Fisheries Investment for Sustainable Harvest

Proceedings of the Fish Feeds Forum
19 January 2006

Cooperative Agreement: 617-A-00-05-00003-00
Department of Fisheries and Allied Aquacultures; Auburn University, Alabama
Proceedings of the Fish Feeds Forum at SCOPE boardroom, Kampala, Uganda on 19th - January - 2006

Agenda:

- Welcome remarks by FISH C.O.P
- Considerations for fish feeds & their manufacture
- Demand for fish feeds in East Africa - Now and in 5 years.
- The Uganda advantage on commodity prices and aquaculture potential
- A view from manufacturers: A panel presentation by representatives of feed manufacturers
- Financing opportunities - a panel presentation by representatives of financial institutions and donor agencies.
- Open Group Discussion: The way forward - a plan of action


The chief of party welcomed guests who included the Finance Ministry Permanent Secretary, guests from Israel, South Africa, and Kenya besides the Ugandan guests. She explained that the idea for a workshop arose out of discussions among various stakeholders in fish farming as well as the fish feeds industry who indicated the need for viable fish feeds mill. Ms. Veverica also explained that the workshop discussion had been grouped into panels and the respective chairpersons for each panel had been selected.

2. Consideration for Fish feeds: - By Dr. Allen Davis (see: Annex 1)

Dr. Davis made a presentation on the best management practices for feeds processing explaining the need to source the right ingredients, follow the correct procedures in processing and storing the feeds in the appropriate facility. Dr. Davis went further to explain the various nutritional requirements of fish emphasizing the importance for use of soybean meal.

3. Demand for fish feeds in East Africa

Chaired by Dr. Nelly Isyagi FISH project pond culture specialist

Dr. Isyagi made a presentation on the fish demand versus the supply in Uganda, noting the supply gaps that she said will only be covered by output from aquaculture sources. With current supply at 233.8 (‘000MT), and demand at 235.3 (‘000MT), the supply deficits of 1.5 (‘000MT) does require feeds of 3.0 (‘000MT), (see: Annex 11).

Mr. Blow from Lake Harvest stated that he was having problems with feeds quality in Zimbabwe and as such in Uganda his company will be processing its own feeds when it starts its pond culture in Jinja. Later the company hopes to move to cage culture. The estimated output is 2000 tons per annum within their 2 year program of the pilot farm on land. Lake Harvest will initially require about 4000 tons of feed with the ingredients.
sourced from multiple suppliers to produce the fish feeds. Lake harvest has been in aquaculture business in Zimbabwe for the last 10 years with output of 3000 tons per year.

Mr. Bbosa from Kabasanda Fish farm explained that he had practiced polyculture whereby he stocked both tilapia and catfish in his ponds. At some point the cost of the feeds was so high that his farm ignored “scientific” advice and went for what he termed as a crude approach. With this new approach, the farm’s cost of production dropped from 1,500/= to about 1,000/= per catfish weighing about 1 kilogram. The cost of feed should not exceed 1,000/= per kilogram of fish produced if aquaculture is to be profitable.

Mr. Were from Dominion farm in Kenya explained that his farm was conducting an environmental impact assessment for starting operations and will be in commercial production mid this year with the first harvest in June 2007. The farm has forecasted an output of 3000 tons per year by the end of the 3rd year. Dominion farms will be producing own feeds on the farm.

Mr. Digo from Sunfish reported that the effective demand for fish feeds processed in factories is low because of cost. He submitted that there was need to create a situation where feeds are made and farmers are buying and making money (earning profits). Sunfish Farm, according to Mr. Digo has been in aquaculture business for the last 8 years.

Discussion:

Q: From Ingo Beikert to Patrick of S.O.N, at what price would the fish feed be meaningful to a fish farmer in Uganda?

A: Patrick Blow, 250-300 dollars per ton.

Q: To Mr. Bbosa; how long have you been practicing this kind of feeding this fish with your feed combinations?

A: Mr. Bbosa, 3 years

4. The Ugandan advantage on commodity prices and aquaculture potential

Chaired by Dr. Rutaisire of Makerere University

Mr. Luseesa (see: Annex 111, a and b), a commercialization specialist with a USAID-funded APEP program made a presentation on soybean market citing fluctuating demand. He also noted that the quality of the soybean seeds available to farmers was low and that this needed to be sorted out. He explained the differences in costs; local feed nutrients costing 148.41 dollars per MT and imported feed nutrients at 250.68 per MT. With a feeds demand of 1000 MT, he explained that would take an area of 2,994 acres for production of Soya, corn, cotton seed, wheat, and sunflower.
Ms. Tumwebaze, a quality controller from Mukwano noted that there was inadequate demand for factory produced feeds. This she said was the main impediment in her company's investment in fish feeds. Also that they have plans to expand sunflower and possibly Soya.

Discussion;

Q: Mr. Digo, How do we get into a situation where feeds are manufactured and farmers are buying the feeds and making money?

A: Veverica; this is exactly what this meeting is trying to address.

5. A View from Manufacturers:

Chaired by Jaap Blom from Danida’s ABDC (Agri Business Development Component)

Mr. Philip Borel (see: Annex V1) took the participants through processing of fish where he indicated that the fish processing industry had a viable potential for manufacturing protein rich feeds from fish certain by-products since the by-products are of a low market value. He stated that the fish by-products were on average, 48% of each fish, in an industry that is processing 80,000 tons of fish per year.

Dr. Flavio Oliveira (see: Annex V), Ugachick’s General Manager made a presentation on the history of the development of the animal feeds industry in Uganda. He explained how the Kitiyo feed processing started as a result of high cost of animal feeds in the early 1990s. He noted that Uganda produces 80,000 tonnes of animal feeds per year with 85% of the animal feeds being for chicken. He categorised feed processors as feed millers, small scale mixers and back yard mixers. Before 1950’s, local birds made 100% of the poultry, after the 50s, there was introduction of hybrids with feeds being imported from Kenya. The feed industry was liberalised in the 1990’s, and there was a sharp increase of raw materials in the mid-1990s.

Mr. Van der Linde, Aquanutro (see: Annex V1) Managing Director presented his company’s position in the aqua feeds industry, where they supply in between 80% and 85% of the South African & Southern Africa market; with the feeds being the floating extruded type. He noted that it takes more than 1,300,000 dollars to start an aqua feed business in Africa. They began production at 370 tons per year and now are at about 2000 tons per year. Noted that Nigeria is producing over 100,000 tons of fish per year and as yet there is no fish feed mill.

Mr. Hadas (see: Annex V11), a nutritionist from RMC in Israel made a presentation on feeds that are extruded. He explained that his company had more than 100 fish feed formulations. His company, he said, is represented by Balton Uganda Ltd. in Uganda.
Discussion;

Q: Why does S.O.N want to begin with pond culture in Uganda yet it has more experience in cage culture?

A: Patrick Blow; the quality of feeds needed by the cages is much higher than that which is available in the market, also cage is not yet permitted on lake Victoria and S.O.N will be producing its own fish feeds.

6. Financing opportunities- a view from financial institutions and donor agencies

Chaired by Mr. Chris Kassami, Secretary to the Treasury, and a fish farmer

Ms. Wendy Engelberts, a private sector officer from the Royal Embassy of Netherlands in Uganda gave a brief presentation on the PSOM (see: [www.evd.nl/psom](http://www.evd.nl/psom)) program that is funded by her government. She explained that PSOM is a program for emerging markets only where joint ventures where the partners have the necessary experience & expertise but are unable to access bank loans because of the risky nature of emerging markets are considered. One of the partners must be a Dutch company, the joint venture’s budget shouldn’t exceed 1.5 million euros, and the PSOM program reimburses part of the investment with the size depending on country invested in

Mr. Dunn, USAID’s C.T.O for FISH project made a presentation on the behalf of the Global Development Alliance (GDA). The GDA serves as a coordinating body in the mobilization of resources, ideas in support of the shared objectives of the public sector, non-governmental organizations as well as the private sector. GDA recognizes the changes in sources of funding for businesses in the developing world; at first it was funding mainly from public sources but it has now evolved into funding by private sources. ([For more information, go to](http://www.usaid.gov/gda)

Mr. Bernard Mboha, the resident Uganda manager of EADB stated that unlike commercial banks, EADBs role is to partner with the private sector to foster economic development in East Africa. EADB recognizes that the fish resources especially on Lake Victoria are no sustainable in the long run. It thus recognizes the importance of aquaculture in Uganda. EADB provides funds under equity terms, leasing, and long term financing terms. The loans are from 100,000 US dollars to 10 million dollars, for a period from 5 to 10 years. The banks leasing terms are such that 20% of the value of the asset is deposited with the bank as security. EADB helps only firms that are already in business.

Mr. Kagaba Muhumuza, a Relationship Manager with Stanbic Bank explained that his bank can help aid joint ventures in Uganda because of its wide network on the African continent. He particularly pointed out at Leasing as a facility that fish feeds firms would take advantage of noting that the asset bought out of the arrangement itself becomes the security, among others.
7. The way forward- a plan of action: open discussion

Chaired by Ms Karen Veverica, FISH project Team Leader

Mr. Kassami, a fish farmer (also the Treasury Secretary) brought forward a suggestion for the farmers to form a cooperative that would run a fish feeds mill. He said this was because the cost of the equipment needed to run a viable feed mill was very high.

Mr. Hadas from RMC in Israel raised the view that it was not cost effective to establish a fish feeds factory in Uganda because, in his view, the ingredients are sourced globally at the prices that Uganda business does not control.

There was a further discussion on costs to import feeds and the cost of feed ingredients. Due to high overland costs, it appears to be more cost-effective to produce the feeds in the country. Hadas stated that there will be need to aim for higher output in order to earn economies of scale if indeed a factory was established for fish feeds in Uganda. He also suggested that they were open to the idea of a joint venture to start an aqua feed business in Uganda to serve the region.

Q: Why is a lot of emphasis placed on Soya bean?

A: Dr. Davis, soybean is desired because in Uganda among the available feed ingredients, it has a combination of a high protein and low fibre, and the fat content of solvent extracted soy meal is sufficiently low.

Q: Dr. Isyagi, can the government offer subsidies or tax exemptions to farmers in order to stimulate aquaculture in Uganda?

A: Mr. Kassami Finance PS, we ought to be very careful with subsidies because they are generally not good for business. Tax exemptions are also an indirect form of subsidy. Also duty exemption (and tax breaks) for feeds & equipment are equal to subsidies.

A: Fisheries Commissioner, the cost of larval diets is high but the profit margin may be high enough to allow importation.

Q: Mr. Borel, levies are being proposed on fish exports?

A: Mr. Kassami, I am personally against the idea of imposing levies on fish exports.

Comment: Ingo Beikert, in fish feeds business, you either produce quality or you do not produce anything.

USAID FISH project chief of party thanked the participants stating that the objectives of holding the workshop (that included providing a forum for information sharing on how to set up a viable feed mill in Uganda) had been achieved.
Attendance:

1. Chris Kassami  Secretary to the Treasury/ Finance Ministry P/S
2. Enos Maawere  Aquaculture Manager, Dominion Farms Ltd, Kenya
3. James Dunn  USAID CTO for FISH project
4. Muhumuza Kagaba  Relationship Manager, Stanbic Bank
5. John Balirwa  FIRRI Director
6. Moses B. Kiyangi  Director, Kabasanda Fish Farm
7. Owori Wadunde  Aquaculture Researcher, ARDC Kajjansi
8. Margaret Massette  Research Officer, FOSRI
9. Eran Hadas  Nutritionist, RMC-Isreal
10. David Luseesa  Commercialization Specialist, USAID-funded APEP
11. Patrick Blow  Managing Director, Lake-Harvest & Son
12. Amy Gautam  Environmental Economic Consultant
13. Patricia Sterenbeng  PSOM Consultant
14. Jaap Blom  Team Leader, Danida ABDC
15. Samasu Natmu  Director/CEO, Uganda Crop Industries Ltd
16. Digo B.T.  Director, Sunfish Farm
17. Bernard Mboha  Uganda Resident Manager, EADB
18. Philip Borel  M.D., Greenfields
19. Dirk V. D. Linde  M.D., Aquanutro
20. Ingo Beikert  M.D., Absolute Aquanutro African
21. Diana Atungire  Project Manager, USAID
22. Peter Kitooke  Farm Manager
23. Justus Rutaisire  FISH Coordinator, Makerere University
24. Dr. Jolly T. Murunji  Ex. Investment Officer, U.I.A
25. D.W. Kasozi  Director, SUNGENOR
26. Dr. Flavio Oliveira  General Manager, UGACHICK
27. Robert Kitandwe  Project Manager
28. Nightingale Nantamu  Program Management Specialist, USAID
29. Penny Tumwebaze  Quality Officer, Mukwano
30. Wilson Mwanja  Fisheries Commissioner, MAAIF
31. Anton Immink  Communication Officer, DFID/ Stirling
32. Paul Sserumaga  Feed miller, UGACHICK
33. Eli Frumizman  Agric Manager, Balton Uganda
34. Grahame Vetch  M.D., Dominion Farms, Kenya
35. Wendy Engelberts  Private Sector Officer, Netherlands Embassy
36. Dr. Allen Davis  Fish Feeds Expert, Auburn University
37. Karen Veverica  Chief of Party, FISH project
38. Dr. Nelly Isyagi  Pond Culture Specialist, FISH
39. Rashid Asiimwe  Cage Culture Specialist, FISH
40. Benjamin Okurut  Asst. Operations Manager, FISH
Feed Processing for Aquatic Animals
Feeds

- Aquatic environment
- Culture differences
  - The animal lives in its own waste
    - Waste reduction is critical
  - High rate of leaching of nutrients from the feed
    - Feed must be stable in the water
    - Ingredients must be selected to reduce leaching
  - Feed and nutrient intake is hard to determine
    - Inventory control is critical
    - Floating extruded feeds is the standard
Aquatic vs terrestrial feeds

- Physical differences
  - Feeds durability: Feed cannot crack or break as it will not be available to the animal.
  - Water stability:
    - Feed must hold together (but not be concrete)
    - Fish must consume it quickly
    - Minimize the loss of nutrients.
Aquatic vs terrestrial feeds

- Nutritional differences
  - Energy requirements are less (8-9 kcal DE/g protein)
    - Protein is generally the limiting factor not energy
  - Carbohydrates are not well digested
    - Require cooking
    - Limitations on inclusion levels
  - Sensitive to anti-nutrients (species dependent)
  - Sensitive to quality of nutrients
    - Undigested nutrients, excreted nutrients and waste feed all add to nutrient loading of the culture environment.
Feed Processing
Conversion of various feed ingredients into a nutritionally complete diet

- **Formulation**
  - Ingredient selection and restrictions
  - Identification of nutritional restrictions

- **Processing**
  - Grinding
  - Mixing
  - Forming
  - Drying
Ingredient selection
(nutrient quality, cost, availability, processing characteristics)

Protein sources-plant (renewable natural resources)

- High quality press cakes are an excellent nutrient source (Low in oil, fiber and aflotoxins).
  - Soybeans - Major protein source of a variety of fish feeds.
    - Contains heat labile anti-nutrients. About 50% trypsin inhibitor is destroyed during normal drying of press cake. Extrusion of raw soybeans will decrease activity to acceptable levels.
      - 44% protein – SBM with hulls are crushed and oil removed
      - 48% protein – SBM without hulls are crushed and oil removed
    - [http://www.soyaqua.org/](http://www.soyaqua.org/)
  - Peanut meal - Mechanically extracted, low levels of lysine, low levels are used. Inconsistent supply and potentially contaminated with mycotoxins
  - Cottonseed meal - Extracted, used sparingly up to 15%, limited by gossypol content (<0.09% free) commonly used in catfish feeds
  - Sunflower meal – Extracted, used sparingly up to 20%, high fiber etc.
Ingredient selection

  - Fish meal - Good source of indispensable amino acids, essential fatty acids, phosphorus and digestible energy. Increases palatability of the feed hence it is heavily used in marine fish feeds but 90% of aquaculture if FW and they do not need to use fish meal.

  - Meat and bone meal - Good source of indispensable amino acids, high calcium content restricts use, poor palatability in a number of fish (<15%).

  - Blood meal - Flash dried, excellent source of lysine, deficient methionine, up to 5% used as a lysine supplement.
Ingredient selection

- Cereal grains for energy, binding and processing characteristics
- Lipids (Fats) for energy, essential fatty acids
- Premixes: vitamin, mineral etc
Once an ingredient is identified, quality control standards must be defined and maintained.

<table>
<thead>
<tr>
<th>Fishmeal</th>
<th>Crude protein</th>
<th>&gt;68 %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lipid</td>
<td>&lt;10 %</td>
</tr>
<tr>
<td></td>
<td>Ash</td>
<td>&lt;13 %</td>
</tr>
<tr>
<td></td>
<td>NaCl</td>
<td>&lt; 3 %</td>
</tr>
<tr>
<td></td>
<td>Moisture</td>
<td>&lt; 10 %</td>
</tr>
<tr>
<td></td>
<td>Ammonia</td>
<td>&lt; 0.2 %</td>
</tr>
<tr>
<td></td>
<td>nitrogen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Antioxidant</td>
<td>200 mg/kg</td>
</tr>
</tbody>
</table>
## Quality standards for fishmeal

<table>
<thead>
<tr>
<th>Chemical test</th>
<th>Recommended Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total volatile nitrogen (TVN)</td>
<td>&lt; 60 mg N/100g raw sample</td>
</tr>
<tr>
<td>Total volatile nitrogen (TVN)</td>
<td>&lt; 150 mg N/100g fish meal</td>
</tr>
<tr>
<td>Pepsin digestibility (Torry)</td>
<td>&gt;87.5%</td>
</tr>
<tr>
<td>Histamine</td>
<td>&lt;800 ug/g</td>
</tr>
</tbody>
</table>
## Quality standards for fish oil

<table>
<thead>
<tr>
<th>Quality Standard</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish oil</td>
<td></td>
</tr>
<tr>
<td>Peroxide value</td>
<td>&lt; 5 meq/kg</td>
</tr>
<tr>
<td>Anisidine value</td>
<td>&lt;10 meq/kg</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>&lt;1 %</td>
</tr>
<tr>
<td>Moisture</td>
<td>&lt;1 %</td>
</tr>
<tr>
<td>Antioxidant</td>
<td>500 mg/kg</td>
</tr>
<tr>
<td>Iodine value</td>
<td>&gt; 135</td>
</tr>
<tr>
<td>n-3 polyunsaturated fatty acids</td>
<td>&gt; 15%</td>
</tr>
</tbody>
</table>
Feed Processing
Conversion of various feed ingredients into a nutritionally complete diet

- **Formulation**
  - Ingredient selection and restrictions
  - Identification of nutritional restrictions

- **Processing**
  - Grinding
  - Mixing
  - Forming
  - Drying
Feed formulations

- Nutritional requirements vary due to
  - Select species
    - Nutritional requirements
  - Production conditions
    - Extensive vs intensive
    - Cages, ponds, raceways
  - Feeding strategy
    - Floating to sinking
    - Satiation to restricted
Typical fingerling feeds (ASA : China program) | Starter (52/16) | Fry (41/11) | Fingerling (36/7, E.Floating)
--- | --- | --- | ---
Fishmeal white (68/8) | 51.0 | 14.0 | 8.0
Anchovy (65/10) | 6.0 | 46.3 | 46.3
Soybean meal 47.5 | 5.0 | 15.0 | 10.0
Corn gluten 60% | 4.0 | 1.7 | 2.2
Wheat gluten | 12.5 | 13.0 | 19.0
Brewers yeast | 19.0 | 12.5 | 10.0
Blood ML 93/.1 | 8.0 | 14.0 | 12.5
Wheat SWW | 5.0 | 15.0 | 10.0
Wheat middlings | 4.0 | 1.5 | 2.0
Soy oil | 10.5 | 4.03 | 4.58
Fish oil | 1.5 | 1.5 | 1.5
Soy lecithin | 0.5 | 0.2 | 0.15
Vitamin premix (two types) | 0.28 | 0.25 | 0.25
Mineral premix | 0.2 | 0.2 | 0.2
CaP-monobasic | 0.2 | 0.2 | 0.2
Stable C 35% | 0.20 | 0.02 | 0.02
Ethoxyguin | 0.02 | 0.02 | 0.02
<table>
<thead>
<tr>
<th>Growout diets (ASA)</th>
<th>Freshwater (32/6, E.Floating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean meal 47.5</td>
<td>52.8</td>
</tr>
<tr>
<td>Corn gluten 60%</td>
<td>6.0</td>
</tr>
<tr>
<td>Wheat SWW</td>
<td>23.6</td>
</tr>
<tr>
<td>Wheat midlings</td>
<td>10.0</td>
</tr>
<tr>
<td>Fish oil</td>
<td>3.53</td>
</tr>
<tr>
<td>Soy lecithin</td>
<td>1.0</td>
</tr>
<tr>
<td>Vitamin premix</td>
<td>0.1</td>
</tr>
<tr>
<td>Mineral premix</td>
<td>0.25</td>
</tr>
<tr>
<td>CaP-monobasic</td>
<td>2.7</td>
</tr>
<tr>
<td>Ethoxyguin</td>
<td>0.02</td>
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</tbody>
</table>
To ensure proper nutrition all feeds should be supplemented with vitamin and mineral premixes.
### Generalized trace mineral premix
(0.5% inclusion)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>g/100g premix</th>
<th>mg/kg diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobalt chloride</td>
<td>0.004</td>
<td>0.050</td>
</tr>
<tr>
<td>Cupric sulfate pentahydrate</td>
<td>0.250</td>
<td>4.97</td>
</tr>
<tr>
<td>Ferrous sulfate heptahydrate</td>
<td>4.000</td>
<td>40.18</td>
</tr>
<tr>
<td><strong>Magnesium sulfate heptahydrate</strong></td>
<td><strong>28.398</strong></td>
<td><strong>68.34</strong></td>
</tr>
<tr>
<td>Manganese sulfate monohydrate</td>
<td>0.650</td>
<td>10.57</td>
</tr>
<tr>
<td>Potassium iodide</td>
<td>0.067</td>
<td>2.58</td>
</tr>
<tr>
<td>Sodium selenite</td>
<td>0.010</td>
<td>0.21</td>
</tr>
<tr>
<td>Zinc sulfate heptahydrate</td>
<td>13.193</td>
<td>150.00</td>
</tr>
<tr>
<td>Filler</td>
<td>55.128</td>
<td></td>
</tr>
</tbody>
</table>
## Practical vitamin premix (mg/kg diet)

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Research</th>
<th>Catfish</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3,000 IU</td>
<td>2,200 IU</td>
</tr>
<tr>
<td>D</td>
<td>2,400 IU</td>
<td>1,100 IU</td>
</tr>
<tr>
<td>E</td>
<td>60 IU</td>
<td>30 IU</td>
</tr>
<tr>
<td>K</td>
<td>60</td>
<td>4.4</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>50-150</td>
<td>50</td>
</tr>
<tr>
<td>Biotin</td>
<td>1.5</td>
<td>None</td>
</tr>
<tr>
<td>Cyanocobalamin</td>
<td>0.06</td>
<td>0.01</td>
</tr>
<tr>
<td>Choline chloride</td>
<td>3,000</td>
<td>None</td>
</tr>
<tr>
<td>Folic acid</td>
<td>5.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Inositol</td>
<td>150</td>
<td>None</td>
</tr>
<tr>
<td>Nicotinic acid</td>
<td>150</td>
<td>None</td>
</tr>
<tr>
<td>Pantothenic acid</td>
<td>135</td>
<td>15</td>
</tr>
<tr>
<td>Pyrodoxine</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>90</td>
<td>6</td>
</tr>
<tr>
<td>Thiamin</td>
<td>13.38</td>
<td>2.5</td>
</tr>
<tr>
<td>Ingredients</td>
<td>Units</td>
<td>Tilapia</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>IU</td>
<td>10 000 000</td>
</tr>
<tr>
<td>Vitamin D3</td>
<td>IU</td>
<td>2 000 000</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>mg</td>
<td>200 000</td>
</tr>
<tr>
<td>Vitamin K3 stab</td>
<td>mg</td>
<td>10 000</td>
</tr>
<tr>
<td>Vitamin B1</td>
<td>mg</td>
<td>15 000</td>
</tr>
<tr>
<td>Vitamin B2</td>
<td>mg</td>
<td>20 000</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>mg</td>
<td>12 000</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>mg</td>
<td>40</td>
</tr>
<tr>
<td>Niacin</td>
<td>mg</td>
<td>120 000</td>
</tr>
<tr>
<td>Pantoth. Acid</td>
<td>mg</td>
<td>50 000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Units</th>
<th>Tilapia + Stay C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Folic Acid</td>
<td>mg</td>
<td>7 000</td>
</tr>
<tr>
<td>Biotin</td>
<td>mg</td>
<td>500</td>
</tr>
<tr>
<td>Vitamin C (Stay C)</td>
<td>mg</td>
<td>200 000</td>
</tr>
<tr>
<td>Petox</td>
<td>mg</td>
<td>125 000</td>
</tr>
<tr>
<td>Choline</td>
<td>mg</td>
<td>600 000</td>
</tr>
<tr>
<td>Manganese</td>
<td>mg</td>
<td>50 000</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg</td>
<td>100 000</td>
</tr>
<tr>
<td>Copper</td>
<td>mg</td>
<td>5 000</td>
</tr>
<tr>
<td>Cobalt</td>
<td>mg</td>
<td>5 000</td>
</tr>
<tr>
<td>Iodine</td>
<td>mg</td>
<td>2 000</td>
</tr>
<tr>
<td>Selenium (1%)</td>
<td>mg</td>
<td>300</td>
</tr>
</tbody>
</table>

Addition rate Kg/MT 4.00
ASCORBIC ACID (Vit. C)

scoliosis

lordosis

coho salmon

dislocated vertebrae

Halver et al 1969
ASCORBIC ACID

short head

short gill operculum

twisted, spiraled cartilage in gill filaments

coho salmon
Vitamin C

- Once the most problematic
  - Easily destroyed by processing
  - 100% destroyed in moist unfrozen pellets
  - 80% destroyed in dry pellets
- Coated forms developed (fat coating, ethyl-cellulose coated etc)
  - Extrusion processing destroyed fat coating systems
- Various conjugates developed
  - Stabilized forms e.g. P, Mg, sulfate etc. are very stable even under extrusion conditions.
Transportation low to high (bagged or bulk)

- Boat
- Train
- Truck
Prior to or upon arrival, sub-sample is taken for analyses (size distribution, dry matter, protein, etc)

Upon arrival
  – Checked for temperature
  – Visually inspected
  – Unloaded
  – Screened for foreign particles, ground if needed
  – Bulk storage
Although, manual systems exist
Most unloading, grinding, etc is directed from a control center.
Control systems eliminates human error which would be common in complex mills
• Ingredients: Unloaded, Screened, Ground (or not), Stored

Hammer mill

Air swept grinder
Prior to forming, ingredients are weighted and then mixed
Steam pelleting

- Good conditioning of mash (gelatinization)
- Requires binding agent
- Processing is less expensive (lower energy costs)
  - Lower moisture addition (15-18%)
- Lower processing temperatures (90°C)
  - Comparatively less destruction of nutrients
Pellet mills used for aquaculture feeds have modified conditioners (larger with longer retention times) and dies that are designed to produce increased stability of the feed.
1. Feeder
2. Conditioning Chamber
3. Pelleting Device
4. Speed Reduction Device
5. Prime Mover
6. Base
Turning of the die and pelleting is based on contact & friction of the feed and the die. High levels of moisture or lipids inhibit the process.

Figure 3 - Typical Die and Roller Assembly Used for Producing Hard Pellets
Extrusion processing

- Plasticizing and cooking of ingredients
  - Increases gelatinization
- Processing costs are higher
  - Require more steam
    - moisture 25%
    - Temperatures 90-150°C
  - Higher pressures
  - Require additional drying
- Binders are generally not used
- Wide variety of products
- Destroys anti-nutritional factors
Extrusion processing

- Processing is much more versatile than pelleting.
- Functionality of the protein influences binding
  - Plants or raw ingredients better than processed animal protein
  - Lipids effect flow (slippage)
    - <12% no effect on extrusion
      - Added as far down the line as possible, adding to mixer coats the feed reducing water absorption. Hence, spray on or add to conditioner
    - <12% increases bulk density
    - 17-22% no expansion
- Note: 0.5-1% phospholipid will help reduce fat migration in high lipid diets.
Extrusion Processing

Insta-Pro Dry Extruder
With pre-conditioner

Extru-tech or Wenger Optima
Final products

- Nutritionally suitable for the target species
- Acceptable
  - Cost per unit of production
  - Size
  - Shape
  - Density
  - Stability
  - Texture and palatability
With improvements in oil seed cake quality the following could be produced today.

<table>
<thead>
<tr>
<th>32 % protein 6% lipid Extruded Floating feed</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressed Soybean meal</td>
<td>30.0</td>
</tr>
<tr>
<td>Cotton seed cake</td>
<td>15.0</td>
</tr>
<tr>
<td>Sunflower cake (decorticated)</td>
<td>20.0</td>
</tr>
<tr>
<td>Corn</td>
<td>20.4</td>
</tr>
<tr>
<td>Fish meal</td>
<td>4.0</td>
</tr>
<tr>
<td>Vitamin premix</td>
<td>0.1</td>
</tr>
<tr>
<td>Mineral premix</td>
<td>0.25</td>
</tr>
<tr>
<td>Mold inhibitor</td>
<td>0.15</td>
</tr>
<tr>
<td>Ethoxyquin</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Challenges for the industry

- High quality ingredients (low fiber and oil)
  - Improve oil cakes
  - Utilize fish processing waste as a fish meal

- Required imports
  - Vitamin and mineral premix
  - Stabilizing agents
  - Feed manufacturing equipment

- Possible imports
  - low fiber, low oil, high protein ingredient such as high protein soybean meal (or produce it yourself).
<table>
<thead>
<tr>
<th></th>
<th>CURRENT</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUPPLY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average fish catch from Uganda's Natural Waters ('000 MT)</td>
<td>233.8</td>
<td>250.0</td>
</tr>
<tr>
<td><strong>DEMAND</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. International Export</td>
<td></td>
<td></td>
</tr>
<tr>
<td>processed product ('000 MT)</td>
<td>36.1</td>
<td>60.0</td>
</tr>
<tr>
<td>raw fish required to produce processed product assuming 45% dressing percentage('000 MT)</td>
<td>80.0</td>
<td>134.0</td>
</tr>
<tr>
<td>2. Regional Export ('000 MT)</td>
<td>40.3</td>
<td>∞</td>
</tr>
<tr>
<td>3. Local Market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>local consumption rates (kg per capita per annum)</td>
<td>5.0</td>
<td>12.0</td>
</tr>
<tr>
<td>whole fish requirement ('000 MT)</td>
<td>115.0</td>
<td>287.5</td>
</tr>
<tr>
<td><strong>TOTAL DEMAND ('000 MT)</strong></td>
<td>235.3</td>
<td>421.5</td>
</tr>
<tr>
<td><strong>TOTAL DEFICIT IN SUPPLY</strong></td>
<td>1.5</td>
<td>171.5</td>
</tr>
<tr>
<td>Amount of Feed ('000 MT)Required to produce this through aquaculture (FCR = 2)</td>
<td>3.0</td>
<td>343.0</td>
</tr>
</tbody>
</table>
**Estimated Current Feed Demand by Small Holder Fish Farmers in Uganda**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Est. total number of ponds</td>
<td>10,000</td>
</tr>
<tr>
<td>Average pond size m²</td>
<td>300</td>
</tr>
<tr>
<td>total small holder pond area (ha)</td>
<td>300</td>
</tr>
<tr>
<td>Current production with on-farm feeds (0.2 tons/ha)</td>
<td></td>
</tr>
<tr>
<td>Current production with good feeds (10 tons/ha)</td>
<td>3,000</td>
</tr>
<tr>
<td><strong>Feed demand therefore (FCR 2) - MT</strong></td>
<td>6,000</td>
</tr>
<tr>
<td>protein requirement 32 to 40% protein diet</td>
<td></td>
</tr>
</tbody>
</table>
**FEED DEMAND FOR BAIT PRODUCTION**

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catfish fingerlings: as bait for long line fishery</td>
<td></td>
</tr>
<tr>
<td>Lake Victoria basin demand (pieces) :</td>
<td>&gt;700 million/yr</td>
</tr>
<tr>
<td>Uganda's share:</td>
<td>300 million/yr</td>
</tr>
<tr>
<td>Estimate 30% from aquaculture:</td>
<td>100 million/yr</td>
</tr>
<tr>
<td>total tons at 10g/fish</td>
<td>1,000 tons/yr</td>
</tr>
<tr>
<td><strong>total feed needed at FCR 1.2</strong></td>
<td>1,200 tons</td>
</tr>
<tr>
<td>require 45 to 35% protein diet</td>
<td></td>
</tr>
<tr>
<td>Feed required if all baitfish from aquaculture for Uganda:</td>
<td>3,600 tons feed/yr or more</td>
</tr>
<tr>
<td>Regional catfish fingerling feed demand could be (7,000T x 1.2):</td>
<td>8,400 tons feed/yr</td>
</tr>
</tbody>
</table>
## Potential Feed Demand For Uganda

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Feed Demand ('000 MT/yr)</th>
<th>Current</th>
<th>Target (5 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium and small-scale pond culture for local table fish</td>
<td></td>
<td>6.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Large-scale fish farms (4 planned) for regional and export</td>
<td></td>
<td>8.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Bait culture for 30% Uganda’s needs</td>
<td></td>
<td>1.2</td>
<td>3.6</td>
</tr>
<tr>
<td>Regional bait culture</td>
<td></td>
<td>2.8</td>
<td>8.4</td>
</tr>
<tr>
<td><strong>TOTAL FEED DEMAND</strong></td>
<td></td>
<td>18.0</td>
<td>72.0</td>
</tr>
</tbody>
</table>
### LOCAL PRODUCTION

<table>
<thead>
<tr>
<th>%</th>
<th>Local price After processing</th>
<th>$/mt</th>
<th>Feed Price per mt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soya Bean Meal</td>
<td>40%</td>
<td>400</td>
<td>219.78</td>
</tr>
<tr>
<td>Corn</td>
<td>24%</td>
<td>225</td>
<td>123.63</td>
</tr>
<tr>
<td>Cotton Seed Meal</td>
<td>15%</td>
<td>210</td>
<td>115.38</td>
</tr>
<tr>
<td>Wheat Middlings</td>
<td>5%</td>
<td>128</td>
<td>70.33</td>
</tr>
<tr>
<td>Sunflower cake</td>
<td>10%</td>
<td>182</td>
<td>100.00</td>
</tr>
</tbody>
</table>

94% $ 148.41

### IMPORTED OPTION

<table>
<thead>
<tr>
<th>%</th>
<th>Imported Price Whole Grain (US$/mt FOB)</th>
<th>Transport in bulk option</th>
<th>$/mt</th>
<th>Feed Price per mt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soya Bean Meal</td>
<td>40%</td>
<td>188</td>
<td>107</td>
<td>295.00</td>
</tr>
<tr>
<td>Corn</td>
<td>24%</td>
<td>110</td>
<td>107</td>
<td>217.00</td>
</tr>
<tr>
<td>Cotton Seed Meal</td>
<td>15%</td>
<td>210</td>
<td>107</td>
<td>317.00</td>
</tr>
<tr>
<td>Wheat Middlings</td>
<td>5%</td>
<td>128</td>
<td>107</td>
<td>235.00</td>
</tr>
<tr>
<td>Sunflower cake</td>
<td>10%</td>
<td>106</td>
<td>107</td>
<td>213.00</td>
</tr>
</tbody>
</table>

94% $ 250.68
### FEED PROJECTIONS

<table>
<thead>
<tr>
<th>Year</th>
<th>Mt Feed Required</th>
<th>Soya Bean Meal</th>
<th>Corn</th>
<th>Cotton Seed Meal</th>
<th>Wheat Middlings</th>
<th>Sunflower Cake</th>
<th>Total Bulk Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>1000</td>
<td>400</td>
<td>240</td>
<td>150</td>
<td>50</td>
<td>100</td>
<td>940</td>
</tr>
<tr>
<td>2007</td>
<td>5000</td>
<td>2000</td>
<td>1200</td>
<td>750</td>
<td>250</td>
<td>500</td>
<td>4700</td>
</tr>
<tr>
<td>2008</td>
<td>15000</td>
<td>6000</td>
<td>3600</td>
<td>2250</td>
<td>750</td>
<td>1500</td>
<td>14100</td>
</tr>
<tr>
<td>2009</td>
<td>25000</td>
<td>10000</td>
<td>6000</td>
<td>3750</td>
<td>1250</td>
<td>2500</td>
<td>23500</td>
</tr>
<tr>
<td>2010</td>
<td>50000</td>
<td>20000</td>
<td>12000</td>
<td>7500</td>
<td>2500</td>
<td>5000</td>
<td>47000</td>
</tr>
<tr>
<td>2011</td>
<td>75000</td>
<td>30000</td>
<td>18000</td>
<td>11250</td>
<td>3750</td>
<td>7500</td>
<td>70500</td>
</tr>
</tbody>
</table>

### Yields in Field (kg per acre)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Soya Bean Meal</td>
<td>538</td>
<td>578</td>
<td>621</td>
<td>668</td>
<td>718</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>1,628</td>
<td>1,709</td>
<td>1,794</td>
<td>1,884</td>
<td>1,978</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton Seed Meal</td>
<td>135</td>
<td>146</td>
<td>157</td>
<td>170</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat Middlings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunflower cake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

### Area required (acres)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Soya Bean Meal</td>
<td>3,721</td>
<td>10,384</td>
<td>16,099</td>
<td>29,952</td>
<td>41,794</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>737</td>
<td>2,107</td>
<td>3,344</td>
<td>6,369</td>
<td>9,099</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton Seed Meal</td>
<td>6,013</td>
<td>16,701</td>
<td>25,774</td>
<td>47,729</td>
<td>66,291</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat Middlings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunflower cake</td>
<td>3,429</td>
<td>9,526</td>
<td>14,701</td>
<td>27,223</td>
<td>37,810</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Total Area

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Area</td>
<td>13,900</td>
<td>38,718</td>
<td>59,917</td>
<td>111,274</td>
<td>154,993</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Area per farmer (acres)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers</td>
<td>1.7</td>
<td>2.0</td>
<td>2.3</td>
<td>2.6</td>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Soya farmers Only

|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

Annex III, b: by David Luseesa of USAID APEP
FISH FEEDS WORKSHOP
F.I.S.H. Project
19.01.2006
SIGNIFICANT FIGURES

In Uganda, the fish processing industry processes between 70 and 80 thousand T of whole fish per annum.

Most of this fish is filleted, leaving in average 48% of by-products of varying value that are sold on the local markets.

Only a small percentage of waste is generated (guts, scales) estimated (own) at 2% of the weight of by-products.

This offer the feeds industry a good potential for manufacturing a feed component rich in protein and fats.
FISH BY-PRODUCTS

• FISH FRAME OF NILE PERCH. NO HEAD.
• EX-FACTORY VALUE : 150 USHS
• Nile Perch headless frame: approx. 35% flesh. 65% bones and fins.
• Bones contain approx. 70% hydroxyapatite and 30% collagen
• Nile Perch skins (fillet side).
• Scale on, it represents approx 5% of whole fish weight.
• Composition(approx.) 50% moisture, 29% protein, 20% lipids.
• Amino acid deficiency for tryptophan and cysteine
• Nile Perch fat content is very dependant on fish size.
• Known to contain high levels of omega 3.
• Fats on photo are hand separated from belly cavity and from maw.
• Local market value: 350 USHS/KG.
• Approx. 2.5% of fish weight.
• Fats are also available in skins, bones and guts.
• Nile Perch guts.
• Approx. 3% of fish weight. Contain organs such as intestines, liver, stomach, heart, gonades, g. bladder etc.
• Local market value: generally sold with the fish frame (150 USHS/kg)
• Fish eggs.
• Local market value : approx. 400 USHS/KG
• % of total weight processed not established. Own estimate : approx 1%
• Nile Perch heads
• Local market value: approx. 400 Ushs/Kg
• Nile Perch trimmings.
• Local market value: 450 Ushs/kg.
• Possible to make fish cake, burger, fingers etc. out of mince
• Fish burger.
• Value : approx 2000 USHS/KG
• Nile Perch stomach, spleen, piece of intestine, gall bl.
• Stomach may have an export potential (China)
• TILAPIA carcass.
• Local market value: approx 300 Ushs/kg
• Approx 55% of whole fish weight
Feed Mill industry in Uganda
Past

- **Before 50's** local birds constituted 100% of the poultry population
- Mainly for ceremonial/superstitious purposes
- Eggs and chicken reserved for men
- Local birds used to scavenge
- Herbs and local medicine for treatment of poultry diseases
- No data on diseases outbreak
Past

- **After 50’s** introduction of the first hybrid (exotic) chicken by L.E.S (Entebbe and Mbarara)
- Wankoko Co-operative Society
- Ugandan Vets interest more in cattle
- Drugs, Vet services and extension controlled by the Government
- Minimmun drug abuse
- Presence of notifiable diseases like New-Castle
- **After 60’s** feed imported from Kenya
- **1965** Nuvita starts as a private company producing animal feed
70’s Nuvita was Nationalized
Spring Valley Hatchery LTD
Bulemezi Farm enterprises
Kungu Farm
Collapse of Wankoko co-op. Society
Chicks, Drugs and feeds allocated by the Government due to shortage
Veterinary and extension services reduced
Past

90’s liberalisation of the feed industry resulting into many feedmills, among them large scale ones - Ugachick, plus other medium and small scale ones

Private sector investing heavily in hatcheries - Ugachick, Bokomo plus other medium and small scale ones

Liberalisation of drugs, veterinary and extension services

- Sharp rise of raw material prices
- Egg and broiler prices stagnant
- Desperate attempt to survive
Feed/ Raw material vs egg price

- Maize
- Maize Bran
- Mukene
- Cotton cake
- Eggs
- Feed (Kg)
Feed Production in Uganda

3 Categories of producers

- Feed millers
- Small-scale mixers
- Backyard mixers

Annual production of feeds in Uganda is of 80,000 tonnes
Poultry Feed Production today

- 85% of the feed produced is poultry feed (68,000 tones)
- Layers mash - 45% (30,600 tones)
- Growers mash - 15% (10,200 tones)
- Chick mash - 10% (6,800 tones)
- Broilers mash - 30% (20,400 tones)
Future

Scenario 1:

- Increase in Kitiiyo mixing
- Poor production
- No quality standards
- No Future to the livestock industry
- Stagnant or poor social-economic stability of the population
Future

Scenario 2:

- Animal feed bill in place
- Quality standards
- Upgrading of Kitiiyo to specialized feed mills
- Better feed
- Better livestock performance
- Growth in the livestock industry
- Increased demand on inputs, (soya, cotton cake, sunflower, maize etc), (research and development), (service providers and allied industries).
- Development of new feed avenues: aquafeed
  Social economic development
Pond culture

Thank you very much
• Established in South Africa in June 1998 with the objective of becoming the preferred aquafeed supplier to the developing Aquaculture industry in South Africa, Southern Africa and Africa.

• Is supplying +/- 80 - 85% of all aquafeed within South Africa and Southern Africa (including countries like Namibia & Angola) – including trout, tilapia, catfish, koi, etc.

• The next step is to establish AquaNutro in Africa – West Africa and East Africa as the preferred supplier.
<table>
<thead>
<tr>
<th>TON/YEAR</th>
<th>373</th>
<th>844</th>
<th>1,351</th>
<th>2,642</th>
<th>1,347</th>
<th>1,941</th>
<th>3,493</th>
</tr>
</thead>
</table>

“To establish AQUANUTRO as Africa’s leader in scientifically formulated extruded feed ”
“To be a successful company to the benefit of all STAKEHOLDERS by Product Leadership Customer Satisfaction & Continuous Improvement.”
FOCUS OF BUSINESS

Design, Development, Manufacturing and marketing of Scientific Formulated Extruded Feeds for the African Aquaculture market.
1. Feed for Trout, Catfish & Tilapia, including:
   - Pre-Starter / Fry Feeds (from 52% Protein to 64% Protein)
   - Starter Feeds (from 45% Protein)
   - Grower Feeds (intensive & semi-intensive systems – from as low as 25% Protein up to 42% Protein)
   - All products must be floating feed
• **Satisfying Customer Needs** – not only supplying feed but also other support services like technical back-up, veterinary services, water-quality testing, online feed management, skills training on fish farming, etc.

• **Empowerment of Employees** – making employees responsible by empowering them through training and skills development

• **Quality of Product** – ISO 9001:2000 / HACCP certify, laboratorium testing of raw-materials and final feeds for total traceability from fed raw-materials to final fish fillet in consumer plate.

• **Continuous R&D** — improving feeds to ensure optimum fish production and water-quality and increase fish farmer profitability

• **Brands** – AQUANUTRO / HIGH QUALITY FISH FROM AFRICA
AQUANUTRO EAST AFRICA:

JOINT VENTURE BETWEEN

AQUANUTRO SOUTH AFRICA & BUSINESS PEOPLE / FARMERS FROM EAST AFRICA;

WHERE AQUANUTRO SOUTH AFRICA

• Management Control

• Sourcing and supply of Raw-Materials & concentrates

• Responsible for Formulations, R&D, Technical support, Training, etc.

• Coordinating & offering other support services, etc.
<table>
<thead>
<tr>
<th>SALES : TONNES PER YEAR</th>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
<th>YEAR 4</th>
<th>YEAR 5</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>2500</td>
<td>3500</td>
<td>5000</td>
<td>7500</td>
<td>10000</td>
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<tr>
<td>Description</td>
<td>USD</td>
<td>Rands</td>
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<tr>
<td>Manufacturing Equipment</td>
<td>400,000</td>
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<td>Quality Control Equipment</td>
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<td>Unforeseen Items</td>
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<td>255,000.00</td>
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<td>Operating Capital</td>
<td>428,328</td>
<td>2,784,133.18</td>
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<tr>
<td><strong>Total Capital</strong></td>
<td><strong>1,352,174</strong></td>
<td><strong>8,789,133.18</strong></td>
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</tr>
</tbody>
</table>
RMC – extruded fish feeds

Presented by:
Eran Hadas
RMC Ltd.
Company overview

• RMC Ltd is a leading fish feed producer in Israel since 1994.
• The company produces feeds that cover the whole fish life cycle, from larvae to market size fish.
• RMC produces a large range of balanced and complete feeding programs:

  Starter feeds for fry, Grower feeds - sinking for marine (Bream, Bass, Red drum), floating for Catfish, Barramundi, Tilapia and Carp (both in intensive & extensive systems) and Ornamental fish.
Company overview

• Production of organic fish feed in a separate organic feed mill. Inspection is according to the standard of I.B.O.A.A.

• RMC fish feeds are developed in close cooperation with the fish farming industry which compels RMC to continuously create innovative solutions.

All RMC products are produced by an extrusion process.
Extrusion technology
Advantages of extruded feeds

• Increased digestibility of carbohydrates and proteins
• Possibility to produce high energy feeds.
• The pellets density can be controlled – production of floating/sinking feeds.
• Reduction of anti-nutritional factors.

4/28/2006
Packaging possibilities
Can these products can be used in the fish culture industry in Uganda?
Growth of catfish fed with different diets

Experimental days

Average weight (g)

- Group 1 (40/9 feed type)
- Group 2 (42/13 feed type)
- Group 3 (45/14 feed type)
Simple food evaluation model

- Fish were fed equal amount of food for 70 days.
- The price of food 1 was 23.5% of the price of food 3.

Weight gain group 1: 160 gr
Weight gain group 3: 230 gr
Difference = 30.5%

- If group 1 yielded 1000 kg, then group 2 yielded 1439 kg.
- Assuming fish price of 2.5 $/kg, then the income from group 1 was 2000$ whereas the income from group 3 was 3600$, a difference of 45%
Summary

• The different RMC products are formulated and manufactured to meet the demands of cultured fish in the different cultured systems.

• RMC products are distributed by “Balton” Uganda

• The production process is according to EU standards, thus increasing the possibility to market the fish in EU markets

• Production of organic fish by using the RMC certified organic feeds can open new markets.
Thank you

4/28/2006