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Assessment of aquaculture potential in South Western Kenya

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## **Glossary**

DoF – Department of Fisheries, Ministry of Agriculture and Rural Development  
FAO - Food and Agriculture Organisation of the United Nations  
GoK – Government of Kenya  
HCA – High Concentration Area (extension area unit for LBDA)  
IoA – Institute of Aquaculture  
JICA - Japan International Cooperation Agency  
KEFRI - Kenya Forestry Research Institute  
KMFRI – Kenya Marine Fisheries Research Institute  
LBDA – Lake Basin Development Authority (formerly funded by UNDP and Belgium, now GoK)  
LVEMP – Lake Victoria Environment Management Project (GEF World Bank)  
LVFO – Lake Victoria Fisheries Organisation  
PD/A CRSP – Pond Dynamics/Aquaculture Collaborative Research Support Programme  
UNDP – United Nations Development Programme (GEF – Global Environment Fund)

## **Planned Itinerary**

Mon 12th March 01 – All team members met in Kisumu for preliminary discussion. Visit roadside ponds in Kisumu district.  
Tues 13th March 01 – Meetings with DoF, KMFRI and LBDA. Visits to fish farms in Kisumu district  
Wed 14th March 01 – Visit farms in Siaya and Bondo districts and landing beaches.  
Thurs 15th March 01 – Visit landing beaches on Lake Victoria and farms in South Nyanza District.  
Fri 16th March 01 – Visit farms in Vihiga and Kakamega. Travel to Eldoret.

## Executive Summary

The land surrounding the Kenyan shore of Lake Victoria is characterised by high population density and strong reliance on agriculture and fisheries. Unfortunately the soils of SW Kenya generally suffer from a lack of phosphorous, limiting crop production. However, the soils are otherwise suitable for aquaculture and the topography of the area means that there is sufficient perennial water to support a substantial number of ponds.

Fisheries production in the area mainly comes from capture of Nile perch and tilapia in Lake Victoria. Most of this production is exported, with only a small amount, including processing waste, affordable to the local population. The staple fish in the local diet is the small cyprinid *omena* (*dagaa* in Uganda), which is marketed as a dried product across the region.

Aquaculture in the area has developed over the last thirty years through the efforts on various local and international government and non-government organisations. The majority of fish cultured are tilapia, but some catfish are also produced - both alone and in polyculture with tilapia. Ponds are typically flow-through, requiring the addition of feed and nutrients at regular intervals. However, recent cessation of extension, because of a shortage of funding, has been matched by a similar sharp decline in the number of households actively conducting aquaculture.

This study assesses the current situation, highlights potential constraints and offers some solutions and areas of potential research. The main technical constraints to aquaculture development in the region are the cost and availability of inputs for use in flow-through ponds. By using still-water ponds, inputs would be required less frequently, and in smaller amounts, which would be encouraging considering the distances people have to travel to obtain these inputs and given the other priorities people have for the time and money required. The leading social issue is the ingrained scepticism of the farmers and the main institutional constraint, which is a remnant rather than a current problem, is how aquaculture has been promoted and assisted in the past to leave farmers feeling so de-motivated with regards to aquaculture. Given the proposed technical changes, research could be conducted into the feasibility of and methods for extending small-scale, homestead aquaculture rather than the previous thrust for commercial aquaculture that just didn't pay.

## 1. Background on SW Kenya

Kenya lies with the sub-humid, highland zone of East Africa. Annual rainfall is around 2000mm, falling between March and June and from September to November. The average temperature range is between 15 and 30°C. Soil is acidic (pH 4-6.5) and characteristically poor in phosphorous, which has severe effects on the productivity of agricultural land. Over the last 30 years the average land holding has declined markedly, with few individuals holding sufficient land to provide enough food and income to support a family. Land holdings range in size from 0.2 - 2.5ha, with secure male inheritance. Many family plots, although divided in law, are operated as whole units in an attempt to maximise returns for labour. Labour constraints, because of migration and AIDS deaths, have lead to deterioration of the farming system.

Population density ranges from 150-1200 people per square kilometre, with the area supporting around 10 million people (about one third of the country's population). Access to credit is minimal, with the local government credit scheme having collapsed in recent years. Most of the population is literate, with English widely spoken, especially amongst males.

Agriculture is the main activity in the area, where the main crops are maize, millet, sorghum, groundnut and cassava, with cash crops including wheat, tea, coffee and sugarcane. Farming is mainly subsistence level, with maize as the main crop. The catchment area of Lake Victoria in Kenya consists of both diverse, small-scale homestead farming activities and highly developed monocultures of cash crops (KEFRI, 2000 and LBDA, 1999). Significant livestock ownership is not widespread, although local chickens are endemic to the point of not being mentioned during surveys.

## 2. Overview of fisheries

Capture fisheries production from Lake Victoria plays an important role in the local economy. However, most of the larger, whole fish never reach the local market. Traditionally, tilapia from the lake were cheap, abundant and readily available to all, but over the last two decades the expansion of large commercial catches of Nile Perch and larger tilapia for export has raised the price and removed fish from the local marketing chain. Most catch of Nile perch and tilapia is transported directly from the landing beaches to the processing factories. The Nile perch and tilapia processing industry employs thousands of people in numerous factories and support industries around the shores of the lake. The waste from this industry now constitutes a significant percentage of the fishery products consumed by the local population. The management of this fishery absorbs most of the time and resources of the DoF and KMFRI as it is a significant export earner for the region.

The only fish abundantly available for the local market is *omena* (known as *dagaa* in Uganda). *Omena* are small cyprinids that are sun-dried by women on the fishing nets after landing. They are available in most village markets and form the main source of fish protein in the region, although few people will admit to buying it. This supply of *omena* as a food fish is also under threat because of increasing demand from the fishmeal industry (Jansen *et al*, 1999). The few tilapia that reach the local market are expensive and marketed whole, putting them beyond the capacity of the local population – with most of them ending up in restaurants. Some smaller, fresh examples are available close to the lake, but they fetch a premium price beyond the daily capacity of people in Kisumu. Away from the lake any tilapia are usually marketed as a dried product.

Table 1. Latest fishery statistics (1999) from the Kenyan part of Lake Victoria

	Weight (mt)	Value (Million KSh)
Nile Perch	115000	5 250
Omena	40000	706
Nile Tilapia	23700	643
Other tilapia	20000	553
Haplochromis	527	10

(n.b. these figures are skewed because some landings on Kenyan shores are re-landings of fish from Ugandan waters)

When the Nile perch fishery expanded the local population refused to eat the fish because it was inferior to tilapia. Ironically, nowadays the carcasses of Nile perch are all some people can afford to eat. The processing waste from the Nile perch factories that dot the edge of the lake is sold to co-operatives who separate, dry and fry the carcasses for sale in the local market. Nothing is wasted, the fat is used as the frying oil, the skins are dried to use as fuel and any spare meat is prized. Women play a substantial role in this industry and often have controlling share in co-operative activities.

One possible link between fisheries and aquaculture would be the production of catfish fingerlings for Nile perch long line fishing. Fishers have experimented with other fish, but their preferred choice is catfish. For this reason we need to know the number of hook fishers and their efficiency.

### 3. Overview of aquaculture production

In SW Kenya small-scale aquaculture is conducted by farmers with access to perennial water sources. It is typically a male-controlled activity, with woman conducting much of the day to day labour. The natural resources present would allow many more farmers to grow fish than have currently been targeted. There is significant flowing perennial water in the valleys and a large number of springs distributed at various levels in the hills. Although there are problems with phosphorous deficiency in the soils, this would not have strongly negative effects on aquaculture, however soil structure is a factor on valley slopes because it can be thin and porous.

Tilapia is the main cultured species, although some catfish are also been grown. Aquaculture appears to have been promoted in SW Kenya first by Peace Corps in the 1970s following the government's "Eat More Fish" campaign. The technique for using flow-through ponds seems to have been adopted at the time (likely to be a remnant of the trout ponds introduced by settlers in the 1920s) and since copied by LBDA and the local Catholic Church. In 1987 a JICA team reported on the farming system requirements of the region to LBDA and recommended the up-scaling of 'feeding culture'<sup>1</sup> as a suitable method for aquaculture in the region (JICA, 1987). Although they realised the need for greatly increasing aquaculture production, their recommendations at the time have failed to fulfil the high potential for this sector. The team predicted a 40,000 metric tonnes deficit in fish requirements by 2005. Although no current data is available, it is likely that the decline in the amount of fish available to the local population has increased that demand significantly - as reflected in the increased price of fish in the local market.

There are inherent limitations with the flow-through system, not only the constant demand for water, but also the need for constant addition of feed and nutrients. Despite its limitations, the flow-through pond

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<sup>1</sup> The term 'feeding culture' is indicative of flow-through systems currently being promoted. Although the JICA team acknowledged the still-water system, they concluded that land pressure and the small size of ponds would mean that this method would not be effective. In support of 'feeding culture' they calculated that feeds would be accessible and affordable.

system has not been adapted or discarded. The system creates high labour and input demands for a product that, although increasing, does not fetch a significantly high market price. Since overseas funding ceased for LBDA their aquaculture programme has declined and in direct correlation so has the number of farmers actively maintaining aquaculture ponds. This study aims to identify the reasons behind this decline.

### 3.1 Aquaculture inputs

The production systems currently extended by the local extension agencies require significant material inputs. Besides being expensive, given the local topography and settlement pattern, these inputs require significant labour time and energy on a regular basis. Changing the system to still-water systems would mean that rice bran, fertiliser and other random feeds would be required less. This would be more appropriate as it was evident that the farmers were not meeting the levels of inputs currently prescribed by extensionists. When LBDA enjoyed a high level of funding they would transport fingerlings and other inputs to the farmers in their pick-ups. Once this resource-rich support system was removed the pressure of the additional labour required to obtain these inputs added to the failure rate of aquaculture.

There is potential to utilise the input network that exists for other farming activities to provide inputs for aquaculture. The feed traders and local vets could be encouraged to include advice about aquaculture in their services and to carry appropriate products.

### 3.2 Resource priorities in the farming system

Resources (manure, feed and labour) are typically utilised for maize production first. Aquaculture comes somewhere down the scale because people believe that the fish will look after themselves. The proximity of the lake (Victoria) also allows people to believe that if they really needed fish, they could just catch one. The ‘wildness’ of fish, their relatively low price (historically), abundance (again historical) and their general ability to survive (if not to grow), means that people will probably always give them low priority. Maize will not survive if you do not tend it.

This ‘low priority’ is probably the main cause of ‘commercial’ aquaculture ventures failing. One farmer reported that his parents had a pond of fish that provided for their needs. He increased the number of ponds he owned to try the ‘commercial’ tilapia farming promoted by LBDA, but when that was not profitable he gave up all ponds. Paradoxically, now he only wants to try ‘commercial’ fish farming, because he perceives no benefit from a homestead pond, but still believes that ‘commercial’ fish farming could work with outside assistance. Research is required into how aquaculture can be re-promoted as a homestead/small-scale activity.

A brief comparison of tilapia and broiler production systems demonstrates that the economic difference is not significant. (Feed costs or animal losses not considered.) Tilapia may not be viewed as a good option because the growth of individual animals is not as large for a similar investment. Also, not being able to observe the animals closely during the growth cycle distances to the farmer from them.

	Broiler		Tilapia	
Juvenile	One-day-old chick =	45 KSh	Fingerling (45 fish) =	45 KSh
Market size	6 month chicken =	250 KSh	6 month (45 fish) =	225 KSh
Gross margin		205		180



### **3.3 Pond outputs**

All farmers who were visited reported brisk pond-side sales whenever fish were harvested. There is significant demand for tilapia, even pond-produced, because less and less fresh fish from Lake Victoria is reaching the rural markets and the few that do are usually beyond the purse of the local people. This raises the question of what price the market will sustain. The fresh fish available from the pond side are favoured, but only fetch a similar price to the lower quality (more time out of the water) fish from the lake. Market research should be conducted to understand how much people will pay.

### **3.4 Post-harvest issues**

Typically, pond-produced fish are all sold, either at the pond-side or in the local market. Those retained by the producer are usually sun-dried. In homestead ponds, there may be some low-level removal of fresh fish throughout the culture cycle. The control of sale lies with the men, but women carry out any processing. For information of processing of captured fish see 'Overview of fisheries', above.

## **4. Gender issues**

Although men appear to have overall control of the marketing of fish and were available at most ponds during the visit, there were indications that much of the day to day management and maintenance of the ponds is conducted by women. This was evident on our unannounced visits, where the man of the house was absent, but we were able to discuss daily fishpond management with the woman of the house.

The role of children requires further investigation as although they were not mentioned by the pond owners, the involvement of young children in Kenyan agriculture and homestead activities is common. One of the ponds visited was a school pond and two other pond owners were teachers. There are perhaps opportunities to build on the involvement of children as extension agents, along the lines of the DFID-funded Fisheries Training and Extension Project in Bangladesh, which is successfully involving children in extending the aquaculture message.

There are three notable fishing tribes in Kenya; Luo are traditionally a Nile fisher tribe, fishing inland waters. Their coastal equivalent is Pokomo, although they are unrelated. The Banyala are fishers of Uganda origin. Banyala and Luo are found around Lake Victoria.

## **5. Livelihood assets**

*Social* – Catholic Archdiocese of Kisumu, LBDA fish farm network.

*Financial* – in recent years the rural credit system in SW Kenya has collapsed.

*Natural* – there are many streams in the valleys of SW Kenya. In addition there are many areas where springs exit the hillsides away from streams. Roadside ponds are also evident in lower-lying areas. The general land pattern of the area is conducive to aquaculture.

*Human* – Limited labour supply was reported by some of the farmers visited as a significant reason for the failure of aquaculture. Labour (like other inputs) is utilised elsewhere in the farming system before aquaculture. Both migration and AIDS were given as major reasons for the labour shortage. Recently there has been a collapse in several industries in Kisumu, with some people returning to their farms (added labour, but added resource pressure) and some moving further away to find work, returning less frequently, especially during periods of high labour requirement (planting/harvesting).

*Physical* – The settlement pattern in Kenya is such that there are no 'village clusters', rather individual houses are built in the middle of smallholdings. This means that services are spread more thinly and it is necessary to travel further to obtain the products and services necessary for farming. The road network is

generally good in SW Kenya. Electricity is not available to all households.

<b>District</b>	<b>Topography</b>	<b>Landholding</b>	<b>LBDA fish farm</b>
Migori (South Nyanza)	Lake to hills	Small to medium	Rongo (9 ponds)
Kisumu	Lake to hills	Small in hills	Kibos (15 ponds)
Bungoma	Undulating	Large	Chwele
Busia	Undulating	Small	Alupe
Siaya	Undulating	Small to medium	Yala
Kisii	Hilly, many streams	Small	Borabu
Rangwe (South Nyanza)	Lake to hills	Small to medium	Kokwanyo
Kakamega	Hilly, streams, poor soil	Small	Lugari
Nandi	Rolling hills, rivers	Large	-
Uasin gishu	Hills	Medium to large	-

Table 2. Typical land pattern in LBDA area.

## **6. Role of KMFRI/LBDA/DoF and other projects, including PDA/CRSP**

The American funded PD/A CRSP project has a long history in Kenya and has worked with the DoF fish farm at Sagana substantially in recent years. PD/A is reducing its presence in the area and this, linked with the declined activity of LBDA means there is little support for aquaculture beyond the Catholic Archdiocese – who in turn used to rely on LBDA for technical support.

KMFRI and DoF are largely concerned with the lake fisheries, indeed the UNDP-GEF/World Bank funded LVEMP is significantly funding both organisations at present. The FAO-supported LVFO has limited capacity, but is also focused almost exclusively on Lake Victoria fisheries.

LBDA has the capacity and facilities to support an effective, extensive extension system. The large farm at Yala swamp, which currently sits idle could produce enough revenue to support part of that extension system and the LBDA fish farms could also be run more commercially. The restrictions of government spending policy means that much of this capacity is wasted.

## **7. Capacity of Collaborators**

The Moi University staff who took part in the field work were very enthusiastic and appeared focused and dedicated to improving the livelihoods of the local poor through appropriate aquaculture. The fact that they are themselves from the immediate study area increases this tie, although care should be taken not to promote a parochial approach. Another strong point, however, are the established links between Moi and LBDA and the less formal ties that Moi has with DoF and KMFRI. There are information needs at Moi University that need to be addressed to aid the planning of more appropriately targeted, current research. FAO was providing ASFA for free to certain information centres, involving Moi in this scheme would assist them and hopefully other universities in the area. The principal author would like to thank the staff of Moi University for arranging an effective and informative field visit very successfully at short notice.

## **8. The main limitations to aquaculture and potential solutions**

The primary issue that would require research is the promotion of aquaculture as a homestead activity rather than a commercial venture. Promoting aquaculture as a homestead activity would make people's expectations far more realistic. The tools and techniques required to achieve this would need to be thoroughly researched, especially given the current attitude amongst farmers, who expect any digging to be paid for. Methods for re-educating the extension services to provide a realistic farmer-centred, rather

than target-oriented, extension system would also need to be investigated, both at senior and field level.

The input requirement for flow-through ponds appears to be most significant technical reason for the failure of aquaculture in the highlands of SW Kenya. By using still-water ponds the input demand would be lower and farmers would not need to purchase, transport and apply the inputs as often for a similar or higher return. The other limiting factor is the way in which aquaculture has been promoted. In recent years, aquaculture was extended by LBDA as a commercial activity. Both the method and the message of extension, including the direct provision of all inputs to the farmers by LBDA, has built an artificial aquaculture system that is reliant, almost exclusively, on project inputs and is therefore not sustainable.

Educating farmers and service providers about the benefits of using still-water systems, especially for omnivorous species such as tilapia, would highlight the reduced input and labour requirements. If adopted, this would move the final product towards being profitable. Knowing that there is no need for a constant water supply could encourage people further away from perennial flowing waters, i.e. further up the valley sides, to adopt aquaculture. There is a need for some research to ensure that still-water systems are both effective and acceptable to the local population. Using still-water (non flow-through systems) would be inline with the security measures utilised by some groups, who cut the pond walls at harvesting time rather than inserting drainage pipes in the walls, so that no one can easily drain the pond and steal the fish. A current DFID/Stirling project in Uganda is addressing the economics and resource-priority issues of tilapia/catfish ponds within similar farming systems.

Having a 'government pond' on your land gives status and security. If the farmer is never given ownership of that pond, even though it is on their land and officially theirs, they will not sustain it after the extension service leaves. If the extension service does all the work, the farmer has no real investment in the pond. If effective extension messages and technical support can be provided to the farmer to enable them to conduct aquaculture on their own land using their own labour, they take ownership of the work and are more likely to maintain it once the extension support has been decreased or removed. This is where a farmer-managed demonstration plot, even if it is not perfect, can be very valuable - if 'planned' carefully.

The question of ownership needs to be addressed. How to overcome this ingrained problem requires work from both ends. The extension services need to let go and the farmers need to take responsibility. Although the techniques for farmer-centred research/extension are largely understood, implementing them in the Kenyan context will require further research.

## **9. Recommendations for possible research interventions relating to aquaculture that could improve the livelihoods of the inhabitants.**

Although a list of possible research topics is included here, the most important is highlighted in each category.

### ***a. Technical***

- i. Although largely taken as suitable, the use of the still-water system may require some preliminary research. Besides the technical issues, the social implications and any potential health issues should also be considered.**
- ii. Juvenile production - for both catfish and tilapia.
  - a. For *hatchlings* the effectiveness of different local substrates readily available in farm systems and general environmental factors affecting hardiness and survival.

- b. For *fingerlings* issues of feeding and water quality and their effect on hardiness and survival, both in the production system and during transportation.
  - c. For *farmer production* of fingerlings how would the production system need to be adapted? (Currently farmers do not select broodstock effectively.)
  - d. In order to increase survival rates during *transportation* an investigation into the best locally appropriate means of fry transport should be investigated.
  - e. **Size preference for catfish fingerlings for *fishermen*. The preferred bait, but what is the most efficient size? Production to best suit the market needs. Economic viability?**
- iii. **The possibility of new species to culture. *Labeo victorianus*, barbus species, *Tilapia esculantus* and other species used to be very popular, however their availability has dropped markedly in the last few years. Captive reproduction would have to be researched (possible links to LVEMP). Market price is reasonably high and there are conservation issues linked in.**
- iv. Feed formulation - using locally available materials. Research will be required on the suitability, availability and competitive uses of possible materials to be used as feed stuffs for cultured fish.
- v. Water and soil survey - to ensure that it is not environmental factors that are hindering production.
- vi. Fingerlings are distributed at present, why? What are the risks/benefits to distributing fry instead?
- vii. *Gambusia* (mosquito fish) production in seasonal homestead water bodies. Not directly adding to food security, but could improve health. Survey of household ponds required and information on effectiveness of *gambusia*. Technically the main concern would be how stocks would be maintained at the household/community level during the dry season.
- viii. Feasibility of trout culture in Mount Elgon district. Markets and water quality would need to be surveyed. Although this fish would probably be produced by richer farmers it would provide employment for the poor. Low temperature is generally understood to slow tilapia production at higher altitudes.

***b. Socio-economic***

- i. **Inclusion of aquaculture in the farming systems allows the farmers to make better use of natural resources within their farms. What are the reasons for starting aquaculture and what effect does this have on other farming systems, hence, its effectiveness? What are its effects on poverty alleviation and food security at household level?**
- ii. In-depth analysis of the economics of tilapia and catfish culture (both separately and in polyculture) needs to be conducted. Initial data shows a purchase price of fingerlings at 1-2 KSh. each and a sale price, after eight months, of 5-10 KSh per tilapia. Some farmers report the practice as just not profitable. (This could be linked to other work currently being conducted in Uganda.)
- iii. The economics of fingerling production should also be investigated. Farmers producing fingerlings on farm have little competition at present and the only market measure is the LBDA

farms, which charge 2 KSh per fingerling, but on-farm production should bring this price down.

- iv. Resource use priorities (manure, in-organic fertilisers and feeds, including rice-bran). Which resources are most limiting and why? Possible seasonality. Include labour. Survey of several sites over one or more seasons.
- v. The role of home-produced fish in the household economy. Compare this to the role of maize?
- vi. Even with inputs provided, farmers do not manage ponds effectively, why?
- vii. Why is it more difficult to promote aquaculture close to the lake? Fish are available in similar forms in markets across SW Kenya and large tilapia are generally expensive and marketed whole. It is assumed that there is the perception that fish are always available from the lake if needed.
- viii. What has been the impact of the fish export business on aquaculture potential in the region?
- ix. What is the potential for fish culture in roadside ponds? Again, technically possible, but issues of ownership and access need to be addressed. For example, one family-owned pond that was visited was open access for everyone to use the water for washing, but the fish belonged only to the family. If culture was started, the family head said she would fence the pond, thereby limiting access.
- x. What is the potential for cage culture in perennial dams? Included here because it should be technically feasible, but the socio-economic issues of using these community waterbodies need to be researched.
- xi. What is the potential of satellite lakes, e.g. Kanyaboli and Sare in the region, for cage culture? Social pressures and permissions.
- xii. Demonstration of model ponds, one in each HCA. Using selected farmers and only offering technical support, no inputs provided. Would farmers be interested, would institutions be interested?

**c. Institutional**

- i. **Aquaculture has been promoted as a commercial activity. As a new venture, farmers may have come to expect this, especially given that extension for other farming activities often involves improving traditional (already existing) farming practices to something more commercial. How could aquaculture be effectively promoted as a homestead activity and what effect would this have on sustainability?**
- ii. **Investigation of farmer dependency on LBDA or church for inputs? Is this simply a matter of how aquaculture is promoted? Is it endemic to the farming system? Will this problem disappear if aquaculture can be made profitable?**
- iii. How can we encourage DoF to be more proactive in aquaculture?
- iv. LBDA currently has significant facilities for aquaculture, including eight hatcheries, which are not fully utilised. How can these facilities be used optimally?

- v. Can an effective team be developed between all the local players? What common ground? Why are they not working together now? Institutional partnerships.
- vi. Can a fingerling trader network be developed? Either similar to those intermediary systems of Asia or possibly using existing mobile networks, like chick producers, vegetable traders, artificial insemination people.

Currently in SW Kenya

LBDA centres → directly → farmers

Asia

Hatcheries → market → fry producers /→/ fingerling producer → market → farmer  
→ market → farmer

**d. Extension/Management recommendations from observations at pond side.**

- i. **Ponds could be still-water, no need to have flowing water, in fact adds to costs as fertilisation is ineffective and feeding is more necessary. Research into social issues may be necessary.**
- ii. Most ponds are very shallow (~50cm). The depth should be increased to around one metre.
- iii. Farmers producing their own fingerlings, especially with tilapia, should be trained to select larger fish for reproduction and sell the smaller ones. They are currently doing the opposite.
- iv. DAP fertiliser could be used in ponds instead of using manure. Manure has added value on the land, where it contributes to soil structure, where DAP provide nutrients as needed in the pond. It should be more cost effective this way.

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## **Annex. Details of visit**

Monday 12<sup>th</sup> March 01 – After meeting with Professor Caleb Otieno and Dr Joseph Rasowo at Kisumu airport, the team discussed the weeks itinerary at the Sunset Hotel, Kisumu. Initial thoughts included visiting the Nile perch processing plants, roadside ponds, small-holder ponds and women's group ponds. These visits would cover an area of diverse topography and varying communication limitations. Some background was given, briefly, to highlight the change in availability of fish in the local area over the last couple of decades. Fish used to be very readily available cheaply to the local people, but now with the processing of Nile perch and Nile tilapia for export markets there are very few large fish available locally.

Those that are, now fetch a price equivalent to or higher than red meat – taking them beyond the purchasing capacity of most local people. The purchasing power of local population has been greatly compromised in recent years because of increasing unemployment due to the closure of many local industries. The main fish that people consume now are 'omena'. However, at a more local level, any fish that are produced from aquaculture ponds are sold very readily at the pond side. There is usually a scramble for these fish.

In comparison to animal production in the local area, fish are harder to produce because of the lack of education and resources in this field. Animal production has been greatly improved in recent years since the introduction of artificial insemination. For tilapia production there has been some limited training by organisations involved in aquaculture extension to teach people to hand sex tilapia.

The author enquired about local literacy levels, which are reported as being high. Although not one hundred percent, evidence during field visits confirmed that literacy is high and many people (mostly males) can speak fluent English as well as their local language.

Both local team members are from the Lake Victoria basin area of Kenya.

Visit to Nile perch carcass processing site in Kisumu - Obunga Mbuta Women's group. (Mbuta=Nile perch)

There are several of these sites around Kisumu and close to other processing plants outside the town. Essentially, the waste from the Nile perch processing plants is sold to local groups to be further processed for local consumption. The waste consists of the carcass, the skin and any excess fats and waste tissue. Occasionally there are small pieces of flesh to be found amongst a pile of bones.

The process starts with the full separation of all parts of the carcass; the skeletons and skin are sun-dried separately for a few hours; the fat is boiled down; and any morsels of meat are closely guarded as they too dry in the sun. After drying in the sun, the skins are used as fuel for the fire to melt the fats to boil the skeletons in. The deep-fried finished product is sold at local markets for five to ten shillings a piece. The original carcasses cost two shillings a piece. At the site that the team visited, men did the carcass separation, the drying was overseen by women and men, whilst the frying and marketing of the skeletons were done solely by women.

Nowadays these carcasses are all that people can afford. The irony is that when the Nile perch boom came to Kisumu, the locals would not eat the fish because they considered it inferior in taste and quality to tilapia.

Visit to Alenda Fish Market, Kisumu

This is the main fish market away from the lake in Kisumu. On the afternoon that we visited there was a small supply of fish for sale, mostly tilapia. All vendors were women, mostly middle-aged and over. One of the women was cutting her tilapia into steaks. These fish had been sold to a local restaurant and this was a service she was providing to them. Normally tilapia are always sold whole. Catfish and lungfish are sold in steaks.

Visit to roadside ponds along Nairobi Road

Pond 1 Kouyas Pond

About 0.4 ha, about 50% overgrown with rushes. The man who approached us on the side of the road appeared to be slightly intoxicated, but told us that the pond was his family pond, which he fishes with his brother and uncles. He was not completely clear on the management regime for the pond, but claimed that the pond is fished every three to four months, with the fish being sold in Kisumu. Apparently the pond is stocked with tilapia from the lake, which are bought from fishermen.

Pond 2 A small, shallow pond half fenced off. Shy woman with children could not answer our questions. She was washing clothes and pans in the water.

#### Pond 3 Masogo Market

This is a cluster of six houses set out towards the back of plot about 0.3ha. The pond, actually more of a broadened river, is about 0.2ha in area and very full of reeds. Although the land and river belong to one family, there are no current restrictions imposed on who can fish there. The family has limited farming activity, but does have a mill on the roadside that they use to earn money from milling services. The daughter of the family speaks some English. They expressed a preference for fish over chicken and like to eat it fried. They have no idea how to farm fish.

#### Pond 4 Ahero/Kisii Junction

A pond of about 0.6ha, largely weed free and very open access. The pond is owned by one family, but the local community has access to the water for washing purposes. Any fish caught belong to the family. Fishing is conducted every 4-5 months. Fish are sold in Ahero. Some fish are eaten fresh, others are preserved (smoked and dried). Fish are bought at times when there are none available from the pond. The family who owns the pond also has other farming activities. When asked about what changes culturing fish in the pond would make, the grandmother of the owning family said that the pond would have to be fenced and patrolled, although local people would still have access to the water through a gate.

Tuesday 13<sup>th</sup> March 01 – Meeting with Acting Assistant Director of Fisheries, Western and Nyanza, Okumu Makogola. Also present through the meeting was Aggrey Ogola (Fisheries Officer) and Jacob Odhianbo (Statistician). The ADF explained their role in monitoring, rather than promoting fisheries activities, and highlighted that statistics are only collected for catches of Nile perch and larger tilapia from the lake. Some background information was given in general to state that people eat pond fish more away from the lake, although they are considered less tasty. The state of the statistics is poor. None of the last two year's information has been worked up. As well as implications for fisheries management, this also means that current government information on the state of aquaculture is negligible.

There are six Nile perch processing plants in Kisumu and one in Bungoma (South Nyanza). Main markets are EU, Israel, Japan, Singapore and USA. Lesser markets are Egypt and UAE. The EU pays the highest prices, but bans come and go. The last ban was very significant and nearly closed some factories. (Other factories/industries in Kisumu have also closed recently – causing unemployment to rocket locally.) Nile perch that are landed are all weighed, but other species are only estimated. Traditional smoking and drying is still practised, especially for *omena*, but the practice has dwindled. As a result of the government's 'eat more fish' promotional policy, more people do eat fish, but there are not enough locally to meet demand. Aquaculture has failed in the local area because i/ the techniques were not good ii/ environmental issues iii/ returns not high enough iv/ feeding and monitoring is poor. In Western province, proximity to the lake limits enthusiasm for aquaculture. There are some technical problems with fry production (although they could not be identified here), but also there is a catch 22 with regard to supply and demand. Extension from DoF is a technical package, not credit. *Moi has an extension package with DoF to assist farmers.* Suggestions for increasing fish production included using location dams and community organisations to culture fish.

Statistics will be provided to Dr Rasowo by Jacob Odhianbo (Fishery Statistics Officer) before the end of March. Aquaculture statistics are not very consistently collected at present, although there is a new



proforma for officers to collect statistics on that should be use from now on. Latest fishery statistics (1999) from the Kenyan part of Lake Victoria are

	Weight (mt)	Value (Million KSh)
Nile Perch	115000	5 250
Omena	40000	706
Nile Tilapia	23700	643
Other tilapia	20000	553
Haplochromis	527	10

Planned meeting with KMFRI was cancelled as director was not available.

Meeting with Pamela Achieng, Fisheries Specialist, Lake Basin Development Authority (LBDA). LBDA was originally funded by UNDP, FAO and Belgian Survival Fund.

Ms Achieng explained that LBDA conducts aquaculture in 11 areas, known as HCAs (High Concentration Areas). Originally LBDA covered large parts of Nyanza, Western and Rift, but this was found to be very costly and not very effective, so the HCA areas were adopted. Each HCA has a radius of about 15-20km from a LBDA fish farm and covers around 3-400 aquaculturists. There are four officers per HCA (n.b. this is the picture from 1999, now there is only one officer per HCA and resources are severely lacking). Each farmer was/is visited once per month.

She had a general feeling that aquaculture was stronger further from the lake, but that people generally think that pond fish are not as sweet as those from the lake.

Major constraints to aquaculture development limited availability of/access to fish feeds of suitable quality and cost (especially for catfish) and low market price for the fish compared to production costs. Farmers prioritise their crops in order of importance, from maize, through coffee and tea to fish (it may be the perception that fish are always available from the lake should you be desperate that gives them this low status).

Most production is tilapia, although catfish are also cultured. Some people will not eat fish without scales, although in Aldai (in Nandi district) they have been culturing only catfish since 1994. To encourage people to culture catfish, LBDA introduced a range of cooking methods for the fish.

Most ponds are owned by individuals, although there are group ponds too. These groups work well in general, but wrangles can occur, especially at harvest time.

Farmers were trained using the training and visit programme. Each farmer would attend a training at the training centre at least once per quarter. Field days to other farmers were held once per month. Farmers would then be expected to train other farmers (without reward). Their training would be checked upon by extension agents.

If the range of species cultured were to be diversified, one strong candidate would be the egg fish (Labeo?). It is riverine and endangered, but has always fetched a high price.

Diversification could also include trout in Rift Valley. Hotels cannot buy enough trout at present. There are issues with the high protein feed requirements though. The cold may have impacts on tilapia farming in the highlands. People start tilapia farming because of market demand, but growth is too slow in the cold.

There is a significant demand by fishers on Lake Victoria for catfish fingerlings for bait to catch Nile perch. Farmers have problems with fecundity/survival of fingerlings – hence fishers buy fingerlings from LBDA farms (@ 2 KSh per piece).

District	Topography	Landholding	LBDA fish farm
Migori (South Nyanza)	Lake to hills	Small to medium	Rongo (9 ponds)
Kisumu	Lake to hills	Small in hills	Kibos (15 ponds)
Bungoma	Undulating	Large	Chwele

Busia	Undulating	Small	Alupe
Siaya	Undulating	Small to medium	Yala
Kisii	Hilly, many streams	Small	Borabu
Rangwe (South Nyanza)	Lake to hills	Small to medium	Kokwanyo
Kakamega	Hilly, streams, poor soil	Small	Lugari
Nandi	Rolling hills, rivers	Large	-
Uasin gishu	Hills	Medium to large	-

Table 1. Typical land pattern in LBDA area.

Afternoon visit to Kibos fingerling production farm, Nyahera, Kisumu (now managed by Mr Michael Spoo, formerly an extension office in the area). Dr Josef Rasowo currently has a student researching different spawning substrates for catfish at this station. Moi University has assisted in the rehabilitation of this site in recent months through the fixing of the borehole pump. It had been closed because of technical (water) problems and a lack of funds to maintain the systems since the withdrawal of the 15year funding from UNDP and Belgium. Since the withdrawal of foreign aid the capacity of the hatcheries to produce fingerlings has decreased and staff are no longer able to visit the farmers to extend the aquaculture message because there are no funds for them to do so. Mr Spoo accompanied us to the farms for that afternoon's visits.

Visit to ponds near Nyahera fish farm, Kisumu

Spoke to one pond owner called Jacob Ogony, who dug a pond close to a good spring water source. The pond is now overgrown. He originally dug it after seeing a neighbour's pond, but he did not stock it because he was waiting for a group to come and sponsor his fish farming. He now grows napier grass for sale to cattle owners instead.

There is another pond in this small area that is also overgrown. The pond belongs to a policeman, although the land is disputed. Someone was employed to maintain the pond, but they had a no experience.

A third pond in this area, also now overgrown, belongs to Wilkista Omollo. She received training from the Catholic Diocese and practised aquaculture for one year. However, the pond dried up because it was in the wrong location (no spring here). She farms the land surrounding the pond and grows maize and potatoes.

The people present know of three other ponds in the area where fish are cultured and they go to those ponds to buy fish directly on the pondside.

Visit to Kisumu Archdiocese Fish Farmers Association

We were introduced to Walter Umbeo, who is the secretary of the association. He has a very diversified land holding of about 2 ha. He has about one ha of maize, 0.5 ha of coffee, some chickens and some cows, as well as two ponds covering about 0.1 ha each.

The KAFFA consists of 21 members, who have a total of 52 ponds along the bottom of the valley. KAFFA was started by the Archdiocese in 199/7. Initially about 30 farmers were involved, but some of the ponds dried out. All ponds in the valley operate on a flow-through system, either spring or river-fed. One problem identified by the farmers is the transportation of fingerlings without the assistance of the church or LBDA. There are problems with birds, turtles and snakes. No hook fishing is practised by the owners because this might encourage poaching. All fish are netted from the pond.

Sales from ponds in the valley takes place mainly at the pondside, with the excess being sold at the local

market.

Some indicative costs given by the groups were:

Fingerlings: 1.50 KSh each

Chicken manure: 150 KSh per sack (c.20kg?)

2kg tilapia, in the market: 150 KSh each

Tin (?) of fish bits: 10 KSh

It is interesting note from the information below that most of the land owners in this valley have other salaried employment – they do not live off the land.

Amfrey Ambora is a local teacher with a pond on his land. He grows maize and beans on the rest of land, this being what the pond land was also previously used for. Banana trees grow on the pond levees. He feeds his fish once per day, after returning from school, using chicken manure. He uses this time to observe his fish.

Joel Aduma – the group's coordinator and initiator is Inspector of Schools. Fish farming appears in the primary syllabus and he thought it would be a good idea for children to practise this firsthand. In 1995 LBDA stocked his school pond.

We visited a new school pond in this valley.

Naftali Ayieko is vice-chairman of the group. He has four ponds. One, the original one was built in 1998 and is situated slightly above the other three, which were constructed in 1999 from land that used to be swamp. The levees of each pond support a crop of bananas. He also grows maize. The upper pond can dry out and is used as a nursery. He supplies fingerlings to others in the valley. He is now retired, but used to be a government worker.

By taking on aquaculture, these not-so-poor farmers also open themselves up for many other benefits and assistance from the Archdiocese. The support has been good, while it lasted, but was never sustainable. There are technical issues in pond design, the farmer-identified problems of fingerling transportation and feed issues. Other issues are understanding why farmers are starting aquaculture and critically assessing how aquaculture has been promoted (as a commercial enterprise, rather than homestead activity)? On the farmer fingerling production side, issues of broodstock selection, the sale of good fingerlings and the maintenance of quality broodstock all need to be assessed. The ponds were all well maintained here, but it is the general opinion of the team that they had been renovated and cleaned out due to our visit.

Wednesday 14<sup>th</sup> March 01 – Visits to fish farmers in the Yala area of Siaya district.

Firstly a brief visit to Yala fish farm. Met with Mr Ngala who is the LBDA extension officer now running this farm. He assisted us with all our visits today.

First farm visit to Mr Joseph Agina Odheck, Onjala Tree Nursery, Yala

He has seven ponds situated in the bottom of the valley, below his farm land of 12 acres. His main crops are maize and beans and bananas. He generates some income from his tree nursery and has one cow and one goat. (At this point it should be noted that farm yard chickens are typically not mentioned by farmers – both male and female – because they are endemic to the rural situation. Farmers only mentioned chickens when they were a cash crop in significant numbers.)

He started farming fish in 1982 – following learning from Peace Corps. He stopped four years ago, but is just starting again, using tilapia from old fish that remained in the ponds. The ponds appear to have been cleaned specially for our visit, although this is a very idyllic setting. Clearing and maintenance are seen as problems by this man. The ponds are river-fed and some erosion of the pond bunds takes place due to the proximity to the flow. The ponds have never dried or flooded. The farmer would like to use a spring source for some of the ponds. Other problems are feeds and fingerling supply. Feeds include mill sweepings, but these too are very expensive.

His family eats fish and meat, which are obtained from the local market when not grown on-farm. Fish from the pond are eaten at home, with harvesting on a 2-3 month cycle. Those not eaten immediately are dried or smoked. Fish in the market are now mostly preserved, rather than fresh. There used to be fewer

people eating fish. Species that have disappeared from the market include labeo, and babas. Also not so much fresh clarius, tilapia, Nile perch or lungfish.

At the peak of farming in Yala there were 21 people practising aquaculture, but that was only because they were expecting handouts. There are only two now.

Mr Nyamas has 2.8 ha. He farms maize, yams, vegetables and bananas. He had one beehive and some coffee, but both of those are now abandoned. His ponds are now completely overgrown and barely recognisable as ponds. His parents had one pond on the land, which they maintained only for household consumption. They had no significant support. It is not clear when Peace Corps support started in relation to his family history, but he reports that PC would bring fingerlings, even from the lake. Although their enthusiasm was good, PC were limited. Lake Basin has a lot of knowledge and it was with their support and encouragement that he start a second pond. Both of the ponds are spring fed, although there is a river in this valley too. The ponds were not productive enough. Fish farming needs a lot of investment, but does not give much return. Low production and problems of division of labour with other farming activities mean that it will only work if you have a lot of ponds. When questioned if he would start again if he had more ponds he said that it might work, but someone would have to come and dig the ponds for him. He has lost his second son (due to AIDS), hence lost more labour. If the ponds come from a government project and people are aware of that they are very secure, no one would poach or damage those ponds. His family fish consumption is now 'omena' from the local market. If he reinstated the homestead pond, maybe he could get enough fish for his family (like his parents did). When he was culturing fish he fed them on household feed waste.

Young woman from Ayora Farm and brick factory, Siaya.

As a whole, her family farms a consecutive 8 acres, although she has 1.5 acres of that herself. The family farms maize, has a small tea plantation (0.2 ha) and a lot napier grass for cows. Animals on the farm are one cow, eight goats, eight sheep and 23 chickens (although the chickens, being endemic, were not mentioned without prompting). On the edge of the plot one of the brothers is excavating his plot of land (about one hectare) to make bricks.

The young woman has three ponds on her land. One was built in 1986/7 and two more in 1994. Of the three ponds, one is now not used because it cannot be drained. All are spring fed, but two can be drained to catch fish. The other two have been neglected, although they were cleared for some stocking in January 2001. However, one remains empty and the other only contains 28 fish. This is due to a misunderstanding when the man was coming to stock the pond – the young woman thought that she was getting the fingerlings for free, but when the man arrived and demanded payment, all she could afford were 28 fish.

When they were in full use, she grew catfish and tilapia. She has limited knowledge because of her age and her siblings are in a similar situation. None of the knowledge has been successfully transferred through the generations – there is a definite need for some retraining here. The ponds are not fertilised and any feeding (which is very minimal) is potato peelings and rice bran. Sales of fish used to take place at the pondside, no need to take to market. However, nowadays she eats some Omena obtained from the market. She likes tilapia, but cannot afford the market prices.

Mrs Wanjiku Ahenda, Kasigunga Women Group, Kasigunga, Siaya.

This all-female group, which has 25 members and was established in 1983, has two substantial ponds on land belonging to Mrs Ahenda's husband. The ponds are about 0.1 ha each, with the upper flowing into the lower. Both catfish and tilapia are cultured, although they try to confine catfish to the lower pond, which is currently quite overgrown. Partial harvesting is done with a net hired from fishers in Siaya, but total harvesting requires that the dykes are cut to drain the pond. Cutting the dykes is preferable to installing pipes because anyone can come along and open pipes easily, whereas wall cutting takes time and effort. Harvesting requires the assistance of men and the women get round this by involving their

sons. All fish are sold on the pond side. Fingerlings are brought to the sight by Kisumu diocese. Predators include turtles, snakes and birds. The group does employ someone to guard the ponds. She does like clarias, but could not imagine eating anything else from the pond apart from fish. As well as fish farming, the group manufacture fuel saving cooking stoves. Other on-farm protein sources are poultry, pigs, dairy and goats. Fish available in the market are catfish, tilapia, lungfish and omena. Omena is the main fish available these days. There was much more fish available 20 years ago.

Alex Milonga Nyawalo's mother, Siaya

The first pond was built in mid 80s. Of the one hectare of cultivated land about one third is ponds and two thirds is fields. There are three ponds, generally square in shape, all of a similar size. The surroundings are quite overgrown, but the ponds are clear of vegetation and well maintained and stocked. The cultivated land has maize, tomatoes and bananas on it. There is also a small tree nursery. The family (Alex and his mother) has three cows. Alex is a fulltime farmer and is currently at market. His main fish crop is tilapia, although his mother thinks that there may be some clarias in the upper pond. He sells his fish mostly on the pond side, although some go to market. As feed, he brings rice bran from a rice project, quite some distance away. He does not have his own nets, he can use the limited stock of nets that the DOF has. Nowadays in the market you can buy omena, Nile perch carcass and dried tilapia. 20 years ago you could easily buy fish, it was cheap and there were many types, including babus and labeo. There were fewer things like clarias and lungfish around then too. There are problems at the moment with poor crop harvest due to unpredictable rains.

Mrs Anne Opieno, Koyeyo Family group, Siaya Agulu School.

The ponds are within a barbed wire fencing complex, but are very run down. The area has been burned in places recently and there is a strong smell of burnt soil minerals in the area. As you enter, there is a concrete monk with the date 1980 stamped into it. When they were built these ponds were quite expensive. This 0.5 ha plot, which is about one fifth of the families total land holding is about 500m from the house. At the upper end is a spring and the lower end runs into a river. At some point between 1980 and 1995, when the family started fish culture again, the ponds were abandoned. In 1998 there was a flooding problem and the family was discouraged once again from continuing. The only fish that they cultured were tilapia, which were sold on the pond side or in the local area for between 85 and 150 KSh per kilo. Other crops on the farm include maize, millet and casava, with maize and vegetables being grown close to the pond. The net for catching fish is hired in Siaya. The only fish they eat now are omena. Fingerlings to stock the pond came from Yala fish farm. She said that she could not compare aquaculture to other activities because it was so different.

From here we travelled to one of the northern landing beaches on Lake Victoria. On the way we passed various waterbodies, including location dams, which are home/village use waterbodies. There is one in most villages in this area. They are perennial and are used for domestic water and animal watering holes. They may have potential for aquaculture on a community or group basis?

We passed Yala Swamp, which is now a huge government-owned farm that is supposed to be run by LBDA. It used to be a delta for Yala river (and one other), before they emptied into Lake Victoria. It was drained by a Dutch project. The farm is not operational at present because of monetary problems within the government system. Orange trees sit idle, laden with fruit that no one dare pick because it is government property. I do not know that anyone has study the impact of draining this wetland, but the whole thing is a sorry mess at the moment – neither a useful wild habitat nor a productive agricultural one. The farm was run by LBDA on a commercial basis, rather than having to return profits to the government each year and re-apply for further money for inputs, it could provide enough income to support a successful extension system to the surrounding areas.

Finally we passed Kanyaboli Lake, a small lake close to Lake Victoria, before reaching Uhanya Landing site as the sun was setting. At this 'beach' there are actually two landing sites – one private and one

government. They are both run by cooperatives. The private landing stage is actually on the shore, the government station is about 50 metres up the 'beach'. Only Nile perch are transported to the government weighing station by women running a stream of wheelbarrows back and forth to the water's edge. For each full barrow of fish, the women receive 10 KSh. There were some fish being loaded straight into the back of a truck from the shore – bypassing the government station. We were ushered away from this sight, although once we had gained a little bit of confidence from one man on the beach he explained that these were secondary landings from Uganda.

A brief comparison of tilapia and broiler production systems demonstrates the economic reasons why people will not invest in feed and fertiliser for tilapia ponds.

	Broiler		Tilapia	
Juvenile	One-day-old chick =	45 KSh	Fingerling =	1 KSh
Market size	6 month chicken =	250 KSh	6 month fish =	5 KSh
Profit per piece		205		4

#### Thursday 15<sup>th</sup> March 01 – Beach visits

Achuodo Beach. There are 22 boats here, belonging to 17 owners, who are all local. This is quite a small beach, but has a beach master (Johanna Olwery - male) who is obliged to keep records for the government. During our time at the beach two boats came in; one had one large Nile perch on-board and the other two two-kilo tilapia, but that was all from one night's fishing.

George Odiambo Oningu is a fisher. He has some land on which he grows vegetables, but otherwise goes fishing 3-4 times a week. The boat goes out in shifts, with six people working each shift. The boat's owner lives in Kisumu.

Richard Anyango Mboya is the man who has caught just two tilapia today. He uses gillnets. He has been a fisherman for three years. He is the boat owner and also owns some land on which he grows maize, casava and millet. The boat sometimes provides the daily bread. He employs three other men who work the land or the boat. He used to be a watch repairer, but fishing is better.

Kenedy Ochieng Obuya has also been a boat owner for three years. He has some land, where he grows ground nuts too. He is a hook fisherman and only fishes during the day because of risk of hook injury working at night. He normally catches only Nile perch, with just a catch of 3 last time, from 300 hooks. (although I suspect not all were baited) The hooks are baited with live mudfish that cost 3 KSh each. He has tried omena and tilapia fry, but he has better catches with the mudfish.

Michael Ochou is a fisher and boat repairer. I asked him about changes in catches over the years. Years back the species were: tilapia; mumi, camongo; sire; omena; dera and okoko. Now Mbuta; ngege; mumi; camongo and omena.

Kendu beach. The actual landing are here is quite small and not very trampled. The cluster of houses spreads perpendicular to the beach towards the town. The drying nets for omena are stretched out in a similar fashion. Elija Omolo, Silvanus Metho and Michael Otieno are fishermen are this beach. They fish in separate boats. All speak English. One of them was fishing yesterday and the other two the day before. The boats go out everyday with shift crews on them – with each man going out 3 times per week. Omena and tilapia are the main species caught at this beach, although Nile perch, mudfish and black mamba are landed too. Two of the men are local, but Michael Otieno is from the other side of the lake (Asembo Bay), but moved here two years ago because he heard that there were more types of fish here. There is only omena on the other side. Otieno is now in late 20s and unmarried. The other two are in their early 20s and married. The wife of one runs a small household products still along the beach. Their pay is dependant upon catch. Once expenses have been deducted half the profit goes to the owner and

half to the crew. The crew divide the money equally.

As soon as boat comes into land, there are several women ready to take the fish from the men. Generally the women take fish from the same boats, often from a relative. There are sixty women at Kendu beach who do this work and they all sell to traders (women) who come to the beach and take fish away on a commission basis. Today, one trader has 30 small to medium tilapia. No mudfish so far. All the families on the beach eat fish most days, with their main preference being for tilapia.

Whilst we were at the beach Mrs Salomi Onyango from KMFRI arrived – she lives and works at Kendu beach to monitor fish catches. She took us to Obaria and Kamollo beach.

Obaria and Kamollo beach.

Mr Samson Omita, who has been a fisherman (boat owner) for four years and owns a shop, explained the two fishing methods used on his boats. He uses gill nets of two, three and seven inch mesh size that are left out overnight, usually having been laid in the morning. He also uses hooks baited with mudfish. He has tried other species, including omena and tilapia, but they are not as effective. The supply of mudfish is decreasing.

Roy Odongo – the son of a local boat owner – and Morris Aluko – the beach secretary - explained that there are between three and four hundred boats operating from this beach. Ownership averages about 3, although it ranges from 1-10.

Justus Osumbo owns two boats fishing with lines only. His crew are salaried. His main catches are Nile perch and tilapia.

A very shy woman drying omena on one the nets stretched endlessly along the beach explains that she buys her catch from any boat landing. She has been drying fish for 4-5 years. She is from the local village and this is her only. Storms and undercurrents do affect the availability of omena.

We visited a significant rice milling operation. The rice bran from this mill is sold to local farmers for feeding to pigs and chickens. Moi University has tried to encourage a new business to start marketing rice bran from the mill to fish farmers. However, the business is now closed. There are likely to be two main reasons for this; firstly because farmers would buy direct from the rice mill, which was close by and; secondly the number of fish farmers in the area has declined significantly in recent times. There would be more requirement to look at using the existing structures to market more effectively/suitably to fish farmers rather than starting new businesses.

Friday 16<sup>th</sup> March 01 – from Kisumu to Eldoret, via Kakamega

Mr Wilson Okelo Palo and his son Daniel have four spring-fed ponds. Wilson started farming fish 1992 and farmed continuously until January this year, when his ponds dried up. He was a model farmer for LBDA and his visitors' book is reference to this. Banana trees are growing on the land immediately around the spring. Just below the ponds (as you move down slope) is a cabbage nursery showing the remnants of some plants. The nursery is also no longer practical as the spring has dried up. The family consists of seven brothers, but only three remain at home – the others are in cities. As well as fish, the family has seven cows, some local chickens and grows maize and finger millet. In order to start again, the ponds would have to refill over several seasons to be confident. He would try new species and would need more information on fingerling production and broodstock management. Tilapia, in the end, did not grow so big. He was given food for the fish by LBDA and the fingerlings came from Rongo fish farm (at 2KSh per piece). They also partial harvest using a net that also comes from Rongo. It was mentioned that omena cost 300-400 KSh for a tin.

Other neighbours' ponds have also dried up, although other finished because they were not getting

enough financial returns or because of old age and no family to take over. Others also stopped because LBDA stopped visiting. Nogaro group received a donation from a visitor to buy a pump to provide water for the drying ponds, but there was a squabble about this and production ceased.

Assistance from Kennedy Bolingu, LBDA extensionist in Kima area

Visit to Omasaba farm

This is a two-wife farm. We were able to talk to the younger wife, who has responsibility for the day to day management of the fish ponds, although her husband takes control of selling any products. The ponds in general appear well maintained (she did not know that we would visit). There are two tilapia production ponds and three catfish fingerling production raceways (currently overgrown).

She says that she feeds the fish twice per day, morning and night, on maize bran from poshomills. On the farm there are two goats, one cow and some sheep that are her responsibility. There are other cows with the husbands other wife. Local chickens are evident, but again not mentioned. Her main tasks are looking after the animals and households chores, although she is also a tailor and maintains a small tea plantation. Harvesting of the fish ponds is done both by net and by draining. After harvesting it is the husband who decides how profits are shared and even though she is the wife who looks after the fish, the elder wife may receive more of the money. As well as table fish, the family sells tilapia fingerlings. They sell the larger fingerlings and maintain the smaller ones.

Management problems include predation, with lizards coming from the papyrus to prey on chicks. They may also take some fish.

Fish consumption is mostly omena, on average twice per week.

There are more than 10 people in the local area farming fish, but not all of them buy fingerlings here.

She knows about chemical fertiliser use and the importance of green water for fish feed. If she had limited fertiliser (both chemical and manure) on farm she would prioritise use as follows; 1. maize, 2. Pond, 3. Tea, 4. Bananas (growing in maize field here), and 5. napier grass.