size with a certain probability. It can also be applied afterwards, when the null hypothesis is not rejected, to find out how likely it was to be rejected (*a priori* and *a posteriori* power analysis, respectively, see Peterman 1990).

It seems that we are all very anxious to avoid concluding that there is a treatment effect when it is not true (avoid Type I errors) but we don't mind accepting a null hypothesis that is not true (making Type II errors). As the null hypothesis often represents the existing situation, this lack of 'power awareness' can easily lead to frustrated researchers, stagnating research and ineffective data analysis. Alternatively, we could look for techniques that utilize the variability rather than try to minimize it in a classical experimental design. The effect of treatments on all trophic levels in ponds could be measured and analyzed using multivariate statistical techniques. In this way, the variability would be reduced systematically, rather than assumed-to-be-absent-but-still-present, as it is in many experiments. Another possibility is to lump data from separate experiments together and analyze the resulting dataset as a whole. Although separate ANOVA's for individual experiments may not detect any treatment effects, multiple regression models can uncover many significant relationships between variables (van Dam 1990; Prein 1985).

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Africa Section

Farmers' Attitudes in Malawi to the Use of Excreta in Fish Farming

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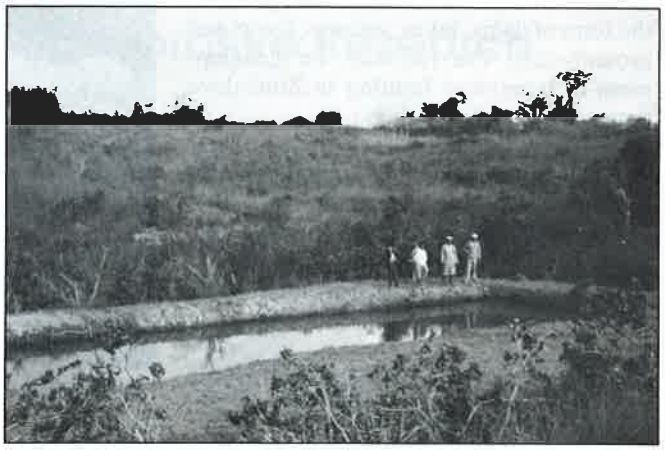
Introduction

Fish farming is becoming increasingly popular among smallholder farmers in Central Malawi, particularly in Dedza and Lilongwe Districts, as a source not only of much needed high quality protein, but also of cash income. A collaborative project between the Malawi Department of Fisheries, the University of Malawi and ICLARM, financed by the German Agency for Technical Cooperation (GTZ), is seeking to encourage farmers to use locally available fishpond inputs. One possibility is to use livestock or human excreta. This depends, however, on the acceptability of the practice by farmers and the produce by consumers. These are influenced by attitudes, beliefs and risk perceptions.

To identify the main impediments to acceptability of fish raised in excreta-fed ponds by smallholder farmers and to suggest ways of encouraging excreta use in fish farming, a survey of 112 fish farmers and non-fish farmers was conducted in late 1988. The team also used published and unpublished documents and held discussions with Ministry of Agriculture (MOA) staff to supplement this information.

Fish farming is very new in Central Malawi. It was first introduced in Dedza Hills in 1986, and in Lilongwe Northeast in 1987. At the beginning of the study, there were 107 fish farmers in Dedza Hills and 16 in Lilongwe Northeast with a total of 134 ponds. However, only about 40% were stocked. Tilapias, locally called chambo (*Oreochromis shiranus chilwae* or *Tilapia rendalli*) are the main species stocked. Others are mlamba (*Clarias gariepinus*), ntchila (*Labeo mesops*) and mbamba (*Haplochromis* spp).



Students of the Bunda College of Agriculture, Malawi looking at a typical fish pond in Dedza Hills. Most of the farmers use livestock wastes in fish farming. (Photo by J.S. Likongwe)
Etudiants du Bunda College of Agriculture, Malawi, au bord d'un étang d'élevage caractéristique de la région de Dedza Hills. La plupart des éleveurs emploient des excréments d'animaux (Cliché: J.S. Likongwe)

Use of Livestock Excreta

Two-thirds of all the respondents and 84% of the fish farmers were aware that livestock excreta could be used in fish farming. In fact, nearly 80% of all practising fish farmers used livestock excreta in their ponds. The remainder were unaware that livestock excreta could be used in fish farming or had no source of livestock excreta.

More than 90% of the respondents said they would eat fish raised on cattle, goat, poultry or sheep excreta, and two-thirds would accept fish raised on pig excreta. The main reasons for rejecting fish raised on livestock excreta were: religious grounds, (by Moslems, Seventh Day Adventists and Zionists); perceived disease risks; belief that excreta use in ponds is dirty; and reluctance based on lack of experience or knowledge that fish can be raised this way.

Seventy per cent of all the survey respondents believed that fish from excreta-fed ponds require a period in clean water before being safe or fit to eat, but nearly all said they would believe a trained scientist who told them that livestock excreta-fed fish are safe to eat and would themselves start raising or eating fish from livestock excreta-fed ponds.

Attitudes to Use of Human Excreta

Nearly all respondents had never heard of human excreta being used in fish farming, and only 9% said that they would accept such fish. Disease risk was the main reason, followed by the perception that eating such fish is dirty or unclean. Other reasons for rejection were bad smells and association with witchcraft or cannibalism. They argued that, unlike livestock, human beings are normally not eaten, and eating fish from ponds that had received human excreta would be equivalent to eating human flesh.

Consequently, the use of human excreta in fish farming is unlikely to be successful in Central Malawi. However, some farmers could perhaps be encouraged to use human excreta, if the excreta were processed to look different and the farmers were assured that there were no disease risks.

Recommendations

Farmers' beliefs and attitudes are the main impediments to acceptability of fish raised on excreta. In this case religious beliefs were an impediment only in the case of pig excreta. However, the farmers' very limited knowledge about fish farming and its potential creates a situation not conducive to changing any negative attitudes or beliefs.

The following recommendations are made to promote use of excreta in fish farming by such smallholder farmers:

- Emphasize Livestock-Fish Integrated Systems
  Fish raised on livestock excreta are likely to be accepted by the majority of farmers.

- Studies on Public Health Aspects
  Studies are needed to confirm whether or not fish raised on excreta are safe for human consumption. An assurance of safety is more important for the use of human excreta.

- Improve Awareness of Fish Farming
  The negative beliefs and attitudes towards eating fish raised on excreta could partly be changed by improving awareness of fish farming and extension.

Integrated Farming in Zimbabwe

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Integration of aquaculture with agriculture (integrated farming) provides balanced food production, increases farmers' income, recycles nutrients, protects the environment and optimizes food production where resources are limited. Zimbabwe is a landlocked country with abundant resources in the form of dams, lakes, streams, rivers and groundwater. The rationale for development of integrated farming in Zimbabwe depends on the following:

1. The livestock and crop sectors are well-developed and their byproducts (crop residues, vegetation and manure) can become fishpond inputs. Poultry-fish and vegetable-fish integration seem the most promising.

2. Swampy lands not used for agriculture can be sites for fishpond development associated with tree planting. Vegetables can also be grown on the pond dikes.

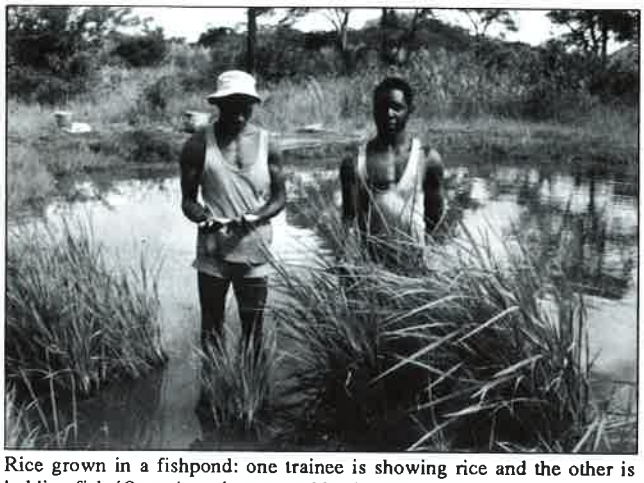
3. About 70% of Zimbabwe's population are rural inhabitants, where water is in great demand for multiple uses. Fishponds can supply water for livestock, vegetables and fire fighting.

Rape (*Brassica napus*) grown around the periphery of a pond uses mud and water from the pond.
Colza (*Brassica napus*) poussant au pourtour d'un étang grâce à la vase et à l'eau provenant de l'étang.

4. Dams not purposely built for aquaculture can be stocked with fish to feed on natural production of plankton, macrophytes and benthos, thereby supplying protein and fish for sale. Larger dams and lakes may have scope for cage and pen aquaculture that could utilize local resources and labor.

5. Rice is becoming an important, though expensive, item of food in Zimbabwe and is being grown in some isolated areas. Rice-fish integrated farming could be important for future research and extension.

6. Irrigation projects that serve communal areas have scope for integration with aquaculture; fishponds can be constructed in communal areas and irrigation canals stocked with herbivorous fish to control aquatic weeds and assist water flow.



Rice grown in a fishpond: one trainee is showing rice and the other is holding fish (*Oreochromis mossambicus*) caught from the pond.
Riz poussant dans un étang: un stagiaire montre le riz et un autre exhibe un poisson (*Oreochromis mossambicus*) pris dans l'étang.

Realizing the potential of aquaculture, the Ministry of State introduced an aquaculture training program at the Chaminuka Training Centre in 1987, associated with a two-year aquaculture training course. The objectives are:

1. To train rural youth in practical approaches to aquaculture;
2. To apply agricultural skills and knowledge to integrated agriculture-aquaculture for broader based approaches to farming systems;
3. To motivate trainees for self-employment or cooperative ventures; and
4. To develop personnel trained in aquaculture appropriate to rural Zimbabwe.

Integrated farming, particularly chicken-fish, duck-fish and vegetable-fish systems, is emphasized in pursuing these training objectives.

In Zimbabwe, aquaculture has had little attention yet from the public and private sectors but could play a vital role in rural development. A sound research, training and extension program in integrated aquaculture could help the expansion of aquaculture to benefit the rural poor, who are badly in need of such an approach.

Editor's Note: It is very encouraging to see moves towards effective training and extension for the development of integrated farming in Zimbabwe. Since it always pays to learn from others' mistakes, readers should be aware that ICLARM's and its Philippine collaborators' first few years of research in training in livestock-fish integrated farming systems suffered a lot from concentrating on research activities on-campus instead of involving farmers from the outset. Consequently, extension and development efforts failed. The Farmer First principle is essential from the outset in all such efforts. Without it, research, training and extension will all fall into the trap of the outdated 'top-down', 'technology package transfer' approach - which will fail. The following reading list is suggested for those interested in farmer participation in research and training:

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Smallholder Farmers in Malawi Adopt and Improve Technologies from Collaborative Research

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Open Days for Farmers

An ICLARM-GTZ project has been pursuing collaborative research with the Fisheries Department (FD), the University of Malawi (UM) and farmers in Malawi since 1986. The research has been directed towards developing aquaculture technology applicable to rural smallholder farmers in Africa. In May 1990, some research results obtained on-station at the FD's Domasi Experimental Fish Farm near Zomba, were presented to farmers during Open Days. ICLARM and FD researchers felt it was very important that farmers should lead the participatory research process and freely modify the technologies they adopt to suit their circumstances.

The technologies demonstrated by the FD and ICLARM and the farmers' reactions were as follows:

- *Use of* Pennisetum purpureum *(napier grass) as an alternative/supplement to maize bran, the most common fish feed.*

The farmers saw that fish (*Tilapia rendalli* and *Oreochromis shiranus*) in a pond that received only grass achieved similar growth rates to those fed on maize bran. They were initially surprised, then excited. They felt that grass could be particularly useful as a pond input as maize bran is often in short supply at certain times of the year.

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