of the world most known aquaculture systems have been introduced over the last 35 years (FAO, 1996a; 1996b). The growth, expansion and production of aquaculture in northern part of Africa especially, Egypt is more advanced in techniques and technicalities in comparison to the Sub Saharan regions.

In Sub-Saharan regions aquaculture in most places is still essentially a rural, secondary and part-time activity taking place in small farms with small fresh water ponds (FAO 1996a). The systems that are generally practiced range from extensive to semi-intensive cultural systems with limited fish yield, which are mostly consumed directly or sold locally (CIFA 1998). Almost all fish farming is carried out by rural small scale operators in small fresh water ponds as a secondary activity to agriculture.

According to FAO (1997), there is abundant potential for the development and expansion of aquaculture in this region, factors such as the novelty of aquaculture, the general poor economic conditions in many countries and the relative paucity of entrepreneurial skills and credit facilities hamper its development.

Aquaculture development in most African countries is primarily focused on socio-economic objectives such as nutrition improvement in rural areas, income generation, diversification of farm activities (integrated farming) and creation of employment especially in rural communities where opportunities for aquaculture in northern part of Africa especially, Egypt as economic activities are limited (CIFA, 1998). This approach over the years has resulted in sustained aquaculture growth in some African countries such as Coté D'ivoire, Egypt, Ghana, Malawi, Nigeria and Zambia while there is still room for enhancing aquaculture production in Africa through improved production systems, genetics and general farm management principles, the desired and expected growth of aquaculture to meet the ever increasing demand for fish and satisfy its socioeconomic functions is only achievable through cost-effective and high quality fish feed (Jamu and Ayinla, 2003).

The consumption and demand for fish as a cheap source of protein is on the increase in Africa, because of the level of poverty in the land. The vast majority of the fish supply in most cases comes from the rivers in the continent while capture fisheries based on species that are presently exploited seem to have reached their natural limits (FAO, 1996c), there is considerable potential to expand aquaculture in Africa in order to improve food security (Kapetsy, 1994; Engle 1997, Jamu and Ayinla, 2003).

Although potentials abound in the continent for the development of viable fish farming, one of the major hindrances to the development of aquaculture industry in Africa is the lack of locally produced high-quality fish feed especially floating feeds.

## MATERIALS AND METHODS

One hundred and fifty (150) *Clarias gariepinus* fingerlings obtained from a fish farm in Ibadan were used for the experiment. The fish were acclimatized for ten days after which ten fingerlings were selected randomly into each tank for the experiment that have been previously labelled to commence the work.

3kg of fresh maize cob were purchased, sundried for several days until the moisture content in it was reduced to 10%. The dried maize cob was pounded in a mortal to break it into smaller particles for ease of grinding in the mill. All the ingredients purchased at Kesmac Fish Feeds, including the maize cob were milled separately into fine particles and the maize cob was sieved to removed the shaft to allow for proper binding with other ingredients. Afterwards the ingredients were weighed, mix with hand, locally prepared hot water starch was used as a binder and pelleted by using a manual pelleting machine. The pelleted feeds were sundried immediately to ensure total removal of water and prevent the growth of moulds.

## EXPERIMENTAL PROCEDURE

The experimental fish were acclimatized for ten days before the commencement of the experiment. The maize cob was used to substitute wheat bran in the feed treatment at 10%, 20%, 30% and 40% inclusion levels. The first treatment does not have maize cob in it, that is, 100% wheat bran, this serves as the control treatment as shown in table 3.1.

*C. gariepinus* fingerlings were distributed randomly at a stocking density of 10 fish per experimental tank containing 15 litres of water. All treatments were replicated thrice and were randomly arranged. The initial weight of fish were taken per treatment before the start of the experiment.

Feed was given 2 times daily at 3% body weight per day with necessary adjustment made in accordance with the changes recorded in their weekly body weight. All the fish were weighed per treatment at the end of each week, this was done with the aid of a weighing scale AND SK-1000, to measure the weight gain of the experimental fish.

**Table 1: Ingredients composition of experimental diets containing 40% crude protein (CP).**

| | Treatments | | | | |
|---|---|---|---|---|---|
| **Ingredients** | 1 | 2 | 3 | 4 | 5 |
| Fishmeal (72%) | 18.50 | 18.59 | 18.68 | 18.76 | 18.84 |
| Soyabean meal | 37.01 | 37.18 | 37.35 | 37.52 | 37.68 |
| GNC | 18.50 | 18.59 | 18.68 | 18.76 | 18.84 |
| Maize | 7.16 | 7.04 | 6.93 | 6.82 | 6.71 |
| Wheat bran | 14.33 | 12.68 | 11.09 | 9.55 | 8.06 |
| Maize cob | - | 1.41 | 2.77 | 4.09 | 5.37 |
| Bone meal | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Oil | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Vit/Min premix | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Starch binder | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Total | 100 | 100 | 100 | 100 | 100 |

**Proximate analysis of experimental diet**

Samples were analyzed chemically according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C., 1998). All analyses were carried out in duplicate.

## RESULTS AND DISCUSSION

The result of the proximate analysis of fresh dried maize cob is shown in table 2. The analyses of the experimental diets are also shown in table 3. The highest value of crude protein was observed in treatment 2 and control diet, with crude protein content of ~~40.23~~ and 40.21 respectively, while the least crude protein was observed in treatment 4 with the value 39.64. The control diet has the lowest crude fibre. The nitrogen free extract values range from 29.06 to 32.61. The moisture contents range from 5.92 to 6.71.

**Table 2: Proximate composition of Maize cob**

| Sample | %CP | %CF | %CFibre | %Ash | % DM | %MC | %NFE |
|---|---|---|---|---|---|---|---|
| Maize cob | 2.15 | 0.37 | 33.73 | 1.63 | 89.18 | 10.82 | 51.30 |

**Table 3: Proximate composition of Experimental Diets**

| Sample | %CP | %CF | %CFibre | %Ash | % DM | %MC | %NFE |
|---|---|---|---|---|---|---|---|
| Treatment 1 | 40.21 | 5.42 | 3.61 | 12.23 | 94.08 | 5.92 | 32.61 |
| Treatment 2 | 39.79 | 5.51 | 6.67 | 11.17 | 93.68 | 6.32 | 30.54 |
| Treatment 3 | 40.23 | 5.28 | 6.81 | 11.63 | 94.08 | 5.92 | 29.06 |
| Treatment 4 | 39.98 | 5.33 | 6.74 | 11.29 | 93.29 | 6.71 | 29.95 |
| Treatment 5 | 39.64 | 5.31 | 6.79 | 11.47 | 93.64 | 6.36 | 30. |

**Table 4: Growth Parameters and Nutrient Utilization of Experimental Fish fed various inclusion level of maize cob for 42 days.**

| Parameters | 1 | 2 | 3 | 4 | 5 | Mean | SD | S.E + |
|---|---|---|---|---|---|---|---|---|
| Initial mean weight (g) | 2.43 | 2.42 | 2.43 | 2.43 | 2.43 | 2.43 | 0.005 | 0.002 |
| Final mean weight (g) | $3.97^{b}$ | $4.17^{c}$ | $4.58^{d}$ | $3.67^{a}$ | $3.65^{a}$ | 4.01 | 0.39 | 0.17 |
| Mean weight gained (g) | $1.54^{b}$ | $1.75^{c}$ | $2.15^{d}$ | $1.24^{a}$ | $1.22^{a}$ | 1.58 | 0.39 | 0.17 |
| MWGPD (g) | $0.04^{b}$ | $0.04^{b}$ | $0.05^{c}$ | $0.03^{a}$ | $0.03^{a}$ | 0.04 | 0.008 | 0.004 |
| PWG (%) | $63.37^{c}$ | $72.30^{d}$ | $88.48^{e}$ | $51.03^{b}$ | $50.21^{a}$ | 65.08 | 15.98 | 7.15 |
| Total feed fed (g) | $122.50^{c}$ | $131.47^{d}$ | $141.92^{e}$ | $117.25^{b}$ | $116.21^{a}$ | 125.87 | 10.82 | 4.84 |
| Specific growth rate | $0.23^{c}$ | $0.33^{d}$ | $0.47^{e}$ | $0.15^{b}$ | $0.10^{a}$ | 0.26 | 0.15 | 0.07 |
| PER | $0.031^{b}$ | $0.035^{c}$ | $0.038^{d}$ | $0.026^{a}$ | $0.026^{a}$ | 0.03 | 0.005 | 0.002 |
| Protein intake | $49.25^{c}$ | $50.31^{d}$ | $57.09^{e}$ | $46.88^{b}$ | $46.07^{a}$ | 49.92 | 4.36 | 1.95 |
| PPV | $0.35^{c}$ | $0.28^{b}$ | $0.33^{c}$ | $0.29^{b}$ | $0.09^{a}$ | 0.27 | 0.15 | 0.07 |
| FCR | $6.62^{c}$ | $4.82^{b}$ | $3.40^{a}$ | $10.02^{d}$ | $15.70^{e}$ | 8.11 | 4.91 | 2.20 |
| FCE (%) | $15.10^{c}$ | $20.77^{d}$ | 29.45 | $9.98^{b}$ | $6.37^{a}$ | 16.33 | 9.12 | 4.08 |
| PSR (%) | 76.67 | 80.00 | 83.33 | 76.67 | 73.00 | 77.93 | 3.90 | 1.75 |

Key: **MWGPD** (Mean weight gained per day), **PWG** (Percentage weight gained), **PER** (Protein efficiency ratio), **FCR** (Feed conversion ratio), **FCE** (Feed conversion efficiency) and **PSR** (Percentage survival rate).

*Values with the same superscript within the rows are not significantly different from each other.

**Table 5: Weekly Mean Weight Gained of Experimental Fish**

| Treatment | Initial | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Treatment 1 | 2.43 | 2.59 | 2.90 | 3.18 | 3.40 | 3.84 | 3.97 |
| Treatment 2 | 2.42 | 2.61 | 3.00 | 3.31 | 3.40 | 3.81 | 4.17 |
| Treatment 3 | 2.43 | 2.63 | 3.08 | 3.40 | 3.81 | 4.34 | 4.58 |
| Treatment 4 | 2.43 | 2.57 | 2.77 | 3.03 | 3.21 | 3.45 | 3.67 |
| Treatment 5 | 2.43 | 2.58 | 2.79 | 3.14 | 3.17 | 3.32 | 3.65 |

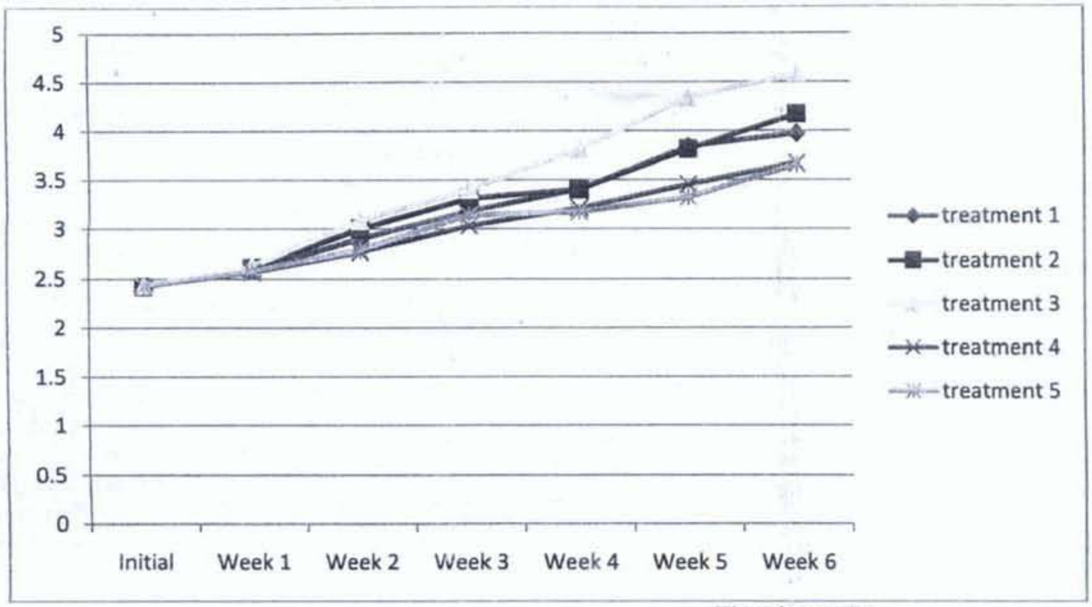


**Figure 1: Weekly Mean Weight Gain of Experimental Fish**

**Table 6: Carcass Composition of Experimental Fish (before and after the experiment).**

| %Composition | Initial | Treatment 1 | Treatment 2 | Treatment 3 | Treatment 4 | Treatment 5 |
|---|---|---|---|---|---|---|
| Crude protein | 38.49 | 55.59 | 52.75 | 57.49 | 51.88 | 42.77 |
| Crude fat | 5.21 | 6.18 | 5.98 | 6.48 | 5.89 | 5.27 |
| Crude fibre | 0.00 | 1.31 | 1.28 | 1.24 | 1.18 | 1.11 |
| Ash | 9.14 | 12.08 | 11.69 | 11.91 | 11.33 | 9.46 |
| Moisture | 5.34 | 3.95 | 3.93 | 3.82 | 4.07 | 4.25 |
| NFE | 41.82 | 21.20 | 24.50 | 29.23 | 25.85 | 37.40 |

**Table 7: Floatability of Experimental Feed**

| % Floatability | Treatment 1 | Treatment 2 | Treatment 3 | Treatment 4 | Treatment 5 |
|---|---|---|---|---|---|
| floatability after 1min | 20% | 50% | 60% | 30% | 20% |
| floatability after 2mins | 20% | 40% | 40% | 10% | 10% |
| floatability after 3mins | 20% | 30% | 20% | 10% | 0% |
| floatability after 4mins | 20% | 10% | 20% | 0% | 0% |
| floatability after 5mins | 20% | 10% | 20% | 0% | 0% |
| floatability after 6mins | 20% | 10% | 20% | 0% | 0% |
| floatability after 7mins | 20% | 10% | 20% | 0% | 0% |
| floatability after 8mins | 20% | 10% | 20% | 0% | 0% |
| floatability after 9mins | 20% | 10% | 20% | 0% | 0% |
| floatability after 10mins | 20% | 10% | 20% | 0% | 0% |

**Growth performance and nutrient utilization**

Table 4 shows the growth parameters and nutrient utilization of the observed *C. gariepinus* fed 5 different diets. The diet 1(control) contained 100% wheat bran, diets 2, 3, 4, and 5 contained 10%, 20%, 30% and 40% maize cob inclusion respectively as partial replacement of wheat bran.

**Mean Weight Gain (MWG)**

Experimental fish fed diet 3(20% inclusion of maize cob) with an initial mean weight of 2.43g and final mean weight of 4.58g had the highest mean weight gain of 2.15g. Diet 5(40% inclusion of maize cob) had the lowest mean weight gain of 1.22g, followed by diet 4(30% inclusion of maize cob) with a mean weight gain of 1.24. The mean weight gain of diets 1(control) and 2 (10% inclusion of maize cob) were 1.54 and 1.75 respectively.

The average mean weight gain of all the diets was 1.58g $\pm$ 0.013.there were significant differences between the fish fed the 5 diets at ($P < 0.05$).

The result of the proximate analysis of the experimental diets shows that the crude protein content ranged from 39.64 to 40.23 with an average of 39.97. Diet 5 had the lowest value.

The higher fibre content in the proximate analysis of the diets 4 and 5 with 30% and 40% inclusion of maize cob as shown in table 4.2 could be responsible for the low growth parameters of SGR, FCE, PER and weight gained of the fish fed with the diets. Falaye *et al.*, (1999a) reported a reduced fish growth caused by high fibre content of cocoa husk which resulted in low apparent protein and dry matter digestibility when *Oreochromis niloticus* was fed varying level of cocoa husk diets. Oladunjoye *et al.*, (2005) also reported that high fibre content could be responsible for growth depression for broilers when breadfruit seed meal was replaced with maize.

Shahin and Abdelazim (2005) indicated that birds fed a high fibre diets had lower carcass weight than birds fed low fibre diets. Furthermore, they confirmed that broilers fed high amounts of fibre in diet had a higher relative muscle and lower relative fat percent in compare with chicks fed low levels of fibre.

The highest mean weight gain was observed in treatment 3 (2.15g), followed by 2 (1.75g), 1 (1.54g) and lowest in fish fed diet 4 (1.24g) and 5 (1.22g) respectively.

The result of floatability of the experimental feed is shown in table 4.6. Ten grains of each treatments were used for the test: diet 1, 8 grains sank immediately and the remaining 2 grains floated for more than ten minutes; for diet 2, 5 grains of the feed sank immediately, 1 sank after 2 minutes, another 1 sank after 3minutes, 2 sank after 4 minutes leaving just 1 grain which floated for over 10 minutes; 6 grains of diet 3 floated and 4 sank immediately, 2 of the floated grains sank at the end of 1 minute, at the end of 2 minutes another 2 grains sank while the remaining 2 floated to the end of the test period; for diet 4, 7 grains sank and 3 grains floated, 2 of which sank after 1 minute and the remaining one sank after 3 minutes and for diets 5, 8 grains sank leaving 2 grains afloat, 1 grain sank by the end of 1 minute and the last 1 sank after 2 minutes. Diet 1 had 20%, diet 2 10%, diet 3 20% floatability, while diets 4 and 5 had 0% floatability at the end of 10minutes.

The carcass composition of the experimental fish is shown in table 4.5. The trend in protein increase in the various treatments with treatment 3(57.49) having the highest value and treatment 1 (control) having the least (42.77).

It can be concluded that fish fed treatment 3 performed best than other treatments including the control in most of the growth parameters measured, it had a mean weight gain of 2.15g, specific growth rate of 0.47, protein efficiency ratio of 0.038 and feed conversion efficiency of 29.45. Maize cob is a by-product often discarded as waste which could be used in feed formulation in order to reduce the cost of fish production and maximise profit in aquaculture.

## CONCLUSION AND RECOMMENDATION

This study compared the effects of maize cob on fish feed floatation, growth performance and nutrient utilization of *Clarias gariepinus* fed with different inclusion levels of maize cob as a replacement for wheat bran. This shows that both wheat bran and maize cob has effects on fish feed floatation which resulted in best growth performance for experimental fish in treatment 3 (20% inclusion).

The experiment provides information for further research into better processing methods of incorporating maize cob at different levels of inclusion. Histology and haematology analyses should be carried out in order to determine the nutritional effects of high fibre on fish muscle and blood.

Farmers should be encouraged to plant more maize, so that it can be made available in abundance for fish feed production.

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