No. 1

Japan International Cooperation Agency

Republic of Malawi
Ministry of Mines, Natural Resources and Environment
Department of Fisheries

The Master Plan Study on Aquaculture Development in Malawi

Working Papers

National Aquaculture Strategic Plan (NASP) 2006-2015

July 2005

SSC **System Science Consultants Inc. Tokyo Japan**

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Master Plan Study Outputs

The outputs of “the Master Plan Study on Aquaculture Development in Malawi” consists of the following,

1. Summary (Japanese version)
2. Main Report -National Aquaculture Strategic Plan (NASP) 2006-2015-
3. ADiM Working papers
4. Aquaculture database (CD1 and 2)
5. NASP profile
6. Photograph collection

MAP OF MALAWI

Contents

Currency

Malawi kwacha = MK

Currency Equivalent

USD 1.00 = MK 113.00 (April, 2005)

MK 1.00 = USD 0.00885 (April, 2005)

Source: OANDA (2005)

Fiscal Year of Malawi

July 1 - June 30

Abbreviations and Acronyms

ADB	African Development Bank
ADiM	Master Plan Study on Aquaculture Development in Malawi
ARTDMIS	Project on Aquaculture Research and Technical Development of Malawian Indigenous Species (JICA)
CAS	Catch Assessment Survey
CNRFFP	Central and Northern Region Fish Farming Project
CPUE	Catch Per Effort Unit
DA	District Assembly
DANIDA	Danish International Development Agency
DEC	District Executive Committee
DFID	Department for International Development, U.K.
DoF	Department of Fisheries
EIA	Environmental Impact Assessment
EPA	Extension Planning Area
EU	European Union
FAO	United Nation Food and Agriculture Organization
FCR	Food Conversion Ratio
FRU	Fisheries Research Unit
GDP	Gross Domestic Product
GNI	Gross National Income
GTZ	Gesellschaft für Technische Zusammenarbeit
HIPC	Highly Indebted Poor Countries
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
ICEDA	Icelandic International Development Agency
ICLARM	International Centre for Living Aquatic Resource Management (WorldFish Center)
IFAD	International Fund for Agricultural Development
IFFNT	Innovative Fish Farmer Network Trust
JICA	Japan International Cooperation Agency
MAGFAD	Malawi-German Fisheries and Aquaculture Development Project
MASAF	Malawi Social Action Fund
MAIFS	Ministry of Agriculture, Irrigation, and Food Security
MMNRE	Ministry of Mines, Natural Resources and Environment
MSY	Maximum Sustainable Yield
mt	metric tonnes
MTF	Malawi Traditional Fisheries
MPRSP	Malawi Poverty Reduction Strategy Paper
NAC	National Aquaculture Centre
NARMAP	National Aquatic Resource Management Programme
NASP	National Aquaculture Strategic Plan
NGO	Non-governmental Organization
NORAD	Norwegian Agency for Development Cooperation
NSO	National Statistics Office
ODA	Official Development Aid / Assistance
ODA (UK)	Overseas Development Agency, U.K.
SIDA	Swedish International Development Agency
S/W	Scope of Work
TOR	Terms of Reference
UNDP	United Nations Development Programme

I INTRODUCTION

The data book consists of seven project papers. Each paper presents data and information that supports the main report in various ways.

The content of each paper is described below.

1. Capture Fisheries in Malawi and Their Contribution to National Fish Supply

   The first paper presents the current situation of capture fisheries in Malawi. The work was done in collaboration with the Department of Fisheries. It gives us an insight of overall fisheries situation by assessing historical trends in capture fishery and attempting to predict the contribution of the sector to the overall fish supply in Malawi by the year 2025. The paper has helped the JICA ADiM Study Team to re-identifies the role of aquaculture within the fisheries sector.

2. Situation Analysis of Aquaculture in Malawi

   The second paper analyses the situation of aquaculture. The work was done in collaboration with the Department of Fisheries. The paper identifies challenges and potentials for aquaculture development in Malawi which helped the JICA ADiM Study Team to generate the first draft idea for the NASP.

3. National Fish Farmer's Socio Economic Survey Report (2003)

   The third paper presents the data obtained from the national socio-economic survey on aquaculture the JICA ADiM Study Team had carried out with assistance by the Department of Fisheries in 2003. The survey is the first national survey implemented in Malawi on aquaculture. It has contributed in providing precious information for stakeholders to understand the overall aquaculture situation in Malawi as of 2003. The data was analysed and used by the JICA ADiM Study Team to generate the first draft idea for the NASP together with Working Paper No. 2.

4. Socio-economic Survey on Fish Farmer's Club in Chingale, Zomba

   The fourth paper presents data obtained from the socio-economic survey on fish farmers' club in Chingale area in Zomba District. After the formulation of the first draft idea of NASP, the JICA ADiM Study Team had implemented the Pilot Project to verify the proposed idea. One of the components of the Pilot Project sought potentiality of the farmers' club in aquaculture development. In its implementation, the socio-economic survey was carried out aiming at verification of the feasibility of the Pilot Project which is discussed in the Project Working Paper 5. At the same, the data itself provides precious information for understanding socio-economic situation of rural farmers in Malawi. This paper puts more focus on explaining the socio-economic situation of farmers as to provide a bench mark for future research or projects targeting rural farmers in Malawi.

5. Evaluation of Two Farmer's Approaches for Aquaculture Development in Malawi

   The fifth paper discusses and evaluates two farmer's approaches for aquaculture development in Malawi. The Pilot Project, aiming at the verification of the proposed NASP, was composed of two components. The first component seeks potentiality of so-called 'innovative' farmers in aquaculture development. The other component seeks potentiality of farmers' club, a group of subsistence farmers, in aquaculture development. The paper was prepared after 15 months of the Pilot Project implementation. It discusses how two approaches can be incorporated into the proposed NASP.

6. Commercial Aquaculture Development

   The sixth paper discusses on the commercial aquaculture in Malawi. Almost all aquaculture projects implemented in Malawi have targeted subsistence farmers, aquaculture as a mean to alleviate the poverty. However, for its development, we should not put aside a thought of aquaculture as a business. The paper seeks potentials and challenges of commercial aquaculture development in Malawi.

7. Literature Review on Research and Development of *Oreochromis mossambicus*

   The last paper reviews the data and information available on *Oreochromis mossambicus*. This review is undertaken in line with the recommendation at the regional workshop in Malawi in August 2004 to look into the possibility of using Mozambique tilapia in fish farming. In Malawi, exotic fish species are not allowed in fish farming because of the policy on diversification. However, people are still seeking better species on aquaculture in Malawi. *Oreochromis mossambicus*, being indigenous in Malawi, yet not widely utilised due to its geographical distribution limited to lower Shire, was therefore studied in this paper.

We are hoping data and information provided by this data book will be referred and utilised by various actors involved in the development in not only Malawi but other sub-Saharan African countries.

ADiM Working Paper 1

Capture Fisheries in Malawi and their Contribution to National Fish Supply

Prepared by

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Capture Fisheries in Malawi and their Contribution to National Fish Supply

Contents

Executive Summary

The objective of this report is to assess historic trends in the capture fishery sector and attempt to predict the contribution of this sector to the predicted overall fish supply in Malawi by the year 2025.

The main capture fisheries areas of Malawi are the four lakes, Malawi, Malombe, Chilwa and Chiuta and the upper and lower Shire River. More than 50,000 people are engaged directly in the sector as gear owners or crew members. The sector is highly diverse ranging from large stern trawls to hook and line fishing from the shore. Essentially, Malawi's capture fisheries fall into three broad categories: recreational, subsistence and commercial. Commercial fishers are either large-scale or small-scale. The large-scale fishing operations in Malawi are formal industries that represent considerable financial and technological investments and which employ specialised labour. Small-scale commercial fishers may be self-employed and/or employ outside labour to undertake the fishing operation. This sector contributes some 87% to the total fish landings and uses a highly diverse assemblage of fishing gear including beach seines, open water seines, gill -nets, fish traps and hooks.

Since 1976, the total fish yield from Lake Malawi has fluctuated between 21 and 43kt per annum.The mean yield for the period 1976 – 1999 was 31 ± 5kt. However, at species group level, changes are evident: (1) there has been a considerable decline in the tilapiine (Chambo) fishery from 8-9kt tons in the late 1970s to less than 2kt in 1999; (2) catfish landings have shown a steadily declining trend from more than 3kt in the late 1970's to less than 2kt in 1999; (3) some increase in total landings of haplochromines were apparent in the 1990's and (4) landings of usipa have been highly erratic and this stock is considered highly unpredictable and subject to environmentally driven fluctuations.

Annual catches from Lake Malombe have ranged from between 6.6kt and 12.9kt in the 1980's to less than 5kt from the early 1990's to 2001. Catches of the tilapiine species group, chambo, decreased from 9.3kt in 1982 to less than 200 tons from 1993 onwards. The decline of the chambo was concomitant to the increased harvest of small haplochromine cichlids, locally referred to as kambuzi, which, by the mid 1990's had almost completely replaced chambo in the fishery. The output of the kambuzi fishery showed large fluctuations, reaching levels of around 9.5kt in 1987 and 1990 but dropping to a level of below 4kt since the mid 1990's.

Annual catches from Lake Chilwa have ranged from about 1kt and 24kt. Due to the effect of the hydrological cycle on the fisheries potential of Lake Chilwa, no increase in production can be guaranteed and the average yield from this water body since 1976 was in the region of 10kt.

Estimated catches from Lake Chiuta ranged from some 700 tons to 5000 tons with an average of 2000 tons. Although wide fluctuations are evident, there appears to have been some inconsistency in data recording and catches of up to 3kt are possible.

Catches from the Lower Shire River have been rather erratic and appear to be influenced by the hydrological cycle in the floodplain. A decline in total catch from some 11kt to 3kt was observed in 1992 but the reasons for this are unclear. However, for long-term planning, an average of 5kt could be expected.

National fish supply from capture fisheries in 2000 was 56kt. When the aquaculture production and imports were added to this the total supply was 58kt and the resultant per capita fish consumption was 5.8 kg. If population growth remains at 2 % per annum, Malawi's population is expected to approximate 17 million by 2025. To maintain the current 5.8kt per capita fish supply would require a production of some 95kt of fish.

The total potential yield from the capture fisheries sector in Malawi was estimated at 78kt. This leaves a deficit of some 17kt to maintain the 2000 per capita fish supply of 5.8 kg per capita in 2025. If imports remain at the 1999 maximum of 2.8kt and aquaculture maintains its current 0.8kt estimated production there will be a 13.4 kt deficit in fish supply by 2025.

1. Introduction

Malawi covers an area of 120,000 km2 of which more than 20% is covered by water. There is little doubt that a large sector of Malawi's population is dependent on the fisheries as a source of food security, livelihood and income. The 1999 frame survey estimated that, in Malawi, at least 48,800 people derive their livelihood directly from fishing (Weyl et al. 2000a) and recent estimates gauge total fishing industry participation at more than 230,000 persons (Bland and Donda 1994, Ferguson et al.1993). The objective of this report is to assess historical trends in the capture fishery sector and to attempt to predict the contribution of this sector to the overall fish supply in Malawi by the year 2025.

1.1 Capture fisheries sectors

Capture fisheries in Malawi are highly diverse ranging from large stern trawls to hook and line fishing from the shore. Since many terms currently used in fisheries definitions are highly context specific, the categorisation of these fisheries has been considered somewhat problematic (Allison et al. 2001). Essentially, Malawi's capture fisheries fall into three broad categories: recreational, subsistence and commercial (Banda et al. 2001).

1.1.1 Recreational fisheries

Recreational fishers are those for whom the utilisation of the resource is solely for recreational purposes and rely on fish protein neither for income nor for food security (Banda et al. 2001). The recreational fishery is, therefore, confined to hook and line fishing. While there is a recreational fishery in Malawi (J.D. Balarin - Angling Society of Malawi *pers com.*) participation is negligible and this fishery will not be considered further.

1.1.2 Subsistence fisheries

Malawi's Fisheries Management and conservation act (GOM 1997) classifies a subsistence fisher as: "a person whom fishes for subsistence fishes in order to provide, without payment therefore, food for himself and persons dependent on him including members of his community" (GOM 2000: 21-3). Therefore, it can be generalised that subsistence users consume most of what they produce, sell little in the cash economy, rely primarily on family labour and maintain a limited economic standard of living. Typical subsistence gears are therefore traps, pole and line, hand line, fishing baskets and spears. This sector contributes approximately 5% to the total yield of the capture fisheries sector.

1.1.3 Commercial Fisheries

Commercial fishers are all those whom utilise the fish resource primarily for monetary gain. While the majority of Malawi's fisheries fall within this category, the commercial fisheries sector varies greatly in the level of technology used, the number of people employed and the output of the fishing unit (Banda et al. 2001). It is therefore necessary to separate the commercial sector into large-scale and small scale-commercial fisheries. While the large scale-commercial fishery is access controlled with a finite limit to the number of allowable fishing units per area (Banda & Chirwa 2000), the small-scale sector approximates an open access system.

Large scale commercial

The large-scale fishing operations in Malawi constitute a formal industry that represents considerable financial and technological investments and which employ specialised labour. The vessels used for large-scale commercial fishing are mechanised and generally operate trawls, purse seines or lift nets. The fishery is currently effort controlled through licensing (GOM 2000) and is

confined to the southern part of Lake Malawi (Banda et al. 2001). It comprises 5 stern trawlers, 13 pair trawlers and, 1 purse seine and 2 lift nets. The sector currently contributes approximately 8 % to the total capture fishery landings.

Small-scale commercial

A small-scale commercial fisher may be self-employed and/or employ outside labour to undertake the fishing operation. This sector contributes some 87% to the total fish landings and uses a highly diverse assemblage of fishing gear including beach seines, open water seines, gill -nets, fish traps and hooks. These gears are described in the 1999 National Frame Survey Report (Weyl et al. 2000a). The number of small scale fishing gear enumerated for each district during the 1999 annual frame survey are shown in Table 1.1.

Table 1.1 Frame Survey counts of fishing craft, gear owners, crew members and fishing gears by District Fisheries Office in Malawi 1999 (after Weyl et al. 2000a)

Effort Indicator	District Fisheries Office								
	Mango-chi	Salima	Nkhota-kota	Nkhata Bay	Karo-nga	Liko-ma	Zom-ba	Ngab u	Total
Fishing craft									
Boats with engine	306	62	101	32	0	14	19	0	534
Boats without engine	1,534	354	427	246	2	87	393	45	3,088
Dugout canoes	1,673	925	1,352	2,716	1,793	338	1,722	938	11,457
Participants									
Gear owners	2,084	1,076	1,505	1,814	1,507	339	2,784	2,394	13,503
Crew members	12,703	3,295	5,673	5,676	2,964	888	3,407	741	35,347
Fishing gear									
Gill nets	6,697	3,396	9,206	4,600	4,458	1,865	10,335	2,873	43,430
Long lines	391	194	317	321	127	125	905	1,574	3,954
Beach seines	445	104	278	39	110	23	427	24	1,450
Open water seines	898	242	369	726	446	143	2	0	2,826
Fish traps	367	277	107	2	140	4	33,581	5600	40,078
Hand lines	324	512	895	848	271	89	83	62	3,084
Scoop nets	9	0	16	3	3	0	0	48	79
Cast nets	42	5	0	0	0	0	0	0	47
Psyailo	0	0	2	0	0	0	0	4	6
Set hooks	0	0	0	0	0	0	23,298	0	23,298

1.2 Fish beach price and marketing

Fish price at the beach is currently only monitored by the Mangochi District Fisheries Office. Beach fish price is the price at which the fisherman sells the fish to his first trade partner. The mean beach fish price for the years 2000, 2001 an 2002 is presented in Table 1.2. It must be noted that, at beach level, the term chambo refers only to individuals of Oreochromis 'Nyasalapia' species that are in excess of 15 cm in length. These chambo are the most valuable fish species and in 2002 the average beach fish price was 62 ± 34 MK/kg. The second highest priced fish was Makumba, the commercial term for large Oreochromis shiranus (>15 cm), which sold at prices between 50 and 60% of those for chambo. Interestingly, kasawala (chambo smaller than 15 cm) were sold at prices similar to those of other cichlids. The lowest price was obtained for the small demersal cichlid groups kambuzi and chisawasawa.

There is a general paucity of marketing information in the fisheries sector. Two reports, Weyl et al (2000) and Friis (2000) provide some initial insight into the marketing of fish in Mangochi District. Weyl et al. (2000) showed that the fishery was supported by an intricate network of marketeers. In a survey conducted in Mangochi District over 140 traders were named by a sample of 185 Fishermen.

In addition, only 10 traders were identified by more than one fisherman and approximately half were local fish traders. This indicates that fish trading occupies a large number of people and the trade route is likely to be intricate. Furthermore, the survey showed that fish traders were the most important trade partners of 87% of the interviewed fishermen and that local sales to consumers and housewives were only considered as important trade by 13 % of the fishermen (Figure 1.1). It can therefore be assumed that at least another 30 000 to 50 000 people are employed directly by the fishery.

In a study on the economics of fishing in Chembe village, Friis (2000) showed that the rates of return on capital and labour were not uniform across the economy but that the return on capital was high and varying between 20% and more than 100 %. He also showed that processing the fish enabled the export of fish to the inland market and insured against spoilage, but that in Chembe, there was no price difference between dried and fresh fish. However, Friis (2000) results are preliminary and little else is known on the fish distribution network. The paucity of information on fish marketing is a severe bottleneck in the planning of fisheries interventions and policies. Detailed studies on this aspect of the fishery are therefore of utmost importance.

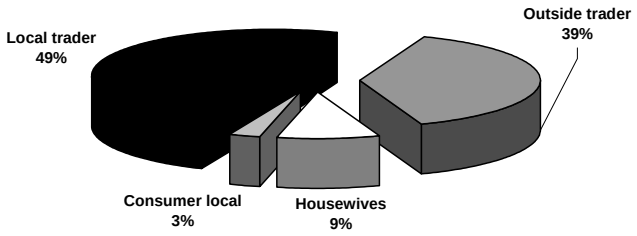

Figure 1.1 Most important trade partners of fishermen
(Source: NARMAP Survey Report 2000)

Table 1.2 Mean annual fish price, standard deviation (std) and sample size (n) for major commercial fish categories landed in Mangochi District between 2000 and 2002. (source: TFD Database District Fisheries Office, Mangochi)

Commercial Category	Description	Beach fish Price MK/kg								
		2000			2001			2002		
		Mean	Std	n	Mean	std	n	Mean	std	n
Chambo	> 15 cm length	60.32	29.92	754	63.76	29.46	818	62.66	34.16	358
Kasawala	Chambo < 15 cm length	25.15	18.46	39	39.92	27.71	130	19.80	9.13	21
Makumba	*O. shiranus*	37.58	17.91	338	37.67	26.93	321	30.68	22.25	80
Mbaba	Medium to large demersal cichlids	19.99	13.16	1,321	23.13	12.32	1434	19.28	10.50	939
Chisawasawa	Medium sized demersal cichlids	14.18	2.96	29	28.21	14.47	109	14.78	3.99	41
Kambuzi	Small demersal cichlids	13.62	10.72	1,411	15.11	8.17	1736	12.39	7.60	1514
Mcheni	Large pelagic cichlids	20.18	9.81	597	23.98	9.15	672	25.11	9.89	433
Utaka	Small pelagic cichlids	19.20	6.75	1,050	23.09	13.53	1194	24.07	11.55	683
Kampango	Catfish	21.54	7.41	407	27.08	13.71	325	23.25	9.07	298
Mlamba	Catfish	18.35	9.97	627	24.71	12.96	547	22.73	10.02	335
Usipa	Lake sardine	18.15	8.85	446	25.38	10.06	673	19.98	8.33	451

1.3 Data sources and methods

The data utilised in this report were derived from published Department of Fisheries (DoF) bulletins, Departmental databases and donor assisted DoF project reports. Reference to the data source is made in the text and a brief description of the methods used by the DoF to collect these data follows.

Effort is assessed by the DoF on an annual basis through the frame survey which is a complete census of basic fishery effort indicators (Sodzabanja et al. 1995). These indicators include the number of gear owners, crew members, number and type of fishing craft and the number and type of fishing gear. A complete description of frame survey methodology is provided in Weyl et al. (2000a). In conjunction with sample catch-effort data the frame survey data are used as a basis for estimating total monthly landings and fishing effort for the various traditional fisheries. Due to logistic and financial constraints, the last complete national frame survey, prior to the preparation of this report was conducted in 1999 (Weyl et al. 2000a).

Catch statistics have been collected for Malawi's fisheries since the early 1970's (Walker 1974ab, 1976, FAO 1993a). To date, the DoF uses two separate statistical systems to monitor the small-scale and subsistence fisheries. These are the Catch Assessment Survey (CAS) developed by Bazigos (1974) and the Malawi Traditional Fisheries (MTF) system introduced during the FAO Chambo project in 1991. Both systems utilise a stratified sampling procedure. However, while the CAS system relies on a boat based sampling procedure, the MTF system is gear based (Alimoso et al. 1990, FAO 1993a).

At the time when the MTF system was set up as the *modus operandi* for catch and effort estimation in Lake Malombe, the Upper Shire River and the southeast arm of Lake Malawi, it was generally acknowledged that this system was superior and should be extended to the rest of the country (FAO

1993b, DoF statistical committee meetings 1993-1994[1]). However, this extension did not occur and annualised data for Lake Malombe and the SEA of Lake Malawi is based on MTF methodology while all other catch and effort data are collected using CAS methodology. All catch and effort data pertaining to small scale fisheries was derived from DoF Bulletins (Tweddle et al. 1994a,b,c,d,e, 1995a,b,c,d, Chisambo et al. 2000, Ngochera et al. 2001a,b, Mwakiyongo et al. 2002, Nyasulu et al. 2002, Sipawe et al. 2001, Weyl et al. 2001ab, Manase et al. 2002**)** and from NARMAP Technical Reports (Weyl et al. 1999a,b). Weyl et al.(1999c) assessed the statistical system and concluded that:

- Due to severe limitations to the catch and effort data, catch statistics derived from these data should serve as an indication of the status of the fishery and can only be used to determine overall trends in the fishery.
- Small species are likely to be misrepresented in catches and the data could, at best, be used for the determination of total catch for smaller cichlids.
- Data for the well-known species such as Usipa (*Engraulicypris sardella*), Chambo (*Oreochromis* spp.), catfish (*Clarias* and *Bathyclarias* spp.) and Kampango (*Bagrus meridionalis*) could be used for the determination of species specific trends.

Due to these constraints it was decided to assess the fisheries yield on the basis of broad species categories. These differ between water bodies and are described for each fishery separately and are listed in Table 2.1. Catch statistics data is available in the ADiM database and a summary of catch and effort data used in this report is provided in Appendix 1.

Table 1.2 Fish categories discussed in this report and their associated species groups

Category	Species groups
Tilapiines	All cichlids of the genus *Oreochromis* and *Tilapia*, comprising traditional groupings chambo, makumba and other tilapia.
Haplochromines	All Haplochromine cichlids comprised in the traditional fisheries categories kambuzi, mbaba, mcheni and utaka.
Catfish	All catfishes comprised by the genera *Bagrus*, *Bathyclarias* and *Clarias* and comprised in the traditional categories mlamba, bombe and kampango.
Usipa	*Engraulicypris sardella*
Others & Matemba	Includes all other species including the traditional species groups ntchila, mpasa, sanjika and matemba

2. Main capture fisheries areas and yields

Four lakes, Lake Malawi, Lake Chiuta, Lake Chilwa and Lake Chiuta and the Upper Shire River and the Lower Shire River floodplain are the mainstay of Malawi's fish production. The physical characteristics as well as historic trends in catch and effort are discussed for each of these fisheries individually.

2.1 Lake Malawi

2.1.1 Physical description

Lake Malawi (09^{o} 30' – 14^{o} 40'S, 33^{o}50' – 33^{o}36'E, 472 m amsl) has a mean surface area of 29 000 km^2 making it the 2nd largest lake in Africa and the 9th largest in the world (Duponchelle & Ribbink 2000). The lake has an average depth of 292 m; a maximum depth of 785 m; is just over 600km in

[1] DoF 1993. Minutes of four Statiscal Committee meetings held between 14th October, 1993 and 1st July 1994.

length; is 87 km wide at its widest point; and has a total shoreline length of 1 500 km (Ribbink 2001). Geographically, about one third of the lakes shoreline is steep and rocky while two-thirds are gently sloping sandy beaches or swampy river estuaries (Ribbink 2001).

Despite it's tropical setting, Lake Malawi it is sufficiently far south to experience marked seasonal variations (Ribbink 2001). There are essentially three seasons, which Ribbink (2001) describes as:

1. Winter - a dry period from May to August when air temperature at the lakeshore may drop to 15^{o}C, though the daily average is 20 to 22^{o}C. This period is characterised by south-easterly winds (locally referred to as *Mwera*) that may reach force 8 on the Beaufort Scale.

2. Dry summer - from September to November with a daily average air temperature of around 28^{o}C, but rising to over 40^{o}C (Ribbink 2001).

3. Wet summer - the rainy season extends from late November to April. The rainy season is usually of shorter duration in the south than in northern regions of the lake. The annual amounts of rainfall average less than 800 mm in the Rift Valley area, 800 to 1000 mm in the Medium-Altitude Plateaux, and from 1000 to 1500 mm in the High-Altitude Plateaux. The prevailing winds during the wet season are northerly (locally referred to as *Mpoto*) and average daily air temperatures are 25^{o}C.

The lake level rises during the wet season, both from rain that falls on the lake and in the catchment, giving annual fluctuations of level between the extremes of 0.4m to 1.8m. Most of the country receives adequate rainfall for rain-fed agriculture, although there is evidence that droughts have become more common in recent years.

The lake is permanently stratified and anoxic at depths exceeding 200 meters (Ribbink 2001). At shallower depths, water temperatures and lake stratification follow seasonal patterns. Surface water temperatures of the open lake range from 23^{o}C in the cool windy season to 28^{o}C in the warm season. From September to December there is a warming of the surface waters and stratification develops. By May the upper 60 to 80m is homothermal at about 27oC, during the cool windy season the thermocline weakens and by July it is poorly defined and there is a gradual temperature gradient of 23oC at the surface to 22.5oC at 250m (Ribbink 2001). Internal waves exist, which may have an amplitude of 50m and a periodicity of 16 to 30 days.

2.1.2 Fish fauna

Lake Malawi has more species of fish than any other lake in the world and the number of described species increases substantially with every taxonomic survey (Ribbink 2001). Eleven families are represented in the lake basin (Table 2.1) of which, the family Cichlidae dominates in terms of species richness, diversity and numerical abundance. There are more than 750 recognised species of which only 388 have been formally described as professional systematists cannot keep pace with the rate at which new species are being discovered (Ribbink 2001).

Table 2.1 The riverine and lacustrine fishes of Lake Malawi
(adapted from Ribbink 2001)

Family	Genera	Species
Anguillidae	1	1
Aplocheilidae	1	2
Bagridae	2	4
Characidae	2	2
Cichlidae	41	Circa 750
Clariidae	2	17
Cyprinidae	5	26
Mastacembelida	1	2
Mochokidae	2	3
Mormyridae	4	7
Protopteridae	1	1

The Cichlidae within the Lake Basin comprise two principal phylogenetic lineages: the tilapiines and the haplochromines. The tilapiines comprise the genera *Oreochromis* and *Tilapia*. The only representatives of the genus *Tilapia* are two non-endemic species, *Tilapia sparmannii* and *Tilapia rendalli*. The *Oreochromis* are represented by a small, endemic species-flock comprising five members. These are collectively referred to as chambo and in the context of Lake Malawi the term Tilapiines is synonymous with chambo. All remaining cichlids are haplochromines, comprising 39 genera and between 700 and 800 species. All haplochromines are endemic, except for *Astatotilapia calliptera* and *Serranochromis robustus.* Due to the high diversity of the fish fauna, the species composition within the fishery is also highly diverse, with more than 200 species being recorded in the fishery (Banda et al. 2002). These fish species fall within 14 commercial categories presented in Table 2.2.

Table 2.2 Commercial fish categories of Lake Malawi, the species comprised and the proportional contribution to the combined landings from Lake Malawi 1976 to 2000

Species group	Species comprised	Percent of total catch 1976 -2000
Chambo	*Oreochromis* spp. other than *Oreochromis shiranus* .	*17*
Chisawasawa	Offshore demersal Haplochromine cichlid species	11
Kambuzi	Small demersal inshore haplochromine cichlid species, mainly belonging to the genus *Lethrinops*.	6
Kampango	*Bagrus meridionalis*	5
Kasawala	Juvenile Chambo.	<1
Mbaba	All Haplochromine cichlid species other than those incorporated in the chambo, kambuzi, utaka, mcheni and other tilapia groups.	<1
Mlamba	Clariid catfish including *Clarias gariepinus* and various *Bathyclarias* spp.	4
Mpasa	*Opsaridium microlepis*	*<1*
Mcheni	*Rhamphochromis* spp.	*1*
Ndunduma	Offshore pelagic cichlids belonging to the genus Diplotaxodon	<1
Ntchila	*Labeo mesops*	*<1*
Other Tilapia	*Oreochromis shiranus* and *Tilapia rendalli*	*1*
Others	All other species	5
Sanjika	*Opsaridium microcephalus*	*<1*
Usipa	*Engraulicypris sardella*	*17*
Utaka	Pelagic small cichlids mainly belonging to the genus *Copadichromis*.	31

2.1.3 Fishing effort

The DoF has collected effort indicators for the Lake Malawi small scale fishery since 1975 in the form of annual frame surveys, with the last complete national frame survey being carried out in 1999 (Weyl et al. 2000a). These frame surveys have been carried out with varying levels of resolution, with the total number of fishing craft being available from 1975, while the number of people employed in the sector and the number of individual fishing gears have been enumerated since 1981 (Figure 2.1). Essentially Lake Malawi's fishery is characterised by rapidly increasing fishing effort. The total number of fishing craft on the lake has increased almost linearly from some 3 300 craft in 1975 to more than 11 000 in 1999 (Figure 2.1). Similarly, the total number of people employed in the fishing sector in Lake Malawi has also increased from some 11 000 participants in 1981 to more than 36 000 in 1999 (Figure 2.1). During the same period, the number of operational fishing gear increased fourfold (Figure 2.2). The number of gill nets and open water seines increased rapidly between 1981 and 1999, with gill nets increasing from 7 000 in 1981 to almost 30 000 in 1999. The number of beach seines increased from 340 in 1981 to more than 1 200 in 1997, where after the number declined by 25 %, probably as a result of diminishing inshore catches (Weyl et al. 2000a).

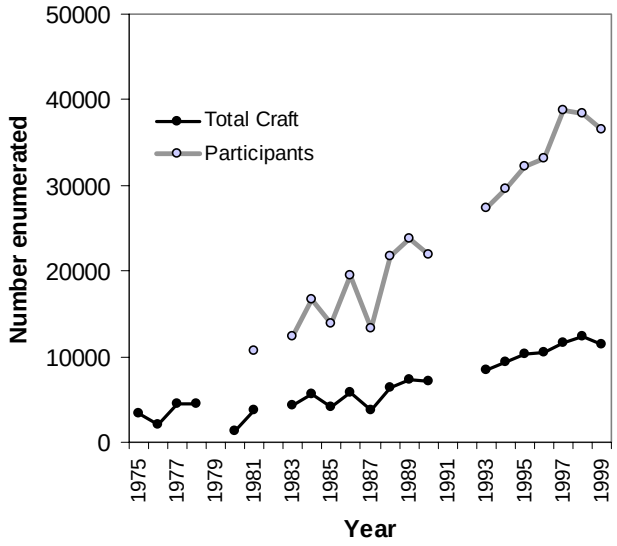

Figure 2.1 Number of participants and the total number of fishing craft in the small-scale fishery of Lake Malawi, 1975-1999

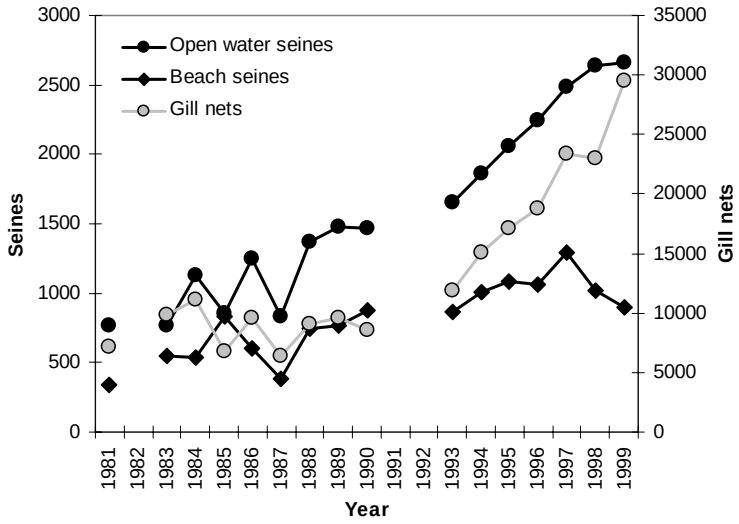

Figure 2.2 Number of gill nets open water seines, and beach seines in the small-scale fishery of Lake Malawi 1981-1999

The earliest records of large-scale commercial fishing in Lake Malawi are from 1943, when purse seining for chambo was initiated in the south east arm (FAO, 1976). This fishery developed rapidly in the shallow waters of the southern part of the lake and in 1976 it was established on the western side of the lake (Banda 2001). Experimental trawling in the mid 1960s led to the establishment of a pair trawl fishery in 1968 (Tarbit 1972). The objective of this fishery was to harvest demersal cichlid stocks in the shallow parts of the south east arm in 1968 (Tarbit, 1972) and the subsequent development of the pair trawl fishery was initially financed under the FAO/UNDP Project for the Promotion of Integrated Fisheries Development (IFDP – 1972-76). In addition to technological developments, the project supported the construction of Mpwepwe boatyard and the training of boat builders and fishing crews, and a government-operated loan scheme was put in place to finance the new fishery (Seymour 2001). By the end of 1984, there were 20 operational pair trawl units in the southern part of Lake Malawi. However, due to a lack of capacity and reinvestment of capital there

was no technical development within this fishery for almost thirty years (Seymour 2001) and by 2001, only 8 units remained active (Banda et al. 2001).

Stern trawlers were introduced into the fishery for bottom trawling in 1972 and for mid-water trawling in 1976 (FAO, 1976, Turner, 1977). The fishery has since expanded and there are currently six stern trawlers operational in the southern part of the lake (Banda, 2001). From 1976 to 1983, the fishery comprised one 180 Hp and two 85 Hp units (Banda 2001). Stable CPUE in this fishery prompted the introduction of a fourth trawler in 1983. Since 1996, one 85 Hp trawler has exited the fishery but was replaced by three more powerful trawlers (220 – 380 Hp), leading to increased CPUE and total catch (Figure 2.3). Subsequent engine refits in the older trawlers have resulted in a current fleet of 6 stern trawlers with engine capacities of between 190 and 380 Hp.

The large scale commercial fishery is effort-controlled through license limitation (Banda et al. 2001) and a summary of the current large-scale commercial fishing fleet is presented in Table 2.3.

Table 2.3 Large scale commercial fishing fleet on Lake Malawi, their engine capacity, gear use, licensed area and activity (after Banda & Chirwa 2001)

Vessel		Hp	Licence Area	Activity
Stern trawlers				
	Ndunduma	380	C	Active
	Kandwindwi	322	C	Active
	Crystal Lake	250	B/C	Active
	Kampango	220	C	Active
	F.H.Fatch	200	C	Active
	Chenga	190	C	Active
Pair trawlers				
	Chimanda	40	A	Active
	Ankhoma	30	A	Active
	Mwenda	30	A	Active
	Mposa 1	30	D	Active
	Mposa 2	30	D	Active
	Chifira LTD. 1	30	D	Active
	Chifira LTD. 2	40	D	Active
	Matumba	30	A	Not active
	Mwakimbwala	30	A	Not active
	Jere	30	D	Not active
	Mzembe	30	D	Not active
	Maulana	30	D	Not active
	Saka & Utaka	40	A	Active
Ring nets				
	Kakowa	90	A	Active
Usipa lift nets				
	Vuwo 1		B	Not active
	Vuwo 2		B	Not active

2.1.4 Yield

For purposes of discussion Lake Malawi has been divided into three main areas comprising different catch statistics strata: (1) **southern Lake Malawi** – comprising the southeast arm and south west arm of the lake; (2) **central Lake Malawi** – comprising the areas Domira Bay and Nkhotakota and (3) **northern Lake Malawi** – comprising the areas Nkhata Bay, Likoma and Chizumulu Islands and Karonga.

Southern Lake Malawi - Small scale fisheries

The development of catch and effort in the small-scale fisheries for this area is well documented (Tweddle et al. 1994bc, Weyl et al. 1999b, Weyl. 2001b, Manase et al. 2002). Historic trends in total catch, relative effort and relative CPUE in the small scale fishery of southern Lake Malawi are shown in Figure 2.3. Annual catch from the small scale fishery in southern Lake Malawi has fluctuated between 7 and 27kt with no definite trend and the annual average landings from this sector were in the region of 14kt (Figure 2.3). This stability in total catch is somewhat misleading as a threefold increase in fishing effort has lead to a 60% decrease in relative CPUE since the mid 1970's (Figure 2.3).

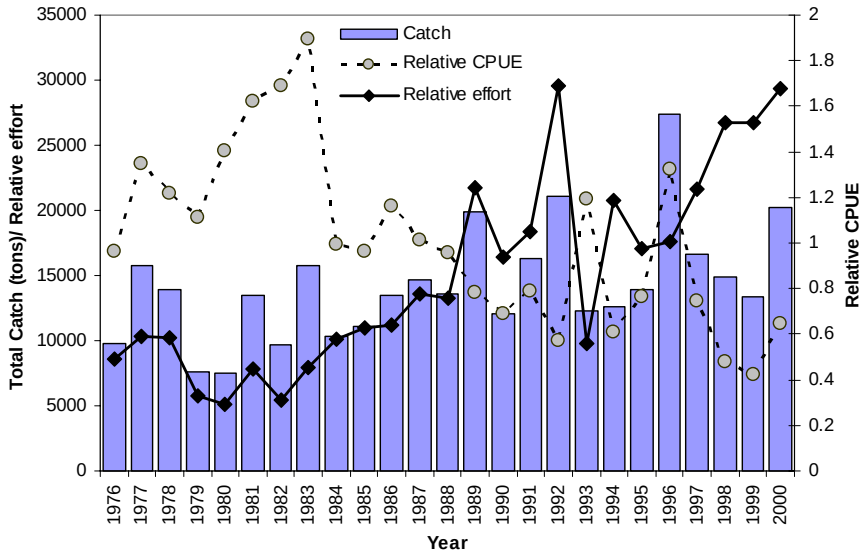

Figure 2.3 Total catch (tons) small scale fishery of southern Lake Malawi, and relative effort and CPUE calculated for a combination of gill nets, beach seines and open water seines from 1976 to 2000 in southern Lake Malawi

Southern Lake Malawi -Large scale fisheries

Purse seine

Purse seine catch, relative effort and relative CPUE since 1974 is presented in Figure 2.4. Chambo was the primary target species, contributing more than 90 % to the catch. Catch trends in this fishery closely follow the decline of the chambo fishery in the early 1990s. Purse seine CPUE was relatively high (>1 ton per day) until the mid 1980's when the fishery yielded in excess of 2kt per annum. By 1994, the total catch had declined to an uneconomic 100 tons per annum. Subsequently, the fishery has only operated sporadically. The tilapiine dominated catch composition indicates that this fishery overlaps with the small scale sector and stock assessments cannot be based on this fishery in isolation.

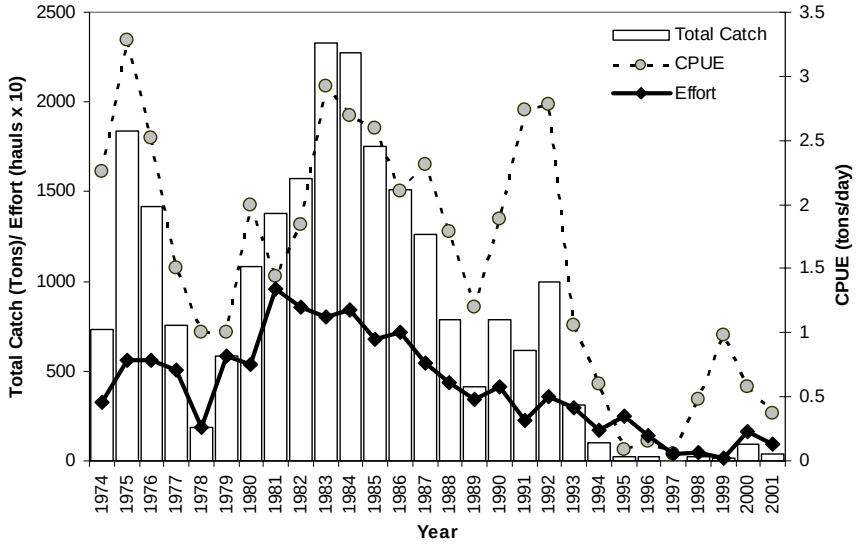

Figure 2.4 Catch, effort and catch per unit effort (CPUE) in the purse seine fishery of Lake Malawi, 1974- 2001. Source: Department of Fisheries catch statistics

Pair Trawls

Pair trawl catch composition was dominated by small haplochromine cichlids and mean annual landings have fallen from more than 3,000 tonnes in the mid 1980's to less than 1,000 tonnes in 2001 (Figure 2.5). However, the relatively stable CPUE in this fishery indicates that the decline in total landings was due to decreased effort rather than as a consequence of declines in the stock (Figure 2.5). Seymour (2001) attributed the decline in the pair trawl fishery to poor reinvestment, bad financial management and inadequate support mechanisms (Seymour 2001). However, the absence of a correlation between effort and CPUE must be viewed with caution as pair trawlers often trawl shallower than the recommended 18 meter minimum and considerable overlaps, at species level, have been observed with the small scale fishery (Nyasulu 2001). Stock assessments based on the analysis of catch and effort of this fishery in isolation must therefore be viewed with caution.

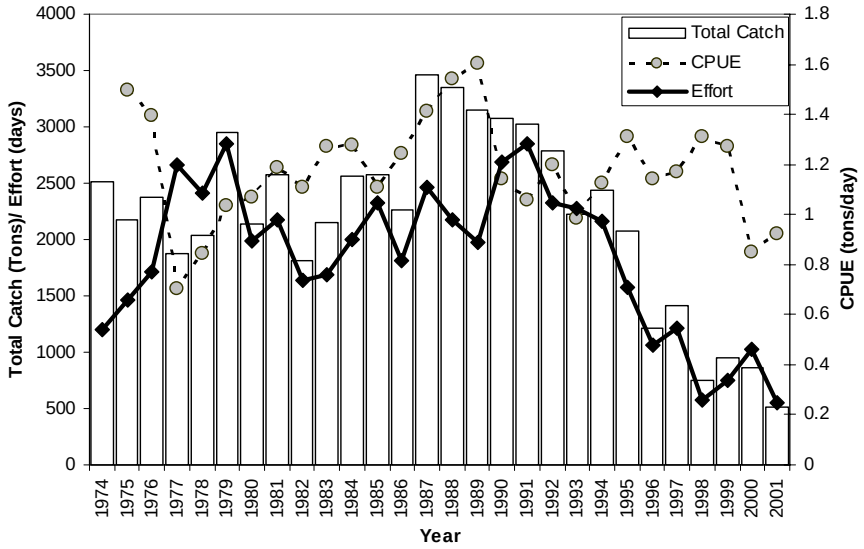

Figure 2.5 Total catch, effort and catch per unit effort (CPUE) in the pair trawl fishery of Lake Malawi, 1974-2001

Stern trawl

Relative catch, effort and CPUE for the stern trawl fishery are shown in Figure 2.6. Total catch from the stern trawl fishery declined steadily from more than 5kt in 1975 to 1kt in 1993, where after landings increased gradually to more than 4kt in 2001 (Figure 2.6). Trends in CPUE follow those of total catch and it must be noted that the post 1993 increase in CPUE is a direct result of increased capacity in this fishery. From 1976 to 1983, the fishery comprised one 180 Hp and two 85 Hp units (Banda 2001). Stable CPUE in this fishery prompted the introduction of a fourth trawler in 1983 and CPUE declined with increased fishing effort (Figure 2.6). Since 1996, one 85 Hp trawler has exited the fishery but was replaced by three more powerful trawlers (220 – 380 Hp), leading to increased CPUE and total catch (Figure 2.6). Subsequent engine refits in the older trawlers have resulted in a current fleet of 6 stern trawlers with engine capacities of between 190 and 380 Hp (Table 2.6). It should also be noted that the entire effort of this fishery is currently concentrated in the relatively small commercial areas B and C of the SEA. Current landings exceed management limits in this area and increased landings and stable CPUE cannot be considered as being indicative of a healthy fishery (Palsson et al. 1999b).

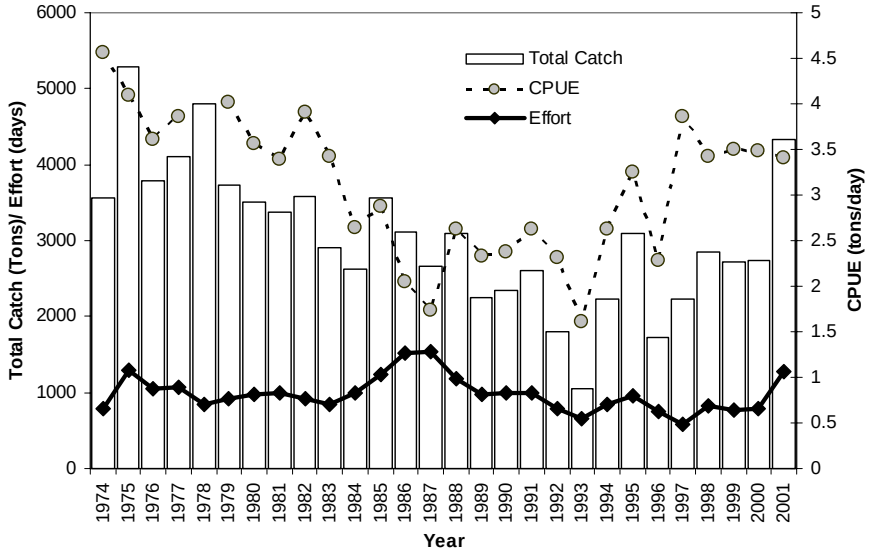

Figure 2.6 Total catch, effort and catch per unit effort (CPUE) in the stern trawl fishery of Lake Malawi, 1974-2001

Lift nets

In 1993-94, MALDECO imported two *kapenta* rigs from Zimbabwe and adapted them to fish for *usipa* (*Engraulicypris sardella*). Unfortunately the technology was inappropriate and the two rigs yielded less than 30 tons per annum and their use was discontinued in 1998.

Southern Lake Malawi - Total catch & species composition

Since 1976, total landings from southern Lake Malawi have fluctuated, without a definite trend, between 14kt and 30kt (Figure 2.7). The main cause of these fluctuations have been large usipa catches, which appear to be sporadic in nature and are controlled by factors other than fishing intensity (Thompson et al. 1996). Furthermore, tilapiine landings, which were in excess of 4kt until the early 1990's declined to less than 2kt by the late 1990's with no apparent recovery (Figure 2.7). However, the loss of tilapiine yield from the fishery has been compensated by increased landings of small haplochromine cichlids. While this species change has undoubtedly led to a decrease in the overall value of the fishery (Bulirani et al. 1999), the total fish production has remained stable, averaging some 20kt per annum.

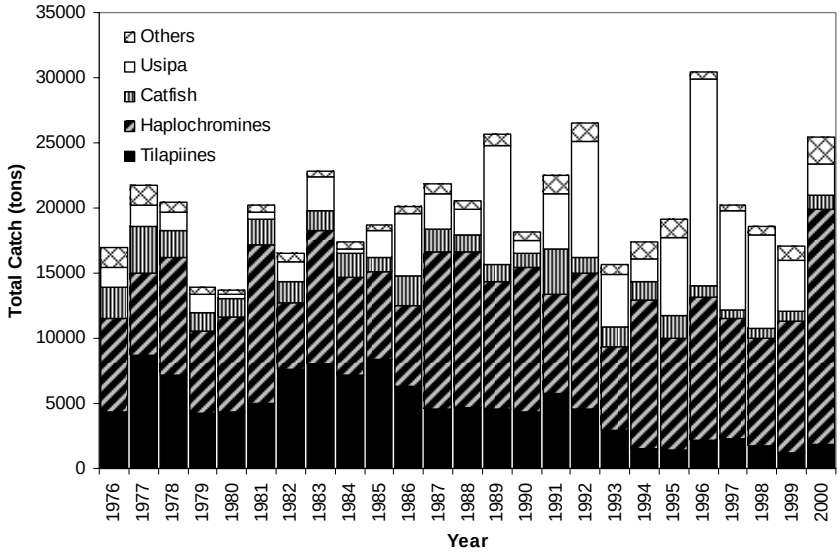

Figure 2.7 Total catch by species category of all fishing sectors in southern Lake Malawi, 1974-2001

Central Lake Malawi – small scale fisheries

No large scale commercial fishery exists in this region and the developments in catch and effort in the small scale fishery are described in Tweddle et al. (1994de), Chisambo et al. (2000) and Sipawe et al. (2001). Historic trends in total catch, relative effort and relative CPUE in the small scale fishery of central Lake Malawi are shown in Figure 2.8. Annual catch from the small scale fishery in southern Lake Malawi has fluctuated between 4 and 11kt with no definite trend. However, some increase in relative CPUE with decreased relative effort was observed (Figure 2.8).

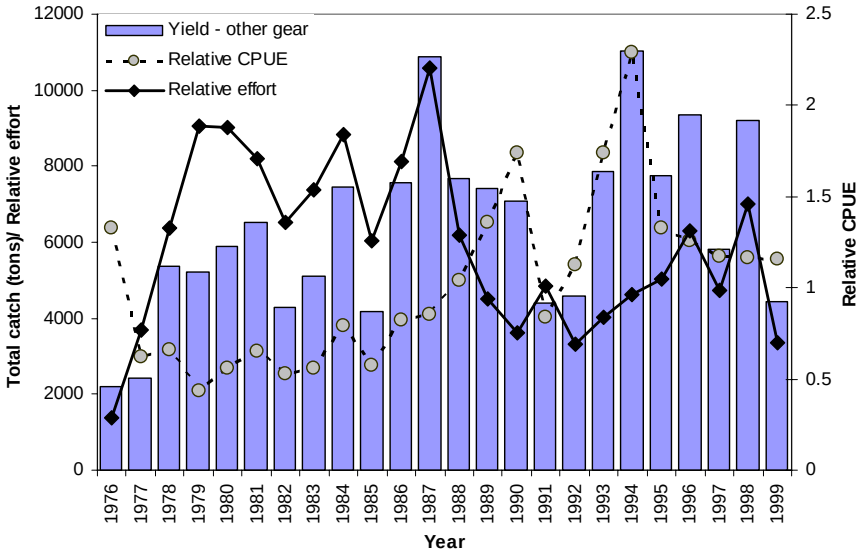

Figure 2.8 Total catch (tons) small scale fishery of central Lake Malawi, and relative effort and CPUE calculated for a combination of gill nets, beach seines and open water seines from 1976 to 2000 in central Lake Malawi

Northern Lake Malawi – small scale fisheries

No large scale commercial fishery exists in this region and the developments in catch and effort in the small scale fishery are described in Tweddle et al. (1995bcd), Kanyerere et al. (2000) and Mwakiyongo et al. (2001). Historic trends in total catch, relative effort and relative CPUE in the small scale fishery of southern Lake Malawi are shown in Figure 2.9. Annual catch from the small scale fishery in southern Lake Malawi has fluctuated between 3 and 8kt with no definite trend and the annual average landings from this sector were in the region of 5kt (Figure 2.9).

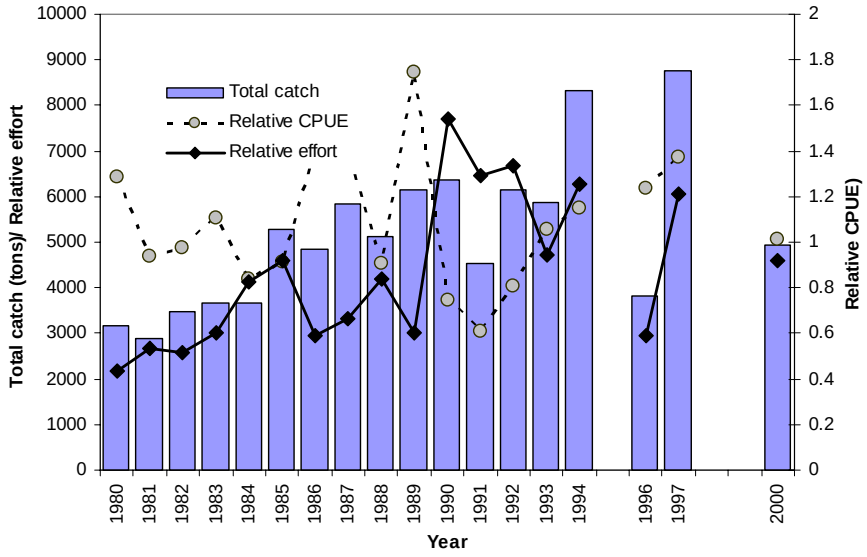

Figure 2.9 Total catch (tons) small scale fishery of southern Lake Malawi, and relative effort and CPUE calculated for a combination of gill nets, beach seines and open water seines from 1976 to 2000 in central Lake Malawi

2.1.5 Total yield for Lake Malawi

The total fish yield from Lake Malawi has fluctuated between 21 and 43kt per annum since 1976 and the mean yield for the period 1976 – 1999 was 31 ± 5kt (Figure 2.10). However, at species group level changes are evident.

Tilapiines - Chambo

The decline of the tilapiine fishery is well documented (FAO 1993a, Bulirani et al. 1999, Palsson et al. 1999a). Historically more than 80% of the tilapiines were landed by large scale and small scale fisheries in southern Lake Malawi. Tilapiine catches peaked at 8-9kt in the late 1970s and in the mid-1980s but declined in 1986-87 to a relatively relatively stable 5-6kt until 1992 (Figure 2.10). Since 1992, tilapiine catches declined further to less than 2kt in 1999. The bulk of the tilapiine catch was made by the small scale fishery, mainly with gill nets and beach seines. The large scale fishery, mainly through purse seine catches contributed between 20 and 40% to the total catch until 1992, where after the purse seine fishery collapsed (Bulirani et al. 1999). Palsson et al. (1999a) estimated an MSY of 6400 tons for Lake Malawi chambo at relative effort levels that are considerably lower than current effort. This indicates that excessive effort in the chambo fisheries may have been a primary cause for the declining chambo catches and that a considerable decrease in fishing effort may be necessary for a rebuilding of the stocks.

Catfish

Catfish landings have shown a steadily declining trend from more than 3kt in the late 1970's to less than 2kt in 1999. The status of the two major components of this group, kampango and bombe are discussed in Bulirani et al. (1999). Bulirani et al. (1999) noted clear declining trends for catch and CPUE while effort remained more stable. MSY for kampango was estimated at 1.7kt and showed that, despite considerable fulctuations, effort in recent years has been higher than the effort corresponding to MSY. For the Clariid catfishes (Mlamba and Bombe) catches were relatively stable in the late 1970s and early 1980s in the range of 1.2-1.4kt, with peaks of 1.7kt in 1977 and 1981 (Figure 2.10). A general decline was observed in later years to 524 tons in 1996. Bulirani et al. (1999) estimated MSY at 1.2kt but observed that effort was been far beyond that corresponding to MSY (Bulirani et al. 1999).

Haplochromines

Total landings of haplochromines have fluctuated between some 12kt and 23kt with some increase in total landings being apparent in the 1990's (Figure 2.10). Bulirani et al. (1999) observed that for the utaka group, catches had fluctuated heavily although an increasing, but non-significant, trend was observed. They also observed that increased effort had not resulted in a significant increase in catches and concluded that a reduction in effort should lead to improved CPUE without substantially affecting total catches.

Usipa

Usipa yields have been highly erratic, with fluctuations from less than 1kt to more than 20kt being observed between 1976 and 2000 (Figure 2.10). The majority of usipa was landed by the small scale fishery at night (Lewis & Tweddle 1990, Weyl 1999, Weyl et al. 2001) and the total catch of this species is likely to be underestimated (Lewis & Tweddle 1990). Lewis & Tweddle (1990) suggested that actual usipa catches may have been in excess of 50kt in some years, and possibly as high as 100kt. Furthermore, biological investigations on usipa have shown that this species has a high reproductive output and natural mortality rate (Thompson & Allison 1996). Therefore, this species can be exploited at relatively high effort levels and the fishery requires low levels of management intervention (Thompson & Allison, 1996). However, it must be considered that the survival of usipa larvae may be influenced by density-independent effects, and therefore years of high abundance may be immediately followed by years of low abundance (Thompson et al.1996). The stock is therefore highly unpredictable and no assumptions can be made on its long-term potential.

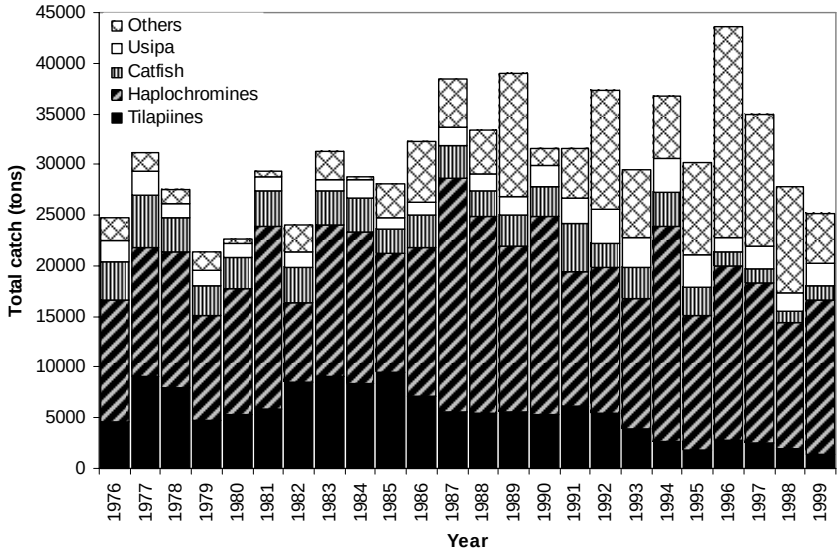

Figure 2.10 Total catch (tons) by species group from Lake Malawi from 1976 to 2000

2.1.6 Long term potential yield from Lake Malawi

For the estimation of the potential yield from Lake Malawi, three distinct stock and thus exploitation areas need to be recognised:

1) Inshore stocks comprising fisheries areas of the lake that are less than 50 meters deep that are harvested by the small scale fishery, purse seines and pair trawlers.

2) Deep water demersal demersal stocks harvested by fisheries targeting a different species composition from the inshore fishery and exploited only through industrial class stern trawlers.

3) Pelagic stocks that are widespread throughout the lake and are currently underexploited.

Inshore stocks

To obtain a first estimate of potential yield from these areas a surplus production function was fitted to relative CPUE and effort data from inshore fisheries in southern, central and northern Lake Malawi. The resultant regressions of CPUE and ln CPUE vs. relative effort as well as the fitted Schaefer (1954) and Fox (1970) surplus production functions are shown in Figures 2.11, 2.12 and 2.13. It must be noted that the MSY estimates obtained here are for the purpose of gaining first estimates of the total potential yield from Lake Malawi. They ignore multi species and multi fisheries interactions and should not be used as management targets. Estimated MSY for the inshore fishery was 18.1kt for southern Lake Malawi, 6.2kt for central Lake Malawi and 6.3kt for northern Lake Malawi. This gives a total potential yield of 30.6kt for the inshore fisheries, provided that they are managed at effort levels resulting in MSY.

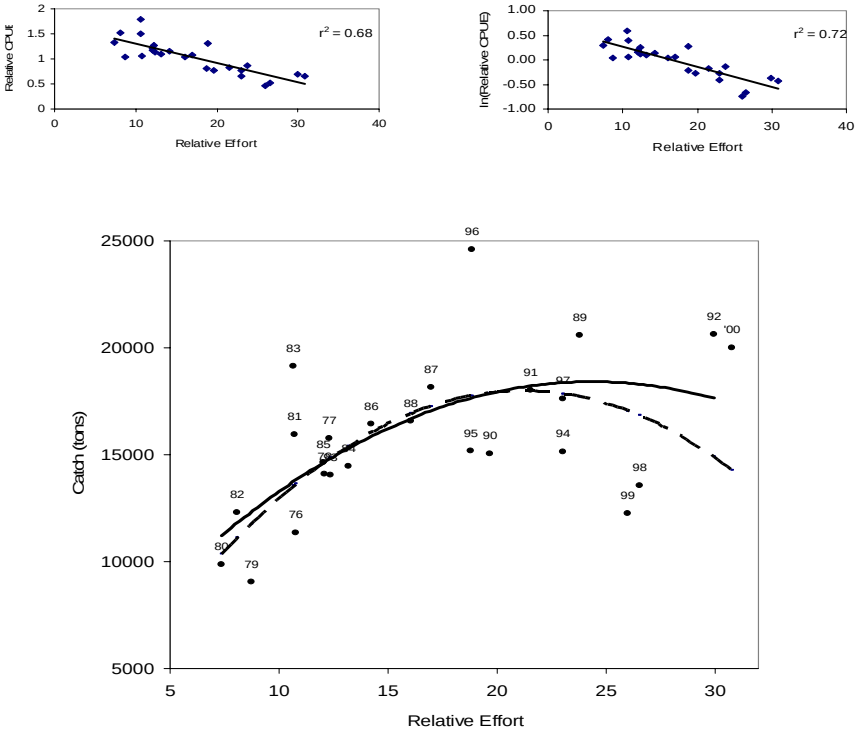

Figure 2.11 Regressions of CPUE and lnCPUE vs. relative effort and fitted Schaefer (solid line) and Fox (broken line) surplus production functions for the inshore fishery in southern Lake Malawi

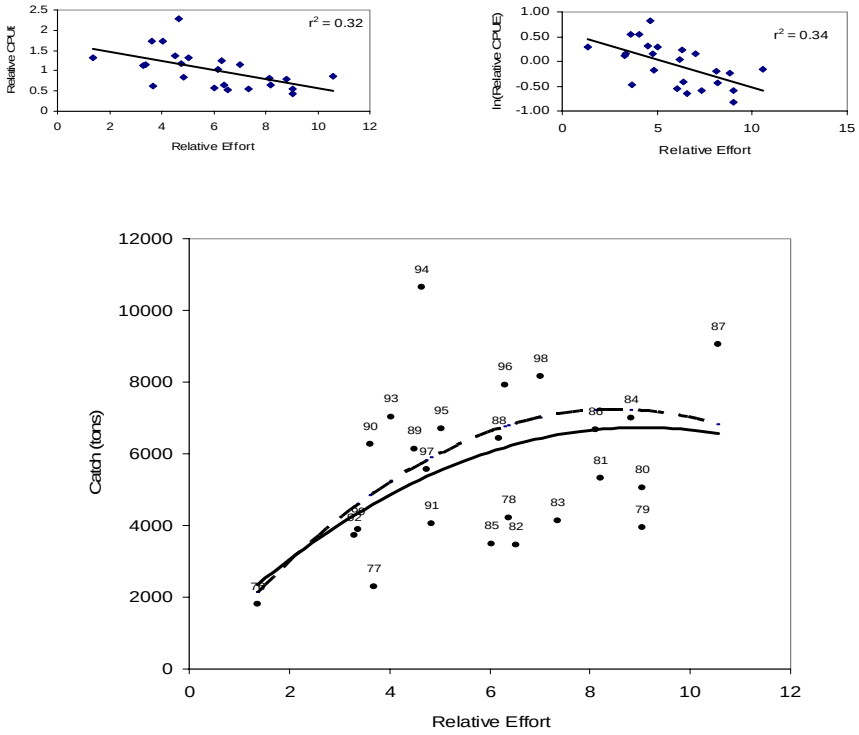

Figure 2.12 Regressions of CPUE and lnCPUE vs. relative effort and fitted Schaefer (solid line) and Fox (broken line) surplus production functions for the inshore fishery in central Lake Malawi

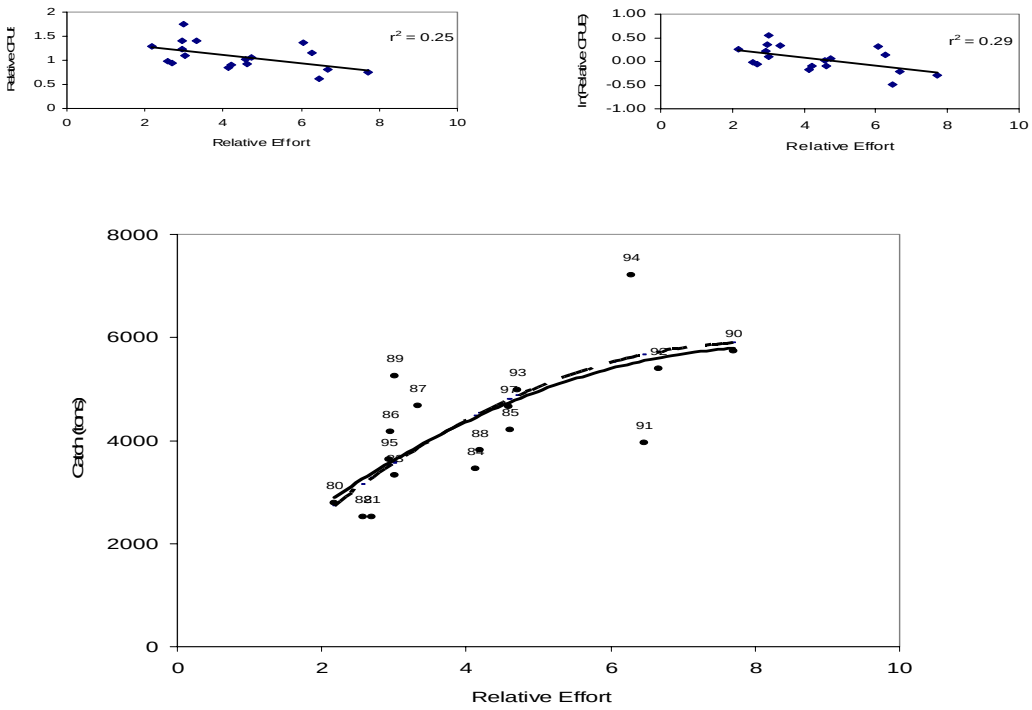

Figure 2.13 Regressions of CPUE and lnCPUE vs. relative effort and fitted Schaefer (solid line) and Fox (broken line) surplus production functions for the inshore fishery in northern Lake Malawi

Deep water demersal stocks

A number of assessments have been carried out on the potential sustainable harvest from the deep water demersal fisheries of Lake Malawi (Banda & Tommasson 1996, 1997, Kanyerere 1999, Palsson et al. 1999, Banda 2001). Recommendations for sustainable yield are based on a proportion of the total biomass estimate. These have been summarised by Seymour (2001) and are presented in Table 2.4. Seymour (2001) estimated total sustainable yield for the deep water demersal fishery at 8.4kt, but only considered Banda & Tómasson's (1996) commercial area C estimate in the analysis. Kanyerere (1999), using trawl survey data from 1994 to 1999, estimated the sustainable yield for the SEA demersal trawl fishery at some 3360 tons and therefore, the total sustainable yield from the deep water demersal fishery approximates 9.9kt for all trawlable areas. However, evidence of locality-specific over fishing has been presented (Turner et al. 1995) and current stern-trawl landings exceed the recommended sustainable yield in the SEA. However, there is considerable room for expansion into the south west arm of Lake Malawi as well as into the central and northern regions (Kanyerere 1999, Banda 2001).

Pelagic stocks

The pelagic ecosystem was assessed by UK/SADC 1991-1994 assessment project (Menz 1995). Using acoustic surveys, the project estimated the Pelagic biomass at 168.4kt with a sustainable exploitation potential of 33.3kt (Table 2.4). In addition, Turner et al. (2001) reported that the pelagic stocks of Rhamphochromis and Diplotaxodon were huge and not in threat of overexploitation from the current fishery. These studies indicate that the pelagic stocks are only marginally exploited by existing fishing operations. The current small scale and large scale fishery currently harvests a total of only 3kt of pelagics and there is considerable room for expansion. The

total possible sustainable yield from the deep water demersal and the pelagic fisheries therefore approximates some 43kt.

Table 2.4 Biomass and sustainable yield estimates of marginally exploited stocks in Lake Malawi (adapted from Seymour 2001)

Stock	Area	Author	Biomass	Yield as % of stock	Estimated sustainable yield
Demersal stocks					
Deep demersal (>50m)	South East Arm (C)	Kanyerere1999	6,040	30	3,360
	South West Arm	Banda& Tómasson 1996	7,220	30	2,166
	Domira Bay to Chia Lagoon		6,865	30	2,060
	Chia to Nkhotakota		850	30	255
	Nkhotakota to Dwangwa		1,050	30	315
	Dwangwa to Sanga		3,570	30	1,071
	Ngara to Lufira	Tweddle 1981	1,588	45	715
	Total Demersal		27,183		9,942
Offshore pelagic stocks					
Diplotaxodon	Lake Malawi	Menz 1995	119,700	19	22,700
Rhamphochromis			16,800	17	2,800
Copadichromis			8,700	16	1,400
Other cichlids			3,400	18	600
Engraulicypris			5,100	63	3,200
Opsaridium			1,300	23	300
Synodontis			13,400	17	2,300
Total pelagic			168,400		33,300
Total harvestable demersal and offshore stock					43,242

2.2 Lake Malombe and the upper Shire River

2.2.1 Physical characteristics

Lake Malombe, which is situated between 14°30'-14°45'S and 35°12'-35°20', is an impoundment of the outflow from Lake Malawi via the Upper Shire river. It is 30km long and has a maximum width of 15km. It has the same climatic regime as that of the southern part of Lake Malawi. At times of low level in Lake Malawi, as was the case in the first 35 years of this century the Lake did not exist and was utilised as rich farmland. The lake is fed by the most eutrophic water from Lake Malawi and is further enriched by streams flowing into the lake from its highly populated catchment area and by recycling of nutrients in sediments as a result of the shallowness of the lake (Tweddle et al. 1994a). Lake Malombe is therefore much more productive than Lake Malawi, though detailed limnological investigations have not yet been made. Due to its connection to Lake Malawi the fish fauna is similar to Lake Malawi's shallow demersal ichthyofauna and is not discussed further.

2.2.2 Catch and effort

Historic trends in the fisheries of Lake Malombe are well documented (Tweddle et al. 1994, Bulirani et al. 1999, Weyl 1999, Weyl et al. 2001a, Banda et al. 2002) and an assessment of the fishery was undertaken by the DoF and management options were presented by Banda et al. (2002). The following description is a summary of Banda et al.'s (2002) report.

The fishery is multi gear, with beach seines, open water seines, called nkacha nets, and gill nets dominating the fishery. Since 1976, the fishery underwent dramatic changes not only in terms of total catch, but also, in gear utilisation (Figure 2.14) and species composition (Figure 2.15). Annual catches have ranged from between 6.6kt and 12.9kt in the 1980's to less than 5kt from the early 1990's to 2001 (Figure 2.15). Catches of the tilapiine species group, chambo, decreased from 9.3kt in 1982 to less than 200 tons from 1993 onwards (Figure 2.15). The decline of the chambo was concomitant to the increased harvest of small haplochromine cichlids, locally referred to as kambuzi, which, by the mid 1990's had almost completely replaced chambo in the fishery (Figure 2.15). The output of the kambuzi fishery showed large fluctuations, reaching levels of around 9.5kt in 1987 and 1990 but dropping to a level of below 4kt since the mid 1990's (Figure 2.15).

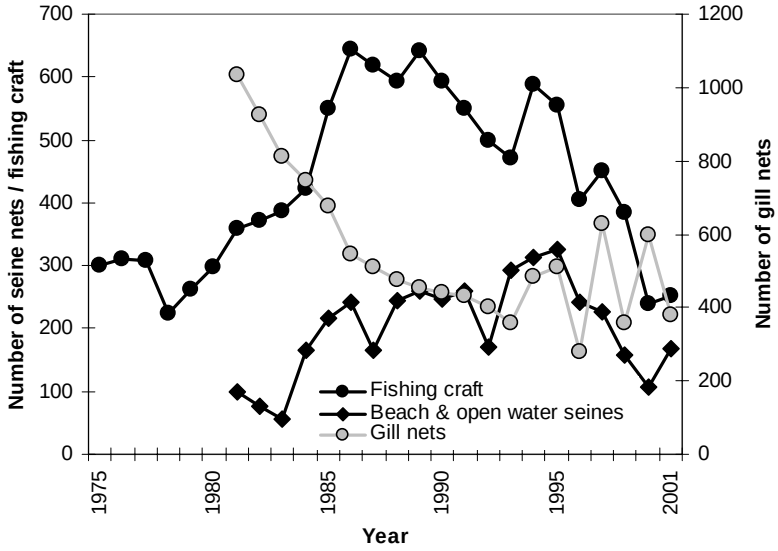

Figure 2.14 Effort indicators for Lake Malombe 1975 - 2001

Chambo fishery

During the late 1970's and early 1980's, when chambo dominated the fishery, gill nets and large meshed chambo seines contributed more than 90 % to the total catch. By the mid 1980s, small haplochromine cichlids, harversted with small-meshed kambuzi seines became increasingly important in the fishery. By the early 1990's, an open-water seine, locally known as the nkacha net, began to replace the kambuzi seines as the dominant gear type. Presently nkacha nets contribute more than 85% to the total annual catch.

The decline of the chambo fishery in the late 1980's gave rise to the FAO (1993) chambo project, which, on the basis of extensive biological and socio-economic modelling, developed management recomendations for the chambo fishery. Essentially, the project showed that the decline of the chambo stocks was a result of excessive fishing effort on the adult stock by gill nets and chambo seines and excessive capture of juveniles by the nkacha and kambuzi seines (FAO 1993a). It is also likely that the destruction of inshore and offshore weedbeds by the beach seine and nkacha fishery has contributed to the decline in the stocks by destroying important habitat (Tweddle et al. 1994, Banda et al. 2002).

FAO (1993) Project assessments showed that rebuilding of the chambo stocks to levels which would sustain a chambo fishery approximating a 4kt per annum MSY would take a minimum of 6 to 8 years if all fishing was halted, or more than 10 years if nkacha and kambuzi seines were banned

from the fishery but gill nets and chambo seines were allowed to remain in operation (FAO 1993a). However, the total closure of the entire fishery as well as the closure of the kambuzi seine and nkacha net fishery was considered unacceptible due to the expected loss of livelihood for a large sector of the population, which at that time had considerable interests in the kambuzi fishery (FAO 1993a). Furthermore, concerns that a management strategy based solely on chambo would leave the kambuzi stocks underexploited lead to the development of a management strategies for rebuilding of the chambo stocks to allow for an annual yied of 1,000 tons while maintaining a kambuzi fishery. In all scenarios where nkacha and kambuzi seines were allowed to operate, the rebuilding of the chambo stocks was slow, with at least 5 years being necessary for catches to exceed 1kt. However, participatory consultations with the fishing community (Bell & Donda 1993) lead to a final management strategy for the fishery whose objectives were to rebuild the chambo stock to yield 1kt per annum while maintaining high yields from the kambuzi fishery. This was to be achieved through: (1) limiting effort to 1992 levels; (2) banning the small-meshed kambuzi seines; and (3) introducing minimum mesh sizes for the remaining fisheries.

Recent reductions in fishing effort, attributed to emigration of fishers to more profitable fishing grounds rather than to effective impementation of the management recommendations, have not lead to increased chambo yield (Banda et al. 2002). This may be due to either or a combination of the following factors:

1. The chambo stocks may be reduced to such low levels that not enough recruits are produced to allow for the rebuilding of the stock.
    a. The existing nkacha fishery, even at relatively low effort levels, may be exerting enough pressure on the juvenile secton of the stock that recruitment is hindered.
2. The destruction of weedbeds may have resulted in a reduction of juvenile habitat which severely affected recruitment (Alimoso & Tweddle 1995).

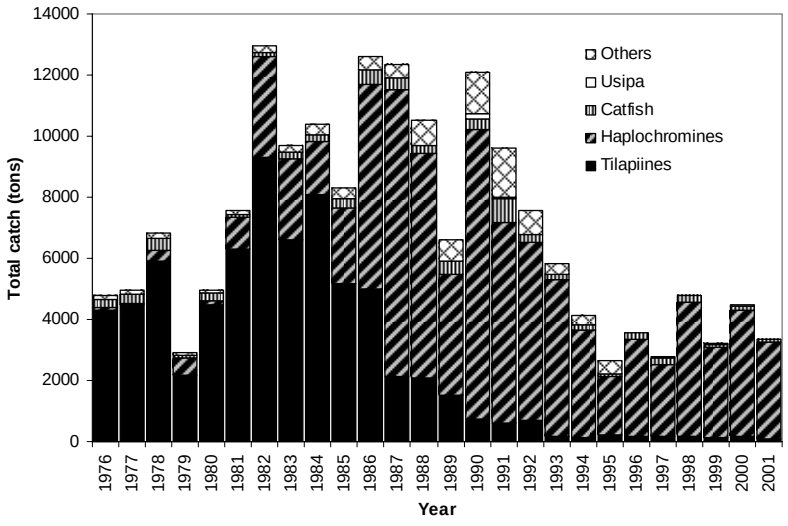

Figure 2.15 Total catch by species group in Lake Malombe 1976 – 2001
(after Banda et al. 2002)

It is therefore likely that the chambo and kambuzi fisheries are mutually exclusive and that a management strategy maintaining relatively high yields of both kambuzi and chambo is not feasible. For this reason, the DoF has presented two separate management options, which focus either on implementing FAO (1993) recommendations for rebuilding chambo stocks to an MSY of 4kt or, on the sustainable utilisation of the kambuzi fishery.

Kambuzi

With catches having decreased from 9.4kt in the early 1987 to less than 4kt in 2000 and 2001, there is little doubt that the kambuzi fishery in Lake Malombe is in a state of decline. Surplus production models indicate that the nkacha net fishery should be effort-limited to between 160 and 180 units to maintain an MSY of between 5kt and 7kt (Figure 2.16). It must however be recognised that the kambuzi fishery is in a state of depression with MSY having been surpassed in the late 1980s and early 1990s and temporary effort reductions to levels below those leading to MSY may be necessary to rebuild the stocks. However, the presence of only 154 nkacha gears in the lake in 2001 (Weyl et al. 2001) presents the opportunity to limit effort at this level until an increase in CPUE and catch is realised. Under good management the fishery may yield either 4kt of high value chambo or up to 7kt of relatively low value kambuzi.

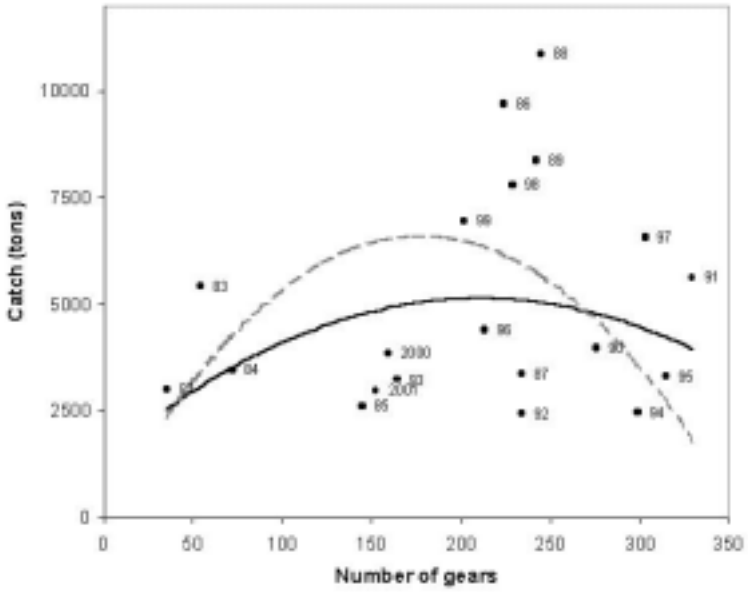

Figure 2.16 Schaefer (dotted line) and Fox (solid line) model fits to catch and effort data for the kambuzi fishery of Lake Malombe (1982-2001). Effort = total number of kambuzi and nkacha seines (after Banda et al. 2001)

2.3 Lakes Chilwa, Chiuta and the Lower Shire River

2.3.1 Lake Chilwa

Although it is the second largest lake in Malawi, Lake Chilwa is subject to extreme fluctuations, including complete desiccation (Lancaster, 1979). Minor recessions in lake level, sufficient to reduce fishing for one or two years, can be expected every six years (Allison et al. 2001) while major recessions which will interfere with fishing in the open lake for 3-5 years can be expected every 60-70 years, with a possibility of an intermediate recession in 30-40 years (Lancaster, 1979). The correlation between the hydrological cycle and fish catches are outlined in Allison et al. (2001). The last drying episode covered the period from late 1994 to 1996, when fishing ceased altogether. Subsequent filling of the lake allowed fishing operations to recommence in April 1997 (Nyasulu, 2001). Since the last period of desiccation, the lake has fluctuated around 1850 km^2 including both open-water and wetland areas and is less than 3 m deep (Allison et al. 2001).

Due to the unstable nature of the lake, the fish fauna is dominated by only three species, matemba *Barbus paludinosus* (43%), mlamba *Clarias gariepinus* (18%) and O*reochromis shiranus* (24%).

Catch statistics from Lake Chilwa were summarised by Ngochera et al. (2001). Annual catch from Lake Chilwa have ranged from about 1kt to 24kt in the 1980s (Figure 2.17). Matemba seines, fish traps, gill nets and long lines have been the main contributors to the total catch. However, their contributions have changed considerably. From 1976 to 1981, fish traps dominated the catches where after matemba seines have been the most productive fishery. The species composition has remained constant in Lake Chilwa and all species groups contribute significantly towards the annual total catch. Due to the effect of the hydrological cycle on the fisheries potential of Lake Chilwa, no increase in production can be guaranteed and the average yield from this water body since 1976 was in the region of 10kt.

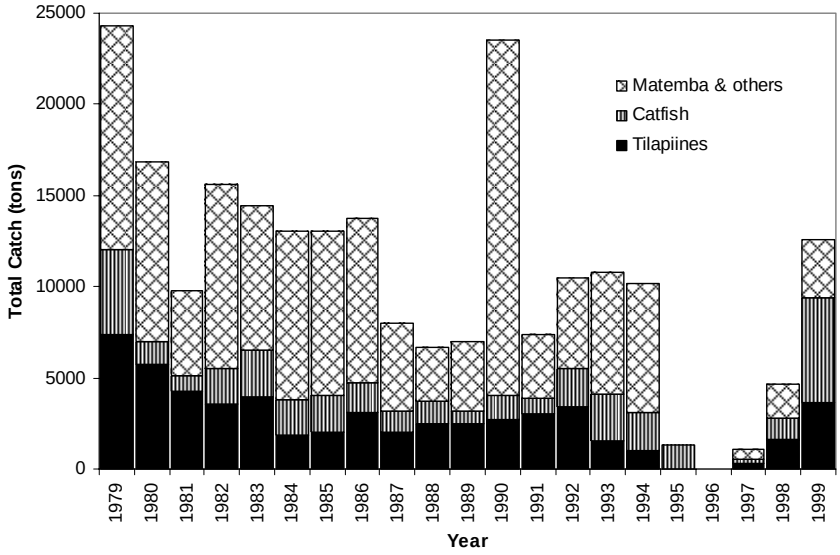

Figure 2.17 Total catch by species group in Lake Chilwa 1976 – 2001

2.3.2 Lake Chiuta

Lake Chiuta is a permanent lake (Tweddle 1983) covering a mean area of 199km^2, oscillating between a minimum area of 93km^2 and a maximum of 304km^2 according to season and rainfall (Nyasulu 2002). The depth of Lake Chiuta varies with season and the lake has a maximum depth of 3 to 4 metres. It lies on the Malawi-Mozambique border between latitudes 14^{0}40' and 14^{0}56', and longitudes 35^{0}47' and 35^{0}55' a few kilometres to the north of Lake Chilwa. The lake is separated from Lake Chilwa by a sand bar, some 15 – 25m higher than the present lake levels and has several terraces indicating higher water levels in the past. Lancaster (1979) suggests that Lake Chilwa became isolated from Lake Chiuta by the sand bar between 8 000 and 15 000 years ago. Although the lake is smaller than Lake Chilwa, it has more fish species than the latter. The difference may be a result of a combination of high salinity, turbidity and other factors in Lake Chilwa, which may restrict the distribution of some species to the rivers and areas of fresher in-flowing water around the periphery of the lake during the rains. However, as in Lake Chilwa, the fishery of Lake Chiuta is dominated by mlamba, matemba and makumba.

According to the 1999 Frame Survey (Weyl et al. 2000), Lake Chiuta had 801 fishermen using 416 canoes and one plank-boat without an engine. The current gear utilisation in Lake Chiuta, with the exception of 4 mosquito nets and 78 hand-lines, is totally reliant on passive gear (Weyl et al. 2000) and Tweddle (1983) reported that the development of a fishery on a large commercial scale was not feasible on Lake Chiuta due to the high proportion of the lake which is covered with emergent vegetation.

Total estimated catch between 1979 and 1999 shows an increasing trend (Figure 2.18). Estimated catches ranged from some 700 tons to 5kt with an average of 2kt. Makumba dominated the total catch with a mean contribution of 76%. The contribution of mlamba to the total catch has increased from the 1990s. Although wide fluctuations are evident, there appears to have been some inconsistency in data recording and catches of up to 3kt are possible. MSY for the fishery of Lake Chiuta has been estimated at some 2.5kt (Nyasulu et al. 2002).

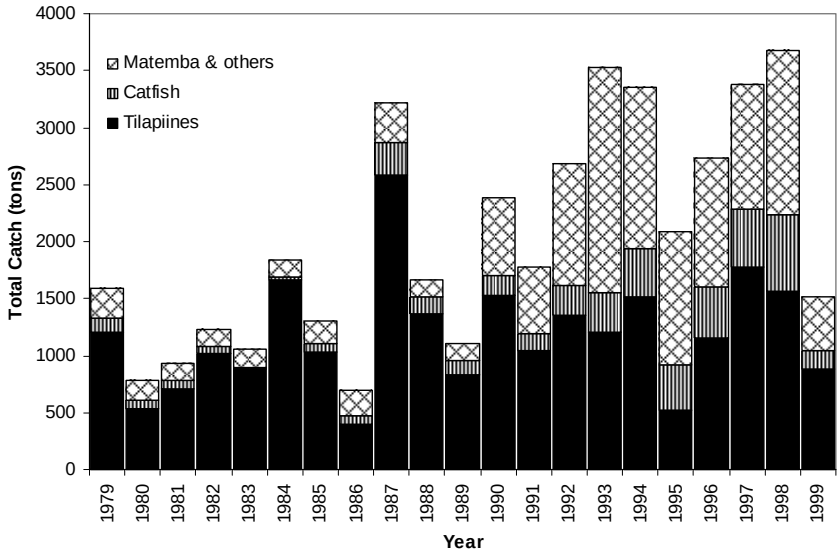

Figure 2.18 Total catch by species group in Lake Chiuta 1976 – 2001

2.3.3 Lower Shire River

The physical attributes of the Lower Shire River, which stretches from the Kapichira Falls to the end of Ndindi Marsh on the border with Mozambique (34º50'-35º17'E and 15º29'-17º05'S). Its boundaries are well defined by dominant physical features. To the east it is bordered by the intensely eroded Thyolo Mountains; to the north by the Kapichila Falls; to the west, by the low-lying hills that include the southern-most end of the Kirk Range; and in southwest by the Matandwe and Namalombo hills extending south from Bangula. Here, the floodplain system is characterised mainly by the Elephant, Eastern and Ndindi Marshes.

The Kapichira Falls marks the boundary between the Middle Shire and Lower Shire River. The Kapichira Falls and the Middle Shire rapids and falls have been described as an environmental and ecological barrier to the upstream migration of the Lower Zambezi fauna (Tweddle & Willoughby 1979). The altitude fall of the Lower Shire is from about 107 m.a.s.l. at Chikwawa to 61 m.a.s.l. at Nsanje (SVADD 1975). Below the Kapichira Falls, the Shire is dominated by Elephant, Eastern and Ndindi Marshes and flows to its confluence with the Lower Zambezi River for a distance of 200 km. The Elephant (473–500 km^2), Eastern (200 km^2) and Ndindi (150 km^2) marshes occur at approximately 50 m.a.s.l. The drought of 1992 and below-average rainfall over five subsequent years (1993-1998) reduced the level of Lake Malawi to a record low of 473 m.a.s.l. This in turn reduced the daily mean flow in the Shire River as little as 130 $m^3.sec^{-1}$ in 1997. Since 1998 river flow has increased, remaining well above 170 $m^3.sec^{-1}$.

The fish fauna of the Lower Shire River is essentially Zambeziine (Tweddle & Willoughby 1977) and the fishery is dominated by catfish and the tilapiine cichlids *Oreochromis mossambicus* and *O. shiranus* (Figure 2.20). Trends in catch and effort in the Lower Shire fishery have been assessed by Tweddle (1995) and further data for analysis was obtained from the FRU database. Catches from the Lower Shire River have been rather erratic and appear to be influenced by the hydrological cycle

in the floodplain. A decline in Total catch from some 11kt to 3kt was observed in 1992 but the reasons for this are unclear (Figure 2.19). However, for long term planning an average of 5kt could be expected.

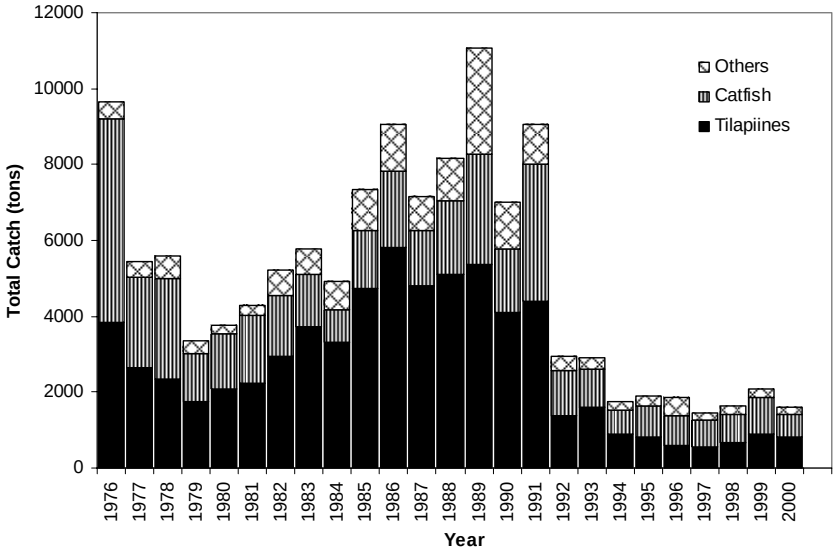

Figure 2.19 Total catch by species group in the Lower Shire River 1976 – 2000

3. National fish supply and overall potential

The overall national fish supply to Malawi is shown in Figure 3.1. Since 1976, the total fish supply has fluctuated between 40kt and 76kt with no definite trend (Figure 3.1). The contribution of each major fishery to the total catch also fluctuated, but Lake Malawi (57%) was the most important contributor to the annual fish supply, followed in importance by Lake Chilwa (18 %), Lake Malombe (12 %), the Lower Shire River (9 %) and Lake Chiuta (3%).

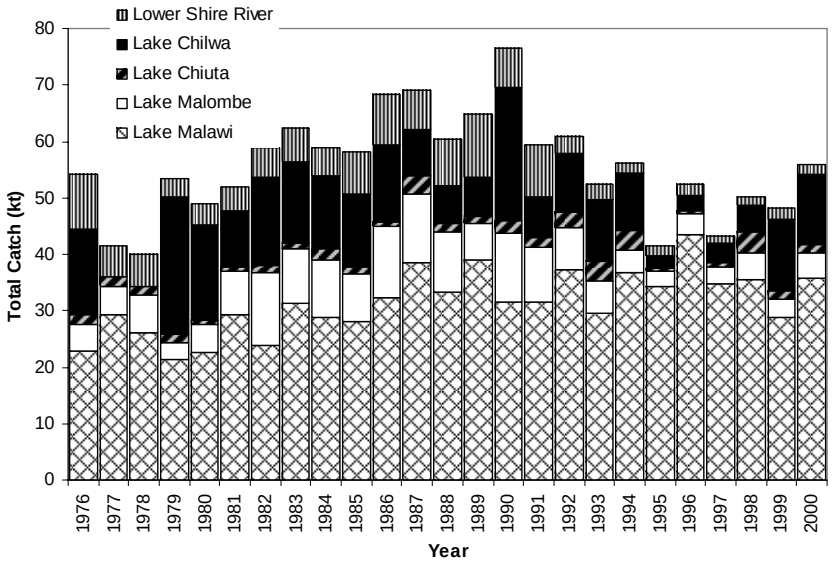

Figure 3.1 National fish supply by water body 1980 to 2000

While there was a general stability in the supply from the fisheries sector, increasing population growth in Malawi has lead to a decline in per capita fish supply. The population increased at an annual rate of 3.8% until 1987 and subsequently decreased to 2% per annum between 1988 and 1998 (NSO 2000). Over a 20 year period from 1980 to 2000, the population of Malawi grew from some 6.2 million to more than 10 million (NSO 2000). Since fish supply from the capture fisheries sector remained relatively constant, the per capita fish supply decreased from 7.9 kg per person to less than 5.5 kg per person in 2000. The decrease in Tilapiine catch from an estimated 21kt to 7kt during the same period lead to a decrease in supply of this fish from 3.4 kg per person in 1980 to less than 1 kg per person in 2000 (Table 3.1).

Table 3.1 Malawi population, total catch from all capture fisheries, tilapia catch from all fisheries and the per capita supply of fish and tilapia from 1980 to 1999. Population data was obtained from NSO 2000 and projections using incremental growth rate were used. 1987 and 1998 were NSO population survey years

Year	Population	Total catch	Fish supply kg.person.yr	Tilapiines	Tilapia supply Kg.person.yr
1980	6.2	49.0	7.9	21.2	3.4
1981	6.4	51.9	8.1	19.0	3.0
1982	6.7	58.9	8.9	21.6	3.2
1983	6.9	62.3	9.0	20.6	3.0
1984	7.2	58.9	8.2	22.6	3.2
1985	7.4	58.1	7.8	21.2	2.9
1986	7.7	68.4	8.9	22.8	3.0
1987*	**8.0**	**69.2**	**8.7**	**18.7**	**2.3**
1988	8.1	60.4	7.4	17.0	2.1
1989	8.3	64.8	7.8	15.1	1.8
1990	8.5	76.6	9.0	13.1	1.5
1991	8.6	59.4	6.9	13.7	1.6
1992	8.8	60.9	6.9	10.8	1.2
1993	9.0	52.5	5.8	9.5	1.1
1994	9.2	56.1	6.1	7.5	0.8
1995	9.4	41.5	4.4	5.0	0.5
1996	9.5	52.4	5.5	3.4	0.4
1997	9.7	43.3	4.4	2.9	0.3
1998*	**9.9**	**50.3**	**5.1**	**5.3**	**0.5**
1999	10.1	48.2	4.8	7.2	0.7
2000	10.3	55.9	5.4	7.2	0.7

Remarks: * 1987 and 1998 are actual NSO survey years. The population increased at an annual rate of 3.8% until 1987 and subsequently decreased to 2% per annum between 1988 and 1998 (NSO 2000).

Two options for increasing fish through capture fisheries need to be considered. These are:

- Good management of capture fisheries to ensure that yields are maintained at sustainable levels.
- Harvest of underexploited or unexploited resources from the capture fisheries.

A summary of potential yields from various capture fisheries sources is shown in Table 3.2. While MSY estimates presented in previous sections of this report are for the purpose of providing total yield potentials from Malawi's water bodies, they can only be achieved through good management. MSY estimates for Lake Malombe are 7kt (Banda et al. 2002) and 2.5kt for Lake Chiuta (Ngochera et al. 2002). For Lake Chilwa and the Lower Shire River the influence of environmental factors negated the calculation of MSY and the average of the 1976 to 1999 fish production was some 10kt for Lake Chilwa and 5kt for the Lower Shire River.

Under good management, the inshore fisheries of Lake Malawi can be expected to yield some 33.3kt. While the total possible sustainable yield from the deep water demersal and the pelagic fishery approximates some 43kt, there are some constraints to harvesting these resources. Seymour (2001) lists the following potential production opportunities some of which may be technically feasible and financially viable:

1. Development of a mechanised fishery for offshore pelagic species, probably by pelagic trawling. This has already been initiated by Maldeco but there is ample room for expansion.
2. Development of artisanal/small-scale mechanised fisheries for offshore pelagic species, probably targeting the high-value Rhamphochromis spp. and possibly based on longlines or gillnets. A small artisanal handline fishery for Rhamphochromis already exists in northern Lake Malawi.
3. Development of a mechanised (trawl) fishery for deep-water demersal stocks. This has been initiated by Maldeco, but again there is room for additional entrants.
4. Development of an artisanal/small-scale mechanised fishery for deep-water demersal stocks, probably by gillnetting. Small artisanal deep-water gillnet fisheries exist in Karonga and Tanzania.
5. Rehabilitation and technical development of the pair trawl fishery to target small demersal shallow-water cichlids in southern Lake Malawi. Further north the stocks would not appear to be adequate to sustain this fishery without damaging existing artisanal fisheries.
6. Development of an artisanal/small-scale mechanised fishery for small demersal shallow-water cichlids beyond the beach fringes.
7. Extension of the "traditional" artisanal fisheries further offshore in areas where suitable habitat and stocks exist.
8. Enhancement of the existing artisanal fisheries by improving management, drawing from a wide range of potential management measures including entry and effort limitation, closed or limited-fishery areas and prohibition or restriction of harmful gears.

The Department of Fisheries through the support of the African Development Bank is planning to address at least some of these potentials (S.J. Donda pers comm). The project aims to increase production by 11kt from the pelagic zone. When this is viewed in conjunction with the current harvest of 3kt of pelagic species by the small scale sector, a potential medium term harvest of 14kt could be expected from the pelagic stock. This estimate appears realistic as a long term harvest as it must be noted that the pelagic assessments were based on the entire lake and that considerable quantities of pelagic species may be landed by the other riparian states, Tanzania and Mozambique. It would therefore be myopic to assume a total availability of 33kt of pelagics for Malawi alone. While no strategies are currently in place to expand the demersal fishery in Malawi, investment opportunities exist and there is a potential for the full exploitation of this fishery in the next 25 years. Therefore a potential total contribution of 24kt may be expected from these sectors. The total, albeit optimistic 2025 yield from Lake Malawi could be in the region of 57kt. This combined with the other capture fishery areas gives an overall potential long-term yield from Malawi's capture fisheries is estimated at 78kt (Table 3.2).

Table 3.2 Summary of long-term potential yields from Malawi's capture fisheries by 2025

Capture Fishery Area	Potential Yield	Comment
Lake Malawi Inshore	31kt	at MSY
Lake Malawi Demersal Stock	8.5kt	at MSY
Lake Malawi Pelagic Stock	14kt	11kt from ADB Project targets and 3kt already harvested by various sectors
Lake Malombe	7kt	at MSY
Lake Chiuta	2.5kt	at MSY
Lake Chilwa	10kt	1976 – 1999 average
Lower Shire	5kt	1976 – 1999 average
Total	78kt	

With Malawi's population growth at 2 % per annum (NSO 2000), the total population by the year 2025 is expected to be in the region of 17 million. If catch levels remained at 2000 levels of 55kt, per capita supply would decrease to less than 3.3 kg per person per year. However, if the total potential yield 78kt was realised, the per capita supply of fish from capture fisheries would decrease to 4.6 kg per person per year.

4. Status of Malawi's fisheries and research priorities

With a demand for 95kt in 2025, the continued supply from capture fisheries is vital. However, there is evidence of over utilisation in almost all of Malawi's major fisheries. Bulirani et al. (1999) assessed various resources of the capture fisheries sector using a precautionary reference point based on the estimating relative biomass reduction, from decreases in CPUE over time. The main findings of ther study were that:

- The status of the traditional (inshore) fisheries seemed to be markedly worse than that of the large scale commercial (offshore) fisheries.
- Only two of the traditional fisheries out of 7 are above the precautionary reference point and 4 were close to or below the absolute predefined precautionary limit. Furthermore, only two of the 9 inshore fish stocks analysed were above the precautionary limit.
- In the large scale commercial sector, on the other hand, 4 out of 6 fisheries are well above the precautionary limit.

Bulirani et al. (1999) hypothesised that the main reason for this difference was probably related to the increase in effort for inshore fisherieswhile offshore effort has been variable or declining. Excessive fishing effort was also found to be the main cause for the chambo stock collapse and subsequent reduction of yield in the kambuzi fishery in Lake Malombe.

Table 4.1 A summary of status of fisheries and fish stocks in Malawian waters 1999 (after Bulirani et al. 1999)

Fish Stock(s)	Fishery/Survey	Waterbody	Area(s)	Long term trends (1976-96)			
				Catch	Effort	CPUE	B_{cur} (%)
All	Traditional	South East Arm	All	Increasing	Increasing	Stable	111
All	Traditional	South West Arm	All	Variable	Increasing	Decreasing	35
All	Traditional	Upper Shire	All	Decreasing	Variable	Decreasing	25
All	Traditional	Lake Malombe	All	Decreasing	Increasing	Decreasing	20
All	Traditional	Lake Chilwa	All	Decreasing	Increasing	Decreasing	11
All	Traditional	Lake Chiuta	All	Decreasing	Increasing	Decreasing	21
All	Traditional	Lower Shire	All	Decreasing	Decreasing	Variable	51
All	Commercial dem.	South East Arm	B	Decreasing	Decreasing	Decreasing	42/65 *
All	Commercial dem.	South East Arm	C	Increasing	Increasing	Stable	63/88 *
All	Comm. pelagic	South East Arm	A-C	Decreasing	Stable	Decreasing	31
All	Semi-commercial	South East Arm	A	Variable	Variable	Stable	84
All	Semi-commercial	South West Arm	D	Variable	Variable	Stable	72
All	Semi-commercial	SWA-Salima	E-G	Decreasing	Decreasing	Stable	84
Chambo	Trad./Commer.	Lake Malawi	All	Decreasing	Increasing	Decreasing	32
Chambo	Traditional	Upper Shire	All	Decreasing	Variable	Decreasing	1 **
Chambo	Traditional	Lake Malombe	All	Decreasing	Decreasing	Decreasing	10
Kampango	Traditional	Lake Malawi		Decreasing	Increasing	Decreasing	43
Bombe	Trad./Commer.	Lake Malawi	All	Decreasing	Increasing	Decreasing	58/25 ***
Utaka	Trad./Commer.	Lake Malawi	All	Increasing	Increasing	Decreasing	37
Kambuzi	Traditional	Lake Malawi	All	Increasing	Increasing	Stable	88
Kambuzi	Traditional	Lake Malombe	All	Decreasing	Stable	Stable	33
Usipa	Traditional	Lake Malawi	All	Increasing	Increasing	Variable	197
Demersal	Monitoring Surveys	SE & SW Arms	A-F		Constant	Stable	93 ****

Remarks: * Means for 1991-93 and 1995-97 respectively. * Current CATCH (%). *** Means for 1994-96 and 1994 & 1996 respectively. **** CPUE 1999/mean CPUE 1994-96

During the Lake Malawi Fisheries Management Symposium in 2000, the two primary threats to the fishery were identified as: (1) environmental degradation and (2) overfishing. The key cause for environmental degradation was the lack of integrated catchment management, while overfishing was seen to be a consequence of limited sucess of fisheries management interventions (NARMAP 2001). The management of the capture fisheries sector at levels approximating MSY as well as the ensurance of environmental conditions that promote healthy fisheries is therefore of vital importance in the supply of fish to Malawi. During the Lake Malawi Fisheries Management Symposium in 2001, recommendations were made pertaining to social fisheries research, fisheries monitoring and taxonomic research. Priority areas were listed as:

- Dissemination of research results to the fishing community.

- Socioeconomic research to determine:

1. The factors controlling the behaviour of the fishers.
2. The social characteristics of the fishing community utilising the various fish stocks.
3. How the acceptance of regulations could be improved in the fishing community.
4. How management interventions could best be implemented in the Malawian context.
5. How management advice should be relayed to resource managers and communities.
6. A legal framework governing access rights to fishing resources.
7. The main sources of conflict between fishing sectors that constrain management.

- Regular fisheries monitoring including:
    1. Regular monitoring of commercial trawl catches.
    2. Independent monitoring trawl surveys by the FRU.
    3. Continued catch and effort monitoring of the small-scale fisheries.

- Research on the exploitation strategies for under-exploited deepwater and pelagic stocks to determine:
    1. Methods for deepwater and pelagic stock exploitation by the small scale fisheries sector.
    2. Why these stocks not exploited by the commercial/ small scale sector.
    3. What the constraints are towards developing fisheries for pelagic stocks.

- The qualification of various stocks to determine:
    1. The unit stock for fish in Lake Malawi, taking into account the highly diverse ichthyofauna.
    2. The species and/or groups of species which form lake-wide or single stocks and which form localised stocks.
    3. The state of these stocks in the lake and in localised areas.
    4. Whether area specific management is feasible.
    5. The various fishing sectors and define their utilisation patterns.
    6. The biology and population structure of major target species in the fishery for the use of analytical fisheries management models.

- Economic research to determine:
    1. The market system on local and regional levels.
    2. The economics of the small scale and large scale fishery.
    3. The economic forces driving the small-scale fisheries.
    4. The use and flow of capital gained from fishing at community level.
    5. The economic benefits of fishing to the local non-fishing community.

- Taxonomic research including the development of a standard field guide for the fishes of Lake Malawi.

5. Reservoirs and small rivers

Apart from the major capture fisheries areas of Malawi, there exist a large number of smaller dams and rivers, all of which have some capture fisheries potential. The ALCOM database lists more than 750 small water bodies in Malawi. A considerable amount of these may have some fisheries potential and undoubtedly these systems are already utilised by small-scale fishers (pers obs). However, the extent of this exploitation is not known and it is likely that there could be considerable expansion and perhaps enhancement of at least some of these fisheries. It is therefore highly recommend that information on the potential of these smaller water bodies be collected.

6. Imports and aquaculture

Import and export data on Malawi fisheries is rather scarce with some statistics kept by the National Statistics Office in Zomba. Fish imports and exports from 1997 to 2000 were compiled by Njaya (2001) and are shown in Table 6.1. Imports ranged from 0.4kt in 1998 to 2.8kt in 1999 with a drop to 1.6kt in 2000.

Table 6.1 Fish imports and exports (tons) from 1997-2000 (Source: Njaya 2001)

Year	Imports	Exports
1997	759.8 t	5.0 t
1998	444.2 t	0.1 t
1999	2,808.4 t	3.9 t
2000	1,630.7 t	

The NAC 2001/2002 annual report (NAC 2002) reports the number of fish farmers and ponds by region as well as total annual aquaculture production figures for the nation (Table 6.2). NAC (2002) estimates that total of 4 000 fish farmers with 9 500 ponds produce some 800 tons of fish per year. Unfortunately, the report does not list total pond area and therefore fish yield was calculated as 82.3 kg per pond for comparison purposes. This estimate is considerably higher than that estimated from available data and the actual yield may be considerable lower (pers obs). The annual production estimates are therefore considered a first estimate. The proportional contribution of imports and aquaculture to the total fish supply was less than 2 % and are considered marginal.

Table 6.2 Number of fish farmers and ponds by region for the year 2002 and annual total aquaculture production from 1995 to 2002.

Year	Region	Farmers	# of Ponds	TFP (Tons)
1995				200
1996				210
1997				250
1998				340
1999				550
2000				640
2001				750
2002	Northern	1,350	3,100	
	Central	1,200	2,900	
	Southern	1,500	3,500	
	Total	4,050	9,500	800

TFP = Total Fish production (Source: NAC 2002)

7. Conclusion

Per capita fish supply in 1972 was some 12 kg per person per year (Njaya 2001). Since current per capita supply is less than half of the 1972 estimate, it is believed that there is currently a significant local demand for fish (Njaya 2001). This is in part illustrated by Weyl (2001) who showed that beach price increases for the main commercial fish categories in 2000 were considerably higher than Malawi's average inflation rate of 35.2%. Furthermore, given the finite nature of Malawi's fisheries resource, the per capita supply of fish from capture fisheries by 2025 is likely to be reduced to 4.6 kg per person per year, if all underutilised resources are harvested and if the inshore stocks are harvested at sustainable levels. If fish supply is to be maintained at the 2000 level, a total of 95kt will have to be produced. This is 17kt more than can be realised from capture fisheries. This shortfall will have to be met by either imports, aquaculture or through the enhancement of the existing fisheries.

Attachment

Attachment 1

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Attachment 2

Tables

Table A 1.1 National fish yield (metric tons) by major contributing fishery 1976 – 2000

Year	Total Catch	Lake Chilwa	Lake Chiuta	Lower Shire River	Lake Malawi	Lake Malombe & Upper Shire River
1976	54,062	15,115	No data	9,659	24,512	4,776
1977	41,388	No data	No data	5,438	31,012	4,937
1978	39,999	No data	No data	5,600	27,558	6,841
1979	53,475	24,310	1,589	3,349	21,310	2,917
1980	48,971	16,839	777	3,778	22,608	4,969
1981	51,946	97,97	937	4,278	29,375	7,559
1982	58,881	15,567	1,230	5,225	23,923	12,936
1983	62,253	14,447	1,053	5,787	31,289	9,677
1984	58,884	13,027	1,839	4,922	28,723	10,375
1985	58,122	13,040	1,306	7,351	28,111	8,314
1986	68,420	13,720	698	9,041	32,343	12,618
1987	69,174	7,990	3,222	7,156	38,476	12,330
1988	60,444	6,719	1,660	8,178	33,352	10,535
1989	64,764	7,023	1,109	11,056	38,969	6,607
1990	76,557	23,562	2,381	6,997	31,533	12,084
1991	59,357	7,389	1,773	9,050	31,520	9,625
1992	60,926	10,454	2,687	2,958	37,257	7,570
1993	52,531	10,810	3,532	2,893	29,485	5,811
1994	56,078	10,156	3,350	1,747	36,691	4,134
1995	38,143	1,328	2,084	1,900	30,178	2,653
1996	48,946	Lake dry	No data	1,848	43,526	3,573
1997	43,535	1,069	3,374	1,449	34,854	2,789
1998	42,546	4,662	3,679	1,621	27,792	4,793
1999	44,623	12,566	1,519	2,085	25,222	3,231
2000	37,736	No data	No data	1,602	31,644	4,490

Table A 1.2 Catch (metric tons) by main gear type from Lake Malawi 1974 – 2001

Year	Total Catch	Beach seines	Gill nets	Hooks	Open water seines	Other	Pair trawl	Purse seines	Stern trawls
1974	6,805	No data	No data	No data	No data	No data	2,511	733	3,561
1975	9,370	No data	No data	No data	No data	65	2,180	1,835	5,289
1976	24,512	4,186	6,787	582	5,190	175	2,381	1,418	3,792
1977	31,012	4,436	12,450	598	6,770	26	1,877	755	4,099
1978	27,558	3,889	8,458	607	7,496	82	2,036	184	4,805
1979	21,310	1,776	6,533	678	4,897	172	2,948	582	3,724
1980	22,608	887	7,148	418	7,308	129	2,132	1,080	3,507
1981	29,375	1,771	7,624	831	11,761	55	2,578	1,380	3,374
1982	23,923	3,047	9,631	556	3,676	47	1,818	1,571	3,576
1983	31,289	2,494	9,412	553	11,358	87	2,152	2,331	2,902
1984	28,723	3,584	8,062	505	9,019	93	2,562	2,276	2,622
1985	28,111	4,453	7,706	562	7,422	91	2,573	1,749	3,555
1986	32,343	3,492	7,009	504	14,327	123	2,257	1,509	3,121
1987	38,476	5,742	6,094	954	18,027	269	3,465	1,259	2,665
1988	33,352	5,919	6,729	739	12,613	137	3,345	785	3,085
1989	38,969	8,624	6,947	974	16,482	115	3,156	413	2,259
1990	31,533	6,729	6,798	1008	10,740	52	3,069	785	2,353
1991	31,520	5,471	8,148	1018	10,395	230	3,026	617	2,615
1992	37,257	9,463	5,832	811	15,536	27	2,791	995	1,802
1993	29,485	7,324	5,783	996	11,768	23	2,231	314	1,046
1994	36,691	3,091	6,612	846	21,351	15	2,440	106	2,230
1995	30,178	3,935	5,621	1027	14,377	8	2,075	39	3,097
1996	43,526	11,509	4,212	345	24,458	14	1,209	50	1,728
1997	34,854	3,910	4,716	515	22,048	4	1,412	19	2,230
1998	27,792	4,233	3,744	275	15,868	18	754	44	2,857
1999	25,222	3,425	4,598	640	12,874	12	946	15	2,713
2000	31,644	2,615	7,633	627	17,069	0	863	93	2,742

Remarks: Catch statistics for the mall scale fishery were only kept after 1976.

Table A 1.3 Catch (metric tons) by main gear type from Lake Malombe 1976 – 2001

Year	Total Catch	Beach seines	Gill nets	Hooks	Open water seines	Other
1976	4,776	339	4,430	4	0	3
1977	4,937	577	4,289	0	71	0
1978	6,841	2,918	3,916	8	0	0
1979	2,917	927	1,984	6	0	0
1980	4,969	1,754	3,215	0	0	0
1981	7,559	2,884	4,675	0	0	0
1982	12,936	8,630	4,135	0	171	0
1983	9,677	4,641	3,715	0	1,321	0
1984	10,375	4,338	5,404	1	632	0
1985	8,314	4,166	4,140	8	0	0
1986	12,618	7,658	4,438	17	505	0
1987	12,330	9,986	2,344	0	0	0
1988	10,535	8,925	1,609	0	0	0
1989	6,607	4,145	2,008	0	454	0
1990	12,084	5,918	966	0	5,200	0
1991	9,625	6,016	912	0	2,696	0
1992	7,570	2,760	788	18	4,004	0
1993	5,811	1,242	163	0	4,406	0
1994	4,134	567	150	0	3,417	0
1995	2,653	324	170	0	2,158	0
1996	3,573	223	264	0	3,086	0
1997	2,789	240	338	0	2,212	0
1998	4,793	38	382	0	4,373	0
1999	3,231	50	249	0	2,931	0
2000	4,490	134	486	4	3,865	0
2001	3,353	184	167	7	2,995	0

Table A 1.4 Lake Chilwa total catch by main contributing gear 1976 – 1999

Year	Total Catch	Beach seines	Gill nets	Hooks	Open water seines	Other
1976	15,115	7,399	1,985	1,722	0	4,009
1979	24,310	2,352	6,559	946	1,471	12,982
1980	16,839	2,541	4,679	631	24	8,964
1981	9,797	1,243	3,688	480	0	4,385
1982	15,567	11,506	2,180	691	9	1,181
1983	14,447	8,201	1,833	610	461	3,343
1984	13,027	9,658	1,121	514	268	1,465
1985	13,040	8,959	395	620	83	2,982
1986	13,720	7,649	621	608	2	4,841
1987	7,990	2,801	1,252	613	0	3,324
1988	6,719	3,202	1,628	575	0	1,313
1989	7,023	3,158	1,570	334	0	1,961
1990	23,562	18,097	2,046	688	0	2,731
1991	7,389	4,586	1,231	816	0	756
1992	10,454	6,409	1,936	1,063	0	1,047
1993	10,810	6,761	1,232	1,589	0	1,228
1994	10,156	7,952	867	556	0	781
1995	1,328	998	218	73	0	39
1996						Lake dry
1997	1,069	744	158	65	0	102
1998	4,662	2,967	757	469	1	469
1999	12,566	3,818	2,987	3826	0	1,935

.Remarks: Data for 1977 and 1978 were lost and that zero catch in 1996 was due to the desiccation of the Lake

Table A 1.5 Catch by main gear type from Lake Chiuta 1979 – 1999

Year	Total Of Total Catch	Beach seines	Gill nets	Hooks	Open water seines	Other
1979	1,589		1,507	31		51
1980	777		716	19		42
1981	937	2	881	25		29
1982	1,230	257	864	21		87
1983	1,053	125	906	4		17
1984	1,839	881	935	4		19
1985	1,306	166	1,057	0		83
1986	698	71	521	20		86
1987	3,222	1,736	1,077	201		208
1988	1,660	850	672	47		91
1989	1,109	387	701	9		11
1990	2,381	1,379	831	39		132
1991	1,773	586	974	25		188
1992	2,687	1,218	831	91		547
1993	3,532	1,289	997	107	15	1,122
1994	3,350	1,929	712	297		412
1995	3,189	1,510	524		1,034	345
1997	2,789	1,670	45	46	771	257
1998	3,679		1,633	150		1,896
1999	1,519	26	974	57		463

Table A 1.6 Lower Shire River total catch by main contributing gear 1976 – 1999

Year	Total Catch	Beach seines	Gill nets	Hooks	Other
1976	9,659	670	6,543	731	1,715
1977	5,438	903	2,661	598	1,277
1978	5,600	487	3,463	502	1,148
1979	3,349	97	1,839	433	980
1980	3,778	267	2,000	550	962
1981	4,278	168	2,385	721	1,005
1982	5,225	694	2,741	408	1,383
1983	5,787	860	2,866	392	1,669
1984	4,922	648	2,251	227	1,796
1985	7,351	758	4,448	307	1,837
1986	9,041	623	5,705	649	2,064
1987	7,156	1,476	3,338	482	1,860
1988	8,178	1,737	3,965	565	1,912
1989	11,056	808	5,747	596	3,905
1990	6,997	585	2,719	559	3,133
1991	9,050	739	4,586	1,267	2,457
1992	2,958	893	769	411	884
1993	2,893	448	686	278	1,482
1994	1,747	228	394	129	996
1995	1,900	253	298	112	1,237
1996	1,848	359	359	101	1,029
1997	1,449	127	517	78	726
1998	1,621	457	448	77	638
1999	2,085	150	1,035	54	845
2000	1,602	25	577	51	949

Table A 1.7 Total catch by major species group from the Domira Bay area of Lake Malawi 1976 – 2000

Year	Tilapiines	Haplochromines	Catfish	Usipa	Others	Total
1974	2	252	9	0	14	276
1975	0	92	3	0	64	160
1976	9	656	14	0	19	698
1977	125	2,041	405	4	242	2,818
1978	133	2,923	494	0	62	3,613
1979	205	2,058	780	0	364	3,407
1980	318	1,665	818	0	351	3,153
1981	252	1,570	624	0	127	2,574
1982	427	525	836	25	260	2,073
1983	297	753	812	0	220	2,082
1984	170	1,404	436	0	124	2,134
1985	120	428	296	0	35	879
1986	97	596	178	71	99	1,034
1987	72	1,632	164	33	56	1,956
1988	50	1,343	180	162	17	1,751
1989	121	2,082	369	203	29	2,804
1990	76	1,327	437	6	17	1,863
1991	21	745	132	271	1	1,170
1992	11	697	100	38	188	1,034
1993	26	851	93	262	51	1,284
1994	5	1,746	33	18	122	1,924
1995	25	442	3	181	14	666
1996	4	505	5	162	23	699
1997	0	248	8	421	25	702
1998	0	227	16	120	12	375
1999	2	381	9	21	4	416
2000	313	2,252	54	102	34	2,756

Table A 1.8 Total catch by major species group from the Nkhotakota area of Lake Malawi 1976 – 1999

Year	Tilapiines	Haplochromines	Catfish	Usipa	Others	Total
1976	158	1,023	229	231	266	1,907
1977	110	54	111	8	154	436
1978	492	312	513	13	386	1,716
1979	332	1,025	273	75	136	1,841
1980	442	1,506	468	2	152	2,569
1981	417	2,581	351	5	339	3,694
1982	318	786	349	295	199	1,946
1983	520	1,445	452	83	203	2,704
1984	870	3,548	362	1	745	5,525
1985	760	1,734	331	172	272	3,270
1986	489	4,998	364	236	250	6,337
1987	795	6,353	484	773	473	8,878
1988	533	3,458	511	1,036	393	5,931
1989	655	2,045	462	752	431	4,345
1990	685	3,204	509	236	482	5,117
1991	283	2,179	393	74	410	3,339
1992	692	1,286	453	415	704	3,549
1993	923	3,705	653	481	887	6,649
1994	1,040	5,930	823	477	749	9,019
1995	296	3,255	905	1,335	1,140	6,931
1996	500	4,263	343	3,094	428	8,627
1997	180	2,705	263	1,431	543	5,122
1998	201	3,956	320	3,228	1,130	8,834
1999	214	2,475	359	689	299	4,035

Table A 1.9 Total catch by major species group from the Karonga area of Lake Malawi 1980 – 2000

Year	Tilapiines	Haplochromines	Catfish	Usipa	Others	Total
1980	133	473	60	7	27	700
1981	87	479	97	0	34	697
1982	47	580	60	187	67	941
1983	69	682	88	9	37	885
1984	73	785	186	12	103	1,159
1985	176	527	152	70	148	1,072
1986	112	654	129	72	128	1,095
1987	134	328	184	250	300	1,196
1988	36	314	142	667	366	1,526
1989	64	731	169	107	204	1,275
1990	76	896	206	54	375	1,607
1991	103	921	218	30	415	1,687
1992	73	876	159	771	358	2,237
1993	84	613	144	956	354	2,150
1994	98	973	203	329	330	1,933
1995	52	1,056	175	1,656	557	3,497
1996	31	1,055	95	356	263	1,801
1997	56	1,284	167	872	647	3,027
1999	41	953	270	421	741	2,427
2000	125	851	93	288	252	1,609

Table A 1.10 Total catch by major species group from the Likoma and Chizumulu Islands of Lake Malawi 1976 – 1999

Year	Tilapiines	Haplochromines	Catfish	Usipa	Others	Total
1976	119	2,667	808	16	130	3,741
1977	3	3,958	697	26	97	4,779
1978	3	893	55	29	9	989
1979	6	769	56	70	21	921
1980	10	803	84	1	18	916
1981	19	397	105	46	13	579
1982	9	261	110	79	47	506
1983	7	1,014	79	0	15	1,115
1984	25	515	102	0	31	673
1985	19	734	99	505	42	1,398
1986	17	1,158	73	146	18	1,412
1987	13	1,717	235	48	79	2,093
1988	29	1,040	166	102	67	1,404
1989	5	458	57	92	36	649
1990	2	510	177	8	31	726
1991	10	411	71	90	26	608
1992	17	519	76	125	119	856
1993	10	442	103	57	121	733
1994	4	355	163	414	89	1,024
1996	6	74	38	1	1	120
1997	6	98	28	0	18	150
1999	4	1,241	46	0	11	1,303
2000	2	344	2	0	2	350

Table A 1.11 Total catch by major species group from the Nkhata Bay area of Lake Malawi 1976 – 1999

Year	Tilapiines	Haplochromines	Catfish	Usipa	Others	Total
1976	50	457	241	452	253	1,453
1977	98	373	499	122	307	1,399
1978	52	445	198	105	96	896
1979	16	206	369	256	384	1,231
1980	54	753	245	130	358	1,541
1981	80	960	279	101	202	1,621
1982	113	583	475	588	283	2,042
1983	96	933	329	157	153	1,669
1984	139	1,233	317	2	141	1,832
1985	80	1,594	322	655	153	2,804
1986	92	1,169	199	745	128	2,333
1987	71	980	352	953	185	2,541
1988	93	1,292	297	269	238	2,189
1989	181	1,198	681	1,833	327	4,219
1990	85	2,667	494	438	345	4,028
1991	50	1,302	476	106	293	2,227
1992	18	713	403	1,353	556	3,042
1993	35	699	616	1,068	571	2,989
1994	25	902	526	3,073	844	5,369
1996	18	440	90	1,255	98	1,901
1997	83	2,131	219	2,652	505	5,590
2000	204	892	344	1,523	8	2,971

Table A 1.12 Total catch by major species group from the Southeast arm of Lake Malawi of Lake Malawi 1976 – 2001

Year	Tilapiines	Haplochromines	Catfish	Usipa	Others	Total
1974	1,249	4,656	339	0	157	6,402
1975	1,754	4,881	154	0	1,133	7,922
1976	3,467	4,611	977	307	917	10,065
1977	5,743	4,510	1228	709	631	12,675
1978	4,385	5,903	926	225	391	11,790
1979	3,441	4,856	731	158	391	9,525
1980	3,782	5,399	634	42	237	10,093
1981	3,909	6,222	740	103	276	11,218
1982	5,739	3,697	856	306	273	10,784
1983	6,475	7,543	719	547	160	15,438
1984	6,627	5,353	1134	150	242	13,506
1985	6,634	4,120	546	1,639	206	13,130
1986	5,368	3,900	829	2,482	196	12,773
1987	3,657	8,073	777	1,137	301	13,934
1988	3,150	5,700	459	1,049	115	10,473
1989	3,716	5,977	391	6,908	317	17,304
1990	4,027	7,189	535	448	334	12,532
1991	4,426	4,836	442	2,562	515	12,781
1992	3,556	4,529	636	5,762	833	15,310
1993	2,590	3,210	630	2,867	312	9,605
1994	1,103	8,605	863	987	487	12,040
1995	937	6,819	465	4,181	619	13,004
1996	1,620	8,415	317	11,878	83	22,287
1997	1,955	7,152	372	4,487	180	14,140
1998	1,451	5,739	321	3,613	234	11,334
1999	950	7,036	250	2,774	249	11,259
2000	1,487	14,991	691	945	95	18,210
2001	1,718	20,927	453	2,569	248	25,914

Table A 1.13 Total catch by major species group from the Southwest arm of Lake Malawi of Lake ,Malawi 1976 – 2001

Year	Tilapiines	Haplochromines	Catfish	Usipa	Others	Total
1974	0	23	5	0	98	127
1975	16	1,159	9	0	104	1,289
1976	879	2,555	1,461	1,169	584	6,648
1977	2,941	1,815	2,302	960	887	8,906
1978	2,838	3,063	1,150	1,159	344	8,554
1979	800	1,425	742	1,206	211	4,384
1980	542	1,896	783	267	148	3,636
1981	1,136	5,856	1,233	430	337	8,992
1982	1,879	1,383	846	1,194	328	5,631
1983	1,618	2,608	827	2,059	284	7,396
1984	540	2,105	797	92	358	3,892
1985	1,699	2,627	612	352	271	5,556
1986	968	2,236	1,453	2,295	406	7,358
1987	913	3,961	987	1,553	465	7,878
1988	1,578	6,237	769	940	555	10,078
1989	881	3,767	954	2,206	565	8,373
1990	374	3,812	567	505	399	5,659
1991	1,297	2,844	2,996	1,684	887	9,708
1992	1,042	5,878	509	3,177	622	11,229
1993	300	3,268	906	1,079	522	6,075
1994	375	2,804	617	787	799	5,382
1995	517	1,742	1,250	1,790	781	6,080
1996	563	2,529	529	4,077	393	8,091
1997	283	2,132	284	3,119	305	6,122
1998	297	2,496	452	3,588	415	7,248
1999	224	3,120	476	1,101	861	5,783
2000	309	3,130	349	1,462	1,961	5,749

Table A 1.14 Total catch by major species group combined for all strata of Lake Malawi Lake Malawi of Lake Malawi 1976 – 2001

Year	Tilapiines	Haplochro mines	Catfish	Usipa	Others	Total Catch
1976	4,681	11,970	3,730	2,175	2,169	24,512
1977	9,019	12,752	5,242	1,829	2,318	31,012
1978	7,903	13,539	3,336	1,531	1,288	27,558
1979	4,800	10,339	2,952	1,765	1,507	21,310
1980	5,280	12,495	3,093	449	1,291	22,608
1981	5,900	18,064	3,428	685	1,329	29,375
1982	8,532	7,815	3,533	2,673	1,457	23,923
1983	9,083	14,978	3,307	2,854	1,072	31,289
1984	8,445	14,943	3,334	,257	1,744	28,723
1985	9,489	11,764	2,358	3,392	1,126	28,111
1986	7,144	14,712	3,226	6,045	1,224	32,343
1987	5,654	23,043	3,184	4,747	1,858	38,476
1988	5,468	19,384	2,523	4,226	1,751	33,352
1989	5,624	16,259	3,083	12,100	1,908	38,969
1990	5,325	19,606	2,925	1,694	1,983	31,533
1991	6,189	13,238	4,729	4,816	2,548	31,520
1992	5,409	14,498	2,336	11,640	3,379	37,257
1993	3,968	12,788	3,144	6,769	2,818	29,485
1994	2,649	21,315	3,228	6,083	3,420	36,691
1995	1,828	13,315	2,798	9,143	3,111	30,178
1996	2,741	17,281	1,417	20,823	1,290	43,526
1997	2,563	15,750	1,340	12,981	2,223	34,854
1998	1,949	12,418	1,109	10,549	1,791	27,792
1999	1,435	15,206	1,410	5,006	2,166	25,222
2000	2,440	22,460	1,533	4,321	2,352	31,644

Table A 1.15 Total catch by major species group combined for Lake Malombe 1976 – 2001

Year	Tilapiines	Haplochromines	Catfish	Usipa	Others	Total Catch
1976	4,300	93	241	0	143	4,776
1977	4,462	75	311	0	90	4,937
1978	5,894	376	369	1	201	6,841
1979	2,191	547	107	0	72	2,917
1980	4,497	98	286	0	88	4,969
1981	6,322	1,005	126	0	106	7,559
1982	9,308	3,296	154	0	179	12,936
1983	6,600	2,670	206	0	201	9,677
1984	8,069	1,745	248	0	312	10,375
1985	5,191	2,475	281	0	366	8,314
1986	4,989	6,704	483	0	441	12,618
1987	2,131	9,410	351	4	433	12,330
1988	2,096	7,323	274	9	833	10,535
1989	1,523	3,975	400	9	700	6,607
1990	734	9,486	331	207	1,326	12,084
1991	598	6,582	786	28	1,631	9,625
1992	686	5,857	236	1	790	7,570
1993	189	5,103	180	9	331	5,811
1994	138	3,535	152	15	293	4,134
1995	217	1,900	101	1	433	2,653
1996	155	3,208	182	0	28	3,573
1997	165	2,370	209	0	46	2,789
1998	159	4,412	194	1	26	4,793
1999	123	2,968	94	1	45	3,231
2000	184	4,136	120	21	29	4,490
2001	67	3,179	82	23	2	3,353

Table A 1.16 Total catch by major species group combined for Lake Chilwa 1976 – 2001

Year	Tilapiines	Catfish	Matemba	Others	Total catch
1976	1,883	4,545	6,783	1,903	15,115
1979	7,383	4,690	5,735	6,502	24,310
1980	5,741	1,221	5,356	4,520	16,839
1981	4,304	856	1,681	2,956	9,797
1982	3,579	1,907	9,660	,421	15,567
1983	3,926	2,627	6,750	1,145	14,447
1984	1,854	1,968	8,935	270	13,027
1985	1,998	2,029	8,145	868	13,040
1986	3,142	1,572	6,336	2,670	13,720
1987	1,987	1,186	2,621	2,196	7,990
1988	2,474	1,273	1,570	1,391	6,719
1989	2,502	656	2,998	868	7,023
1990	2,682	1,393	14,971	4,516	23,562
1991	3,038	860	1,942	1,549	7,389
1992	3,399	2,083	2,527	2,445	10,454
1993	1,515	2,607	5,381	1,306	10,810
1994	1,035	2,049	6,245	827	10,156
1995	6	1,296	26	0	1,328
1996	Lake dry				
1997	325	245	479	20	1,069
1998	1,623	1,161	1,844	34	4,662
1999	3,619	5,778	3,156	13	12,566

Table A 1.17 Total catch by major species group combined for Lake Chiuta1976 – 2001. No data were available for 1996

Year	Tilapiines	Catfish	Matemba	Others	Total catch
1979	1,210	118	28	233	1,589
1980	531	78	16	151	777
1981	705	79	11	142	937
1982	1,020	58	41	110	1,230
1983	879	18	91	65	1,053
1984	1,664	28	13	133	1,839
1985	1,035	69	13	190	1,306
1986	392	79	42	185	698
1987	2,585	289	61	287	3,222
1988	1,369	141	16	133	1,660
1989	832	122	8	147	1,109
1990	1,530	167	484	200	2,381
1991	1,039	147	245	342	1,773
1992	1,357	253	362	715	2,687
1993	1,204	343	588	13,96	3,532
1994	1,520	414	437	980	3,350
1995	525	392	44	11,25	2,086
1997	1,782	500	0	10,94	3,376
1998	1,569	664	270	11,76	3,679
1999	882	166	3	468	1,519

Table A 1.18 Total catch by major species group for the Lower Shire River 1976 – 2000

Year	Tilapiines	Catfish	Others	Total Catch
1976	3,825	5,369	464	9,659
1977	2,637	2,408	393	5,438
1978	2,340	2,664	596	5,600
1979	1,751	1,257	341	3,349
1980	2,070	1,465	243	3,778
1981	2,240	1,799	239	4,278
1982	2,937	1,615	674	5,225
1983	3,728	1,370	688	5,787
1984	3,320	872	730	4,922
1985	4,723	1,552	1,077	7,351
1986	5,825	2,018	1,198	9,041
1987	4,790	1,486	879	7,156
1988	5,122	1,913	1,143	8,178
1989	5,368	2,915	2,773	11,056
1990	4,108	1,660	1,230	6,997
1991	4,402	3,597	1,050	9,050
1992	1,365	1,221	371	2,958
1993	1,590	1,003	300	2,893
1994	881	650	216	1,747
1995	827	822	252	1,900
1996	601	792	455	1,848
1997	561	711	177	1,449
1998	656	769	197	1,621
1999	880	989	216	2,085
2000	823	611	168	1,602

Remarks: No data were available for 1996

Table A 1.19 Mean beach fish price (MK/Kg) for major commercial fish categories landed in Lake Malombe January 1994 – December 1997

Year	Month	Chambo	Kambuzi	Kampango	Mcheni	Mlamba	Mpasa	Usipa	Utaka
1998	Jan.	19	2	14		12			
1998	Feb.	18	3	12		11		5	
1998	Mar.	20	4	12		11	11	5	
1998	Apr.	27	5	12		12	16	7	
1998	May	26	6	15		14	27		
1998	Jun.	34	8	13		11	27		
1998	Jul.	24	7	14		12	41		
1998	Aug.	25	7	14		12	30		
1998	Sep.	25	7	15		10	27		
1998	Oct.	26		11		10	33	9	
1998	Nov.	24	11	12		10	25	12	
1998	Dec.	21	12	8		7		9	
1999	Jan.	20	4	11		8	28	7	
1999	Feb.	20	4	12		9	20		
1999	Mar.	26	5	15		10	10	7	
1999	Apr.	27	8	16		11	47	11	
1999	May	40	11	18		12	26	14	
1999	Jun.	38	12	21		15	65	9	
1999	Jul.	40	11	22		17	33	11	
1999	Aug.	31	10	19		15	14	14	
1999	Sep.	26	12	24		18		13	
1999	Oct.	36	13	18		15		13	
1999	Nov.	40	21	15		13		15	
1999	Dec.	43	17	21		13		14	
2000	Jan.	40	6	18		15		16	
2000	Feb.	32	6	21	17	14		7	
2000	Mar.	27	9						
2000	Apr.	37	8						
2000	May	32	9						
2000	Jun.	45	11						
2000	Jul.	51	13						
2000	Aug.	34	13						
2000	Sep.	50	18						
2000	Oct.	50	30						
2000	Nov.	58	17						
2000	Dec.	71	20						
2001	Jan.	35	9						
2001	Feb.	56	8						
2001	Mar.	45	10						
2001	Apr.	58	12						
2001	May	50	15						
2001	Jun.		15						
2001	Jul.	41	19						
2001	Aug.	29	22						
2001	Sep.	49							
2001	Oct.	72							
2001	Nov.	72							
2001	Dec.	83							

Source: FRU

Table A 1.20 Mean beach fish price (MK/Kg) for major commercial fish categories landed in the southeast arm of Lake Malawi January 1994 – December 1997

Year	Month	Chambo	Kambuzi	Kampango	Mcheni	Mlamba	Mpasa	Usipa	Utaka
1994	Jan.	4	2	2	1	2	4	2	2
1994	Feb.	4	2	2	3	2	2	2	2
1994	Mar.	5	3	2	1	2	1	2	2
1994	Apr.	6	3	2	1	2	6	2	2
1994	May	6	2	3	3	2		2	2
1994	Jun.	6	3	3	3	2	5	3	2
1994	Jul.	6	3	3	4	2	5	3	2
1994	Aug.	6	3	4	4	3		3	3
1994	Sep.	7	3	3	3	3	2	2	2
1994	Oct.	8	3	4	4	3		2	3
1994	Nov.	7	4	3	4	3		2	3
1994	Dec.	10	4	3	3	4		2	3
1995	Jan.	7	3	3	3	3	3	3	3
1995	Feb.	8	2	3	4	3	5	3	4
1995	Mar.	7	3	4	3	4	4	4	5
1995	Apr.	9	3	4	4	4	10	3	4
1995	May	10	4	5	3	5		3	4
1995	Jun.	15	5	6		5		4	5
1995	Jul.	13	5	4	5	4	10	5	6
1995	Aug.	15	5	5	5	5		5	6
1995	Sep.	14	6	6	4	7		5	6
1995	Oct.	12	5	6		6		5	5
1995	Nov.	13	7	5	7	6		8	4
1995	Dec.	15	6	7	6	6		5	5
1996	Jan.	11	3	7		6		4	5
1996	Feb.	12	5	7	5	6		3	5
1996	Mar.	13	4	7	3	5	16	4	6
1996	Apr.	10	4	6	3	6	10	4	6
1996	May	5	4		4			8	4
1996	Jun.	16	6			15			6
1996	Jul.	15	5	7	8	6	9	6	8
1996	Aug.	18	7	11	13	6	11	7	7
1996	Sep.	15	5	7	7	6	9	4	7
1996	Oct.	17	4	7	6	7		5	7
1996	Nov.	17	6	7	5	9		7	5
1996	Dec.	13	7	17	5	6		3	7
1997	Jan.	16	6	7	7	7		7	5
1997	Feb.	14	4	5	3	6	10	6	6
1997	Mar.	14	4	9		6	12	7	6
1997	Apr.	14	6	5	16	11	3	7	8
1997	May	21	7	7	8	6		9	6
1997	Jun.	17	9	8	7	8		6	7
1997	Jul.	21	7	8	16	10	14	7	8
1997	Aug.	20	7	10	11	10		5	8
1997	Sep.	19	5	15	9	8		5	8
1997	Oct.	19	5	8	9	9	6	5	
1997	Nov.	16	16	9	21	7		5	10
1997	Dec.	18	6	8	21	9		5	8

Source: FRU

Table A 1.20 Mean beach fish price (MK/Kg) for major commercial fish categories landed in the southeast arm of Lake Malawi January 1998 – December 2001

Year	Month	Chambo	Kambuzi	Kampango	Mcheni	Mlamba	Mpasa	Usipa	Utaka
1998	Jan.	17	6	18		14		6	6
1998	Feb.	20	7	12		11	6	5	8
1998	Mar.	18	8	4		6		5	3
1998	Apr.	19		14		7		6	5
1998	May	20	9	8		10		7	4
1998	Jun.	25	10	9		9	12	11	8
1998	Jul.	31	11	12	12	23	7	11	11
1998	Aug.	22	7	14		7		12	11
1998	Sep.	24	11	12		7	6	11	11
1998	Oct.	27	11	20	4	16	26	14	9
1998	Nov.	28	14	17		18	30	17	11
1998	Dec.	20	12	11		8		18	7
1999	Jan.	28	8	10		19	7	16	9
1999	Feb.	26	9	11		8	11	17	9
1999	Mar.	31	11	17		10	6	12	9
1999	Apr.	30	14	19	15	11		16	16
1999	May	45	16	23		21	11	25	21
1999	Jun.	46	19	11		23	15	26	23
1999	Jul.	57	20	38		35		24	25
1999	Aug.	47	9		6	16		9	11
1999	Sep.	44	17	28	22	38	38	18	19
1999	Oct.	49	19	27	15	32	28	13	21
1999	Nov.	54	16	37	21	27			19
1999	Dec.	54	21	18	32	26			19
2000	Jan.	56	13	24	17	29		20	18
2000	Feb.	38	15	21	15	20		10	14
2000	Mar.	35	14						
2000	Apr.	49	11						
2000	May	54	13						
2000	Jun.	42	19						
2000	Jul.	45	14						
2000	Aug.	79	13						
2000	Sep.	76	12						
2000	Oct.	88	20						
2000	Nov.	76	22						
2000	Dec.	73	21						
2001	Jan.	68	14			20			
2001	Feb.	67				27			
2001	Mar.	59				20			
2001	Apr.	69				30			
2001	May	65				18			
2001	Jun.	83				23			
2001	Jul.	72				15			
2001	Aug.	58				17			
2001	Sep.	86				26			
2001	Oct.	57							
2001	Nov.	67	25						
2001	Dec.	54							

ADiM Working Paper 2

Situation Analysis of Aquaculture in Malawi

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Situation Analysis of Aquaculture in Malawi

Contents

Attachment

1. Introduction

This report reviews the history of aquaculture in Malawi, the national aquaculture policy and the fisheries act, the current status, and the impact of donor funded aquaculture support projects. It further provides an overview of past and present extension, research and development initiatives and culminates in an analysis of "lessons learnt". The report also considers the prospects of aquaculture in Malawi. Collectively this provides some of the background information required for, and serves as a contribution to the development of an Aquaculture Master Plan for the country.

The information contained in this report was drawn from published papers in the primary literature, government and donor project reports, data obtained from the National Aquaculture Centre and WorldFish Center at Domasi as well as from interviews conducted with the Director and senior staff of the Fisheries Department, aquaculture research and extension staff at the National Aquaculture Centre at Domasi, the Central and Northern Regions Fish Farming Centre in Mzuzu and discussions with academic staff of the University of Malawi as well as personal experience and field notes based on discussions with fish farmers throughout Malawi.

The report is structured as follows. It is prefaced with a review of the national fisheries and aquaculture policy (2001) and the Fisheries Conservation and Management Act (1997). This provides the foundation upon which to examine the current status and developments in fish farming in the country. This is followed by an historical account of the sector since its early beginnings in the mid 1940's and an analysis of technological developments, successes and failures of small scale and "commercial" aquaculture in the country. Finally, the report focuses on aquaculture development opportunities, possible strategies for development and these are considered in light of the National Decentralisation Policy (1998).

2. Fisheries and Aquaculture Policy

To develop an Aquaculture Master Plan for Malawi, it is necessary to examine the National Fisheries ad Aquaculture Policy in the light of the recently (December 2002) adopted vision and mission statement of the Department of Fisheries as well as its new goal and strategic operational objectives to achieve the goal.

Vision

"To be a dynamic, high performance, consultative and client focussed Department that promotes, builds and ensures sustainable development, utilisation and management of the fisheries resources of Malawi"

Mission statement

"To provide framework conditions and excellent services for the maximisation of socio-economic benefits through sustainable utilisation and management of capture fisheries and increased aquaculture production"

Departmental goal

"Provide professional services to ensure sustainable fisheries utilisation and enhanced aquaculture through principles of good governance".

Strategic operational objectives

i. *All fisheries are managed according to operational management procedures*
ii. *Restructure, reorganise and strengthen the Department of Fisheries for effective internal, national and international communication.*
iii. *Strengthening user institutional capacity for fisheries resource management and governance.*
iv. *Update legislation and policy in line with other national policies and legal instruments.*

Strategic operational objective (iv) is of pivotal importance for the process of developing the Aquaculture Master Plan. In particular *"the Department of Fisheries recognises and strongly supports poverty reduction by undertaking to ensure the sustainable, responsible and optimal utilisation of the national fisheries resources and products, and to actively promote the development of aquaculture in Malawi, through research, user participation and education. Consequently the Department of Fisheries has prepared its developmental strategies in a manner that ensures optimal contribution towards the four pillars of the Malawi Poverty Reduction Strategy Paper"* (DoF 2002).

Never before have such strong statements of intent and commitment been made by the Department of Fisheries for the adoption and promotion of responsible of fisheries and aquaculture in the country and this strongly underpins the development of the Aquaculture Master Plan and its future implementation.

The principal goal for fish farming as described in the National Fisheries and Aquaculture Policy (2001) is *"to increase and sustain fish production from smallholder and large scale fish farming operations in order to improve the fish supply in Malawi"*. Four objectives (and associated strategies to achieve the objectives) are outlined in the Policy. These are:

Objective 1: To solve problems related to fish farming and the management of small water bodies through biotechnical research.

Strategies.

a. recommend suitable management strategies for achieving optimum fish growth and fish production at different production intensities
b. recommend brood stock and hatchery management strategies
c. develop protocols for the management and conservation of the genetic diversity of farmed fish
d. improve existing species through genetic selection, inbreeding and crossbreeding
e. establish collaboration between aquaculture and capture fisheries extension and research to exchange information and experiences
f. develop protocols to integrate fish farming into agriculture

Objective 2: To develop adaptive / appropriate recommendations for fish farming

Strategies

a. identify indigenous species for different climatic as well as agro-ecological zones for different scale of operations through on-farm research
b. prepare economic analysis for different scales of fish farming enterprises and advise farmers accordingly.
c. assess productivity of reservoirs and small water bodies and test stock enhancement, management and utilisation.
d. investigate socio-economic feasibility of the management of reservoirs and small water bodies.

Objective 3: To encourage farmers to adopt fish farming as a source of subsistence and income.

Strategies

a. create awareness about potential of and encourage fish farming
b. establish demonstration farms for integrated fish farming
c. co-operate with agricultural extension officers to broaden knowledge about target group behaviour
d. introduce and support participatory extension
e. monitor and evaluate fish farming extension regularly to analyse limitations and constraints in fish farming practice.
f. Co-operate closely and regularly with research projects and programmes on fish farming and exchange findings.

2.1 The need for a revision of the aquaculture policy and the act

The overall policy goal of fish farming is to improve fish supply in Malawi. Given the past performance of the sector this goal is over ambitious and hardly achievable and should be revised on the basis of a comprehensive social and economic analysis of fish farming in the country.

Instead development goals for small-holder and commercial aquaculture development should focus on

A: Small holder aquaculture

- Contributing towards poverty reduction and ensuring food security,
- Improving the protein supply in the diet of rural people, particularly those in areas remote from the countries traditional fish markets and fish trading routes.
- Optimal use of resources (land, water and farm by-products)
- Increasing farmer income through diversification (and integration) thereby enhancing the well being of small holder households,
- Improving scientist / farmer technology transfer

B: Commercial aquaculture

- Establishing, updating and maintaining an enabling investment environment, based on macro-economic indicators.
- Establishing capacity in industrial scale aquaculture research and promotion (All previous capacity building initiatives have focussed on small scale aquaculture. Unless the DoF develops capacity in commercial scale aquaculture this sector will struggle to get off the ground).

The three current objectives of the aquaculture policy goal are reasonable, although two additional objectives need to be incorporated into the policy. These are;

1. specific objectives for capacity building (and in particular aquaculture extension).
2. clearly defined goals and objectives for the NAC and other satellite aquaculture stations throughout the country.

The strategies to achieve the three current objectives of the policy are in many instances loose statements that lack any substance in terms of the “who, where, when, through what means and how”. Technically this makes the strategies a mere wish list. This needs to be corrected.

Some comment on the strategies is provided below:

Objective 1: To solve problems related to fish farming and the management of small water bodies through biotechnical research.

Comment: Firstly, suitable management strategies for achieving optimum fish growth and production have in many instances already been researched and developed. At this stage it is more important to develop a strategy for the dissemination of research information. Secondly, a strategy for the development of protocols for the management and conservation of genetic diversity of farmed fish is far-fetched and unrealistic at this stage of the development of the sector. Thirdly, the strategy to establish collaboration between capture and aquaculture extension and research is misplaced as there no cross cutting issues. The focus should rather be on developing a workable strategy for greater collaboration between agriculture and aquaculture extension staff.

Objective 2. To develop adaptive / appropriate recommendations for fish farming

The strategy to identify suitable indigenous species for different climatic and agro-ecological zones is not necessary as such findings have been published since the mid 1980s. Instead what is necessary is to develop a strategy as to how this information might be transferred most effectively to small-holder farmers. The strategies associated with reservoir and small water body fisheries management are misplaced. These fall squarely into the fold of capture fisheries development.

Objective 3. To encourage farmers to adopt fish farming as a source of subsistence and income.

The objective itself is poorly worded and if pursued could cause more damage than good. It must be born in mind that fish farming is not suited to all regions and to all households. There are certain minimum requirements that a farmer should meet before being encouraged to become a fish farmer. It is important therefore to change the wording such that it includes the words “were appropriate”.

The strategy to establish demonstration fish farms, as a source of encouragement, has become outdated since the mid 1990s. A more appropriate and useful strategy would be to assess how to make the existing demonstration units and farms more appropriate either as tools for the dissemination of information or as tools for the commercialisation of aquaculture in the country.

These comments are not exhaustive but they do serve as a basis for the argument that the policy, and by implication the act, needs to be revised.

3. History of aquaculture in Malawi

According to Meecham (1976) aquaculture in Malawi began in 1906, when rainbow trout (*Onchorhynchus mykiss*) was first introduced into the Mulunguzi Stream on the Zomba Plateau. Rainbow trout have also been stocked into various streams and ponds on estates in Mulanje, Southern Region during the 1930s and elsewhere since then (see below).

A Nutritional Survey team headed by Dr B.S.Platt in 1938 and a Fisheries Survey team (Bertram, Trewavas and Borley) in 1939 highlighted the importance of fish in the economy. The combined aims of their missions were:

- to survey the existing fisheries in the lake and determine the part played by fish in the national economy,
- to estimate the total fisheries resource of the lake and the extent of its exploitation,

- to study how best to exploit fish without damaging the main stocks and increase fish supply to the country.

They pointed out that improved access to fish would improve the nutrition of the rural population in areas away from the lakeshore. Follow-up activities to these surveys were disrupted by the outbreak of the Second World War in 1939. The results were first published in 1942 (Bertram *et aI.* 1942) with ten recommendations, five of which had implications for fish farming:

1. The government was to improve the availability of fish in the rural areas most remote from the lake.
2. The government was to organise the fish trade, which would include turning the desire for fish into a conscious demand for fish among Malawians in upland areas.
3. The government was to stock impounded waters in the uplands to increase the supply of fresh fish.
4. The government was to continue biological observations on fish species, including studies on breeding, feeding habits, growth rates and ecology of tilapias, *Labeo* spp., *Barbus* spp., *Haplochromis* spp., and *Engraulicypris* spp.
5. Observations were to be made on predator birds and crocodiles to understand the extent of their feeding on commercial species.

In 1950 the Game, Fish and Tsetse Control Department was established by the Colonial Government. This Department stationed a Trout Warden (A.V. Gifkins) at Nchenanchena to establish a trout hatchery in the North to stock rivers on the Nyika Plateau. The hatchery was stocked with 3,000 eyed rainbow trout ova from the River Research Station in Kenya and 10,000 from South Africa. An attempt was made in 1954 to hatch trout eggs from the founder population. Eyed ova from South Africa were also hatched *in situ* in the headwaters of the Wamukurumuzi River of the Kirk Range in 1956 (GNP 1957).

In addition to his work with trout, Gifkins also established several "coarse fish" ponds at Tipwiri, Nchenanchena, which he stocked with *Oreochromis shiranus* and *Tilapia rendalli* from Lake Malawi. His attempts at tilapia culture met with some success, producing up to 2.76 t/ha/yr using maize waste and 1.4 t/ha/yr using “green” compost. This generated substantial local interest, with many farmers building their own ponds. In response, the Department established a training and research centre close to the trout hatchery to train local farmers. Extension work by the Trout Warden and his staff was carried out over large parts of the Northern Region resulting in ponds being built in Livingstonia, Nchenanchena, Mzuzu, Chikwina and Nkhata Bay. By 1958 there were 52 ponds in the area. The yield from approximately half of these ponds with a combined area of 5.9 ha in 1958 was 1000kg.

The role of Nchenanchena as a focal point for tilapia culture, ended in February 1959 because rising political tensions and the onset of violence in the Northern Region necessitated the evacuation of Gifkins. Never the less, the legacy left by Gifkins in the Northern Region led to the adoption of fish farming by many small scale farmers in the region. He was reassigned to Domasi, near Zomba with the remit of building a new fish culture station. Three 0.1 hectare ponds were built in 1959 and stocked with 19 *T. rendalli* and 42 *O. shiranus shiranus* obtained from a reservoir belonging to the Imperial Tobacco Company at Limbe in 1960.

Domasi Experimental Fish Farm began to supply juvenile fish (*T. rendalli*) to farmers in 1960. (A total of 1,252 *T. rendalli* fry were provided to 4 farmers in the Southern Region in 1960). In 1960 a further 20 ponds (2.12 ha) were built at Domasi and another 4 ponds were built in 1961. From this

point onwards, Domasi became the main experimental and demonstration unit for aquaculture in the country.

The Nchenanchena station was re-opened in April 1961, which temporarily revived interest in aquaculture in the Northern Region. During the two-year break in activities, interest in aquaculture in the Nchenanchena area had dissipated, although ponds in the Chikwina area in Nkhata Bay district were still properly maintained. By the end of 1962 there were 141 ponds operating in the Northern Region. Support for the Nchenanchena farm declined after independence (1964) so that by the start of the EU Central and Northern Region Fish Farming Project in 1989, the ponds at Tipwiri had not held water for many years and any remaining farmers' ponds were almost totally unproductive.

The role of the Domasi Experimental Fish Farm was strengthened through the 1970s and 1980s with the activities and funding of a series of research projects. In 1991 it was renamed the National Aquaculture Centre (NAC). The NAC has received substantial long term support through MAGFAD (GTZ) and ICLARM (now WolrdFish Center), the NARMAP (GTZ) programme and the JICA project (see Section 4 of this report). The extension activities from Domasi and Zomba saw the development of smallholder aquaculture in the Southern Region, particularly in Zomba, Mwanza and Mulanje. Research ponds were built at Bunda College and became the source of fish seed for smallholder farmers in the Dedza area. A project based in Mulanje provided extension support to farmers in that area. The other main fish culture developments in Malawi have been a Government research and demonstration farm at Kasenthula near Chikwawa and commercial fish farms associated with the two main sugar estates at Dwangwa and Chikwawa.

The fish culture centre at Kasenthula in the Southern district of Chikwawa was established in 1970. The two main objectives of this station were to provide fish and fingerlings for local communities and to test fish farming technologies in the region.

The project preparation report for the Central and Northern Regions Fish Farming Project (LMA 1983 a and b) argued strongly for the need for a research and demonstration farm in Mzuzu. The facility was constructed and made operational during the early part of the CNRFFP, which began in 1989 and ended in 1995. Since 1992 this station has served the needs for research and extension mainly in the Northern Region and has had a major impact on the development of small scale fish farming there. Since 1996 small holder fish farming initiatives have been supported by the Border Zone Development Project funded principally through the GTZ.

Overall, there has been substantial investment in the establishment of research stations. In 1990 there were 12 government stations and substations and one operated by Bunda College. Together these facilities have more than 180 experimental ponds. In comparison to many African countries Malawi has an excellent research record (see Bibliography in AdiM Database). Unfortunately, as will become evident later in this report, the impact of the research has been relatively low.

4 Objectives and achievements of past and present donor funded and NGO supported aquaculture projects

The following section chronicles the history of donor funded aquaculture development projects in Malawi and lists their objectives, main activities and major achievements. It also provides information on the NGOs that are currently involved in aquaculture extension in the country.

4.1 Aquaculture Projects

i. FAO Kasenthula Project

Duration: 1970 - 1976

Objectives: Demonstrate commercial viability of aquaculture in Malawi.

Main activities:

- Construction of ponds and offices at Kasinthula
- Research on O. mossambicus, O. shiranus, T.rendalli and O. karongae as suitable candidates for aquaculture.
- Introduction of Chinese and Common Carp

Major achievements:

- Introduction of common carp.
- Successful stimulation of commercial aquaculture at Kasinthula and SUCOMA.
- Use of O. mossambicus and common carp at the Domasi.

Comments:

1. The introduction of common carp has been a controversial issue in Malawi and is dealt with later in this report.

2. While Kasenthula stimulated commercial aquaculture at SUCOMA (though short lived) it has not had the resources to demonstrate the commercial viability of aquaculture.

3. An application has recently (May / June 2002) been made by commercial interests to lease the farm from the Department.

ii. Mulanje/Phalombe ODA Project

Duration: 1987-1990

Objectives: Mitigate large deficit in animal protein consumption in the district by demonstrating and stimulating integrated aquaculture-agriculture practices.

Main activities:

- Construction of a station at Chisitu.
- Promotion of integrated fish farming practices and training of farmers

Major achievements:

- Established 146 fish farming families producing an estimated 2 tonnes /ha per family per annum in 1992.
- Trained Fisheries Department personnel to continue the work after completion of the project

iii. ICLARM/GTZ Aquaculture Project

Duration: 1986-1995

Objectives: Through collaborative biological and socioeconomic research to develop and demonstrate a more appropriate system for aquaculture in Malawi and to develop Domasi as the lead research centre.

Main activities:

- Development of National Aquaculture Centre infrastructure.
- Development of low-tech farming technologies.
- High level staff training.

- On-farm/On-station farmer participatory Research and Development

Major achievements:

- Development of aquaculture research facilities.
- Six staff trained from B.Sc. to M.Sc. levels.
- A basket of technologies defined for dissemination to farmers through extension service.
- Establishment of a library and information service for aquaculture.
- Development of R&D protocols and technologies for fish farming experimentation.
- Initiation of Research Extension Teams (RET) and training of extensionist in RESTORE field data collection from farmers.
- Introduction of seasonal fish farming in small water bodies (Thamandas in the Lower Shire).
- Initiation of selective breeding of tilapias at NAC

Comment:

1. The long-term involvement of the GTZ/ICLARM project as well as the MAGFAD and JICA projects (see below) and the present support of the WorldFish Centre has established Domasi as the undisputed aquaculture lead centre in Malawi.

2. Without donor support NAC would not be able to survive and this would have serious consequences for the development of the sector in the country. Strategies need to be developed to address this serious situation.

iv. Malawi German Fisheries & Aquaculture Development Project (MAGFAD)

Duration: 1989 - 1995

Objectives: To improve the standard of living of fisheries and fish farming communities.

Main activities:

- Test integrated aquaculture systems.
- Develop extension methods and materials.
- Develop and test potential “estate” (commercial) aquaculture models

Major achievements:

- Aquaculture staff trained through short courses, in-service training and study tours abroad.
- Development of extension aids.
- Fish farming promoted and small scale farmers trained in aquaculture techniques.

v. Central and Northern Regions Fish Farming Project

Duration: 1989-1995

Objectives: Phase 1 - Establish the technical and economic parameters for developing fish farming in the Central and Northern regions of Malawi.

Phase 2 – Not implemented

Main activities:

- Establish cost-effective extension service.
- Train farmers
- Train Fisheries Department staff.
- Determine the technical and economic viability of fish farming.
- Evaluate the potential for small water body development.

Major achievements:

- Major infrastructure development (regional headquarters and nine satellite stations).
- Extension service operational in 10 areas servicing 1,600 farmers spanning 2/3 of the country. More than 500 farmers trained.
- Viability demonstrated by 25 pond trials and 2 independent consultancies.
- Assessment of potential development of small water bodies completed.

Comment:

1. The Mzuzu station has unquestionably contributed towards the promotion of small-holder fish farming, particularly in the Northern region and to a lesser extent in the Central region.

2. The CNRFFC is a classic example for the need of the Department of Fisheries to develop innovative initiatives and plans for the maintenance of infrastructure and as well as of research & extension activities after donor support has ceased.

vi. JICA Aquaculture Project

Duration: 1996 to present

Objectives: Screen indigenous cyprinids for suitability in aquaculture and to promote on farm cooperative research.

Main activities:

- Development of hatchery and office infrastructure at NAC
- Rehabilitation of Kasinthula facilities.
- Staff and farmer training
- Development of breeding/hatchery techniques for indigenous cyprinids (Mpasa, Ntchira, Ningwi, Thamba, Kadyakolo)
- Development of suitable feeds and appropriate rearing techniques for the new species and current species.

Major achievements:

- On-going major infrastructure development at NAC, comprising hatchery, offices and laboratories, guest house and staff houses.
- Hatchery techniques for cyprinids have been defined and mass fingerlings are being produced.
- Feeds have been developed for different sizes of fish and rearing techniques for current and new species are being developed.
- Initiation of GMIT (all male tilapia production) experiments.
- Initiation of on-farm trials and continuation of integrated on-farm fish farming.

Comment:

1. Though good work has been done, there is an impression that the project was not adequately planned to meet the needs for the development of the sector.

vii. Border Zone Development Project (BZDP)

Duration: 1996 to present.

Objectives: The aim of the aquaculture component of this multifaceted development project was to enhance pond production through improved management and the integration of fish farming with other agricultural activities in the Nchenachena, Mpompha and Livingstonia areas.

Main activities:

- Selection of a core group of farmers for participation
- On farm participatory trials
- High level extension and farmer club formation
- Promotion of record keeping
- Farmer training in integrated agriculture technologies through workshops and on farm demonstrations
- On farm catfish spawning

Major achievements:

- Fish production of core group of farmers significantly enhanced through farm integration.

Comment:

1. The BZDP essentially stepped into the void left by the CNRFFP, when Phase 1 was terminated in 1995 and Phase 2 was not supported.

2. The focus on a small group of farmers was successful.

3. The project demonstrated the need for intensive high level extension in order to achieve success.

4.2 Non-Governmental Organizations (NGOs) in Aquaculture

There are 8 NGOs that are currently active in fish farming in Malawi. It was noted that there appears to be a serious lack of co-operation between NGOs, the Department of Fisheries and donor funded projects. This is a serious shortcoming that needs urgent attention by the Department of Fisheries. A possible mechanism would be the establishment of an Aquaculture Working Group consisting of all role players that co-ordinates the varied activities. The work of each NGOs is briefly described below.

i. Action Aid

This NGO has facilitated training of fish farmers in Mwanza, resulting to the construction of 19 fishponds with a total surface area of 3,925m^2 in Thambani area.

ii. World Vision International

This NGO is working with fish farmers in Zomba West (Chingale) and Mulanje. The National Aquaculture Centre has provided training to farmers from Chingale area, initial fingerlings, assistance in pond construction and advice on pond management. In Mulanje, staff at Chisitu has provided training to fish farmers in Thyolo at Masambanjati. In Ntchisi, World Vision International organized farmers' training programs or training of trainers for the Thondo area. A total of 32 farmers have been trained in:

- Irrigation farming systems
- Principles of fish farming practices
- Integrated farming systems

iii. CARD

This NGO is working in Mchinji district and has organized a training course for fish farmers and potential fish farmers in Mchinji district.

iv. COMPASS

This NGO has invited project proposals for communities to apply for grants on community participation on natural resources management. The projects should aim at conserving the diversity of natural fauna and flora. Four proposals have been submitted from fish farming communities in Dedza, Zomba, Mulanje and Mangochi. These proposals are awaiting final approval from Compass.

v. OXFAM

This NGO is active in Mulanje and is assisting farmers by supporting the extension services.

vi. Concern Universal

This NGO is operating in Dedza where fish farming has been stimulated in areas surrounding Bembeke, Mpalale and other areas. They are operating on a chick debt basis, i.e. the farmers are given free fingerlings so that they should also supply free fingerlings to others.

vii. Christian Council of Churches

This NGO is working in Phalombe area, where the targeted farming families are being encouraged to take up fish farming. Initial training courses on site selection and pond management have been conducted in the area.

viii. US Peace Corps

The US Peace Corp has been assisting fish farmers in the Rumphi area in integrated farming techniques.

5 Aquaculture in Malawi

5.1 Distribution and number of farms and ponds

The information on the number of ponds and farmers and Malawi is disparate and varies according to the source of information. Never the less, it is clear that the number of ponds and fish farmers has increased significantly in the last 15 years. In 1995 it was estimated that there were approximately 2000 small-holder fish farms in Malawi (Dickson & Brooks 1997). According to NAC (2003) the number of farmers have doubled to 4050 in 2002.

On a regional basis the estimated number of farmers and ponds and average pond size in 2001 and 2002 are shown in Table 5.1 and Figure 5.1 shows the distribution of the major fish farming areas in Malawi. Though this map was developed in 1983 it would appear that the general farmers distribution pattern has not changed.

Table 5.1 Total number of farmers and ponds per region in 2001and 2002 and average pond size

REGION	No. of farmers		No. of ponds		Average pond size (m^2)
	Year 2001	Year 2002	Year 2001	Year 2002	
South	1,500	1,500	3,278	3,500	200
Central	990	1,200	2,056	2,900	150
Northern	1,320	1,350	3,100	3,100	300
TOTAL	3,810	4,050	8,434	9,500	

Source: NAC 2001 and 2002 and Chimangesi 2002.

These figures show that that an additional 240 farmers took up fish farming between 2001 and 2002 and that they together with the existing farmers build an additional 1166 ponds during this period. Alternatively the figures may suggest a correction of the pond and farmer database. Either way, it is clear that these figures need to be validated. Unfortunately no information is available on how many

of the farmers are active and how many of the ponds are in production. Most of the new farmers who took up fish farming in 2002 are from the central region.

The high number of ponds in the Northern Region is principally a result of the intervention by the Central and Northern Region Fish Farming Project, which operated in the region from 1989 to 1995 (Dickson and Brooks 1997).

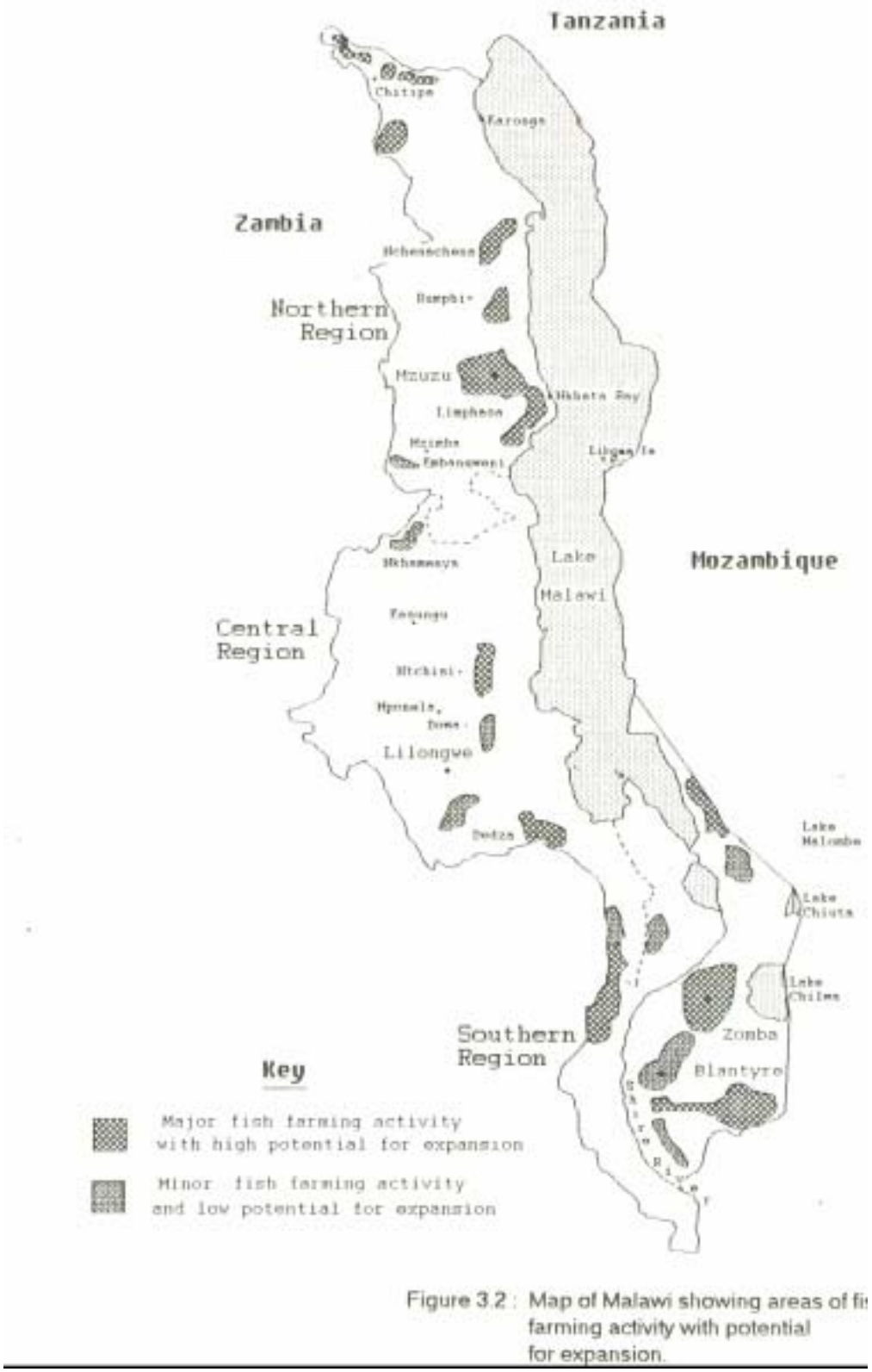

Figure 3.2 : Map of Malawi showing areas of fi
farming activity with potential
for expansion.

Figure 5.1 MAP1: Fish farming areas of Malawi (ICLARM Stud. Rev. 18, 1991)

5.2 Fish production

5.2.1 Country production

Country production figures are currently estimated as follows. Due to logistical and financial constraints and the lack of accurate farmer records, the number of active farmers, as well as the number and size of active ponds are enumerated annually in each extension area by fisheries officers stationed at satellite stations. The number of abandoned or new ponds are also counted. On the assumption that farmers harvest their fish once a year the total production per district is estimated by number of ponds x mean surface area of ponds in the area x average production per ha per year. This differs per region because of the difference in average pond size and availability of inputs. Average production in kg/ha/year per area is calculated from data collected by extension officers during their visits to farms on harvesting days. Total production for the country is then calculated by addition of the estimated total production per area for each district. NAC is of the opinion that the total production figure for the country is an underestimate because there are numerous farmers who are not registered with the fisheries / agriculture extension offices in the area and who prefer to work with NGO's.

Total aquaculture production in Malawi is currently estimated by the National Aquaculture Centre at 800 metric tones (Table 5.2), comprised of 93% tilapia (O.shiranus, O.karongae and T.rendalli), 5% catfish and 2% exotic species such as common carp, black bass and trout. In relation to capture fisheries the proportion produced by aquaculture (even if the total country production estimate is correct) is insignificant. Assuming that the production figures are correct then the contribution by aquaculture to total fish yield in 2000 was 1.3%.

Table 5.2 Malawi aquaculture production statistics 1995 – 2001 (NAC 2002)

Year	Production (metric tons)
1995	200
1996	210
1997	250
1998	340 (224)
1999	550
2000	640 (490)
2001	750
2002	800

The reliability of these figures is highly questionable. Production figures in parenthesis are figures obtained from other sources and these highlight the discrepancies.

Most of the fish is produced in the Southern Region in the Mulanje and Zomba areas. In the Northern Region the fish is produced mainly in the Rumphi district (Nchenanchena and Mpompha) and Nkata Bay. In the Central region the area around Dedza and Dowa appear to be the most important fish producing areas (see Figure 5.1). There is a need to determine why these areas, in particular, are the premier production areas in relation to rainfall patterns, soil types, proximity to markets, distance from capture fisheries and fish trade routes. Several maps (Maps 2 to 6) are presented at the end of this report that may give some sort of explanation for the location and distribution of fish farming areas and also provide some information upon which to assess the suitability of other areas for fish farming in the future.

A simple analysis of these figures and the information on the number of fish ponds suggests that the 2002 total production figure for Malawi is grossly over estimated. Using the NAC data would suggest that the average production by farmers in 2002 was around 3.9 metric tons/ha/year. Our own

data suggest that such production levels are only achieved by a few farmers and cannot be accepted as a valid average production figure. Reported average production is nearer 1.2 t/ha/yr. On the assumption that all ponds were actively farmed in 2002 at an average production level of 1.2 mt/ha/yr would put the total country production at around 246 metric tons per annum.

Data and information collected by Hecht between 1996 and 2002 in the northern region was used to calculate total country production in different ways. Two examples are provided. Firstly, in the northern region approximately 40% of ponds are either not tended, harvested or are dry (Hecht 1998). If this is taken as an average figure for the whole country and that average production was at 1.2 mt/ha/yr then total country production would be around 148 metric tons.

Secondly, fish farming households in the northern region harvest between 10 and 50kg of fish from their ponds per annum. This permits an alternative method of calculating total country production. On the assumptions that the average fish farming household harvests 20kg's of fish per annum and that only 60% of the total number of farmers actively tend their ponds then the total country production is around 48 metric tons.

These calculations are obviously as tenuous as the NAC estimate of 800 tons per annum and indicate the need to undertake a formal and detailed study of fish production in Malawi. The socio-economic study should provide the data upon which to calculate a more reliable estimate of total production.

5.2.2 On-farm production levels

There are several studies that have examined the effect of donor interventions on fish production levels. Overall, there is substantial evidence to suggest that good extension has lead to significant increases in production over relatively short time periods. Several examples are provided below.

Costa Pierce & Pullin (1992), for example, claim that the ICLARM/GTZ project initiated in 1987 led to an increase in production from 500 kg/ha/yr to 1.5-2 t/ha/yr, while the CNRFFP estimated that average production increased from 1 t/ha/yr to 1.44 t/ha/yr between 1989 and 1995 (Dickson and Brooks 1997). Our own work in the Nchenanchena and Mpompha area suggests that significant increases in production (up to 2.8 t/ha/yr using on farm by-products) can be achieved with small target groups coupled with intensive extension (Hecht and Andrew 2002). Similarly, the ICLARM/GTZ project at Domasi also showed that significant and rapid increases in production to be a direct consequence of intensive on-farm extension and on-farm participatory trials.

In an analysis of pond yield, Dickson & Brooks (1997) reported that 6% of small holder fish farmers in the Northern Region produced > 3 tons / ha/ yr, while the remainder produced between 1 and 3 tons/ha/yr. Production figures from the Southern Region during that time were significantly lower at between 0.4 and 0.6 tons/ha/yr (Costa Pierce et al. 1991). In an analysis of returns to land and labour for the Northern Region in 1994, it was calculated that with net yields of 1.5 tons/ha/yr the returns to small holder farmers are higher than those achieved for crops and are comparable with returns realised from semi-intensive animal husbandry and at this level of production fish farmers could obtain the highest returns to labour of all agricultural enterprises, except tobacco (CNRFF Project Annual report for 1994/1995). Since then a detailed study of return to land and labour has not been repeated and it is strongly recommended that this be done to place fish farming into a better perspective relative other farm activities.

The advances that have been made in aquaculture production are best presented on a regional basis. In a review of aquaculture in the Southern Region in 1989 Noble and Chimatiro (1991) presented data for 131 farmers, who collectively owned 229 ponds. Fifty one per cent of the farmers at that time practiced polyculture (O.shiranus and T. rendalli or O. shiranus, T. rendalli and Cyprinus

carpio) with an average yield of 974 (241 – 3637 kg/ha/yr) per 330 day production cycle. By comparison the average yield per annum has now increased to around 1500 kg/ha, indicating a near doubling of production efficiency.

In the Northern Region the farmers had a better knowledge base (the legacy left by Gifkins). In a preliminary assessment of aquaculture in the Northern Region in 1990 (Dickson & Brooks 1997), reported an average production figure from small holder fish ponds of 1180 kg/ha/yr. In the ensuing years average production increased steadily to 1440 kg/ha/yr in 1995. By 2000 the average production figure of a small core group of farmers was 1800 kg/ha/yr (Hecht 2000).

The increase in production has been ascribed to;

- Intensified extension through donor support,
- Development of farmer to farmer extension methods,
- Demonstration days at experimental stations
- Farmer education and training (on farm workshops, lectures, information pamphlets, demonstrations)
- Club formation (leading to a better exchange of ideas and knowledge) and
- On-farm participatory trials.

(Likongwe 1991, Dickson and Brooks 1997, Brummett 1999, Hecht and Andrew 2002)

5.3 Fingerling availability and distribution

The number of fingerlings distributed during the 2000 / 2001 season in the South and Central Regions is shown in Table 5.3. No figures are available for the Northern Region as the CNRFFC was flooded during the rainy season and the Centre did not have any operational funds (M.Kumbikano, CNRFFC, pers comm.). *Clarias gariepinus* fingerlings are produced at NAC on demand, so only 16,905 fingerlings were sold in 2001. The average weight of *C. gariepinus* fingerlings sold to farmers was 5 – 15g at a price of MK 10 per fish. Cichlid fingerlings ranged from 10 – 20 g and sell for MK 1 to 3, depending on size. Brood fish were also sold to farmers in 2001 at MK80 / kg.

The capacity of the National Aquaculture Centre (NAC) and Kasinthula to produce fingerlings has been estimated at over 1 million fish per year. According to NAC there are fingerlings available at any time for distribution to farmers through out the country.

Table 5.3 Fingerling distribution by species and region during the 2000/2001 season

Region	Tilapia	Catfish
Central	44,300	5,002
South	72,785	11,903
North	?	?
TOTAL	117,085	16,905

5.4 The farmers (Who are they?)

A review of the available literature (published and contract reports) shows the following farmer profiles.

- Fish farmers, on average, have 3 x more livestock than the baseline farming population (see Table 5.4).

- The average cash income of fish farming households is 7 – 8 times higher than the average. Chimatiro & Janke (1994) argued that this is perhaps the reason why these farmers could afford the risk to start a new and unknown enterprise such as fish farming. Similar conclusions were reached in the Northern Region by the BZDP.
- There seems to be a great degree of status attached to fish farming.
- Fish farmers have larger farms than the baseline average (1.6 ha in the southern region and 3 ha in the northern region vs. a baseline average of 1.2 ha).
- On average 55% of fish farmers in the South had access to a perennial water supply, while only 23% of non fish farmers had access to year round supply of water. This illustrates the greater affluence of fish farmers in comparison to non fish farmers.
- Fish farmers on average are more educated that the baseline farming population
- Fish farmers on average are more literate and numerate than the baseline farming population
- In the Northern Region the most successful fish farmers are the vegetable and grain farmers. Tobacco and coffee farmers are less successful. This illustrates several points. The vegetable and grain horticultural calendar is more compatible with fish farming than either the tobacco or coffee calendar. The vegetable and grain farmers have more readily available on-farm by-products for feeding of fish. Vegetable and grain farming lends itself to a greater degree of integration with fish farming than other forms of agriculture.
- Income from fish farming is largely a secondary source of income after sale of food crops.
- Though total income may be lower in comparison to tobacco, for example, fish farmers are more diversified and therefore enjoy greater income and food security than other farmers.
- In the Southern Region 61% of fish farmers produce fish for home consumption. This is markedly different to the North where 67% of farmers sold their fish and 25 % kept fish for home consumption.
- Men normally dig and maintain the ponds and harvest fish, while the women and children feed the fish and the women sell the fish.

(Petry 1996, Dickson & Brooks 1997, BZDP Backstopping Reports)

Table 5.4 Livestock ownership

Animals	% of fish farmers owning animals	% of non fish farmers owning animals
Chickens	100	77
Pigeons	78	36
Goats	100	41
Cattle	13	5
Pigs	9	5
Ducks	22	5
Others	17	9

Source: Petry 1996

5.5 The species and their production potential

The most common species in small-holder and commercial aquaculture operations are Oreochromis shiranus, O. karongae, Tilapia rendalli . Other species include Clarias gariepinus, Cyprinus carpio and Oncorhynchus mykiss. African catfish was first introduced into Malawian aquaculture in 1991 by the CNRRFP and some years later in the southern region through work undertaken by the ICLARM/GTZ project.

Common carp (Cyprinus carpio) was introduced into Malawi in 1976 (Msiska & Costa-Pierce 1993). Contrary to expectations C. carpio breeds successfully in small holder ponds and it is supposedly

still being produced in some ponds in the Lower Shire area. Further importation and distribution of common carp was prohibited in 1992 (Msiska & Costa Pierce 1993). Fortunately, it has not been translocated to the Central and Northern Region catchments that drain into Lake Malawi. Common carp has been shown to grow rapidly at Kasinthula and in small holder fish ponds. However, it would appear that the superior growth rate of the species is only sustainable during the first year of production, where after the availability of benthic organisms becomes limiting and as a result growth declines to the same level as for cichlids.

Rainbow trout, Oncorhynchus mykiss, (see history) is still produced on the Zomba Plateau, though in small quantities. There are remnant populations in Mulanje and in some streams and rivers on the Nyika.

Black bass (Micropterus salmoides) occurs in some small water bodies but is not farmed in Malawi.

Research on suitable indigenous species for aquaculture in Malawi has been an ongoing endeavour since the establishment of the Domasi station in 1960. In particular the focus has been on the genetic improvement of O. shiranus and O. karongae, developing suitable technologies for production of Clarias gariepinus, and testing the suitability of various indigenous cyprinid species (JICA) (Kaunda 2003). Given the research that has been undertaken in the past it is clear that the most suitable indigenous species for aquaculture in Malawi are O. shiranus and O. karongae, Tilapia rendalli and Clarias gariepinus. Each of these species has specific advantages and disadvantages. It is doubtful that any other indigenous species will be identified as having potential for fish farming in Malawi.

Oreochromis shiranus is a precious breeder. Reproduction in ponds takes place at a small size (<20g) and most of the *O. shiranus* produced by farmers are <50g. The juveniles are omnivorous and at ca. 100 mm TL the fish change to a phytoplankton and diatom diet. The species is hardy and tolerant of low DO and high temperatures. Fingerling production is easy and new brood stock can be easily obtained from the wild. Given that fish of any size can be sold on the market this species lends itself to the production of quantity rather than quality. Mutambo and Langston (1996) considered the slow growth of the species to be one of main reasons that inhibits investment in aquaculture in Malawi.

Tilapia rendalli is widespread throughout Malawi and is a much- favoured fish throughout the country due to its superior flavour. The juveniles are omnivorous and adults (> 120 – 150 mm TL) are mainly macrophytic. The growth rate of *T. rendalli* exceeds that of *O.shiranus* and *O.karongae* and the fish attains a “large” size. For these reasons it is probably the most appropriate species for small scale aquaculture in Malawi and should become the major focus of research. *T. rendalli* reproduces easily in ponds but fry production is low in comparison to *O.shiranus* and juveniles are not as hardy as those of *O.shiranus*. These life history characteristics are of benefit to farmers. Many farmers are fully aware of the superior growth potential of *T. rendalli* and are experimenting with different vegetable feeds.

Traditionally the most favoured species in Malawian aquaculture was *Oreochromis karongae*. The species shows strong reproductive seasonality in ponds and fry production in comparison to *O.shiranus* is low (Maluwa and Dickson 1991). *O.karongae* only starts breeding at 50-80g. As with *T. rendalli* this is an advantage for the farmer in terms of producing larger fish. On the other hand, *O.shiranus* under pond conditions may start breeding at 10-15g. Farming with *O.karongae* in the North has not been popular and farmers have stuck to *O.shiranus* and *T. rendalli* because of higher yields and better growth under farm conditions. This is probably a consequence of the lower water temperatures in the North, particularly in winter. It has been found that at temperatures below 17^{o}C feeding with madeya should be suspended as the fish do not feed. Knowledge of mean monthly

water temperatures throughout the fish farming regions of Malawi and drawing up a seasonal feeding table would be of great benefit to farmers.

It is a well known fact that male cichlids grow faster than females. Production of *O.shiranus*, *O.karongae* and *T. rendalli* could be enhanced by training farmers in the technique of hand sexing and changing to monosex culture. Some progress in this regard has been made recently by the JICA Team at Domasi. However, this initiative should be greatly expanded and become one of the major focus points for extension.

Despite its recognised potential the incorporation of African catfish into Malawian aquaculture has been relatively slow. This was mainly due to the difficulty in producing sufficient quantities of juveniles by NAC and CNRFFC. However, both NAC and CNRFFC are now in a position to produce fingerlings on demand (given that they have the necessary financial resources). On-farm catfish spawning and fingerling production trials have been ongoing in the North since 1998. Farmers are quite capable to produce 12 day old fish but have not yet been able to produce adequate numbers of fingerlings for stocking. Growth of catfish under local farm conditions far exceeds that of cichlids. Consequently there is a high demand for catfish and an urgent need to perfect the technologies for on-farm production of fingerlings.

5.6 Aquaculture technologies in Malawi

5.6.1 Pond construction

The techniques of pond construction have been actively and successfully disseminated since the 1950s. Most new farmers do not require the inputs of fisheries extension staff and rely on advice provided by practising fish farmers. Ponds range in size from 100 m2 (or smaller) to 2000m2. The average size of ponds in Malawi is around 250m2. Most ponds are fed by an inlet channel, but have no outlet. The amount of water let into the pond is largely determined by rate of evaporation and seepage. More recently there has been a move towards the incorporation of inlet and outlet pipes (PVC or bamboo).

5.6.2 Integrated farming

Chikafumba (1994) showed that aquaculture techniques that incorporate other on farm activities are more likely to be adopted than those that are independent of existing on-farm systems. Integrated farming can therefore make a greater overall impact on annual household income and leads to enhanced farm efficiency and profitability. The most commonly integrated systems are fish / vegetables and fish / rice. Adoption of these simple technologies has been rapid, indicating that farmers realise greater farm efficiency and profits. For example, rice and fish farming was first introduced in 1991 to 35 farmers in the Southern Region. By 1992 there were 57 farms practising the technology and by end 1993 there were 200 farmers. The rapid evolution of this practise was driven by farmer to farmer diffusion and extension, with no inputs form organised extension services (Chikafumba 1994). It is however quite obvious that knowledgeable extension services are required to further promote integrated agri/aquaculture. For example, 65% of farmers in the South use the pond mud to fertilise vegetable gardens, whereas in the North this is hardly practised at all.

Integrated farming systems research was introduced by ICLARM in 1990 and is ongoing through the initiatives of most donor and NGO support programmes. This has had a major impact in improving overall farm production. The underlying philosophy of this research is that all on-farm trials are designed in collaboration with the farmers, which largely guarantees their buy-in into technology

development. A very innovative way to further improve farmer participation is to let the farmer decide and design the production plan and for the scientists and extensionists to check for possible pitfalls and to provide corrective advice (Brummett & Noble 1995). The Department of Fisheries has now adopted the methods and will be promoting it in future. A guide for participatory technology development and transfer (PTDT) was produced in 2003.

5.6.3 Pond management and harvesting

Except in isolated instances ponds are generally poorly managed. Pond management by fish farmers needs to be improved if production is to be enhanced. Given the capacity of the extension staff and the dissatisfaction with aquaculture by many farmers it is however questionable whether pond management can be improved. For example, draining of ponds and drying the substrate on an annual basis and fertilisation methods are little understood concepts.

The most commonly used methods for partial harvesting of fish are hook & line, traps and nets, (some farmers use reed fence nets). Total harvesting is achieved through netting or breaking the pond dyke. In general, the hook & line harvesting method is the most popular partial harvesting method because larger fish are harvested. The more successful farmers have perfected the dyke breaking technique to a fine art so that they do not loose too many fingerlings. Others, however, loose all fingerlings and then have to start from scratch and either purchase fingerlings or obtain them in exchange for goods or services or as gifts. This technique of harvesting is a consequence of the fact that most farmers cannot afford to purchase a net or logistical problems (transport and fuel) in obtaining a community or club owned net or nets from the extension stations. The problem of access to nets has bedevilled fish farmers in Malawi for decades. This is ridiculous and the time has arrived to address this problem in a pragmatic and practical sense. It is suggested that a container of used pilchard and anchovy netting be imported from South Africa and made available to farmers at a subsidised price.

There is considerable variance in the inter-harvest period and this appears to be related to farmer knowledge base, the level of intensification and the reasons for having ponds. There is also considerable confusion as a consequence of conflicting (or unclear) extension messages. Those farmers who grow fish mainly for home consumption catch fish (hook and line) as and when required (sometimes weekly) and only drain their ponds once every 2 or 3 years. The harvesting method (partial or total) should be determined by the individual farmers business model (partial harvesting for home consumption and total annual harvest for commercial farmers).

5.6.4 Feeds, pond inputs and feeding

Maize bran (madeya) has been recommended as a fish feed in Malawi since the 1940s and over 90% of all fish farmers use it (though irregularly) as a fish food. Other feeds include, amongst others, vegetable leaves, grass, left over homestead food (e.g. nsima), and termite ants. In the Southern Region the use of vegetable leaves as a feed for *T.rendalli* is more commonly practised than in the North (83% vs. 52%). Table 5.5 provides a list of possible feed ingredients and their nutritional value and Table 5.6 provides some data on yield using several on farm feed ingredients.

Table 5.5 Some on-farm by-products and their nutritional value

By-product	Crude Protein (% of dry mass)
Madeya	2.1
Stover	6.3
Casava leaves	25.9
Sweet Potato leaves	19.4
Grasses	7 – 11
Banana leaves	9.9
Pawpaw leaves	26.8

Table 5.6 Fish yields using various on-farm resources in Southern Malawi

Input	Input rate	Mean yield Kg/ha/yr	Range
Napier grass	100kgDM/ha/day	1,405	647-2,195
Madeya	3% mean BW/day	1,726	406-2,368
Napier / Madeya	As above	3,013	2,726-3,299
Pumpkin leaves	50kgDM/ha/day	1,444	1,372-1,616
Stover compost	3% mean BW/day	750	710-790
Madeya	when available	951	241-3,336

Very little reliable work on food conversion ratios has been undertaken in Malawi. Some studies report a FCR for madeya as 3:1. Clearly this is impossible and only creates false expectations and leads to over inflated production estimates. A more realistic value would be in the order of 12 – 20:1 (Hecht 1999). There is a need to undertake controlled FCR and digestibility experiments of farm by-products. Never the less, in Malawi as in many other sub Saharan countries, maize bran (madeya) is the most common and available fish food and its use has been promoted since the 1950's. The gross protein content of madeya is low (2 and 3 %) and the poor nutritional value of madeya is reflected by the slow growth rate of fish and low pond yields. Availability of madeya is normally good but can vary by region and rainfall when there is a general shortage of maize. However, given that most successful fish farmers are more food secure than others, madeya is usually available for fish and other animal feed (mainly chickens) throughout the year. However, food insecure farmers experience shortages, particularly during the rainy season. Optimal recommended feeding rate is 5% BW/day, however this normally exceeds availability, so practically a rate of 3%BW/day is recommend by the extension service.

Other inputs are maize stover, cassava leaves, sweet potato leaves, various grasses (Buffalo bean grass, Antelope grass leaves, giant grass leaves, Napier grass), mulberry leaves, Leucana leaves, Banana leaves, pawpaw leaves, and cabbage leaves. There are obviously many more possible ingredients that could be used as pond inputs, particularly for *T. rendalli*. It is clear that there is a need for an extension drive to educate farmers on the nutritional value of their available on farm resources. Such knowledge will allow farmers to make the best possible choices for fish growth.

In the North the use of cooked Soya beans has been promoted by the BZDP. Those farmers who have adequate land and labour have adopted the technology with significant successes. FCR of 3:1 have been achieved with the use of cooked Soya and farmer income from fish fed on Soya was significantly higher than if the beans had been sold to buyers and the profit margins were 34% higher than if the fish had been fed on madeya (Hecht 1999).

All donor aquaculture projects have strongly advocated the use of inorganic fertilisers, animal manure and the use of submerged compost pits in fish ponds to enhance primary and secondary

production in fish ponds. It has been reported that most (if not all) farmers do not have the financial resources to purchase inorganic fertilisers for use in fish ponds. However, given the quantities of inorganic fertiliser required (5 kg per 200m2 pond per year) to achieve the same effect as organic fertilisers (72 kg chicken manure /200m2 pond per year) this conclusion is unfounded. Those farmers who own livestock (cattle, pigs and chickens) use some manure to enhance pond productivity. However, most manure resources are used for vegetables and most often farmers do not have adequate numbers of livestock to obtain sufficient quantities for pond fertilisation. All farmers have adopted the submerged compost pit technique to enhance productivity. In the Northern Region the BZDP has supported several on-farm training sessions in modern composting methods. The fish farmers who attended these courses have enhanced their production levels.

Experimental trials undertaken at CNRFFC have shown that fertilisation of pond water with chicken manure results in higher yields and final body mass in comparison to cow dung and or other organic fertilisers. For example, best yields have been obtained with *O.karongae* at a fertilisation rate of 4.7kg chicken manure/are/week and fed on madeya at 3% of BW per day. This translates to 507 kg/200m2 pond/year. Clearly, given that the average maximum of chicken manure produced by farmers is in the region of 2 kg per week the use of chicken manure is out of reach to most small-holder farmers. To a great extent findings such as this are of academic interest only, as farmers do not have enough chickens or do not rear chickens in a confined space to collect the manure to fertilise their ponds. A more practical and feasible solution would be to strongly promote the use of inorganic fertilisers.

5.6.5 Stocking density and polyculture ratios

Most farmers practise some sort of polyculture. The most productive cichlid combination is O. *shiranus* and *T. rendalli* (Noble & Costa Pierce 1992). The major problem with tilapiine fish culture is their precocious breeding habits (leading to severe stunting) and the inability by the farmers (due to lack of resources and knowledge) to control fingerling numbers in their ponds. Due to higher yield per unit area obtained with *Tilapia rendalli* and the production of larger fish some farmers in the North have now switched to *T. rendalli* monoculture. The evolution to monoculture in some instances is dictated by the availability of on-farm resources for fish farming and the realisation by some farmers that their ponds are more suited to monoculture than polyculture (Hecht, pers. observations). The comment made by Costa Pierce & Pullin (1992) that "*working on farm we have learned that small scale farming systems are not as simple as assumed at the beginning but are complex and diverse*", aptly describes the difficulty of small-scale integrated agri/aquaculture.

Prior to 1994 farmers were all largely dependent on Government hatcheries for fingerlings. Intervention by the major aquaculture projects has however contributed greatly towards making the farmers less dependent on government hatcheries by encouraging fingerling exchange (within and between clubs) and farmer to farmer sale of fingerlings. Never the less the reported fingerling distribution figures suggest that there is a role for Government hatcheries to provide seed stock. It is our opinion that the overarching role of Government hatcheries should be to focus on developing appropriate transferable techniques (e.g. hand sexing and catfish fingerling production), genetic improvement of seed stock and proper feeding methods and to ensure that small-holder farmers have access to these products to increase production.

Presently there are few farmers who have fingerling production systems. All of these are relatively new initiatives. However, they should be vigorously encouraged with appropriate extension.

The average stocking density of fingerlings that has been promoted by extension services is 2 – 3 fish / m^2. We are of the opinion that this figure should be increased to between 4 and 5 per m^2 to compensate for mortalities as a consequence of transport and transfer stress.

In the South the farmers have a preference for *O.shiranus* (83%), *T.rendalli* (65%) while only 4% of farmers have *O.karongae*. 65% practise polyculture, while only 22% practice monoculture. The two main species that have been promoted in the North are *Oreochromis shiranus* and *Tilapia rendalli*. As a consequence of the lower average water temperatures in the North the growth of *O.shiranus* in this region is significantly lower than in the Southern Region. However the growth of *T. rendalli* does not appear to be affected by the lower winter temperatures. Experimental trials in the North during the period 1991 to 1995 (EU project) have shown that higher stocking densities results in a higher final yield but smaller fish. Farmers had no problems in selling the smaller fish and by increasing their stocking density were able to realise higher profits. This situation has however changed. Farmers now obtain a higher price per kg for larger fish.

All polyculture trials with African catfish, *Clarias gariepinus* with *O.shiranus* or *O.karongae* have resulted in significant increases in yield. The most commonly used ratio is 1:2 (*C.gariepinus*: *Oreochromis* sp.), resulting in yields of 4.6 tons/ha/yr. Equal ratio trials have also been undertaken, with even higher yields at around 5.94 tons/ha/yr (CNRFFC and BZDP).

Table 5.7 Performance indicators and yield of Oreochromis karongae and O.shiranus in polyculture with Clarias gariepinus (168 day trial at CNRFFC, Mzuzu) (Brooks and Maluwa 1997).

Treatment (Fish/sq m)	MBW 1 (g)	MBW 2 (g)	BW Gain (g/day)	Survival (%)	Yield (t/ha/yr)
O.shiranus (2)	10.9	50.8	0.24	77	1.70
C.gariepinus (1)	14.1	94.5	0.48	94	2.25
					Total = 3.95
O.karongae (2)	13.5	64.7	0.30	83	2.33
C.gariepinus (1)	12.3	108.6	0.57	88	2.42
					Total = 4.75
O.karongae (2)	13.0	65.5	0.31	71	
C.gariepinus (1)	13.1	97.7	0.50	95	
					Total = 4.47

Table 5.8 Performance indicators and yield of Oreochromis karongae and in polyculture with Clarias gariepinus (168 day trial at CNRFFC, Mzuzu) using chicken manure only at 7kg/are/week (Brooks and Maluwa 1997)

Treatment (fish/sq m)	MBW 1 (g)	MBW 2 (g)	Wt gain (g/day)	Survival %	Yield t/ha/yr
O.karongae (2)	25.6	58.2	0.21	76.9	2.03
C.gariepinus (2)	2.0	121.4	0.71	74.1	3.91
					Total = 5.94

On farm results obtained by the BZDP project in the Nchenanchena area in the North (Hecht 1999) are summarised in the two following tables (Table 5.9 and 5.10). These results confirm the valuable contribution that *C.gariepinus* can make to overall yield.

Table 5.9 Mean yield from two catfish polyculture trials in Nchenanchena ponds (n=6), standardised to 200 m2 after 227 days (winter and spring growth). Fish were fed with madeya as and when available

Species	Mean yield
Catfish & T.rendalli	14.8kg (Range 12.8 – 16.2kg = 1.2 tons/ha/yr
Catfish & O.shiranus	27.2kg (Range 23.9 – 31.7kg) = 2.1tons/ha/yr

The trials were run during winter and early spring. Production was encouraging but would have been higher if hey had been undertaken in summer.

Table 5.10 Summary statistics of a 227 day Clarias gariepinus x O.shiranus polyculture field trial in 4 farmer ponds in Nchenanchena in winter/spring

Pond Size (m2)	Number stocked	Number of fish at harvest	% numbers at harvest	% weight at harvest	Mean wt of fish at harvest (g)
155	*Clarias* = 78	48	20	50	119
	O.shiranus = 272	191	80	50	30
	Total = 350	239			
227	*Clarias* = 797	211	15	48	238
	O.shiranus = 228	37	85	52	45
	Total = 1025	248			
406	*Clarias* = 203	146	37	80	211
	O.shiranus = 1421	254	63	20	32
	Total = 1624	400			
440	*Clarias* = 200	114	46	85	434
	O.shiranus = 1540	133	54	15	63
	Total = 1740	247			

These results show that *Clarias* is the main contributor to total yield at harvest. The data also indicate that the catfish prey on the cichlids and this was confirmed by gut content analysis.

The results obtained by the BZDP project suggest that further work needs to be undertaken to

a) Determine the optimum polyculture stocking densities with *C.gariepinus* using *O.shiranus* as a fodder fish.

b) Determine the optimal size difference between *C.gariepinus* and *O.shiranus* at time of stocking.

c) Refine on-farm catfish fingerling production techniques.

Most fish farmers do not keep records of number of fish stocked and number of fiosh harvested. For example in 1996 duriing a rapid assessment of fish farming practices Hecht (1996) found that 87% of farmers in the South and 100% of farmers interviewed in the North had no idea of the number of fish in their ponds. To monitor the development of fish farming Malawi it is pivotal that record keeping becomes an important part of the extension message

5.6.6 Predators

The main predators of fish in small holder ponds are the Cape clawless otter (*Aeonyx capensis*), the marsh mongoose (*Herpestes paludinosus*), birds (including herons, hammerkop kingfishers and pelicans). In some instances theft is a serious problem. There is little that small holder farmers can do to prevent predation by birds. Much has however been done by the NAC, CNRFFC and by the farmers in particular to reduce predation by otters. Several techniques are used. These are the inclusion of thorn branches in the ponds in which the fish can hide, the construction of wooden fences through which the fish can swim thereby impeding the predation rate by otters, the construction of reed or bamboo enclosures around the ponds to prevent entry by otters and by constructing the ponds close to the homestead to deter the approach by otters and the use of traps. While all methods seems to be successful in limiting predation to some degree or other there is a need to evaluate the various techniques so that a single method rather than mixed messages can be given to farmers. Observations made by farmers seem to suggest that the most effective method to date is the construction of an enclosure that has several openings. Farmers have observed that as

soon as the otter enters the enclosure it is threatened and escapes from the enclosure without entering the water.

5.6.7 Conclusion

In conclusion, given the highly variable resource base of the farmers it is clear that single option farming models for a particular eco-region are inadvisable. Given that the target groups are non-uniform there is a need to offer small scale farmers a basket of options from which s/he can choose on the basis of, and depending on, the availability and diversity of on-farm resources, water availability and geochemistry (Mutambo & Langston1996). To advance aquaculture in Malawi it is fundamental that some sort of co-ordinating committee be established (under the auspices of the Director of Fisheries) to keep abreast of developments and advances made by various aquaculture projects and stations and to use this for the collective advancement of aquaculture in the country.

6. Impact of research on aquaculture development

The bibliography of aquaculture research in Malawi (see AdiM data base) and the report by Kaunda (2003) show the substantial extent of aquaculture research in Malawi. Juxtaposing the technologies used by small holder fish farmers in Malawi with the research that has been undertaken suggests that research, as a whole, has had little impact on fish farming. Most of the technologies used presently by farmers were developed in the 1950s and early 1960s. Amongst others this may be indicate that,

- the research was undertaken without input from farmers,
- the research was driven by curiosity rather than by needs,
- the research was esoteric and of no use to farmers, or
- there has been no effective link between the scientific and the extension sections of the Department of Fisheries
- the extension service is hamstrung by inadequate financial resources and the insistence by staff on allowances.

It is difficult to single out any of the above reasons as the overriding cause of the poor record of technology transfer. During the period 1950 to the late 1980s, research was driven by project and Department of Fisheries scientists. Realising that the transfer of information and technologies was ineffective, ICLARM (now World Fish Center) adopted a farmer centred approach to research in 1990. A decade of farmer centred research has had some significant measures of success. By implication this points to ineffective communication between scientific and extension staff as the root cause for the poor level of technology transfer and the slow progress of aquaculture in Malawi. This may be a consequence of research results not being translated into appropriate extension messages by the scientists, or that extension staff do not have the capacity to transfer the technologies and research findings to the farmers.

There are many examples of very valuable research results that have not been transferred to farmers, e.g.

- The use of inorganic fertilisers
- Male monosex culture of cichlids
- The use of fire ash as a pH buffer and source of phosphorous in fish ponds (Jamu & Costa Pierce 1993)
- The active promotion of O.karongae and T. rendalli as the premier cichlid aquaculture species in Malawi

Moreover, the results of polyculture experiments with African catfish and cichlids undertaken during the EU CNRFFP in Mzuzu (1990 to 1995) and on farm trials in the Northern Region through the BZDP have clearly shown that this species is an ideal species for aquaculture under Malawi small holder conditions. It is difficult to comprehend why appropriate technologies for on farm fingerling production have therefore not been developed.

A very worthwhile endeavour would be to undertake a review of all Malawi aquaculture research papers and reports to summarise what has been undertaken, to identify the research shortcomings, to identify needs and to prevent repetition and duplication (which seems to be a common occurrence).

There is also a need for;

- Detailed information on farm economics and in particular information on return to land and return to labour of integrated fish farms and non-integrated farms.
- Digestibility studies of agricultural by-products
- Sustainable techniques for on-farm fry production of O.karongae and T.rendalli
- On-farm production of African catfish fingerlings.
- Developing capacity in financial management and record keeping.

Further research is also needed to develop a sound explanation for why some farmers are more successful at fish farming than others. In particular we need more information on the following issues:

- how fish farming fits (or does not fit) into different farming systems,
- the constraints that operate in the different farming systems
- quantification of return to land and labour for various farming systems, e.g. fish/vegetable or fish/tobacco.

7. Considerations on the introduction of exotic species

7.1 Carp species

Introduction

The impetus to introduce exotic species arose from strong pressure in 1975 to make the Kasinthula Fish Farm in the Lower Shire Valley financially viable. This was spearheaded by the FAO/UNDP "Promotion of integrated fisheries development" project. After considerable national and international debate permission was granted in April 1976 to import common carp, grass carp and silver carp from Israel and *O.mossambicus* from South Africa, with the proviso that the importer would ensure that the fish would not be allowed to enter the natural water and the lakes of Malawi, and in particular the catchment of Lake Malawi. The decision to permit the importation of carp and other species was influenced by the notion that the growth rate of indigenous species was not adequate for the development of aquaculture in Malawi. (Mkoko & Mutambo 1993). Given the short duration of the FAO project at Kasinthula the push for and the approval for the importation of exotic species was considered by many as too hasty and over zealous (Msiska 1993). The initial growth trials at Kasinthula in 1976 showed that the growth performance of common and silver carp was superior to that of the indigenous cichlids and an application was made to import more fish. On the other hand *O.mossambicus* performed poorly and requests were made to introduce *O.noliticus*. Fortunately, no efforts were made to introduce the species. In 1984 the Department of Fisheries formulated conditions for the release of carp fingerlings to farmers. These were that (i) no farmer would be allowed to breed the fish, (ii) that the fish would only be distributed to farmers outside the

Lake Malawi catchment area, (iii) all carp fingerlings were to be supplied by the Domasi and Kasinthula hatcheries, (iv) farm ponds should have inlet and outlet screens to prevent the fish from escaping, (v) at harvest all fish should be killed and sold in the presence of a fisheries officer and (vi) all farmers growing carp must submit records on their carp stocks and provide information on carp transfers to neighbours (Msiska 1993, Mkoko & Mutambe 1993). These conditions were well founded but given on-farm conditions they were impractical. There have been several reports of fish escaping into the Lower Shire from estate farms and from small-holder farms into rivers draining into Lake Malawi. Fortunately, the number of escapees was low and there is currently no evidence of their occurrence in the natural waters of Malawi. Apart form the early reports on growth of grass and silver carp no further information is available for these two species.

Realising the potential negative effects of the introductions in Malawi a workshop was convened in 1991 to debate and to decide whether further introductions should be permitted. This was a milestone in the history of conservation of biodiversity in Malawi. The workshop was attended by 20 scientists and administrators from the Department of Fisheries, University of Malawi, and several donor funded projects. At the conclusion of the workshop 14 out of 20 voted for the discontinuation of carp culture in Malawi, 2 voted for a phased withdrawal of carp, 2 voted in favour of continuation and 2 abstained. This overwhelming majority gave the Department of Fisheries the opportunity to ban any further importation of exotic species (Msiska and Costa-Pierce 1993).

Despite the decision reached at the 1991 workshop *Cyprinus carpio* fingerlings are still produced and the fish is still being farmed on an experimental basis in Kasinthula as a means to "demonstrate" the commercial viability of aquaculture in Malawi. This compromising situation needs to be re-assessed internally by the Department of Fisheries.

Advantages and disadvantages of common carp

The advantages of common carp are largely related to its fast growth rate under tropical conditions. During the initial trials undertaken at Kasinthula, and later in SUCOMA and Satemwa estate ponds, common carp grew at rate of 8g per day (8x faster than indigenous cichlids) and reached final weights in excess of 1 kg after 150 days (Msiska 1993 and Kasinthula Project Reports). However, Noble (1993) showed that common carp did not lead to significant increases in small-holder pond production because of low stocking density, although they did attain a significantly larger size than *O.shiranus* and *T.rendalli*. Effectively the production trials with common carp in small-holder ponds took place over two seasons (1989 to 1990). The higher growth rate of carp in the ponds can be ascribed to their benthic invertebrate feeding habit, a niche not exploited by *O.shiranus* or *T.rendalli*. Given the low level nitrogenous inputs it is highly unlikely that the growth rate of the species could have been sustained in future years. Identical growth rates to common carp have been achieved with *Clarias gariepinus* and the production potential of catfish is approximately 5 x times higher than catfish.

The disadvantages of common carp include:

- Feeding habit disrupts nesting and breeding success of cichlids (Madagascar).
- Feeding habit can directly result in increased turbidity, reduced primary production and rapid eutrophication.
- Welcomme (1984) reports that the feeding activities of carp also increase suspensoid levels indirectly through ingestion of organisms from the phosphate-rich substrate and later excretion of the phosphate in a soluble form which is more available to algae. This results in a phytoplankton bloom which serves to increase the turbidity of the water. There is then less light penetration, which adversely affects submerged aquatic plants which die and decay, releasing suspensoids into the water. High suspensoid loads in the water result in a

multiplicity of effects on the ecosystem: there is a decrease in light penetration and a subsequent decrease in photosynthesis resulting in reduced primary productivity, reduced visibility of pelagic food, reduced availability of benthic food due to smothering, and a clogging of gillrakers and gill ftlaments of fish. Thus there is a general decrease in food availability with resultant decreases in growth rates, fecundity and recruitment of fish. Ultimately this results in a decrease in habitat niche diversity and a decrease in productivity and population sizes of fish (Bruton 1985).

- C. carpio introductions have resulted in increased epiphytic growth resulting in macrophyte losses (Williams, Moss & Eaton 2002)
- C. carpio (at critical densities) have been one of the major causes of loss of biodiversity and water clarity in numerous shallow lakes and ponds worldwide (Zambrano, Scheffer and Martinez (2001)
- C. carpio has been implicated in the displacement of indigenous species (C.gariepinus in Zimbabwean reservoirs), though there is no evidence to suggest that it has become dominant in species rich environments.
- C. carpio is highly fecund. Successful breeding in shallow littoral zones, lagoons and marshes could cause major disruption of cichlid breeding grounds and lead to unnatural increases in cichlid egg and juvenile mortality as juvenile C.carpio are carnivorous.
- Malawi is a signatory to the Convention on the Conservation of Biodiversity. Given its recognition as a fish biodiversity hotspot the introduction of exotic species would not be politically expedient, unless strictly controlled.

Conclusion on Common Carp

The risks of re-introducing the species into Malawi should be carefully weighed against any perceived commercial benefits. Unless there are clearly demonstrable advantages for common carp it should not be re-introduced into Malawi. Should there be any extenuating circumstances for the re-introduction of common carp then the species should be subject to a comprehensive risk assessment. All costs associated with a risk assessment should be born by the applicant and be undertaken in accordance with internationally recognised protocols (e.g. EU, FAO, AFS).

7.2 Oreochromis niloticus

There is overwhelming scientific evidence on the impact of *Oreochromis niloticus* on indigenous cichlid species, wherever it has been introduced. It has the ability to hybridise with other species of the genus *Oreochromis*. It is considered to have had a greater effect on the indigenous cichlid fisheries of Lake Victoria than the Nile Perch (*Lates niloticus*), by out-competing the indigenous *O.esculentus* for breeding space Lowe-McConnell 1982). There is no evidene to suggest that *O.niloticus* would do better than *O.karongae* in local small holder and commercial farms (e.g. Kasinthula). DeMoor and Bruton (1988) recommend that its distribution throughout southern Africa be strictly controlled and if permitted for aquaculture then strict measures (with clean-up penalties) should be introduced to prevent any fish escaping from farms.

Malawian capture fisheries are cichlid dominated and yield approximately 46000 metric tons per year. The purposeful introduction of an invasive species such as *O.niloticus*, which has the ability to hybridise with other species in the genus and capable of displacing indigenous species, would be completely indefensible. A possible 100 tons of farmed *O.niloticus* per annum does not justify the risk of a possible alteration in the structure and function of the fish communities of the lakes and other aquatic ecosystems in Malawi.

8. The potential for commercial and enhanced small-holder aquaculture in Malawi

Several commercial fish farming initiatives have been launched in Malawi since 1978 and several studies have been undertaken on the viability of commercial fish farming in Malawi (Balarin & Hecht 1991, Brooks 1992, Balarin 1997, plus others). The conclusion reached by Balarin & Hecht (1991) was that the price of fish at that time was too low for commercial aquaculture to be a viable proposition. The contribution by commercial farms to the total aquaculture production figures remains small. Of the estimated 490 tons produced in 2000 only 120 tons was produced by the commercial sector (NAC 2001) at Kasinthula and SUCOMA. The SUCOMA fish farm, despite its low production was one of the most successful producing around 49 tons from 21 hectares. Other previous commercial ventures include the Dwanga farm that produced ca. 93.5 tons in 1990. The fish at Dwanga were produced for the feeding of crocodiles. There have been several other initiatives, e.g. Club Macacola, but none produced adequate volumes of fish and were not sustainable. The reasons for failure are many and include the lack of commercial fish farming expertise, inadequate fingerling production (quality and quantity), problems relating to the importation of inputs and equipment, infrastructural problems, lack of adequately equipped feed mills or expertise in feed mills to produce quality fish pellets, and fish farming not being the core business of the entrepreneur. Most importantly perhaps is the failure of Government fish farming stations to produce reasonable quantities of fish, which has sent the signal to business that fish farming is commercially non viable. The end effect is investor hesitancy. (This was one of the main reasons given to me by industrialists and entrepreneurs at a seminar on commercial aquaculture opportunities in Malawi held in Blantyre in 2000). The most recent commercial trials have been those by Maldeco Fisheries on cage culture of chambo, *O.karongae*. This initiative should be strongly supported as its failure might drive the final nail into the coffin of commercial aquaculture in Malawi. It also has important implications for the "Save the Chambo" campaign of the Department of Fisheries.

Despite the constraints the opportunities for commercial aquaculture in ponds and cages are significant. The capture fishery cannot supply the demand, the price of fish has risen to a level where it would now be profitable and government is offering some tax incentives. However, the tax holiday of 5 years for an investment of $5 – 10 million and a 10 year tax holiday for investments greater than $10 million is not a viable proposition for investment in commercial aquaculture. These tax incentives, though encouraging, seem to be geared towards large industrial scale investments and are unrealistic in terms of aquaculture. In order to attract investment in aquaculture they need to be revised downwards. In addition, raw materials may now also be imported duty free (theoretically this may include fish meal and other nutritional additives).

It is also necessary to consider the issue of land tenure and how this may constrain development. Small scale farmers operate on customary land (with maternal or paternal heritability), while commercial farms operate on "private" land, that can be held on a 99 year leasehold. We need to understand how this affects aquaculture development but clearly the commercial sector will have to develop within these constraints. Moreover, commercial farms need to obtain a permit, issued by the Director of Fisheries in terms of the Act (Fisheries Conservation & Management Act 1997). However, presently there are no guidelines for applications and no permit conditions. This needs to be addressed urgently by the Department of Fisheries as industry requires some form of guarantees and conditions to stimulate investment.

However, Malawi has several attributes that greatly favour the development of the aquaculture sector. These are;

- Excellent environmental conditions for the farming if fish that are low on the food chain.
- Good quality water and an adequate supply in certain areas.
- Low national wage structure.

- High demand for fish (Malawi has the third highest demand for fish in Africa).
- Declining capture fisheries and increasing fish prices.
- Good species (O.karongae, T.rendalli and C.gariepinus)

On the other hand the constraints to small-holder aquaculture are;

- Available land (particularly in the South).
- Available labour
- On-farm fingerling production
- Water (competition and availability)
- Poor quality feed ingredients (e.g. madeya, agricultural by-products, household waste)
- Theft
- Predation
- Lack of credit facilities
- Extension (quality of extension, motivation of extension officers, inadequate institutional support)

Most of the constraints to the wider development and expansion of small-holder aquaculture in Malawi are of a socio economic nature. Most farms in Malawi are less than 5 ha (mean size = 1-2 ha) and most produce diverse crops on a seasonal basis, the result of which is an over loaded agricultural labour calendar. Over half (55%) of farms do not produce enough to feed the family. Poverty is the single major factor limiting entry to fish farming. This is evident in that most fish farmers are more affluent (5-7 x higher incomes) and better educated than the baseline farming population (Petry 2001).

There are several ways in which the potential for aquaculture in a country can be assessed. Several attempts have been made in the past. However, given the complexity of the social, economic and agricultural framework conditions in Malawi it is not possible to use any one single technique and requires significantly more information that what has been used in previous attempts. Kapetsky (1993), using GIS technology, estimated that Malawi has 55905 km^2 suitable for the production of a single crop of fish per annum and an additional 8994 km^2 for the production of 2 crops of fish per year. This study should however not be used to estimate the production potential of the country. It merely indicates areas that might be suitable for aquaculture. Specific areas within the broadly identified geographic ranges need to ground-truthed before any first estimate of the production potential can be made. What the study does show is that suitable areas are not a constraint to small holder or medium scale commercial aquaculture development in Malawi.

Estimating the aquaculture production potential of any country is not a simple computation and Malawi is no exception. Obtaining a realistic estimate of the aquaculture potential will be a complex exercise that will require many inputs, amongst others;

- Estimating the number of currently active farmers and ponds per district per region.
- Estimating current production levels per district per region.
- Identifying additional suitable areas for aquaculture development per district per region.
- Assessing water availability in suitable areas.
- Estimating the number of suitably resourced farmers.
- Estimating the number of suitably innovative farmers.

- Estimating the number of additional ponds that can be built in suitable areas, by suitable farmers.
- Identifying the most suitable species or species combination per district per region
- Estimating potential yield under prevailing climatic and low energy input conditions.

9. Considerations on the future of aquaculture extension

As mentioned elsewhere, extension methods underwent a radical change in the early 1990s from top down to participatory on-farm and later to farmer-to-farmer methods. In considering the future direction of extension the following should be born in mind.

- The principal aim of aquaculture extension should be to increase integrated farm production through optimal on farm water resource management.
- On-farm participatory extension method provide better returns than the top-down extension method. There is a need to promote this method through farmer-to-farmer extension, promoting the formation and illustrating the advantages of fish farmer clubs (sharing resources) and the "lighthouse concept" of using local entrepreneurs.
- There is a general perception by farmers that extension officers do not understand farmer needs and the concept of enhancing farmer ideas.
- The value of on-farm training courses should not be underestimated.
- The main target group should consist of horticulturalists. Horticulturalists tend to have good access to water, have a greater degree of food security and have more food and labour available than other farmers to invest in fish farming. Fish farming also integrates more easily with seasonal horticultural activities. Tobacco and coffee farmers appear to face seasonal food insecurity and labour constraints and this limits their ability to invest adequate labour and food into fish farming at the right time to make this activity successful (Hecht and Andrew 2002)..
- The radio programme "Uzodzi wa Lero", started by NARMAP, should be used as an extension vehicle (87% of farmers know the programme, 78% regard it as very educative, 74% of farmers listen every week – Petry 1996)

On-farm participatory extension and research should focus on the following aspects:

- Pond management.
- De-mudding and integration with vegetable farming.
- Promoting the use of inorganic fertilisers
- Enhancing composting techniques and promoting pen farming of chickens (were possible).
- Enhancing on-farm fingerling production methods, particularly for T. rendalli and C. gariepinus.
- Promoting the concept of fingerling producers in clubs and on-farm research and development.
- Promoting best feeding practices (fixed time and place, feeding rings, vegetables and high protein plant materials).
- Promoting and demonstrating optimal harvesting strategies.
- Increasing overall farm production through optimal integration of activities.
- Promoting and teaching the value of record keeping.

On farm extension and research should be undertaken jointly by scientists and extension officers.

The extension services of the Departments of Fisheries is inadequately financed and supported. As a consequence the extension officers' lack motivation and new staff (though adequately trained) quickly become demotivated. This results in a reduction in the quality of technology transfer and a reluctance by the farmers to adopt new technologies and in many instances retards farmer-to-farmer extension. Moreover, there are clear indications that the capacity of extension staff needs to be enhanced. Given the information provided by Kaunda (2003) it is clear that the curriculum cannot adequately equip anybody in the complex field of fish farming and farm integration.

10. Lessons learnt from the past

A review of the annual progress reports and the final reports of several donor supported fish farming project have revealed a number of common problems and lessons learnt. These can be divided into five categories (a) Project design, structure and operation, (b) Donor / Government relationships, (c) Understanding the farmers, (d) Research and (e) Extension.

It was also of interest to note that there were very few fundamental differences in the objectives of several of the previous donor supported aquaculture projects. All projects, except for the BZDP project, were over ambitious and as a consequence no single project achieved its stated objectives. Perhaps the single most important lesson learnt is that the objectives of any new project should be realistic and well defined within the framework of local conditions.

(a) Project design, structure and operation

- Projects must have a realistic and measurable goal (e.g. fish production of selected farmer groups increased to 3.5 tons/ha/yr).
- Realistic and measurable indicators of progress and failure must be defined.
- Minimum project duration should be 5 years (quick fixes don't work).
- Ensure effective communication and sharing of knowledge with other donor projects in the target areas. Donors often have conflicting development philosophies and these can cause serious problems in project promotion and execution.

(b) Donor projects / Government relationships

- There must be a simple and streamlined and continuous flow of information between donor, government and project.
- To promote transparency and communication all donor funded fish farming projects should be under the umbrella of an aquaculture co-ordinating / steering committee managed by the Department of Fisheries.

(c)Extension

- Most appropriate extension method must be defined and adhered to.
- Extension service must be cost effective and measurable.
- Communication between project office and extension officers must be effective..
- Extension officers cannot address individual farmer needs. Problems and constraints are largely generic and can best be dealt with through extension at the club level and through inter-club visits and the farm-to-farmer method of extension.

- Focussing on core groups of farmers and clubs is a successful extension method.
- There may be merit in promoting farmer-to-farmer extension, but this requires farmer participative development of methods and the need to identify innovative farmers who could lead the process.
- Choice of field staff is pivotal to achieving intended goal
- Farmer training workshops in integrated farming methods are successful in increasing farm production.

(d) Research

- All applied research must be farmer needs driven.
- All research must take cognisance of on-farm limitations and constraints and be responsive.
- Where possible, applied research must be undertaken in collaboration with farmers in their ponds.
- There is an urgent need to synthesise research results. Malawi has a proud and voluminous record of aquaculture research. However, the research findings have rarely been transferred to the users.

(e) Understanding the farmers

- The commercialisation of small-scale fish farming under the present social and economic conditions is only possible in isolated cases. For most farmers it is not an option. We are only now beginning to understand some of the constraints to this option.
- There must be effective supervision of extension field staff to ensure that project objectives are addressed at all times and to prevent field officers pursuing their own agendas.
- Understanding the socio-economic dimensions of different small holder farmers on a regional basis is a prerequisite for implementation and selecting target groups.
- Understanding the agricultural calendar of different farmers is critical for the promotion of fish farming (e.g. the horticultural calendar is more suited to the integration with fish farming than the tobacco or coffee calendar).
- Fish farming can probably only be intensified by farmers who have greater access to infrastructure and resources. For those who do not have access to adequate on-farm resources, fish farming will remain at a relatively low level but can still contribute towards overall household food security.
- Through club formation farmers recognized the need and the benefit of pooling their resources.
- Introduction of new technologies and ideas are possible but require longer follow-up periods. For example, the on-farm training of farmers to produce catfish fingerlings has been successful but no single farmer has yet perfected the technique.
- Well resourced farmers can most easily make the change from keeping fish to becoming small-scale commercial operations.
- The introduction of alternative fish feeds (e.g. Soya beans) is only successful with the more entrepreneurial farmers.

Consideration of the lessons learnt has highlighted a number of pre-conditions for the successful execution of aquaculture projects in Malawi. These can be summarised as follows:

1. All projects should have a well founded and researched project goal, based on an assessment of
    (i) Physical and environmental suitability (water availability and quality, climate, soil type)

(ii) Farmer knowledge base, education level and motivation

(iii) Understanding of farming systems inclusive of spatial and temporal labour requirements

(iv) Understanding of farm economics

(v) Livelihoods analysis

2. Adherence to project goals and objectives
3. Identification of the most appropriate target group

   Given the significant difference in income and education levels between fish farmers and non fish farmers suggests that any intervention should focus on the more affluent farmers or farming communities. Based on our own observations in the Northern Region we concluded that fish farming did not lead to the more affluent status of the farmers. Instead the more affluent status of some farmers permitted the allocation of resources to fish farming, which has contributed to their status.
4. Identification of the most suitable fish species per area or district and based on farmer experience.
5. Medium to long term project involvement (6-8 years)
6. Suitably qualified, motivated and experienced field advisors and extension officers
7. Maintenance of a project database for evaluation and impact assessment
8. The objectives of any project should be guided by resource constraints, the results of previous research and on-farm trials, a critical evaluation of lessons learnt and farmer knowledge.
9. The principal aim should be to increase production of selected farmers to the realistically maximum possible yield under local constraint limitations.
10. The project should not be over ambitious and have clearly defined goals and measurable and comparable indicators.

11. Conclusions

The overriding question that underpinned this review of the literature and available information was "what are the underlying causes for the poor performance of aquaculture in Malawi and how can fish production be improved within the framework of local conditions and poverty". Through the distillation of the information the principal causes for the poor performance of the sector can be split into the following categories; species selection and fish feeds, donor projects, extension services and socio-economic constraints.

11.1 Species selection and fish feeds

Malawi has an extraordinary diversity of fish species with wide ranging life history strategies,

that can be manipulated to the advantage of the farmer. The most suitable indigenous species that have been identified for aquaculture in Malawi are the cichlids Oreochromis shiranus, O.karongae, and Tilapia rendalli and the clariid catfish Clarias gariepinus and currently these species are the mainstay of small holder fish farming in Malawi. Several others (principally cyprinids) have been tested for their aquaculture potential but are generally regarded as unsuitable. Because of poor growth and low yields under local pond culture conditions there have been several attempts to introduce exotic species to improve production. These initiatives focussed mainly on common carp, grass carp and silver carp and more recently Red Tilapia. Examination of growth and production of these species in polyculture or monoculture has shown that production was not significantly improved. More recently, research has been initiated to develop strains of *O.karnogae* with superior growth performance. This research is valuable and must be pursued vigorously. In addition the

search for a "super fish" has been re-initiated. The re-introduction of common carp is once again being considered as is the introduction of the Nile tilapia, *Oreochromis niloticus.* It has been argued that the introduction of *O.niloticus* should not be allowed by the Department of Fisheries and that the introduction of common carp be preceded by a risk assessment.

By juxtaposing the indigenous as well as the proposed exotic species with the fact that madeya is the most used, most readily available and affordable feed and that pond fertilisation is limited mainly to submerged compost pits provides us with the most likely explanation why aquaculture production in Malawi has stagnated at around 1.2 tons/ha/yr. Unless better quality food (with a minimum protein content of around 15%) is used by farmers production levels of *O.shiranus* and *O.karongae* will not increase, irrespective of whether indigenous or exotic species are being used. It is our contention that the growth potential of *O. shiranus* and *O.karongae* is such that, with adequate nutrition, the average production levels could be increased five fold. Under current frame conditions this is obviously not possible.

The promotion of *Tilapia rendalli* as the most suitable cichlid species for aquaculture in Malawi and concerted research on enhanced on-farm fingerling production of this species has been inadequate and another possible reason why average yield per hectare has not advanced beyond 1.2 tons/ha/yr. The on-station and on-farm research that has been undertaken on *Tilapia rendalli* clearly shows the advantages of this species over *O.shiranus* and *O.karongae*. Results of protein content analysis of various local plant leaves and grass show that there is an adequate provision of food for this species in all regions. This suggests that *Tilapia rendalli* should be promoted as the principal target aquaculture species in Malawi and that *O.shiranus* and / or *O.karongae* (depending on location) should be secondary polyculture species. Under this scenario madeya would be used to supplement the nutritional requirements of *O.shiranus* or *O.karongae* and that vegetable matter would be the principal feed. *T. rendalli* is also the most preferred consumer species.

In addition, on-farm trials in the south and the north have illustrated the superior growth and production potential of African catfish, *Clarias gariepinus* in comparison to cichlid species. As with *O.shiranus* and *O.karongae* farmers do not have access to nutritionally adequate feeds to realise the growth potential of the species. However, given the precocious breeding habits of *O.shiranus*, it could be used as a fodder fish for *C.gariepinus*. Yields in excess of 3.5 tons/ha/yr have been achieved using this strategy in the Northern Region. It is also an acknowledged fact that farmers in all regions wish to farm with catfish but cannot do so due to the shortage of fingerlings. As with *T.rendalli*, insufficient attention has been paid to on-farm production of catfish fingerlings.

11.2 Donor projects

An analysis of the results and outputs of the numerous donor funded aquaculture projects that have been operative in Malawi since 1970 presents a mixed bag of pro's and cons. The positive elements are clearly evident, as all projects have contributed, in some way or another, towards the promotion, adoption and practise of fish farming in Malawi. The negative aspects are obviously seen in the wisdom of hindsight. Mistakes that have been made in the past can however guide us in future. The primary objective, or so it would seem, of most projects was the building of research stations and the subsequent rigorous pursuit of research. Moreover, the research was undertaken in an exclusive manner with minimal involvement of the farmers. There is no doubt that the research undertaken at the stations could have been of greater use and benefit for the development of fish farming in Malawi. Two principal issues have prevented this. Firstly, the effect of excluding the farmers from the research meant that the extension officers had to operate in a top down fashion (which has clearly not had the desired effect). All stations held regular open farmer days. Discussions with farmers in the Northern Region revealed that the open days made very little practical impression on them because of the stark differences between on-farm and on-station resources. In other words many farmers found it difficult to transfer that which they had seen on stations tot heir farms.

Moreover, most of the projects were far too ambitious and had unrealistic expectations. It was only since around 1991 that the ICLARM/GTZ and the MAGFAD projects realised the impracticality of top down research and extension and acknowledged the successful exchange of information between farmers that was being practised in parallel with government extension services. This led to the adoption of a new participatory research approach (Farmer-Scientist-Research-Partnership) in which the research was needs driven and farmer led. A similar approach was adopted by the BZDP in its endeavours to integrate agriculture and aquaculture since 1996. Since the adoption of this approach farmers have participated with greater enthusiasm and a sense of realism..

Secondly, the many important research findings have not found there way to the farmers. This may be either a consequence of inadequate capacity by extension staff to translate scientific findings into practical farm technologies, an attitudinal problem by scientists to draft extension documents, or simply, nobody taking notice of the on-farm research findings. Irrespective of the reasons, some very good research has been undertaken particularly by the EU/CNRFFP in Mzuzu, and the ICLARM/GTZ project at Domasi.

11.3 Extension

As a consequence of the realisation that station based research and top down technology transfer did not achieve the desired effect, a fundamental shift in the methods of extension took place in the early 1990s. Since then extension services have progressed further through the active promotion of farmer to farmer extension and club formation and collective technology transfer. The impact of these new extension approaches however still needs to be evaluated and assessed.

However, irrespective of the approach, extension services are hamstrung by the lack of financial and logistical support by government. This leads to a rapid decline in staff motivation (even of new, eager and enthusiastic staff). Given its current level of financing from central Government it is impossible for the Department of Fisheries to provide the necessary support to actively and properly resource its extension staff. It is of pivotal importance that this shortcoming is highlighted in order that future donor projects may provide long term support for extension services.

11.4 Social issues

Coupled with the reasons outlined above, poverty and the resultant inability to access loans is another contributing factor to the poor performance of the sector in Malawi. This is not about to change. However, there is an urgent need to assess the minimum infrastructure requirements of the farmers without which they cannot attain a reasonable measure of success. In addition any new donor development project must take cognisance of the “community levelling syndrome”. It is real and is a major stumbling stone to progress, particularly in areas where poverty levels are high. This suggests that extension efforts should not be focussed on the poorest of the poor. Instead extension efforts should be focussed on innovative individuals or groups of farmers.

Attachment

Attachment 1

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Attachment 2

Figures

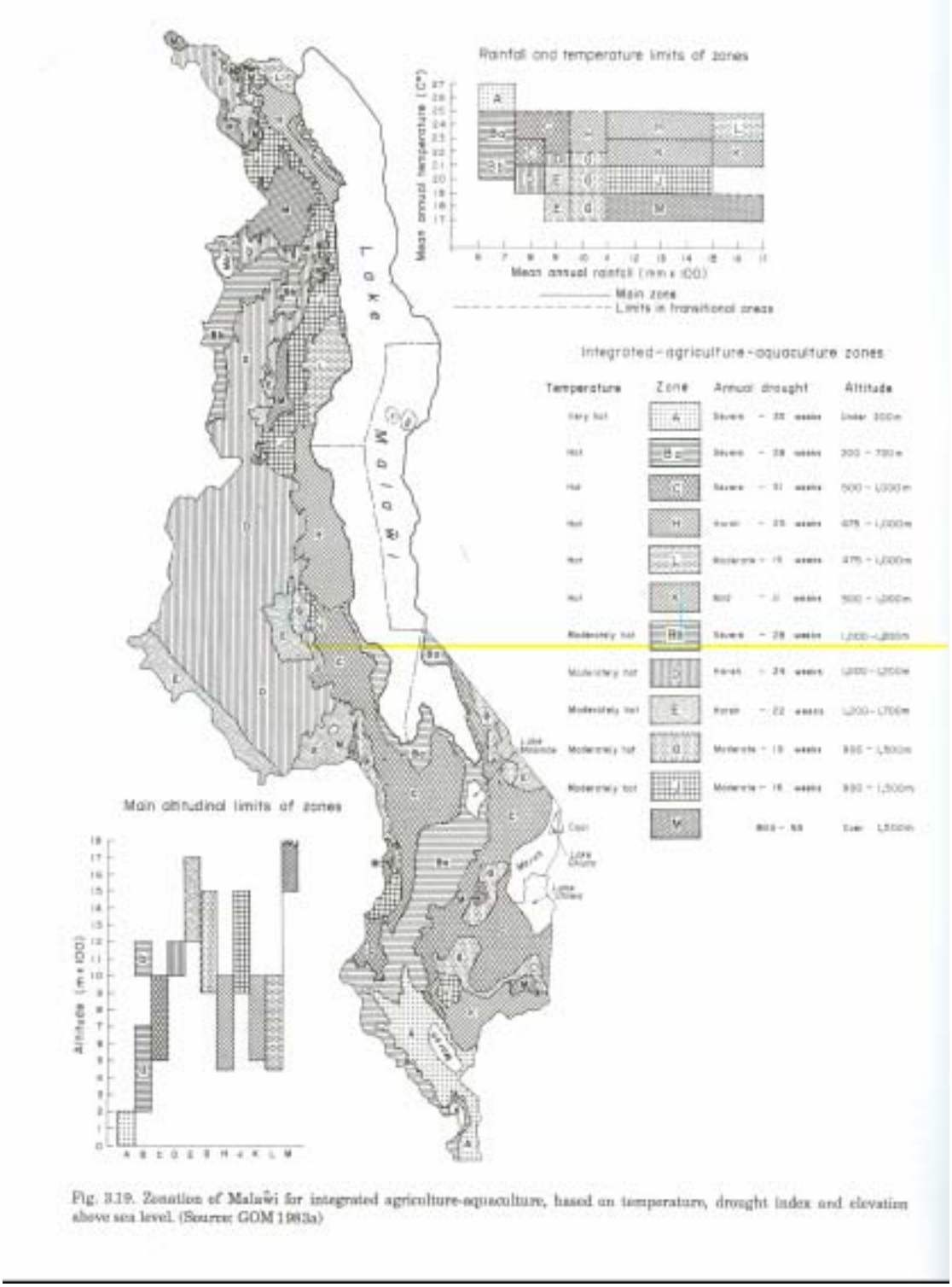

Fig. 3.19. Zonation of Malawi for integrated agriculture-aquaculture, based on temperature, drought index and elevation above sea level. (Source: GOM 1983a)

Figure A1 MAP2: Zonation of Malawi for integrated agri-aquaculture
(ICLARM Stud.Rev. 18, 1991)

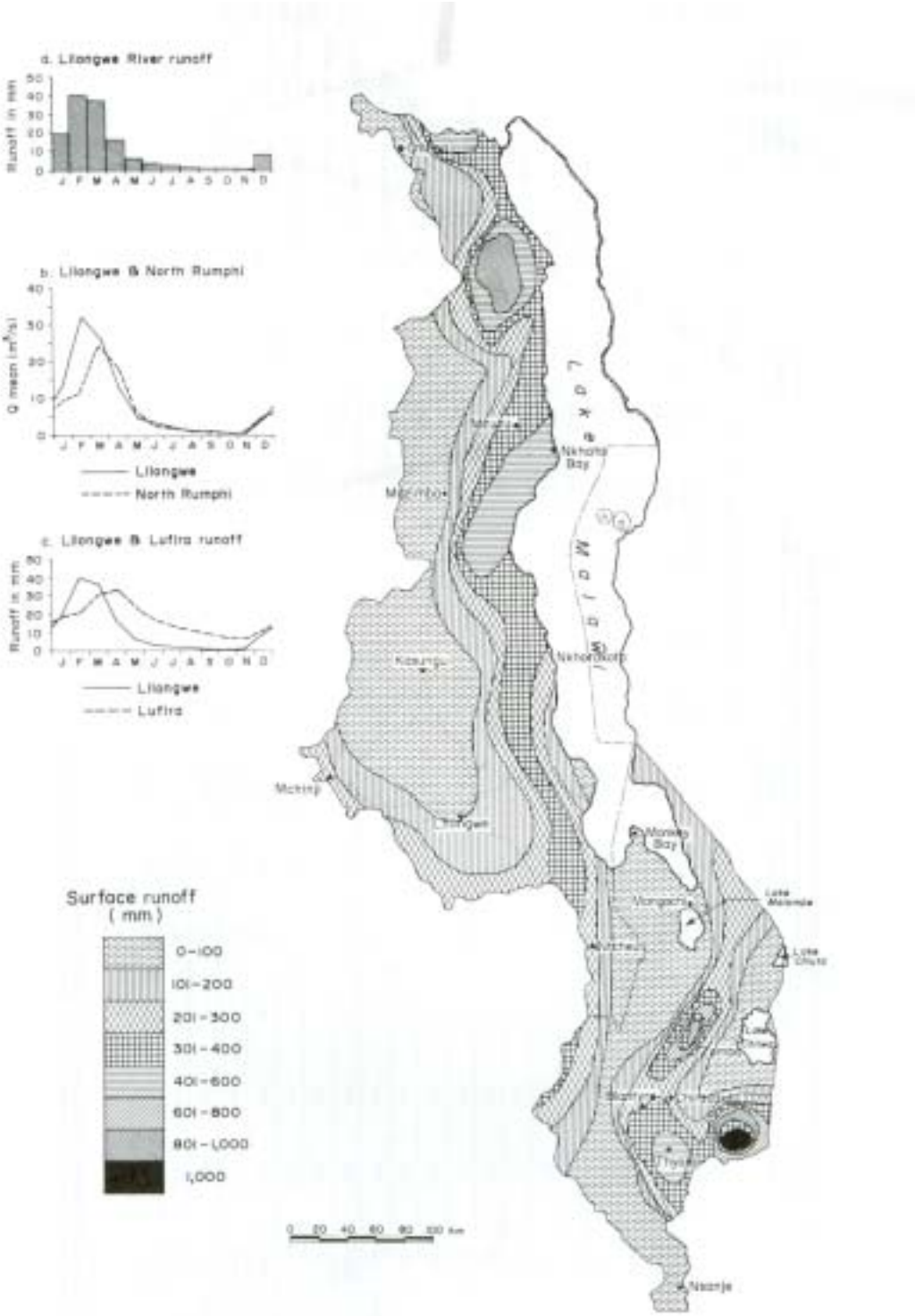

Fig. 3.23. Geographical distribution of mean annual surface runoff in Malawi and monthly distribution of runoff rates at (a) Lilongwe, (b) North Rumphi and (c) Lufira. (Source: GOM 1983a)

Figure A2 MAP3: Mean annual surface run-off (ICLARM Stud.Rev. 18, 1991)

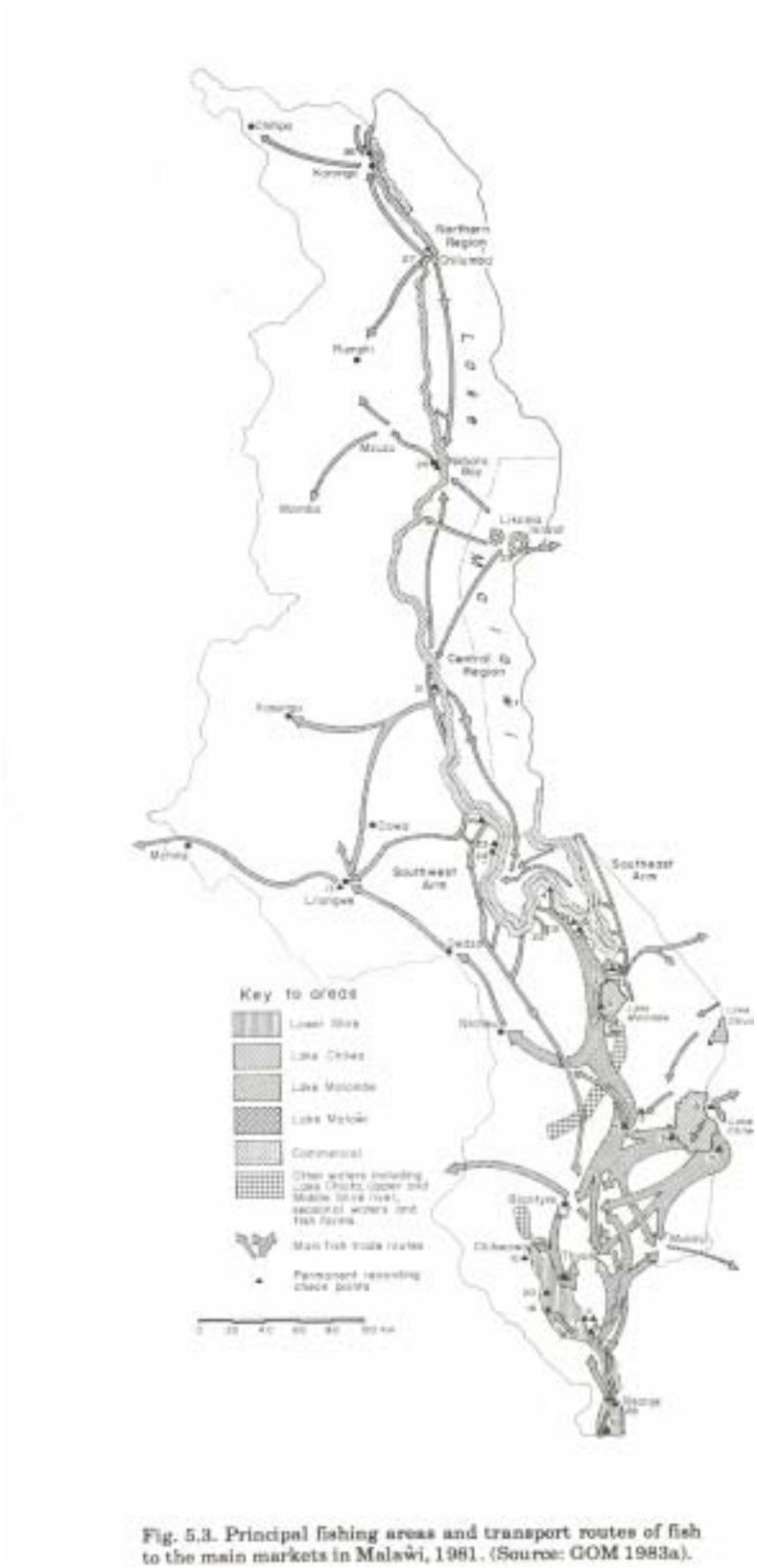

Fig. 5.3. Principal fishing areas and transport routes of fish to the main markets in Malawi, 1981. (Source: GOM 1983a).

Figure A3 MAP4: Fish distribution routes (1983) (ICLARM Stud.Rev. 18, 1991)

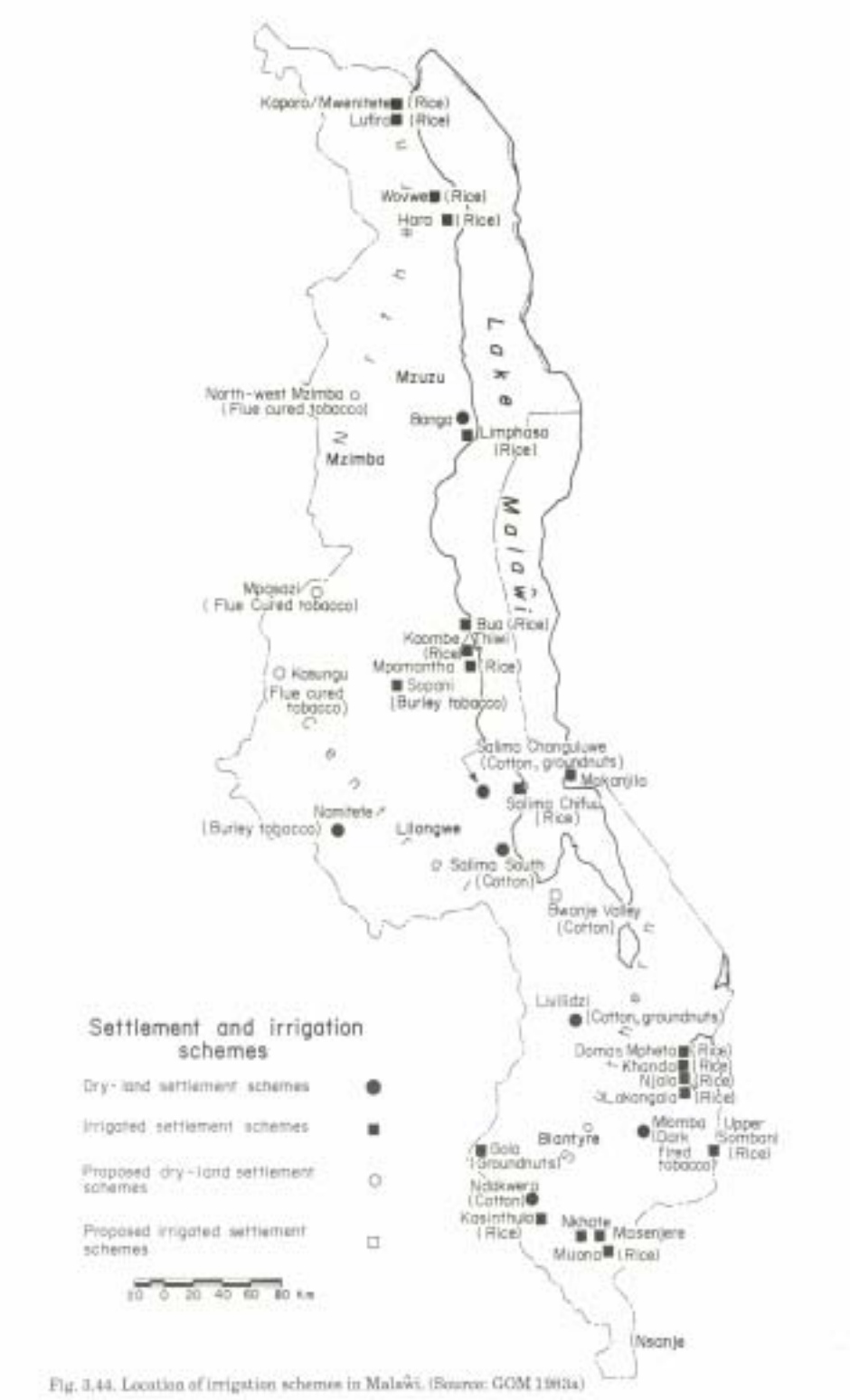

Fig. 3.44. Location of irrigation schemes in Malawi. (Source: GOM 1983a)

Figure A4 MAP5: Irrigation schemes in Malawi in 1983 (ICLARM Stud.Rev. 18, 1991)

Figure A5 MAP6: Distribution of research stations and aquaculture projects from 1950 to 1989 (ICLARM Stud.Rev. 18, 1991)

ADiM Working Paper 3

National Socio-Economic Survey Report

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National Socio-Economic Survey Report

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Executive Summary

The questionnaire survey formed part of the initial information gathering process required for the development of a Master Plan for aquaculture in Malawi to the year 2025. The Master Plan Project is funded by the Japanese Government's Overseas Development Assistance (ODA) system of JICA, and runs over a 2.5 year period from January 2003 to June 2005. The project is operated from within the Department of Fisheries (DoF), Ministry of Natural Resources and Environment of the Malawi Government. The survey was carried out over a five-week period during May and June 2003, by members of the JICA consulting team and counterparts within the DoF.

The survey covered 563 farmers from 13 districts in the three regions of Malawi and was limited to smallholder farmers who owned ponds located at or near their homestead. Farmers without ponds but from the immediate vicinity of the fish farming respondents were also included in the survey so that comparison could be drawn between these groups. The overall objective of the survey was to characterise the small holder fish farming sector in Malawi to inform the development of a Master Plan designed to take aquaculture into the future.

The results of the questionnaire are generally internally consistent and clear. Although fish production from small-holder farmers was lower than expected, the more productive fish farmers also tend to be the more productive farmers in general. These more productive farmers tend to be older, have larger families, more labour, more dependents, higher education levels, and more skilled employment experience. They also have access to and cultivate more land of all types, have better access to water, produce a more diverse range of agricultural produce, have more diverse livelihood strategies and are less food insecure than less productive households.

In terms of fish production, they produce more fish, have larger or more ponds and are more likely to feed their fish manure, compost and vegetable matter than the less productive farmers. Production per farm does not seem to be related only to the intensity of fish farming activities (ie. kg/ha/yr), but also to the area of pond available to raise fish.

The survey has indicated that the various categories of farmers are relatively evenly spread across the country. Even though variations in biophysical, political and economic characterisitics occur in the different regions of Malawi, it is apparent that household level factors such as access to labour, availability of pond inputs and the level of agricultural diversification have a stronger influence over farmers than the geographic variations. In this regard, one of the significant findings from the survey is the relationship between age of the household head, and the level of agricultural production. In summary, as the age of the household head increases, so too does their household size, availability of labour, diversity of income sources, area of land cultivated and overall value of agricultural production. Fish production in households tends to follow the same trends as that for general agricultural production.

Two fundamental groups of active fish farmers are apparent on a national level:

a) Those that have ponds but receive only minimal production from them. These farmers benefit mostly from direct contribution to household food production through the availability of fresh fish.

b) Those that have ponds who receive a tangible income from fish production. These farmers benefit both from the cash that is generated, and also from the availability of fresh fish to the household.

The vast majority of fish farmers fall into the first category. This has major implications for the planning process for aquaculture development. While increasing production of fish within these households should not be discounted, in reality, limited access to pond inputs within this group is likely to constrain significant increases in fish production by these farmers. It is clear however, that even these low levels of production form an important part of household livelihoods through providing an additional option for spreading agricultural risk and increasing the overall value of the farming system.

The survey has indicated that in almost all cases fish farming forms part of a variety of activities that are combined to maximize the food security of the small holder farmer. This suggests that

fish farming needs to be viewed as part of the overall agricultural system being employed at the farm level rather than an activity that can be considered alone. It should be recognized that ponds are constructed in areas where water is available, and this also allows other agricultural products to be grown in the immediate surrounds of the pond. The pond and the products of the surrounding areas are intimately connected in two ways:

c) the pond acts as a water storage system and adds to the capacity for dry season agriculture either through seepage or active irrigation systems

d) the agricultural productivity of the dimba around the ponds contributes to the required pond inputs to increase fish yield

These two points are fundamental to understanding the opportunities and constraints to increasing overall farm production by including aquaculture as an additional livelihood on the farm. This survey has also indicated that the constraints facing small holder aquaculture are similar to those facing small holder agriculture in general. It is suggested that without understanding these linkages, the challenge of improving both small holder productivity of fish per unit area, and the spreading of aquaculture activities to new geographical areas in Malawi, will be difficult to meet.

Although our survey showed that fish from aquaculture formed a maximum of around 17% of value of total household productive activities, the contribution in terms of increased diversification may be significant. Although the hidden value of access to fish from fish ponds is difficult to measure, it is clear that fish farming improves the level of diversification at household level. The results suggest that households with more diverse livelihoods are also better off.

The current survey has provided a excellent baseline upon which planning for future development of small holder aquculture can be based. Clearly this sector is currently contributing insignificant amounts of fish on a national level (less that 1%) as compared to the capture fisheries. Although this contribution could increase in the future with active intervention or changes in markets for fish, it is unlikely to ever meet the required shortfall in fish supply that is expected in the next 20 years. Therefore other approaches need to be taken to meet these national demands over time. As indicated in other reports from the Master Plan study, these options may include increased fish imports, commercial aquaculture, and utilisation of new stocks within the capture fisheries. However, as mentioned above it is apparent that the value of aquaculture integration at a household level is significant in terms of ensuring food security at household level.

As far as the future is concerned, it is clear that a dramatic increase in the rate of new pond establishment has occurred since the 1980's, with the most dramatic increase in pond numbers occurring from 1999 to the present. An increase of about 15% in pond numbers has occurred per year since 1965.

If this rate of annual increase is projected into the future, it is apparent that up to 80 000 ponds may be constructed by 2025. This assumes that it will be possible to maintain a 15% growth rate per annum until that time. Clearly, significant infrastructural and institutional support would be necessary to allow this kind of growth to occur. It is likely that greater reliance would be placed on support from fellow farmers as the overall number of fish farmers increases. On a national level, it is believed that there is sufficient new suitable pond sites to allow this increase to occur over time. Apart from the active promotion of aquaculture by Government and NGOs, it is also likely that a multiplier effect would be activated with new farmers constructing ponds due to the increasing awareness of this option through the observation of neighbours.

If these future projections are assumed and if a realistic estimate of fish production per unit area is attained, it may be possible to achieve a total fish production from this sector in the order of 1750 tons by 2025.

1. Introduction

The development of a Master Plan for aquaculture in Malawi to the year 2025 is a project funded by the Japanese Government's Overseas Development Assistance (ODA) system of JICA. The project is operated from within the Department of Fisheries, Ministry of Natural Resources and Environment of the Malawi Government.

The Master Plan will be developed over a two and a half year period from January 2003 to July 2005 and will map out strategies for aquaculture development in Malawi for the next 20 years. The planning process needs to be founded on a reliable situation analysis of aquaculture and related sectors. The status of small-holder aquaculture in Malawi was poorly documented, and the requirement for an national survey of activities was viewed as critical for appropriate planning for the future.

Prior to the design of the survey an extensive review of past aquaculture and related projects in Malawi was undertaken. Documentation reviewed can be seen in the reference section. In addition field sites in all the regions were visited and initial discussions were carried out with fish farmers and other key informants in these areas.

These initial investigations revealed a number of generalities which guided further thinking with regard to the socio-economic survey. Firstly, it has been estimated that more than 80% of Malawians are engaged in rural livelihoods (Cross, 2002). The national well-being is directly linked to the land and natural resources. These resources are under heavy pressure from the large rural population with the average land holding per household limited to approximately 2.5 hectares (Cross, 2002). In the absence of obvious alternatives to a land based economy, maximum and sustainable use needs to be made of natural resources. In this context, aquaculture may offer certain small-holder farmers the opportunity to improve the productivity of limited land and water supplies. These initial investigations also indicated that aquaculture had been adopted differently by various categories of farmer and that for most smallholder farmers aquaculture only formed part of a variety of activities that have developed to reduce the risk of food shortage in an extremely harsh and seasonal environment. Further, previous studies identified some of the constraints to intensification of aquaculture, and the survey needed to be designed to provide more insights into current constraints and trends.

Small-holder farmers make up the majority of the aquaculture sector in Malawi and it was therefore appropriate to focus significant attention on this sector, if aquaculture development in the Malawian context was to be properly understood. The potential role of larger scale semi-commercial and commercial aquaculture in the development of the small-scale sector was also considered during the design of the survey, but forms part of other activities of the Master Plan development process. In essence, the socio-economic survey was designed to provide the required baseline information for a sound understanding of current small-holder aquaculture activities in Malawi with a specific focus on determining how aquaculture fitted into the overall livelihood strategies of small-holder farmers.

The survey needed to provide information on some of the following aspects. Firstly there was a need to identify why some farmers had adopted aquaculture while others have not, and why some are more successful than others. It was necessary to understand how household and rural economies worked. There was a requirement to determine if, and how, aquaculture was contributing to improved food security through enhancing household livelihood diversification.

Taking the above into consideration the following approach was adopted for the survey:

1.1 Purpose

The socio-economic survey was carried out as part of the Master Plan development process to provide the primary information necessary to determine the current status, constraints, key success factors and opportunities within the small-scale aquaculture sector in Malawi.

1.2 Guiding Principles

1.2.1 The survey should be carried out in pre-selected areas that are environmentally suited to aquaculture in its various forms.

1.2.2 The survey should be designed to obtain specific and detailed information on constraints, key success factors and opportunities in aquaculture and how these are related to other agricultural and livelihood activities.

1.2.3 The questionnaire should be designed so that it compliments the existing surveys that have been carried out rather than duplicating these efforts.

1.2.4 The survey should be designed within the context of developing the Master Plan; that is, it is only one aspect of the process rather that the focus of the project. It should only yield information that is going to feed into and inform the development of the Master Plan.

1.2.5 Investigations on larger-scale commercial aquaculture potential form part of a separate process. The information required for this will be obtainable from different sources and using different techniques.

1.2.6 The survey should focus on farmers who have been active in the past, are currently active or have shown an interest in becoming active (the last category would be limited by environmental and other farming systems in place in a particular area).

1.2.7 There is a need to compare farmers who have not adopted fish farming with those that have in particular environmental areas. Therefore a sample of non-fish farmers should be included in the survey.

1.3 Specific Objectives

1.3.1 To determine the current contribution of aquaculture to rural livelihoods on a local and national level.

1.3.2 To determine why certain farmers have adopted fish farming as an additional livelihood activity.

1.3.3 To determine why some farmers have intensified aquaculture activities more than others.

1.3.4 To determine why some farmers have given up fish farming.

1.3.5 To collect the primary information required to determine the potential, and key factors (biological, environmental, institutional, cultural, human capacity) required for increasing aquaculture production, either through improving the production of existing farmers, or through increasing the number of farmers, or both.

1.3.6 To validate the current national aquaculture production statistics.

2 Methods

After reviewing past surveys used to determine characteristics of agriculture/aquaculture activities in Malawi, it was apparent that a livelihoods approach would best suite the requirements for this survey.

The fundamental principles of this approach require that aquaculture activities are recognized as generally forming only a part of a host of livelihood activities that contribute to food security/income generation at household level. An important finding of the Border Zone Development Project's evaluation of aquaculture activities in parts of the Northern Region (Hecht and Andrew, 2002) was that the degree of intensification of aquaculture activities may be correlated to the farming system in place in a particular household. It was suggested that resource poor farmers generally struggled to increase their aquaculture activities over time and that the farming system in place (for example dominated by coffee/maize, tobacco/maize, and general horticulture) determined the extent of inputs and resources (such as farm by-products, labour and land) that are available to a farmer for inputting into his or her aquaculture activities. Linked to this is the relative importance of other crops grown, and activities contributing to household income generation and food availability, to meet basic consumption needs. A strong seasonal component to various constraints was apparent and this was corroborated by our own pre-survey field investigations.

Although many surveys have been undertaken in the agriculture/aquaculture sector by different organisations, these have often been restricted to particular areas of Malawi and linked to particular projects with specific objectives. These surveys have also used differing techniques and are therefore not always suitable for comparative purposes. The current survey was designed as a national survey that concentrated on agriculture/aquaculture activities and to allow comparative analysis between areas through using common techniques throughout the country. A random sample from a range of representative areas throughout Malawi was chosen in order to determine the constraints, key success factors and opportunities for aquaculture development under varying conditions.

2.1 Geographic area of sample

The geographic focus areas for the survey (Table 1) were chosen based on existing reported information from various organizations and projects, field visits by the project team, and from wide consultation with people knowledgeable of aquaculture activities in various parts of the country. Cogniscence was also taken of the process followed by the DoF in identifying beneficiaries and focus areas for the HIPC (Highly Indebted Poor Countries) Programme. The following criteria were considered:

- They fall in proven environmentally suitable areas, specifically with regard to water availability and soil type
- They cover representative areas in all three regions
- They cover areas that vary in physical distance from Lake Malawi, the main source of fish for the country
- The presence and number of active fish farmers, and the intensity of current aquaculture activities.
- The areas covered did not overlap with surveys carried out by the World Fish Center during April 2003

2.2 Random Sampling Methodology

To maintain a statistically robust sampling strategy for the socio-economic survey it was necessary to strive towards obtaining as random a sample as possible based on existing information.

However, due to incomplete existing records of farmers and logistical constraints associated with the selecting farmers on name alone, it was decided that villages or groups of villages with clusters of farmers within particular focus areas would be selected. This method was considered as random as could be achieved within the logistical framework of the survey.

The total sample size was limited by time and budgetary constraints. It was aimed at covering at least 500 farmers, one quarter of these being non fish farmers while the other three quarters being either previous, active or new fish farmers. The overall number of fish farmers was considered as an acceptable sample (25%) of the estimated 1500 active fish farmers in the country as a whole. Numbers of fish farmers chosen for each region was based on the proportion of the estimated national total located in that region.

The inclusion of non-fish farming neighbours of the sample fish farmers was considered important in order to determine why certain farmers had adopted this activity while others had not, and the effects that adoption may have had on the household. One non fish farmer to every three fish farmers was considered a sufficient sample to show these differences.

In order to include a representative spread of fish farmers from the full range of geographical areas in the country, various districts, and in some cases areas within districts, where pre-selected for the survey based on existing information and consultation with personnel familiar with fish farming activities in these areas. It was attempted to cover as many of the environmentally suitable area of the country where at least some fish farming activity was taking place. It was acknowledged from the outset that certain areas excluded from the survey were suitable from an environmental point of view for aquaculture activities but the objectives of the survey required that at least some fish farming activities were taking place in the areas chosen. Identification of new environmentally suited sites was not an objective of this survey and will form part of a separate process.

The number of farmers selected for interview in these known fish farming areas was based on the total number of fish farmers known from the area (from DoF records), which in turn reflected a relative proportion of the estimated total fish farmers in the region as a whole.

Using the above approach it was anticipated that the sample would include relative proportions of farmers that had a) given up fish farming, b) were currently involved in fish farming (either individually or communally), or c) that were located in suitable areas for fish farming but had not yet engaged in this activity. Among these it was anticipated that the following categories of farmer would to be included:

- Food insecure (poorest of the poor – fish and other farm outputs mainly for household consumption, and generally are insufficient for annual requirements)
- Partially food secure (innovative poor - fish and other farm outputs mainly for household consumption, some for sale, and generally sufficient outputs for annual requirements)
- Food secure (middle-class, fish and other farm outputs mainly for sale).

2.3 Questionnaire Design

It was acknowledged from the outset that fish farming among small-holder farmers formed only a part of a variety of on-farm activities. Therefore, the questionnaire was designed to obtain not only information of fish farming activities. It was necessary to gather enough information to firstly characterise farmers according to their fish farming activities, and secondly to assess if and how the overall farming activities of these categories differed.

The questionnaire was therefore split into six major sections dealing with different categories of information. These sections were:

1. Household structure

2. Access to, and the use of land and natural resources
3. Livelihood and wealth indicators
4. Food security issues
5. Fish farming activities

The questions within each section were drafted so that the answers could be relatively easily placed into a database for further processing and analysis. To this end most questions had a predetermined range of possible answers. It was acknowledged that some questions required a more open-ended approach and detailed discussion with the respondent. The information from these questions was recorded in a similar manner by the six enumerators whose methods were standardised through the training process carried out prior to the survey. In all cases the questions were designed to encourage discussion with the farmer to ensure that as much interaction as possible was achieved while at the same time ensuring that the data was manageable. For example, information on land use and production was obtained through the development of a farm map together with the respondent. The detailed information obtained through this technique was then filled into tables by the enumerator after the interview. In most cases information was further sorted and categorised after the survey during the data entry and analysis stage (see section 2.6 below).

Where possible questions were prepared that would validate the answers from other questions. For example, periods when respondents had a food shortage from own production was compared to periods when food needed to be purchased. This technique allowed discrepancies within answers to be revisited by the enumerator to ensure that the question was understood by the respondent and the meaning of the responses was clear.

While the objectives of the current survey differed from previous studies, ideas for the design of the questionnaire were also developed through assessing various previous activities.

Previous studies that were drawn upon for guidance included but was not limited to:

- The RESTORE baseline questionnaire used by ICLARM
- BZDP aquaculture component evaluation (Hecht and Andrew, 2002)
- BZDP economic questionnaire (Murray, 1998)
- CNRFFP pond inventory form
- CNRFFP pond stocking and harvest data form
- Criteria listed in baseline survey for aquaculture in the Northern Region (S. Krone, 1998)
- Indicators of wealth from NARMAP fishing village socio-economic surveys (Ganter et al., 2001)
- Kulima APIP Concept Project, BZDP farming system analysis (Charman, 2002)
- BZDP food security situation report (Langa, 2002)
- NAC basic pond information form (DoF)
- MAGFAD Reports (1997)

Further guidance for the questionnaire design and on the choice of sample, which needed to be based on the current situation of aquaculture in Malawi, was obtained through interacting with farmers and key stakeholders in a wide range of areas. The stakeholders who were visited and consulted prior to the survey are listed in Attachment 1.

The draft questionnaire was tested in the field in the areas surrounding Namwera in the Mangochi district. A sample of 18 fish farmers and 6 non fish farmers were selected and each enumerator had the opportunity of carrying out four interviews. Apart from testing the effectiveness of the questions,

the exercise formed part of the enumerator training that took place prior to the survey (see section 2.5.2 for details). Choice of test area was determined by the proximity to Mpwepwe Fisheries Training College, where the enumerator training took place.

Once the test questionnaires had been analysed by the survey team, questions were adapted accordingly in order to arrive at the final form to be used in the survey (see Attachment 2).

2.4 Logistical design of the survey

The survey was conducted over a five week period (5 May to 9 June 2003) using two teams operating independently with their own vehicles and drivers. Each team consisted of three enumerators drawn from the Department of Fisheries who conducted interviews separately but within the same logistic area. That is, each vehicle transported three enumerators to farms within the same general area on any particular day. This allowed for a degree of flexibility as to the areas that the two teams could operate and allowed the greatest geographic area to be covered in the shortest possible time. Each team collated their questionnaires at the end of the day and these were checked by either Dr Andrew or Dr Weyl for consistency. Any entries that were unclear were then discussed with the enumerators. This mechanism of checking and reporting back allowed consistency to be achieved between the enumerators. Greater effort was placed on this system early on in the survey so that this high level of consistency could be achieved as soon as possible.

Each vehicle was accompanied by a local fisheries officer, or when unavailable, another person (either from the Department of Agriculture or a locally based NGO) knowledgeable of the area to be surveyed in order to guide the team to the chosen farmers and to act as liaison between the team members and the farmers.

During the period in a particular area to be surveyed the team was based at a point that was close enough to the survey area to avoid time wastage in reaching farmers. Once the survey was completed in one area, the teams moved to a new base from which daily operations were conducted.

Once the target areas and overall sample number from each area was established, it was necessary to plan the logistics of reaching the required number of fish farmers within the constraints of logistics. The most effective way of achieving this was found to be in-depth discussion with the most knowledgeable extension personnel in that area. In most cases this was the responsible Department of Fisheries officer closest to the target area, but in areas where the DoF was not currently active, the staff of NGO projects in the area were consulted. These consultations where conducted by one of the JICA consulting team a few days prior to the survey team arriving in an area. In this way, villages with clusters of fish farmers and located in varying geographic areas were identified. The representative number of interviews required in each cluster was calculated, and the survey team responsible was nominated. An example of the pre-prepared operational tables used in the field can be seen in Attachment 4.

The logistical arrangements of reaching the respondents in the limited time available was organised so that the survey teams could proceed immediately into the field once arriving in an area. The farmers were notified of the survey dates in advance by the local extension officer so that they would be available when the team arrived in their village. In most cases the local extension officer accompanied the teams into the field but did not participate in the interview.

The above procedures resulted in the following timeframe of activities for the survey:

Table 1 Timeframe of activities

Date	Weekday	Team 1	Team 2	Weyl	Andrew
05-May	Monday	Preparation	Preparartion	LLW	LLW
06-May	Tuesday	Dowa	Dowa	Dowa	Dowa
07-May	Wednesday	Dowa	Dowa	LLW	Dowa
08-May	Thursday	Dowa	Dowa	LLW	Dowa
09-May	Friday	Dowa	Dowa	LLW	Dowa
10-May	Saturday	Travel to Nkhotakota	Travel to Nkhotokota	LLW	Nkhotakota
11-May	Sunday	Nkhotakota	Nkhotakota	LLW	Nkhotakota
12-May	Monday	Nkhotakota	Nkhotakota	LLW	LLW
13-May	Tuesday	Nkhotakota	Nkhotakota	North	North
14-May	Wednesday	Travel Dedza	Travel Mchinji	North	North
15-May	Thursday	Dedza	Mchinji	North	North
16-May	Friday	Dedza	Mchinji	North	North
17-May	Saturday	Travel to North	Travel to North	North	North
18-May	Sunday	Lusangadza	Chikwina	North	North
19-May	Monday	Lusangadza	Chikwina	North	North
20-May	Tuesday	Lusangadza	Chikwina	North	North
21-May	Wednesday	Lusangadza	Chikwina	North	North
22-May	Thursday	Lusangadza	Lusangadza	North	LLW
23-May	Friday	Travel to Nchenachena	Travel to Nchenachena	North	LLW
24-May	Saturday	Mphompha	Livingstonia	North	LLW
25-May	Sunday	Mphompha	Livingstonia	North	LLW
26-May	Monday	Mphompha	Livingstonia	North	Zomba
27-May	Tuesday	Mphompha	Mphompha	LLW	Zomba
28-May	Wednesday	Travel South & Preparation	Travel South & Preparation	LLW	Mulange
29-May	Thursday	Travel Zomba	Travel Zomba	LLW	Zomba
30-May	Friday	Chinseu	Chinseu	LLW	Mwanza
31-May	Saturday	Zomba	Zomba	LLW	Zomba
01-Jun	Sunday	Travel to Mulanje	Travel to Mulanje	LLW	Mulanje
02-Jun	Monday	Thyolo	Thyolo	LLW	Thyolo
03-Jun	Tuesday	Mulanje	Mulanje	Mulanje	Mulanje
04-Jun	Wednesday	Phalombe	Phalombe	Kasinthule	Kasinthule
05-Jun	Thursday	Travel to Namwera	Travel to Mwanza	Zomba	Zomba
06-Jun	Friday	Namwera	Mwanza	LLW	LLW
07-Jun	Saturday	Namwera	Mwanza	LLW	LLW
08-Jun	Sunday	Namwera	Mwanza	LLW	LLW
09-Jun	Monday	LLW	LLW	LLW	LLW

2.5 Personnel used

2.5.1 Selection of enumerators

Six enumerators were selected as part of the survey team. These personnel were drawn from the DoF and selected based on their prior experience with field surveys. Members of the core team that carried out the survey are listed in Table 2 below.

Table 2 Survey core team

Name	Affiliation	Task
Dr TG Andrew	JICA Team	Supervision
Dr O Weyl	JICA Team	Supervision
Ms J Kazembe	Mpwepwe (DoF)	Coordination/Enumerator
Mr D Kachilonda	Mpwepwe (DoF)	Enumerator
Mr T Njobvu	Mpwepwe (DoF)	Enumerator
Mr M Ngachera	FRU (DoF)	Enumerator
Mr W. Nomoto	FRU (DoF)	Enumerator
Mr S Nyolo	NAC (DoF)	Enumerator
Driver # 1	Team # 1	Driver
Driver # 2	Team # 2	Driver
Driver # 3	JICA team	Driver

In addition to the core team local field assistants were recruited from either the DoF, Department of Agriculture, or an NGO to facilitate field operations in particular areas with which they were very familiar. Table 3 lists these field assistants.

Table 3 Local fisheries and other field assistants

Area	Name	Affiliation and Base
Livingstonia	Mr Lungu	DoF, Nchenachena
Mphompa	Mr Mkandawa	Mphompa
Nkhata Bay/Chikwina/Limphasa	Mr D. Kumwenda	DoF, Chikwina
Mzimba/Chikwina	Mrs D. Msukwa	DoF, Mzuzu
Mchinji	Mr Chisale	CARD, Mchinji
Dedza	Mr Chiwamba	Concern Univ., Dedza
Nkhotakota	Mr Makwinja	DoF, Nkhotakota
Mulange/Pholombe/Thyolo	Mr Nhlani/Mr Thengo	DoF, Chisitu
Zomba	Mr Bato	DoF, Zomba
Namwera	Mr ???	DoF, Namwera
Mwanza	Mr Malizeni	DoF, Mwanza

2.5.2 Pre-survey training

It was considered essential that the techniques used by enumerators during the survey were standardized as much as possible in order to reduce the variability of responses from respondents. Training of the six enumerators took place at Mpwepwe Fisheries Training College near Mangochi over a 3 day period from 28 to 30 April 2003. The training incorporated workshopping of the draft questionnaire prior to testing. The techniques required for each question was focused on so that standardization could be achieved within the team. Particular attention was paid to ensuring that the enumerators were familiar with the participatory techniques to be used in the survey in order to ensure that farmers opinions and information was recorded in the most objective manner possible. Problem areas were adapted through consultation with the enumerators who were all familiar with the general social, economic and cultural conditions that prevailed in the sample areas. It was decided that the questionnaire form should remain in the English language for the purpose of simplicity, while agreement was reached on the manner that each question would be approached using Chechewa in the field.

Once agreement was reached on the structure and content of the draft questionnaire, enumerators proceeded into the field in the Namwera area where the questionnaire was tested on 24 respondents including fish farmers and non fish farmers. Members of the JICA study team accompanied the enumerators into the field to assess the practical application of the survey techniques. This exercise formed part of the training process of enumerators. After the field test, a day was spent working through the completed questionnaires and finally adapting any questions that were not effective in the field.

Based on the outcome of the field test it was agreed that each enumerator would be able to complete at least 4 questionnaires per day during the survey thereby achieving the minimum sample size of 500 within the survey timeframe.

The general impressions of enumerators on small holder fish farming in Malawi was recorded by conducting a workshop in Lilongwe on 9th June 2003 once the survey was completed (see IV).

2.6 Data analysis

Completed questionnaires were assessed using exploratory data analysis procedures. In all cases only those respondents who answered a particular question were included in the analysis of that question. Questions that were not answered, or for which the answer was unclear, inconsistent or ambiguous, were discarded.

An MS-ACCESS database was designed for the storage and analysis of the questionnaire data. Subsequently two assistants were trained in data input and completed questionnaire responses were entered into the database using predefined forms (see Social Survey Database in ADiM Database).

Summary tables of the various questions were generated using numbers and percentages according to standard methodology. Further mathematical analysis was carried out only for selected information categories to allow additional interpretation of the data. These information categories included the following:

2.6.1 Total annual fish production (TFP) per farmer

This was estimated using the following procedure:

$$TFP = \left(\frac{LH_{2002} + LH_{2001}}{2} \right) + PH_a$$

were LH2002 and LH2001 are the total weight in kilogrammes of the annual large harvests in the 2002 and 2001 seasons and PHa is the estimated annual partial harvest weight in kg estimated by:

$$PH_a = n \times \alpha TL_{est}{}^{\beta} x PH_n$$

were n is the estimated number of fish harvested during each partial harvest, α and ß are the parameters for the length:weight equation for chambo (α= 0.017; ß=2.99), TLest is the estimated average length of the fish harvested in centimetres and PHn is the estimated number of annual partial harvests.

The value of fish produced per farmer was calculated based on a value of MK 70 per kg, which was the average price of Chambo in 1997 (Department of Agriculture data).

2.6.2 Annual crop production of each crop i (CPi) per household

In order to determine the contribution of fish to farm income (2.6.3. below) it was first necessary to calculate relative amounts of the various crops grown on the farm as follows:

$$CP_i = A_i \times P_i$$

were Ai was the estimated area covered by crop in hectares and Pi was the annual national average small-holder farmer production estimate for crop i, obtained from Department of Agriculture statistics.

2.6.3 The relative economic value of fish production to total farm production

This was estimated by the proportion that the fish value made up of the total of all crop production values per household. The crop production value was estimated by multiplying the crop production for each crop by the mean national farm gate price for that crop. The absence of recent crop and fish price data necessitated the use of 1997 data derived from the Department of Agriculture as a standard.

2.6.4 Calculation of national fish production

Due to the uncertainty regarding the national (a) number and (b) total surface area of ponds, and the (c) number of farmers, national fish production was estimated using each of these criterial. This allowed a range of estimates for national production to be obtained rather than a fixed figure, and was considered a more realistic method.

To determine the fish production per pond and per hectare only established ponds constructed prior to 2002 (from this survey) were used in the analysis.

(a) The mean production per pond Ppond was estimated by:

$$\overline{P_{pond}} = \frac{\sum_{i=1}^{n}\left(TFP \big/ n_{pond}\right)}{n}$$

were npond is the number of ponds constructed prior to 2002 for each farmer i and n is the total number of farmers (from this survey). National production was then estimated by raising mean Ppond by the NAC (2002) estimate of 9500 ponds for Malawi as a whole.

(b) The mean production per hectare (Pha) was estimated by:

$$\overline{P_{ha}} = \frac{\sum_{i=1}^{n} \left(TFP / SA \right)}{n}$$

Where SA is the surface area of all ponds constructed prior to 2002 by each farmer i and n is the total number of farmers. National production was then estimated by raising mean Ppond by the product of the NAC (2002) estimate of the number of ponds and mean surface area per pond (from this survey) in each region.

(c) On a farmer level, the NAC (2002) estimate of 4500 farmers was divided into the number of farmers within each production level (no harvest, 0-19 kg pa, 20-60 kg pa, +60 kg pa, new farmer and ex fish farmer) by using the proportions of farmers occurring within each category (from this survey). The number of farmers within each category was then raised by the corresponding mean annual production (TFP) of that category based on estimates from this study.

3 Results

This results section first describes the sample in general terms, after which farmers are categorised according to fish production per farm. General characteristics of smallholder fish farmers that have become apparent from the survey are presented in section 3.3. Section 3.4 provides updated estimates of national aquaculture statistics based on the sample.

These sections are followed by a more detailed examination of any relationships between various household attributes and fish farming category (sections 3.5 to 3.8), in an attempt to characterise these categories according to overall household livelihood strategies.

3.1 Description of the sample

A total of 563 farmers were interviewed during the survey, which was more than the minimum of 500 set prior to the survey. Of these, 448 were either established, new, or past fish farmers (had ponds) while 115 were non fish farmers drawn from the same geographic areas as the fish farmers. A total of 13 districts spread throughout the three regions were included as follows:

Table 4 Distribution and numbers of fish farmers and non fish farmers interviewed

Region	District	Total number of questionnaires	Ex Fish farmer	Fish Farmer	Non Fish Farmer
Central	Dedza	30		23	7
Central	Dowa	67	9	43	15
Central	Mchinji	25		19	6
Central	Nkhotakota	51	2	41	8
Northern	Mzimba	19	6	8	5
Northern	Nkhata Bay	81	11	54	16
Northern	Rumphi	97	12	64	21
Southern	Mangochi	37	4	27	6
Southern	Mulanje	26	1	19	6
Southern	Mwanza	40	2	31	7
Southern	Phalombe	22		17	5
Southern	Thyolo	24	2	18	4
Southern	Zomba	44	3	32	9
TOTAL		563	52	396	115

3.2 Categorisation of the sample

The sample indicated that a wide range (1 kg/year to 452 kg/year) existed in the level of fish production among fish farmers. Fish production was measured as the total of both large and partial harvests undertaken by the farmer, averaged over the last two years. This measure is represented as the total production per farm rather than per hectare. It should be noted that the survey showed that very few farmers kept records of fish farming inputs and production. 91% of active fish farmers had no records, while of the 9% that did keep records, 6% were considered good records while 3% were poor.

One of the main objectives of the survey was to determine why fish farming had been adopted differently by different farmers. As mentioned previously, a livelihoods approach was followed in

this survey because initial investigations indicated that fish farming almost always formed only one aspect of the overall farming system among smallholder farmers. Consequently, fish farming activities were compared to overall livelihood strategies at a household level. The sample was first categorised during the data analysis phase according to the level of fish production recorded per farm. Seven categories were identified for all further analyses as follows:

a. Fish farmers that have produced 60kg/yr or more over the last two years
b. Fish farmers that have produced from 20kg to 59kg/yr over the last two years
c. Fish farmers that have produced from 0kg to 19kg/yr over the last two years
d. Fish farmers who have produced no harvest over the last two years
e. Fish farmers that have new ponds and have not yet harvested
f. Ex Fish farmers who have given up fish farming
g. Non Fish farmers

The number and percentage of fish farmers in each category (excl non fish farmers) in the 3 regions and the 13 districts covered, and national totals of the different categories are shown in Table 5 below. Of the 448 fish farmers in the sample, only 4% produced in excess of 60kg/yr, 10% produced between 20 and 59kg/yr, while the majority of 54% produced less than 19kg/yr. Although there were slight differences between regions this is not considered significant.

If only the 312 active fish farmers, who had produced a harvest in the last two years, are considered, then 6 % produced more than 60kg/yr, 15 % from 20 to 59kg/yr, and 79 % less than 19kg/yr.

Table 5 Proportions of the different fish farmer categories according to number and percentage in the different regions and districts surveyed

Region	District	No Harvest	0-19	20-59	60+	New	Ex Fish farmer
Northern	Mzimba	3	7		1	1	2
Northern	Nkhata Bay	9	37	5	5	3	7
Northern	Rumphi	15	38	8	3	3	10
Northern Region Total		*27 (17%)*	*82 (52%)*	*13 (8%)*	*9 (6%)*	*7 (5%)*	*19 (12%)*
Central	Dedza	4	18	1			
Central	Dowa	8	37	2	1		4
Central	Mchinji	3	11	2	3		
Central	Nkhotakota	15	14	5		7	2
Central Region Total		*30 (22%)*	*80 (58%)*	*10 (7%)*	*4 (3%)*	*7 (5%)*	*6 (4%)*
Southern	Mangochi	5	19	4			3
Southern	Mulanje	4	11	5			
Southern	Mwanza	2	20	6	1	3	1
Southern	Phalombe	6	2	2	1	6	
Southern	Thyolo	1	12	3	2		2
Southern	Zomba	5	19	4	3	1	3
Southern Region Total		*23 (15%)*	*83 (53%)*	*24 (15%)*	*7 (5%)*	*10 (6%)*	*9 (6%)*
National Total		*80 (18%)*	*245 (54%)*	*47 (10%)*	*20 (4%)*	*24 (5%)*	*34 (8%)*

Note: The entire figure was rouded off and omits the figure after the decimal fractions

Figure 1 represents the proportion (%) of each category on a national level.

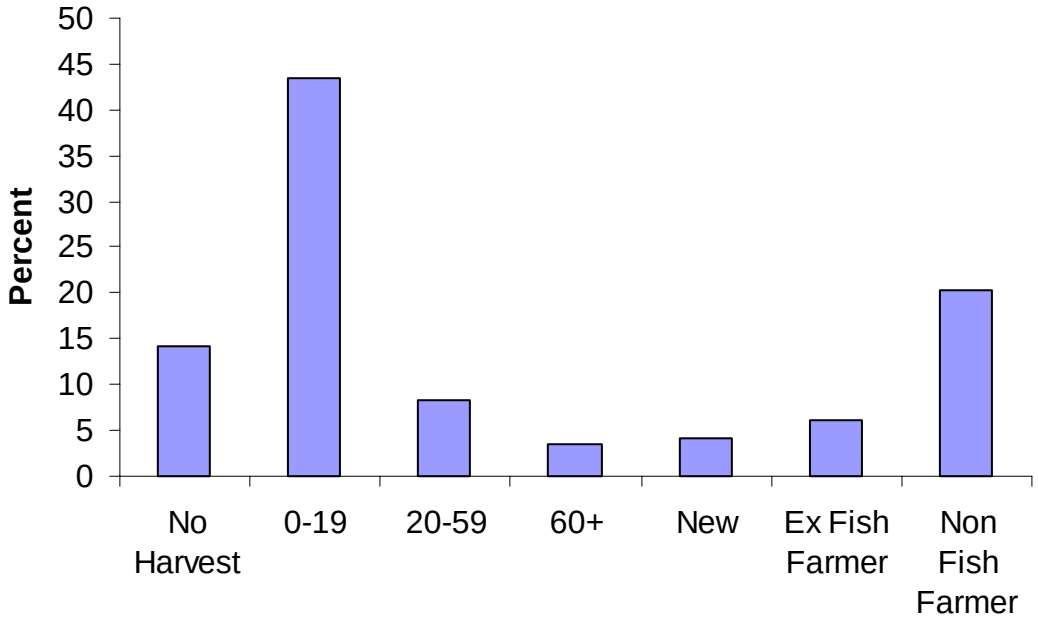


Figure 1 Proportions of the various categories of fish farmer on a national level

3.3 General aspects of small-holder fish farming in Malawi

The survey yielded a wide range of information that serves to generally characterise current fish farming activities in Malawi. This information is important as it allows the sector to be understood in its current form so that strategies can be developed as part of the MasterPlan process to support aquaculture development in Malawi into the future. Without this reliable baseline information long-term strategies run the risk of being fundamentally flawed and doomed to failure.

3.3.1 Fish farmer objectives and perceptions

The questionnaire was designed to obtain information that would assist in understanding the perceptions and perspectives of fish farmers in Malawi. Tables 6 to 11 provide insights on how farmers felt about fish farming and how they would like to see their future development in this field. These tables are related to specific questions in the questionnaire.

Table 6 indicates that most farmers in all categories saw aquaculture as an opportunity to provide an additional protein source to the household while at the same time increasing household income. Of interest is the perception of a higher proportion of farmers who produced in excess of 20 kg/year that fish farming would improve the diversity of food produced on the farm as compared to those that produced smaller quantities of fish.

Table 6 Objectives of fish farmers (% per objective per category)

Status	Protein	Diversify food	Distribution	Income	Social status	Hobby	Educational	Other
No Harvest	94	49	5	94	4	9	4	3
0-19	94	44	2	93	2	10	4	4
20-59	100	51	9	91	0	9	15	6
60+	100	65	25	100	5	30	15	5
New	96	21	4	100	0	4	4	0
Ex Fish farmer	100	12	0	88	0	0	0	0
ALL	97.33	40.33	7.50	94.33	1.83	10.33	7.00	3.00

Note: More than one response was possible in this question. Therefore some total % of response by different categories can be over 100%
ALL in status shows that % per objective in total

Table 7 indicates that the majority of all farmers, and to a lesser extent the ex fish farmers, wished to expand their fish farming activities. It should be noted that answers to this question may have been influenced by the perception that they would receive certain benefits from the JICA project if they indicated that they wished to expand. However, when viewed in relation to other information from the survey it seems likely that given the right framework conditions most farmers would like to improve their fish production.

Table 7 Farmers desire to expand fish farming operations (% per response per category)

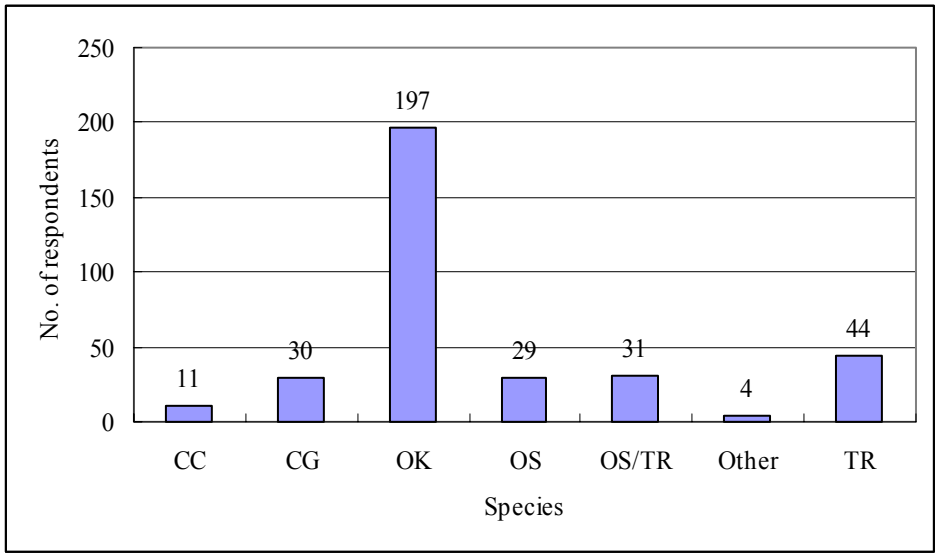
Status	Response (%)		Response (No.)		
	No	Yes	No	Yes	Total
No Harvest	5.0%	94.0%	5	74	79
0-19	12.0%	88.0%	29	216	245
20-59	9.0%	89.0%	5	40	45
60+	10.0%	90.0%	2	18	20
New	8.0%	88.0%	2	18	20
Ex Fish farmer	29.0%	59.0%	2	3	5
ALL (ex. EX FF)	8.8%	89.8	43	366	409

Note: The entire figure was rounded off and omits the figure after the decimal fractions.

Respondents were asked to indicate which species of fish they preferred from their own experience, and the reasons for this preference. Figure 2 indicates that the majority of respondents preferred the Chambo, *Oreochromis karongae*. Farmers were able to choose more than one species and reason in this question.

Table 8 suggests that, for most species, those that were perceived to grow large and fetched a higher price were preferred. Of interest is the preference of *O. shiranus* and *T. rendalli* because they breed faster than other species, a fact that is corroborated by scientific experiments. This suggests that farmers are equipped to make rational choices as far as suitable species for pond culture are concerned. It should be noted though, that few farmers had experience in the culture of Chambo, and the perception that they grow larger and fetch a higher price is likely to be related to observations of lake-caught fish.

There was no noticeable difference in the stated preferred species and reasons for this between the different categories of fish farmers in the sample.



Note: CC = Cyprinus carpio; CG = Clarias gariepinus; OK = Oreochromis karongae; OS = Oreochromis shiranus; TR = Tilapia rendalli; OS/TR = combination

Figure 2 Number of respondents (346 in total) indicating that they preferred certain fish species for aquaculture.

Table 8 Reason for preferring certain species for aquaculture
(% of respondents per species and reason)

Species	CC		CG		OK		OS		OS/TR		TR		Other		ALL	
	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No
Big & High price	82	9	77	23	86	169	14	4	19	6	45	20	100	4	60	34
Breeds fast	9	1	10	3	6	12	62	18	39	12	36	16	0	**0**	23	**9**
Easy access	0	0	0	0	0	0	7	2	23	7	2	1	0	**0**	5	**1**
Easy to sell	0	0	3	1	2	3	0	**0**	0	**0**	2	1	0	**0**	1	**7**
Nice taste	9	1	3	1	4	8	0	**0**	6	2	11	5	0	**0**	5	**2**
Other	0	0	7	2	3	5	17	5	13	4	2	1	0	**0**	6	**2**
TOTAL	100	11	100	30	101	197	100	29	100	31	98	44	100	4	100	55

Note: Each figure was rounded off and omits the figure after the decimal fractions. Therefore some total figure happened to be below or over 100%.

Respondents were asked whether they were satified or not with their current fish farming activities, and the reasons why. Choices for reasons why were not provided but were categorised during the data analysis phase. Table 9 shows that most fish farmers in all categories (except those that had not yet harvested) were not satisfied with their current fish farming activities. Table 10 indicates that the main reasons for this dissatisfaction in all groups currently engaged in fish farming was slow growth of fish in their ponds and the lack of technical support. Pond size was also sited as a problem among those farmers producing less than 60 kg/yr. Of interest is the fact that very few farmers indicated that marketing fish was a problem or that the lack of water was the cause of their dissatisfaction.

Table 9 Percentage of farmers from different categories that are satisfied or not with their fish farming activities

Status	Response		No response (%)
	No (%)	Yes (%)	
No Harvest	59	20	20
0-19	65	33	2
20-59	78	20	2
60+	55	35	10
New	36	9	55
Ex Fish farmer	60	30	10
ALL ex. Ex FF	58.6	23.4	

Note: Each figure was rounded off and omits the figure after the decimal fractions. Therefore some total figure happened to be below or over 100%.

Table 10 Percentage of farmers from different categories that sited various reasons for their dissatisfaction

Status	No Harvest	0-19	20-59	60+	New	Ex FF	ALL ex. Ex FF
Better species needed	3	2	9	10	0	0	4.8
Fish don't grow	24	27	17	50	0	0	23.6
Inadequate water	5	4	6	0	0	17	3.0
Lack finances	13	3	6	0	33	0	11.0
Lack technical support	13	7	11	20	0	33	10.2
Limited market	3	2	3	0	0	0	1.6
More ponds	0	3	9	0	0	0	2.4
No harvest	11	9	3	20	67	0	22.0
Predation	5	8	11	0	0	17	4.8
Small pond	8	25	20	0	0	0	10.6
Other	16	10	6	0	0	33	6.4

Note: More than one response was possible in this question. Therefore some total % of response by different categories can be over 100%.

Respondents were asked to list issues that they felt were important to improve their aquaculture operations. This questions was open ended and no predetermined choiced were offered to the respondent. A wide range of responses were obtained to this question. Lack of pond inputs, small size of ponds, lack of technical support, and difficulty in obtaining fingerlings were cited by all categories of fish farmer as issues that needed to be addressed. Again market was not seen as a problem while issues related to feeding and pond management were low on the priorities of issues that needed to be addressed. This is interesting in that it is likely that feeding and pond management are the main reasons for low production by small holder fish farmers. This may indicate a poor understanding of the critical requirements for successful fish farming.

Table 11 Percentage of farmers from different categories that sited various issues requiring attention in order for them to improve their fish farming operations

Status	No Harvest	0-19	20-59	60+	New	Ex FF	ALL
Feeding	4	3	2	5	0	0	2.3
Fingerlings	15	11	5	15	9	25	13.3
Inputs	21	27	23	10	18	38	22.8
Market	4	2	0	0	0	0	1.0
Pond expansion	22	32	48	20	64	13	33.2
Pond management	13	11	11	15	0	0	8.3
Pond management & fingerlings	0	0	0	5	0	0	0.8
Technical support	19	14	11	30	9	25	18.0

Note: More than one response was possible in this question. Therefore some total % of response by different categories can be over 100%.

3.3.2 Issues relating to the supply of fish farming inputs (on and off-farm)

Questions were included in the questionnaire to investigate the nature of current inputs into fish farming activities among small holder farmers. These inputs include firstly those that come from elsewhere over which the farmer has little control such as fish farming information and fingerlings, and secondly direct pond inputs derived from on-farm sources such as food and nutrients.

3.3.2.1 Sources of information

Table 12 shows the sources from which farmers obtained information on fish farming for the whole sample on a national level. More than one response was possible in the question. Fisheries Extension was cited as the most frequent source of information by all categories of fish farmer, while the other sources are off lesser importance. Of relevance in this table is the importance of obtaining information from other farmers and from radio programmes. Other farmers provide a greater proportion of information to farmers that produce more than 60kg/yr perhaps indicating greater innovation and resourcefulness among this group. This suggests that this group may not rely on receiving information from project and DoF sources but actively seeks out information, the most accessible source being other fish farmers. Reading material provided the least information to farmers, perhaps indicating the scarcity of appropriate information pamphlets and manuals for use by farmers. The high reliance on information from extension staff does not necessarily indicate that this support is adequate, only that generally information is scarce, and that the extension service provides most of this limited amount.

Table 12 Sources of information for fish farming by category
(% of respondents per category per source of information)

Status	No Harvest	0-19	20-59	60+	New	Ex Fish farmer	ALL
Family member	6.3	5.7	8.5	20	4.5	5.9	8.4
Discussion w/ neighbours	30.4	24.1	31.9	40	9.1	5.9	23.5
Observation of neighbours	34.2	42.4	44.7	25	31.8	26.5	34.1
Farmers club	21.5	13.9	21.3	25	13.6	0	15.8
Extension officer	57	52.2	72.3	70	63.6	29.4	57.4
Project	16.5	28.2	14.9	25	27.3	0	18.6
Reading material	0	2	6.4	0	4.5	0	2.1
Radio	25.3	22	31.9	40	9.1	2.9	21.8
School	3.8	2.4	0	5	9.1	2.9	3.8
Training	13.9	14.3	34	30	13.6	2.9	18.1

Note: More than one response was possible in this question. Therefore some total % of response by different categories can be over 100%.

An attempt was made to determine if differences existed between the sources of information between regions and districts. Table 13 indicates a similar trend to that in Table 12 with information from the extension service making a significant contribution in most districts. The exceptions are Thyolo and Dedza, which are known to lie on the periphery of the current reach of the extension stations. It should be noted that an extensionist has recently been appointed for the Dedza area, so access to information from the DoF should improve. Thyolo relies on the services of Chisitu station which is relatively distant geographically and given current logistic restraints tends to focus on more accessible areas.

In some areas such as Mchinji and Dedza information from projects is significantly higher than from other sources. Once again a correlation can be found between the presence of active NGO driven initiatives in these areas and the provision of information on fish farming. In some areas such as Dedza, where a fisheries extension officer has not been present in the recent past, an NGO is fulfilling this function. This suggests that extension services could be strengthened by making use of the resources and geographic distribution of development NGOs.

Table 13 Sources of information for fish farming by region and district (%)

Region	District	Family member	Discus -sion	Obser- vation	Farm- ers club	Exten- sion	Proj -ect	Reading material	Ra- dio	School	Train -ing
Northern	Mzimba	14	29	43	36	50	7	0	29	0	14
Northern	Nkhata Bay	6	17	34	2	65	17	2	18	0	8
Northern	Rumphi	11	33	29	16	84	4	4	22	5	16
Central	Dedza	4	17	17	0	9	74	0	4	0	22
Central	Dowa	4	17	48	10	35	33	2	15	0	10
Central	Mchinji	11	32	26	0	37	68	0	32	0	26
Central	Nkhotakota	5	30	49	30	44	0	7	40	14	12
Southern	Mangochi	10	42	58	10	58	6	0	35	0	23
Southern	Mulanje	0	35	45	40	55	25	5	25	5	25
Southern	Mwanza	3	0	21	12	76	36	0	9	0	12
Southern	Phalombe	0	24	29	18	76	47	0	24	6	35
Southern	Thyolo	10	30	45	40	15	20	0	30	0	20
Southern	Zomba	9	23	57	20	49	23	0	17	3	20

Note: More than one response was possible in this question. Therefore some total % of response by different categories can be over 100%.

3.3.2.2 Sources of fingerlings

A fundemental requirement for successful fish farming is the supply of good quality fingerlings which should be stocked into ponds regularly rather than farmers relying on natural reproduction in the pond itself. The availability of fingerlings to farmers has been recognised as a contraint to success previously, so it an attempt was made to determine where farmers where obtaining their fingerlings, and if there where regional and district differences between these sources. It was anticipated that this information may provide an indication as to the effectiveness of support for aquaculture between areas.

Table 14 indicates that all categories of fish farmer rely heavily on the purchase of fingerlings from the DoF. Significantly, pruchase from other fish farmers is also an important source of fingerlings to all except the new fish farmers. A higher proportion of the 60kg+ farmers produced their own fingerlings, again pointing to greater innovation as compared to the other categories.

The importance of supply from NGOs is also apparent, emphasising the facilitating role that these organisations have in aquaculture development. It should be noted that NGOs purchase thei fingerlings for farmers from either the DoF or other fish farmers.

Table 14 Relative importance of various sources for the supply of fingerlings to the different fish farmer categories (%)

Status	No. of response	Donation from neighbors		Purchase from Farmers		Purchase from DoF		Self Production		NGOs or other		All	
		%	No.	%	No.	%	No.	%	No.	%	No.	%	No
No Harvest	79	6	5	36	28	26	20	0	8	31	24	99	85
0-16	243	11	26	39	94	31	75	3	8	3	64	87	267
20-59	46	7	3	39	18	43	20	9	4	2	11	100	56
60+	20	10	2	10	4	50	10	20	4	20	4	110	24
New	23	0	0	0	0	17	4	0	0	17	4	34	8
Ex FF	16	19	3	25	4	44	7	0	0	6	1	94	15
ALL	427	10	44	37	156	37	157	6.6	28	27	117		

Note: More than one response was possible in this question. Therefore some total % of response by different categories can be over 100%.

As far as regional and district differences in source of fingerling supply is concerned, a similar pattern is evident in Table 15 below to that found with access to information displayed in Table 13 above. It is apparent that fingerlings supplied from the DoF and from other farmers are important in almost all regions, with the exception of areas such as Mchinji which have recently been supported by NGO initiatives. In cases such as Mchinji, greater reliance on NGOs for fingerling supply exists. Again, it should be noted that NGOs also source their fingerlings through either the DoF or other fish farmers. But this confirms the supportive role that NGOs play in areas that are poorly covered by DoF staff.

Also, the importance of supply from DoF is underestimated in some districts such as Nkhotakota due to the fact that fingerlings supplied as part of the HIPC programme have been included under 'NGO and other'. On a national level the effect of this categorisation of HIPC farmers is less influential as these farmers made up less than 10% of the overall sample.

Table 15 Relative importance of various sources for the supply of fingerlings at regional and district level for all categories of fish farmer (%)

Region	District	Donations from neighbours	Purchase from farmers	Purchase DoF	Self Production	NGO or other
Northern	Mzimba	0	8	85	0	8
Northern	Nkhata Bay	15	34	34	0	18
Northern	Rumphi	11	34	41	3	13
Central	Dedza	17	26	9	0	52
Central	Dowa	6	60	22	2	24
Central	Mchinji	11	32	0	5	68
Central	Nkhotakota	2	12	15	0	66
Southern	Mangochi	7	36	61	7	0
Southern	Mulanje	5	40	30	5	35
Southern	Mwanza	3	27	33	6	27
Southern	Phalombe	0	18	35	0	18
Southern	Thyolo	28	61	11	11	22
Southern	Zomba	12	39	39	15	6

Note: More than one response was possible in this question. Therefore some total % of response by different categories can be over 100%.

The opinion of respondents on the availability of fingerlings of different species was canvassed. Table 16 indicates that of those respondents that felt fingerlings were difficult to obtain, the vast majority suggested that this was due to scarcity. That is, difficulty in finding a reliable source of these species. While most species were scarce, this was less of a problem with O. shiranus and T. rendalli. Overall this strengthens the widely held opinion that supply of fingerlings is a real obstacle in the way of aquaculture development in Malawi.

Table 16 Relative difficulty of obtaining fingerlings of various species and perceived reason for this among fish farmers who indicated that there was difficulty in obtaining these (%)

Species	All		CG		OK		OS		TR	
	%	No	%	No	%	No	%	No	%	No
Dependent on delivery	0.0	0	0.7	1	0.0	0	5.3	3	3.5	3
Expensive	0.0	0	0.7	1	0.0	0	17.5	10	10.5	9
Scarce	100.0	39	98.6	137	100.0	87	77.2	44	86	74
TOTAL (261 response)	100.0	39	100.0	139	100.0	87	100.0	57	100.0	86

Note: Respondent talks about several species.

3.3.2.3 On-farm inputs

The input of food and nutrients into ponds is known to be a critical issue in determining fish production. This issue was investigated through questions relating to the kinds of inputs to ponds, the variety of these inputs, and the frequency that these inputs were made. No attempt was made to quantify these inputs due to the lack of reliable records kept, and the unreliability of estimating these from memory.

Table 17 indicates that a wide variety of inputs were used if the sample as a whole is considered, with certain categories of inputs being very widely used. The most common inputs include maize bran, manure of different kinds, and vegetable matter. If differences in inputs are compared between fish farmer categories some interesting trends result. It is apparent that there is a positive correlation between both the number of different input types and the frequency that these are made, and increased fish production. That is, the more variety of food items fed at more frequent intervals results in higher fish production. Although it was not possible to obtain reliable information on the quantities of inputs, the diversity and frequency of inputs provides an interesting indicator of the degree to which fish farming has been adopted.

Table 17 Diversity and frequency of pond inputs per fish farmer category (%)

Input type	No harvest	0-19	20-59	60+	New	ALL
Cassava	5.0	5.0	14.0	5.0	0.0	5.8
Compost	17.0	17.0	17.0	25.0	0.0	15.2
Leaf & grass	12.0	19.0	11.0	10.0	0.0	10.4
Maize bran	90.0	95.0	97.0	95.0	80.0	91.4
Manure all	75.0	75.0	78.0	100.0	100.0	85.6
Other	17.0	15.0	11.0	5.0	0.0	9.6
Rice bran	8.0	6.0	3.0	5.0	0.0	4.4
Soya	3.0	2.0	3.0	5.0	0.0	2.6
Vegetables	45.0	48.0	56.0	75.0	60.0	56.8
Average No. of input types	2.8	2.8	2.9	3.3	2.4	2.9
Average No. of months that inputs were added	7.7	8.8	9.7	10.4	7.3	8.8

3.3.3 Issues related to fish farming outputs (harvest)

To fully understand small holder fish farming activities it was necessary to investigate issues related to the production of fish. Tables 18 to 22 present information on the motivation for harvesting, methods used, use of the harvest, and perceptions of farmers on the marketability of various sizes of fish produced.

Table 18 suggests that all groups decide to harvest when protein for household consumption, or cash is required. Less importance is given to market related requirements such as ideal fish size or the availability of cash among consumers to buy fish. This suggests that either fish farmers can sell any excess production easily whenever they decide to harvest, or that the need for household protein and cash at particular times overides other factors. In general the survey indicated that there was no pattern regarding the month when large harvests were conducted. Also, it was apparent that fish of any size could easily be sold whenever the farmer chose to harvest. This could be due to the relatively small quantities of marketable fish currently produced by this sector. Therefore, this suggests that the perceived returns of adhering to a formal harvesting strategy where fish of a certain size are harvested at predetermined times, are not sufficient for the majority of small holder fish farmers to adopt this approach. Alternatively, the price received for fish may be too low to encourage farmers to adopt a formal harvesting strategy.

Table 18 Reasons for deciding when to harvest per fish farming category (%)

Status	No Harvest	0-19	20-59	60+	ALL
Protein	29.0	34.0	30.0	25.0	29.5
Available Lake Fish	4.0	3.0	4.0	6.0	4.3
Absence of other Protein	9.0	12.0	11.0	13.0	11.3
Money	26.0	26.0	27.0	24.0	25.8
Social	6.0	4.0	4.0	4.0	4.5
Size	10.0	8.0	12.0	14.0	11.0
Demand	14.0	7.0	8.0	10.0	9.8
Threats	1.0	3.0	3.0	4.0	2.8
Other	1.0	3.0	2.0	1.0	1.8
TOTAL	100.0	100.0	101.0	101.0	101.0

Note: Each figure was rounded off and omits the figure after the decimal fractions. Therefore some total figure happened to be below or over 100%.

Table 19 shows that the main harvesting methods in all farmer categories are seine netting, followed by hook and line, followed by breaking the dyke. The recommended method of harvesting when following a formal harvesting regime is the use of a seine net. However the scarcity of these in many areas surveyed encourages farmers to use the method of pond drainage through breaking the bank of the pond, when a major harvest is required. The prevalence of the use of hook and line method shows the importance of partial harvesting, usually of a few fish at a time for household consumption. Table 20 summarises the percentage of farmers in all categories that make use of partial and total harvesting techniques. Again this shows the prevalence of partial harvesting among small holder farmers.

This fact relates to the information in Table 18 above which indicates that one of the main reasons for harvesting is to satisfy household protein requirements. Without the ability to store large quantities of fish from a large harvest for later home consumption, regular small partial harvests with hook and line appears to be an approriate choice for many household.

Table 19 Harvest method per category of fish farmer (%)

Status	0-19		20-59		60+		ALL	
	%	No	%	No	%	No	%	No
Break dyke	18	51	23	18	26	9	68	78
Seine nets <1 inch	40	121	39	30	29	10	108	161
Seine nets > 1 inch	10	31	3	2	6	2	19	35
Hook & line	25	75	29	22	29	10	83	107
Basket	2	7	3	2	6	2	11	11
Reed fence	1	3	0	0	0	0	1	3
Other	5	15	4	3	3	1	12	19
TOTAL (433 response)	101	303	100	77	100	34		

Note: More than one response was possible in this questionnaire. Each figure was rounded off and omits the figure after the decimal fractions. Therefore some total figure happened to be below or over 100%.

Table 20 Percentage of fish farmers from all categories who made use of partial harvest and total harvest techniques over last 2 years

Status	Partial Harvest (%)	Total harvest (%)
0-19	87	68
20-59	96	89
60+	100	95
New	0	0

Table 21 indicates how the harvest is used by fish farmers. Most fish is used in the household or sold locally. Sale to market is relatively unimportant, again suggesting that quantities produced are small enough to be absorbed within the immediate vicinity of the fish farm. It is also interesting to note that significant proportions of the harvest are distributed to family and friends, a factor which should not be underestimated as this has a social significance and could lead to indirect improvement in the status of the household through reciprocity, increased prestige and other security benefits.

The differences in the use of the harvest are not great between the different categories of fish farmer, which may be expected given the overall low levels of production. Clearly the market in the immediate vicinity of the household is sufficient to absorb most excess fish produced and there is little need to transport fish to markets further afield under the current conditions. It is, however, clear that the more productive farmers sell greater proportions of their fish harvest and the less productive farmers eat greater proportions of their fish harvests themselves.

Table 21 Use of the harvest by different categories of fish farmer (%)

Data	0-19	20-59	60+	New	Ex Fish farmer
HH Consumption	44	27	24	2	19
Distribution	12	14	12	0	7
Sale local	30	43	46	6	16
Sale market	4	10	8	0	0
Other	1	1	0	0	0
TOTAL	91	95	90	8	42

Note: Each respondent showed the usage of proportion by different categories.

Table 22 indicates the perception of fish farmers of the price received for the same weight of small and large fish. Although many farmers were not able to answer this question with certainty, most of those that did answer indicated that larger fish fetched a higher price per kg than smaller fish. This suggests that it would be benefitial for farmers to grow their fish to a larger size before harvesting for sale. However, the information presented above on the decision when to harvest clearly indicates that other factors are more important to farmers than the potential benefit of keeping fish until they are larger. Given that small fish are acceptable to both the household and the local market, further research to assess the benefits of growing larger quantities of smaller fish over a shorter time period to those of keeping fewer fish for a longer period before harvesting would provide interesting insights into this issue.

Table 22 Perception of fish farmers from the different categories on the price received for the same weight of small and large fish (%)

Status	small	Large	No difference	Don't Know
No Harvest	3	21	3	74
0-19	5	48	4	43
20-59	6	79	4	11
60+	0	65	10	25
New	0	0	0	100
Ex Fish farmer	0	18	0	82
All	4	43	4	49

Note: Each figure was rounded off and omits the figure after the decimal fractions. Therefore some total figure happened to be below or over 100%.

3.3.4 Fish pond characteristics

The physical characteristics of fish ponds on a national level was not well documented prior to the current survey, so information on pond size and number was collected from the sample. It is of interest to compare these characteristics between different categories of farmer and also between areas in the country.

Table 23 shows that both the number and total surface area of ponds in a household increases with increased fish production. This can be expected and is further investigated in terms of fish production per hectare under section 3.4 below. This data suggests that the more productive farmers are obtaining higher yields by having larger or more ponds, as well as producing more fish per unit area. This might explain why expansion of ponds is perceived as more important than improving feeding and management in all categories of fish farmer (see Table 11 above).

This information highlights the point that increased pond surface area needs to form part of any strategy to increase overall national fish production from aquaculture. This factor needs to be addressed in combination with maximising production per unit area.

Table 23 Average number of ponds and total pond surface area within the different categories of fish farmer

Status	Total no. of response	No of ponds		Surface area m2	
		Mean	Ste	Mean	Ste
No Harvest	79	1.2	0.1	204.3	36.7
0-19	244	1.6	0.2	237.9	33.7
20-59	46	2.0	0.4	432.1	141.2
60+	19	2.9	0.9	902.5	861.3
New	23	1.3	0.4	316.7	62.2
Ex Fish farmer	17	1.1	0.1	185.5	89.4
All	428	1.6	0.1	284.2	47.4

Regional and district differences in both the number and surface areas of ponds per household are apparent in Table 24. The number of ponds per household in districts ranges from 1 to 2.5 with average pond numbers highest in the Southern Region, followed by the North and lastly the Central Region. As can be expected mean surface area per farm follows the regional pattern with the largest mean surface area occurring in the Southern Region and the smallest in the Central Region. Fish farmers in Zomba District have significantly more pond surface area on average than any of the other districts. These district and regional trends may be related to the history of fish farming in the country, with the South having had more sustained aquaculture development attention over a longer

period than the North, which in turn has received more attention than the Central Region. The presence of the two main aquaculture research facilities in these two regions, at Domasi and Mzuzu respectively, is likely to have contributed to these differences due to greater support being provided to fish farming in the areas geographically close to them.

Table 24 Average number of ponds and surface areas per household in the different districts. Regional means are also shown

Region	District	Total no. of response	No. of ponds		Surface area M2	
			Mean	Ste	Mean	Ste
Northern	Mzimba	11	1.6	0.5	322.8	143.2
Northern	Nkhata Bay	63	1.7	0.2	322.4	63.4
Northern	Rumphi	76	1.5	0.2	261.7	57.6
Regional North		150	1.59	0.14	291.7	40.9
Central	Dedza	23	1.0	0.1	123.1	26.7
Central	Dowa	49	1.2	0.1	121.4	39.5
Central	Mchinji	19	2.1	0.8	427.3	273.9
Central	Nkhotakota	40	1.2	0.2	351.4	139.0
Regional Central		131	1.29	0.14	236.3	63.2
Southern	Mangochi	28	1.5	0.2	214.1	50.3
Southern	Mulanje	19	1.5	0.4	175.0	93.8
Southern	Mwanza	33	1.8	0.4	250.2	72.1
Southern	Phalombe	17	1.2	0.2	267.6	72.6
Southern	Thyolo	18	2.0	0.8	230.7	138.1
Southern	Zomba	32	2.5	1.0	645.5	520.6
Regional South		147	1.8	1.27	319.3	118.9

Table 25 shows that the mean size of ponds does not differ significantly between the regions. However there are differences apparent in the mean size of ponds between districts. Some areas such as Dowa, Dedza, Mulanje and Thyolo have particularly small mean pond sizes, although when production per hectare is considered (Table 29 below) there does not seem to be any clear relationship between pond size (Table 25) and production per unit area in the different districts. In general, it seems that the size of ponds in individual households has not developed in a strategic manner but rather has depended on the resources in terms of labour, finances and advice that was available to farmers at the time of construction. It is generally accepted that management is more effective if ponds are a particular size. Further development in aquaculture in Malawi should perhaps be guided by this strategic pond size.

Table 25 Mean pond size in the different districts and regions

Region	District	Total no. of response	Mean pond size
Central	Dedza	23	123.1
Central	Dowa	49	101.2
Central	Mchinji	19	203.5
Central	Nkhotakota	40	292.8
Regional Central		131	183.2
Northern	Mzimba	11	201.8
Northern	Nkhata Bay	63	189.6
Northern	Rumphi	76	174.5
Regional North		150	164.6
Southern	Mangochi	28	142.3
Southern	Mulanje	19	116.6
Southern	Mwanza	33	139
Southern	Phalombe	17	223
Southern	Thyolo	18	115.4
Southern	Zomba	32	258.2
Regional South		147	177.3

3.4 National smallholder fish production statistics

3.4.1 Fish production at farm level

Fish production on a national level for the different farmer categories is shown in Table 26. The mean production per hectare and per pond for each farmer category is shown in Table 27. Production per hectare and per pond increased with annual production, implying an increase in pond management and husbandry among the more productive fish farmers. The mean fish production per fish farmer on a regional and national level is shown in Table 28. Fish production per farmer was highest in the Southern Region and lowest in the Central Region.

Table 26 Annual fish production per farmer category

Category	Fish production kg		
	Mean	Ste	Total no. of response
No Harvest	0	0	79
0-19	5.2	0.1	245
20-59	36.1	1.0	47
60+	115.7	17.1	20
New	0	0	24
Ex Fish farmer	0	0	16

Table 27 Production per hectare and per pond of fish farmers by category

Region	Production (kg.ha^{-1})			Production (kg.pond^{-1})		
	0-19	20-59	60+	0-19	20-59	60+
Northern	459.90	2345.09	2801.38	3.79	17.98	48.05
Central	522.32	1364.66	2214.60	3.51	29.72	33.20
Southern	638.46	1677.60	1751.44	4.97	20.50	31.14
National	537.79	1793.01	2316.54	4.08	21.67	39.16

Table 28 Fish production per farmer in kg per year

Region	Mean	Ste	Total no. of response
Northern	11.38	4.09	151
Central	10.44	7.07	132
Southern	14.80	4.39	148
National	12.26	3.00	431

Fish production per hectare and per pond at district level is shown in Table 29 and at regional and national level in Table 30. Mzimba, Nkhata Bay, Dedza, Nkhotakota and Mwanza show significantly lower fish production per unit area as compared to other districts. On a national level highest production per unit area is being achieved in the Southern Region followed by the Northern Region and then the Central Region.

Table 29 Mean fish production per hectare and per pond in all sampled districts

Region	District	Production (kg.ha^{-1})			Production (kg.pond^{-1})		
		Mean	Ste	Total no. of response	Mean	Ste	Total no. of response
Northern	Mzimba	308.11	389.27	13	2.44	2.24	13
	Nkhata Bay	591.33	267.31	56	8.59	5.43	56
	Rumphi	913.82	545.03	54	7.37	3.76	56
Central	Dedza	524.26	367.69	21	4.46	3.78	21
	Dowa	592.35	277.81	44	6.16	3.74	44
	Mchinji	1006.61	774.49	13	11.64	8.26	13
	Nkhotakota	284.63	269.90	21	5.67	5.35	21
Southern	Mangochi	781.05	465.17	28	6.13	3.43	28
	Mulanje	1177.72	412.89	16	11.33	6.35	16
	Mwanza	470.09	281.29	19	6.13	3.52	19
	Phalombe	932.67	894.42	8	16.70	16.80	8
	Thyolo	852.48	431.58	17	12.18	8.39	17
	Zomba	887.03	411.53	26	8.76	4.44	26

Table 30 Mean fish production per hectare and per pond at regional and national level

Region	Production ($kg.ha^{-1}$)			Production ($kg.pond^{-1}$)		
	Mean	Ste	Total no. of response	Mean	Ste	Total no. of response
Central	567.03	188.11	99	6.42	3.63	99
Northern	702.98	272.41	123	7.40	3.63	125
Southern	830.36	187.92	114	9.10	4.95	114
National	706.14	130.81	336	7.69	4.03	338

3.4.2 National fish production

National fish production from small holder aquaculture was estimated using 3 methods in order for a range of estimates to be obtained based on all available information. Table 31 indicates that total production could be in the order of 73 tons per year when calculations are based on average production per pond and the NAC (2002) estimate of 9500 for total number of ponds is used.

Table 31 Total regional and national annual production of fish from small holder aquaculture calculated using mean production per pond and the estimated total number of ponds provided by NAC (2002)

Region	Production (kg.pond.yr)	Total Ponds	Total Production (tons.yr)
Northern	7.4 ± 3.6	3100	22.9 ± 0.1
Central	6.4 ± 3.6	2900	18.6 ± 0.1
Southern	9.1 ± 4.9	3500	31.9 ± 0.1
National	7.7 ± 4.0	9500	73.2 ± 0.3

Table 32 suggests a total annual production of around 117 tons per year when calculations are based on this survey's production estimates per hectare. Total pond area was calculated based on the total number of ponds provided by NAC (2002).

Table 32 Total regional and national fish production based on mean production per hectare and the total pond area

Region	Production (kg.ha.yr)	Total Area	Total Production (tons.yr)
Northern	703.0 ± 272.4	51	35.9 ±13.9
Central	567.0 ± 188.1	53	30.1 ± 10.0
Southern	830.4 ± 187.9	63	51.5 ± 11.7
National	706.1 ± 130.8	166	117.1 ± 21.7

The national fish production based on this survey's production estimates per farmer is shown in Table 33 to be around 50 tons per year. This estimate is based on the total number of farmers quoted by NAC (2002).

Table 33 Total regional and national fish production based on the total number of fish farmers estimated by NAC (2002)

Region	Production ($kg.farmer^{-1}.yr^{-1}$)	No. of Farmers	Annual production (tons)
Northern	11.38 ± 4.09	1350	15.36 ± 5.52
Central	10.44 ± 7.07	1200	12.53 ± 8.48
Southern	14.80 ± 4.39	1500	22.20 ± 6.58
National	12.26 ± 3.00	4050	49.67 ± 12.15

The NAC (2002) report states that 4050 fish farmers own 9500 ponds and produced some 800 metric tons of fish. This corresponds to an annual production of some 197 kg per farmer and 85 kg per pond. It is evident that the findings from this survey do not support these results.

3.5 Relationship between farming category and over-all household structure

The data from Table 34 below indicates clear trends in household characteristics between the different fish farming categories. Generally, the more productive the household is in its fish farming activities, the larger the household size, the greater the number of able bodied adults it has, the greater the number of dependents it has, the higher the average level of education amongst household heads and the older the household head. The 60+ category has a much higher average age than the other categories, and the ex-fish farmer category has a much lower average age of household head than the rest.

New fish farmers tend to have similar characteristics to the more productive fish farming households, probably due to the criteria used to select these households to receive assistance under the HIPC programme.

There are no significant differences in trends between the regions. They generally follow the national trends. It is clear however, that education levels amongst household heads are generally higher in the Northern Region than the others. Household size, and numbers of able-bodied adults and dependents were slightly higher in the Central Region than the other regions.

Table 34 General household characteristics per fish farmer category on a national and regional level

Status	Region	All HH sampled	Ex FF	Non FF	FF 0	FF 0-19	FF 20-59	FF 60+	FF New
Number of able bodied adults	Northern	3.6	2.9	3.2	3.3	3.8	4.6	4.6	3.0
	Central	3.8	3.5	3.8	3.8	3.5	4.6	4.5	5.0
	Southern	3.3	2.8	2.6	3.2	3.8	3.2	4.1	2.5
	National	3.6	3.0	3.2	3.5	3.7	3.9	4.4	3.4
Dependency ratio	Northern	1.6	1.6	1.4	1.6	1.6	1.2	1.8	1.8
	Central	1.8	2.8	1.8	1.3	1.7	2.2	4.2	0.9
	Southern	1.6	2.0	1.8	1.8	1.4	1.7	1.5	1.6
	National	1.6	1.9	1.7	1.5	1.6	1.7	2.2	1.5
Highest education level (Grade)	Northern	7.5	9.2	7.1	7.4	7.0	8.2	7.9	8.7
	Central	6.2	5.2	5.0	6.5	6.0	8.0	9.0	8.9
	Southern	6.1	7.0	7.7	5.5	5.6	5.3	6.0	7.6
	National	6.7	8.0	6.6	6.6	6.3	6.7	7.5	8.3
Household size	Northern	8.3	7.6	7.3	7.6	8.8	9.1	11.1	6.7
	Central	8.6	10.0	8.0	8.3	8.2	10.2	15.8	8.9
	Southern	7.7	7.9	6.5	7.5	8.0	8.8	9.0	6.1
	National	8.2	8.1	7.3	7.9	8.3	9.2	11.3	7.1
Age of Household head	Northern	42.4	34.4	42.3	39.5	44.6	43.5	53.6	34.0
	Central	39.1	31.6	37.7	42.7	37.8	43.2	47.7	37.9
	Southern	45.2	40.3	38.4	50.9	46.3	44.5	46.9	52.4
	National	42.4	35.6	39.7	44.0	43.2	44.0	50.2	42.8

Figure 3 below indicates the percentage of each age category in each of the farmer categories. In the 60+ category 57% of respondents were over the age of 50. This is significantly larger than all the other categories. Also interesting is the very large number of respondents under 30 years in the ex-fish farmer group. Many of these could be cases where the pond and fish were inherited from deceased fish farmers and subsequently abandoned.

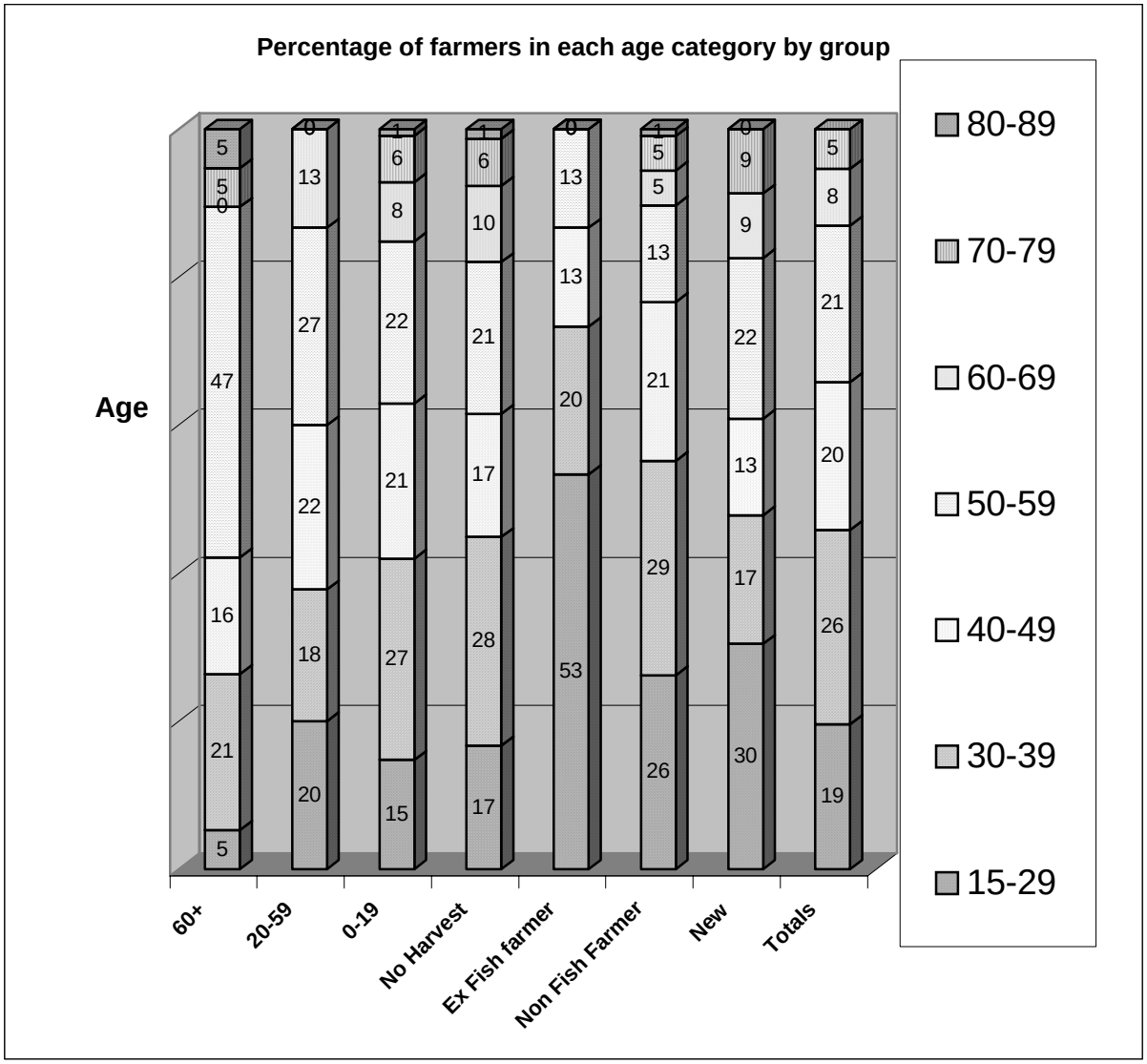


Figure 3 Percentage of each age category in each of the farmer categories

Table 35 shows that a comparison of the age of the respondent and household size did not show a marked difference in the median number of persons per households in each age category. However, the households with the two youngest categories of household heads, had lower median numbers of persons per household than most of the other older age categories.

Table 35 Relationship between the age of the household head and the size of the household

	Age Category (years)						
	20-29	30-39	40-49	50-59	60-69	70-79	80+
Median household size	5	7	8	9	8	7	9

Table 36 indicates that the average number of able-bodied adults per household is also lower for the households in the lowest three age categories. This makes sense in that younger household heads are less likely to have children over the age of childhood (15 years). However, once the household head

reaches the age of 50, s/he is more likely to have adult children and therefore likely to have more labour available for productive work.

Table 36 Average number of able-bodied adults per household categorised by the age of the household head

	Age Category (years)						
	20-29	30-39	40-49	50-59	60-69	70-79	80+
Average able bodied adults	2.8	3.0	3.7	4.5	3.9	4.4	4.8

In terms of luxury items owned by households, Table 37 shows clear trends. The more productive the fish farming operation of the household, the more likely they are to have various luxury or productive items. The significant investment in productive items such as nets, wheelbarrows, and ox-carts amongst the 60+ category is particularly striking.

Table. 37 Luxury items per household in each of the fish farming categories (%)

Status	Radio	Bicycle	Motor vehicle	Net	Wheel Barrow	Iron Sheets	Ox Cart	Other
No Harvest	75	59	3	1	14	20	1	5
0-19	82	62	1	3	12	23	2	12
20-59	79	77	2	9	28	49	2	9
60+	95	75	5	25	30	45	10	25
New	88	63	0	0	33	21	0	4
Ex Fish farmer	88	62	6	0	3	26	0	15
Non Fish Farmer	69	54	0	0	5	19	3	4
All HH	79	62	1	3	13	25	2	9

Note: More than one response was possible in this question.

Similarly, Table 38 shows that the average number of luxury or productive items per household is highest among the more productive fish farming households. Interestingly the 60+ category has more of these items than new, ex, and non fish farmers.

Table 38 Average luxuries per household in the different fish farming categories (number of items)

Status	Average luxuries
No Harvest	1.78
0-19	1.96
20-59	2.53
60+	3.10
New	2.08
Ex Fish farmer	2.00
Non Fish Farmer	1.54

In terms of previous employment, the data in Table 39 suggests that the proportion of farmers who have never been employed outside farming is substantial. Of those who have been employed outside farming, about half have been employed in skilled positions and the rest in unskilled or semi-skilled positions. The higher proportion of the 60+ farmers previously employed in skilled positions is significant. Generally, the more productive the fish farmer, the more likely they are to have been previously employed in a semi-skilled or skilled capacity.

Table 39 Percentage of fish farmers in the different categories who had previous employment of different kinds

Status	No Job	Unskilled	Semi-skilled	Skilled
No Harvest	48	16	13	23
0-19	41	23	11	25
20-59	28	20	36	16
60+	25	8	17	50
New	10	30	30	30
Ex Fish farmer	40	25	10	25
Non Fish Farmer	49	12	19	21

3.6 Relationship between farming category and access to land and natural resources

As far as national trends are concerned, the data shown in Table 40 indicates that the more productive the fish farmer the more land (in total) they are likely to have. It is also clear that the more productive the fish farmer the more damp land they are likely to have. It is also interesting to note that the 60+ category tend to have less sodden land than the 20-59kg/yr category. This could be because they have better quality land or alternatively, that they have drained and made their sodden land more usable.

In terms of regional differences, the average area of total land, dry land and damp land available to all farmers is greatest in the Northern Region and least in the Southern Region. Within each region, the differences between the various categories of respondents generally follows the national trend mentioned in the paragraph above. In other words, the more productive the fish farmer the more land he is likely to have.

Table 40 Average size of land holdings per household in hectares

Region	Land Type	All HH sampled	FF 0	FF 0-19	FF 20-59	FF 60+	FF New	FF Ex	Non FF
Northern	Sodden	0.15	0.02	0.17	0.68	0.23	0.00	0.00	0.13
	Damp	0.64	0.57	0.44	0.34	1.82	0.70	1.69	0.45
	Irrigated Dry	0.02	0.12	0.00	0.00	0.00	0.00	0.00	0.00
	Dry	3.87	3.22	3.82	7.77	6.09	2.77	3.75	2.95
	Total	4.69	3.94	4.43	8.79	8.13	3.47	5.45	3.54
Central	Sodden	0.21	0.31	0.12	0.56	0.78	0.49	0.00	0.18
	Damp	0.43	0.41	0.37	1.39	1.17	0.03	0.45	0.33
	Irrigated Dry	0.04	0.02	0.03	0.00	0.52	0.00	0.00	0.07
	Dry	2.62	2.10	2.63	1.87	3.52	8.83	2.47	1.95
	Total	3.32	2.84	3.15	3.81	5.99	9.36	2.92	2.53
Southern	Sodden	0.10	0.14	0.07	0.26	0.03	0.04	0.05	0.05
	Damp	0.42	0.35	0.46	0.24	1.10	0.36	0.46	0.38
	Irrigated Dry	0.03	0.06	0.01	0.01	0.00	0.20	0.05	0.02
	Dry	1.37	1.75	1.30	1.59	1.90	1.33	1.35	1.09
	Total	1.92	2.31	1.84	2.10	3.03	1.93	1.90	1.53
National	Sodden	0.15	0.16	0.12	0.44	0.27	0.15	0.01	0.12
	Damp	0.50	0.45	0.42	0.49	1.44	0.38	1.15	0.39
	Irrigated Dry	0.03	0.07	0.01	0.00	0.10	0.09	0.01	0.03
	Dry	2.64	2.38	2.58	3.39	4.11	3.88	2.89	2.04
	Total	3.32	3.06	3.14	4.32	5.92	4.50	4.06	2.58

If the entire sample is broken up into age groups it is evident from Table 41 below that the average area of land cultivated increases with the age of the household head. This is important in that it has been noted (Figure 3 above) that the more productive fish farmers are also generally older.

Table 41 Average area of land cultivated by each age group in hectares

Age Cat	Number	Average	Minimum	Maximum	Std Dev
80-9	5	8.33	1.9	15	5.2
70-9	26	7.17	2	32.5	7.1
60-9	38	6.09	2.3	25	4.1
50-9	107	5.49	1	18	3.5
40-9	101	5.26	0.8	28	4.3
30-9	133	4.84	1.3	13.5	2.8
15-29	99	3.70	0.5	12	2.2

When the average area of land cultivated by households categorised according to age and farmer group is considered, it is apparent (Table 42) that not all farmers above the age of 69 are productive fish farmers or amongst the most productive farmers generally. It is also clear that some of the more productive fish farmers (60+) were younger farmers cultivating much smaller areas of land. This indicates that although the general trend is for the older farmers to be more productive, there are exceptions.

Table 42 Average area of land in hectares cultivated by age and fish farming category. Numbers in brackets represent the number of respondents

Age Cat	No. Rspnts	60+	20-59	0-19	No Harv	Ex-FF	Non-FF	New FF
80-9	5	12 (1)		10.9 (2)	6 (1)		1.9 (1)	
70-9	26	10 (1)		7.4 (14)	7.3 (5)		(5)	3.7 (2)
60-9	38		4.6 (6)	6.9 (18)	5.6 (8)		5.1 (5)	7.6 (2)
50-9	107	9.4 (9)	5.2 (12)	5.2 (49)	5 (16)	3.5 (2)	5.2 (14)	5.2 (5)
40-9	101	13.8 (3)	8.1 (10)	5 (47)	3.8 (13)	6 (2)	4.3 (23)	3.6 (3)
30-9	133	4.1 (4)	5.5 (8)	4.8 (61)	5 (22)	4.7 (3)	4.6 (31)	6.1 (4)
15-29	99	2.6 (1)	3.9 (9)	3.8 (33)	3.6 (13)	4.9 (8)	3 (28)	4.8 (7)
Total	509	8.3	7.2	6.1	5.5	5.3	4.8	3.7

The information in Table 43 suggests that there is generally no perceived shortage of suitable land for ponds. However, it should be noted that many of these responses may have been influenced by the perception of farmers that they may be more likely to receive development support in the future if they indicated that they have land for expansion.

Table 43 Access to suitable land for aquaculture in each category of fish farmer (%)

Status	Response			Total no. of response	(No Response)
	No (%)	Yes (%)	Don't know (%)		
No Harvest	3	90	4	80	(4)
0-19	5	85	4	245	(6)
20-59	6	87	4	47	(2)
60+	10	85	0	20	(5)
Ex Fish farmer	0	71	0	17	(29)
New	0	92	4	24	(4)

Table 44 indicates that most farmers have access to a reliable source of water, with the two main sources of water being individual furrows and ground water. Some farmers have access to more than one source of water. The higher investment in wells and spring fed furrows amongst the 60+ category is interesting and may indicate greater innovation within this group.

Table 44 Access to water (%)

Status	Access to water	Individual furrow	Shared furrow	Spring fed furrow	Well	Ground water
No Harvest	99	49	4	13	8	67
0-19	100	53	4	9	8	64
20-59	98	45	9	9	6	57
60+	100	50	6	28	17	61
New	100	54	8	4	4	58
Ex Fish farmer	100	74	9	6	3	32
Non Fish Farmer	90	56	5	5	7	50
All	97	54	5	9	7	59

Note: Each figure was rounded off and omits the figure after the decimal fractions.

Table 45 indicates again that most respondents have enough land and water to expand either irrigated cultivation or ponds. However, there is an interesting inverse trend evident in the data in this table. The more productive the fish farmer is, the more likely he is to prefer to use additional land for irrigated cultivation. However, the less productive the fish farmer is the more likely he is to prefer to invest in pond expansion than irrigated cultivation despite low returns. This suggests the possible influence of strategic answers aimed at securing outside assistance. Another possible interpretation, is that farmers want to expand fish production and believe that the most effective way to achieve this is to expand their ponds. However, this does not seem rational as they are likely to get a much better return on an investment in irrigated cultivation than on an investment in low input-low output fish production.

Table 45 Enough water for more ponds (%) & preferred use. More than 1 answers possible

Status	Enough for more ponds	Preferred use		
		Irrigation	Ponds	Other
No Harvest	92	47	75	5
0-19	91	50	75	3
20-59	91	70	79	9
60+	100	56	78	0
New	96	63	63	0
Ex Fish farmer	91	35	65	0
Non Fish Farmer	81	63	44	3

The data in Table 46 below indicates that the 60+ category generally do not have problems with water supply. The other fish farmers have some minor problems with water supply during the year. The most problematic period in just before the wet season (Sept-Nov). What is more significant is that the ex fish farmer and non fish farmer have far more difficulty in securing a reliable supply of water throughout the year than the fish farmers.

Table 46 Percentage of farmers with enough water for ponds on a monthly basis

Status	No Harvest	0-19	20-59	60+	New	Ex Fish farmer	Non Fish Farmer
Jun	92	98	95	100	88	44	26
Jul	94	97	95	100	88	44	26
Aug	92	97	86	100	75	44	26
Sep	92	93	81	90	75	38	26
Oct	86	89	76	90	75	38	24
Nov	86	92	86	90	75	50	24
Dec	92	95	95	100	75	50	26
Jan	94	98	95	100	100	50	24
Feb	94	98	95	100	100	44	24
Mar	94	98	95	100	100	44	24
Apr	94	98	95	100	100	44	26
May	94	98	90	100	100	44	26

3.7 Relationship between farming category and livelihood strategy

3.7.1 Livestock

As far as the general investment in livestock is concerned, the national data in Table 47 indicates that farmers in Malawi tend to have higher average numbers of small livestock (such as pigs, birds and rabbits) than large livestock units that depend on the availability of grazing. This is not surprising given the relatively high population densities and the pre-dominance of cultivation in the farming systems. Of the large livestock types, goats are by far the most commonly owned type.

This table also shows that in general, households in the Northern Region have the highest average numbers of the large livestock units (LLU) and those in the Southern Region have the lowest. This could again be explained by population densities and land shortages in the south as compared to the other regions. This affects access to grazing. To compensate for this households in the Southern Region tend to invest more in pigs, rabbits and small stock.

Some differences are apparent between categories of farmers. With regard to small livestock, the general trend is that the more productive the fish farmer, the more small livestock units they are likely to have. This also appears to be true for the large livestock units except that the 60+ category tends to have lower average numbers of LLUs than the 0-19 and 20-59kg/yr categories.

Table 47 Average number of livestock per household for the different categories of fish farmers in the different regions. 1 Large Livestock Unit (LLU) is equal to 1 head of cattle, or two head of sheep or goats

Region	Status	Cattle	Goats	Sheep	Pigs	Birds	Rabbits etc	LLUs	Small Stock
Northern	No Harvest	0.15	2.52	0.19	0.30	11.41	0.00	1.50	11.41
	0-19	0.96	2.77	0.35	0.40	14.27	0.52	2.52	14.79
	20-59	0.46	4.08	0.00	0.38	14.31	0.00	2.50	14.31
	60+	0.22	3.22	0.11	0.22	15.33	0.00	1.89	15.33
	New	0.00	2.00	0.00	0.86	8.57	0.00	1.00	8.57
	Ex FF	0.42	0.21	0.00	0.21	13.47	0.00	0.53	13.47
	Non FF	0.19	1.52	0.00	0.76	8.55	0.33	0.95	8.88
	Combined	0.54	2.31	0.18	0.45	12.45	0.29	1.78	12.73
Central	No Harvest	0.21	1.97	0.07	0.38	12.79	0.72	1.22	13.52
	0-19	0.84	2.12	0.23	0.81	7.32	0.78	2.04	7.89
	20-59	2.90	3.50	0.40	0.80	9.30	1.00	4.85	9.80
	60+	1.50	0.50	0.00	1.00	12.75	0.00	1.75	11.50
	New	0.00	0.71	0.14	1.14	16.14	0.00	0.43	16.14
	Ex FF	0.00	1.67	0.50	0.67	4.83	0.00	1.08	4.83
	Non FF	0.14	1.74	0.00	0.23	6.00	0.09	1.01	5.29
	Combined	0.66	1.99	0.17	0.63	8.49	0.56	1.75	8.73
Southern	No Harvest	0.00	1.77	0.27	0.00	9.73	0.36	1.02	10.09
	0-19	0.17	2.38	0.28	0.24	12.16	0.84	1.50	13.00
	20-59	0.46	1.63	0.00	0.38	13.13	0.63	1.27	13.75
	60+	0.00	2.71	0.00	0.71	8.86	0.00	1.36	8.86
	New	0.00	2.50	0.00	0.30	11.60	0.00	1.25	11.60
	Ex FF	0.00	1.89	0.22	0.11	8.44	0.00	1.06	8.44
	Non FF	0.10	1.10	0.00	0.08	7.64	0.15	0.65	7.79
	Combined	0.15	1.95	0.16	0.21	10.77	0.51	1.21	11.27
National	No Harvest	0.13	2.10	0.17	0.24	11.45	0.37	1.26	11.82
	0-19	0.66	2.42	0.29	0.49	11.27	0.71	2.02	11.91
	20-59	0.98	2.70	0.09	0.47	12.64	0.53	2.37	13.06
	60+	0.40	2.50	0.05	0.55	12.55	0.00	1.68	12.30
	New	0.00	1.83	0.04	0.71	12.04	0.00	0.94	12.04
	Ex FF	0.24	0.91	0.15	0.26	10.62	0.00	0.76	10.62
	Non FF	0.15	1.45	0.00	0.37	7.47	0.20	0.87	7.43
	Combined	0.44	2.09	0.17	0.43	10.66	0.45	1.58	11.01

3.7.2 Area cultivated

Table 48 shows that the average area of land per household planted to most crops (summer maize, cassava, rice, sweet potatoes and jams, vegetables, ground nuts, fruit trees and sugar cane, woodlots and tobacco) tends to increase as fish production increases. This correlates with other data that indicated that the more productive the fish farmer the more land they are likely to cultivate, the more labour they are likely to have and the more mouths they have to feed.

Table 48. Average area (Hectares) of land planted to various crops per household

Status	No Harvest	0-19	20-59	60+	New	Ex Fish farmer	Non F. Farmer	All
Summer Maize	0.68	0.79	0.72	1.24	0.81	0.77	0.71	0.30
Winter Maize	0.09	0.09	0.20	0.11	0.06	0.08	0.06	0.03
Cassava	0.40	0.36	0.40	0.42	0.45	0.32	0.28	0.12
Millet	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.00
Sorghum	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rice	0.06	0.04	0.08	0.08	0.08	0.03	0.03	0.01
Irish Potatoes	0.04	0.03	0.03	0.04	0.03	0.05	0.05	0.02
Sweet potatoes & Jams	0.07	0.07	0.12	0.24	0.04	0.11	0.08	0.03
Vegetables	0.07	0.08	0.11	0.11	0.12	0.11	0.09	0.04
Beans & Peas	0.13	0.16	0.16	0.10	0.15	0.19	0.14	0.06
Ground nuts	0.13	0.09	0.04	0.14	0.13	0.09	0.08	0.03
Fruit trees & Sugarcane	0.13	0.17	0.21	0.36	0.16	0.25	0.09	0.04
Woodlot	0.04	0.02	0.05	0.28	0.05	0.00	0.03	0.01
Tobacco	0.11	0.13	0.10	0.39	0.01	0.05	0.06	0.03
Coffee	0.03	0.04	0.06	0.00	0.03	0.21	0.01	0.00
Cotton	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Tea	0.00	0.01	0.00	0.00	0.00	0.04	0.00	0.00
Paprika	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.7.3 Income

Table 49 shows that by far the most common sources of income amongst respondents were from the sale of food crops (all foods minus fruits and vegetables) and fruits and vegetables. It is significant that the next most common source of income was off-farm sources which includes all the various types of formal, casual, seasonal, full-time and part-time off-farm employment, remittances and pensions. The sale of non-food cash crops such as tobacco and coffee is a very uncommon source of livelihood for most respondents. Incomes from various sources of livestock or livestock products was limited to 26% of households. Only 19% of respondents derived any income from fish production.

In terms of the differences in sources of incomes between the groups, it is difficult to pick out any significant differences. The only thing that is clear is that the more productive the fish farmer the more likely they are to derive income from the sale of food crops and fruits and vegetables.

Table 49 Number and percentage of respondents from different categories deriving income from various sources

Source Of Income	Non-FF	Ex-FF	No Harv	0-19	20-59	60+	New FF	Total
Sale Foodcrops	82	82	76	79	89	90	83	83
Sale Fruit & Veg	63	62	65	83	62	90	50	74
Off-Farm Sources	41	62	46	49	38	45	33	49
Livestock Total	12	18	35	29	23	25	17	26
Sale Fish	2	6	8	26	51	60	0	19
Other	14	12	20	16	15	15	4	18
Sale Tobacco	13	12	14	16	15	15	0	14
Sale Chicken	9	6	23	16	6	10	13	14
Sale Livestock	3	6	19	17	19	5	4	13
Employ-Casual Off Farm	14	6	6	11	4	5	0	9
Remittances	6	21	6	8	2	5	4	7
Employ-FT Formal	4	15	8	7	9	15	8	7
Employ-PT Formal	3	3	6	7	4	5	0	5
Sale Coffee	4	15	4	5	2	0	8	5
Sale Milk & Eggs	2	9	0	7	0	10	0	4
Pension	0	12	3	4	2	10	4	4
Employ-Seasonal Farm	4	6	3	4	0	0	4	3
Rent	3	9	4	1	4	10	8	3
Total no. of respondents	113	34	80	244	47	20	24	562

Table 50 suggests that in general the value of fish production as a proportion of the total value of all agricultural production by the household is very low – under 17%. For the vast majority of fish farmers it contributes less than 8% of the value of total production. When the differences between the categories of fish farmers are examined, the more productive the farmer is, the greater the proportion that fish contributes to total production. Because the value of total farm produce is greater among the more productive fish farmers, it follows that the actual cash value of fish being realised by these farmers is significantly higher than the less productive fish farmers.

The differences between the groups within each region tends to follow the national trend very closely. However, fish production makes the largest contribution to total production in the Southern Region and the smallest contribution in the Northern Region. This can be explained due to the greater availability of land and higher value of general agricultural production in the Northern Region than in the South and Central Regions.

Table 50 The mean percentage value of fish production as a proportion of the value of total household production by fish farmer category and region

Status	Region	Mean	STE	N
0-19	Central	1.61	0.44	80
	Northern	3.47	3.34	82
	Southern	3.36	0.70	82
	National	2.82	1.16	244
20-59	Central	7.24	4.65	9
	Northern	6.88	3.93	13
	Southern	16.60	3.62	24
	National	12.02	2.71	46
60+	Central	14.53	4.05	4
	Northern	9.23	2.69	9
	Southern	27.70	5.74	7
	National	16.75	4.40	20

Table 51 indicates that 80% of fish farmers in the 60+ category earn income from three or four sources, while 76% of farmers in the 20-59 group and 72% of the 0-19 group earn their income from two or three sources. The less productive categories and non-fish farming groups also tend to have more farmers deriving income from only one source. So while most households tend to diversify their income sources as much as possible, the more productive farmers tend also to have more numerous sources of income than less productive farmers.

Table 51 Diversity of income sources by farmer category

Groups	No. of Source of Income					Total %	Total no. of response
	1	2	3	4	5		
0-19	7	36	36	17	4	100	242
20-59	4	38	38	11	9	100	47
60+	0	20	45	35	0	100	20
Ex Fish farmer	6	41	44	9	0	100	34
New	27	41	27	5	0	100	22
No Harvest	16	43	30	10	1	100	80
Non Fish Farmer	20	49	27	4	0	100	114
Total	11	40	34	12	3	100	559

Following the trends evident in Table 51, the data in Table 52 indicates that the more productive farmers tended to rely less on one source of income for the bulk of their income. 50% of these households had no income source that contributed 50% or more to total household income. The non-fish farmers and less productive farmers on the other hand were much more likely to rely on one source of income for the bulk of their household income, suggesting a greater degree of vulnerability amongst these households. In other words these sources of income could be lost due to shocks such as losing one's job, drought, fire, or sickness and death in the family. It is interesting to note that most of the new fish farmers have a high level of dependency on once source of income. These farmers may therefore be more vulnerable to risks that could undermine the potential of their fish farming operations in the future.

Table 52 Percentage of respondents who had zero, one or two income sources that amounted to 50% or more of their total income

Group	No of income sources > or = 50% of household income			Total no. of response
	None	1	2	
Ex-FF	35	65		34
New	14	86		22
No Harvest	21	79		80
0-19	33	66	0.4	242
20-59	36	64		47
60+	50	45	1	20
No of respondents	30	69	2	559

Table 53 indicates that, although the differences in the number of income sources and agricultural products produced by the household is not great, there is a general tendency for the average number per household to increase with the age of the household head.

Table 53 Average number of sources of income and agricultural produce per household per age category of the household head

Age Cat	Average number of		
	Income	Agric. Products	Income & Agric. Products
80-9	3.4	7.4	9
70-9	2.5	6.0	6.6
60-9	2.7	6.3	6.8
50-9	2.6	5.9	6.6
40-9	2.5	5.6	6.4
30-9	2.3	5.8	6.4
15-29	1.9	5.2	5.7

Similarly, when the average value of total agricultural production (in Malawian Kwacha) by age category is considered in Table 54, it is very clear that the value of agricultural production increases steadily with age of the household head and peaks when they reach their seventies. This trend relates to the findings shown in Table 41 above that the average size of land cultivated also increases with age of the household head.

Table 54 The average value of total agricultural production (in Malawian Kwacha) by age category of the household head

Age Cat	Number of respondents	Average Value Agric Production
80-9	5	97,478.58
70-9	26	108 583.37
60-9	38	86,080.11
50-9	107	78,185.70
40-9	101	67,069.47
30-9	133	66,505.95
15-29	99	59,903.33

3.7.4 Expenditure

It can be seen from Table 55 below that around 40% of most household incomes are spent on various kinds of food, mostly 'other food' followed by staple foods and then fish. Households in the Central Region appear to spend more of their income on food, particularly staples, while those in the Northern Region seem to have substantially less need to buy staples and spend more on other foods. This is consistent with the results discussed earlier in this report that indicate that households in the north have more land and produce more food that those of other regions. When expenditure on food is combined with other basic necessities, this amounts to around 60% of household expenditure. Expenditure on productive inputs amounts to around 19% of household expenditure, but is highest in the Southern Region where stronger processes of intensification may be underway due to population pressures and land shortages. Education represents a long-term investment in future livelihoods and generally amounts to 9% of household expenditure. Once again this investment in education appears to be highest in the Northern Region.

Table 55 Average percentage of household income spent on various items by region

Regions	Central	Northern	Southern	Total
All types of food	43	38	38	40
Basic necessities	64	59	59	61
Productive inputs	16	19	23	19
Luxuries & sundries	20	22	19	20
Specific Items				
Other foods	23	27	22	24
Clothing & Blankets	19	17	17	18
Tools & inputs	13	16	18	16
Staple foods	17	5	13	12
Education	7	12	7	9
Furnishings	4	5	7	5
Fish for food	3	5	4	4
Other	6	4	2	4
Labour	2	3	5	3
Luxuries	2	2	2	2
Transport	1	3	2	2
Building materials	1	2	1	1
Rents	0	0	0	0

The data in Table 56 below indicates that there are some differences between the various farmer categories in terms of the average amount of income spent on different items. The top half of the table indicates that the more productive fish farmers tend to spend less on food and other basic necessities and more on luxuries and productive inputs than the less productive farmers. These more productive farmers also spend more on education than less productive farmers.

Table 56. The average percentage of household expenditure on various items by farmer category

Expenses	No Harv	0-19	20-59	60+	New	Ex-FF	Non-FF
Basic Necessities	58	62	51	48	61	64	65
All food expenses	37	41	32	32	42	42	42
Luxuries & sundries	23	20	25	24	22	19	17
Productive Inputs	17	19	25	29	19	16	19
Specific items:							
Other foods	21	25	23	25	22	28	23
Clothing & Blankets	18	17	16	12	16	17	21
Tools & inputs	14	15	20	20	16	13	16
Staple food	11	12	7	6	16	9	14
Education	11	8	14	17	7	8	7
Furnishings	7	5	4	2	8	7	4
Other	4	4	5	3	3	2	4
Fish for HH cons	5	4	2	1	4	4	5
Labour	2	3	5	8	3	3	3
Luxuries	1	2	1	2	4	3	2
Transport	2	2	1	3	3	4	2
Building materials	1	1	1	2	1	1	1
Rents	0	0	0	1	0	0	0

Basic Necessities = all foods+ clothing + building materials + transport. Productive Inputs = tools and inputs + labour + rents. Luxuries and sundries = all other items that are not basic necessities, or productive inputs

3.8 Relationship between farming category and food security issues

The data in Table 57 below is generally consistent with the results on land use and value of production. The more productive farmers have generally indicated that they are more food secure than the less productive farmers. The only anomaly in this table is the responses of ex-fish farmers. Once again these responses may be strategic answers aimed at trying to secure assistance from outside agencies – especially since some better off farmers in these areas have recently been selected for HIPC assistance to construct fish ponds.

Table 57 Perception of household food security status by category

Status	Food secure (%)	Insecure food (%)	Partially food secure (%)
Ex Fish farmer	67	0	33
Non Fish Farmer	47	10	43
No Harvest	53	10	37
0-19	57	7	36
20-59	74	2	24
60+	75	0	25
New	63	8	29

Figure 4 demonstrates a consistent inverse relationship between the availability of food and the purchasing of food. The period of severest food shortages and highest purchases being during the wet season from December to February. This has important implications for fish farming as this period of greatest shortage falls within the warmer months of the year during which fish feeding

should be maximised to ensure maximum fish growth. This represents an important constraint to the intensification of fish farming activities.

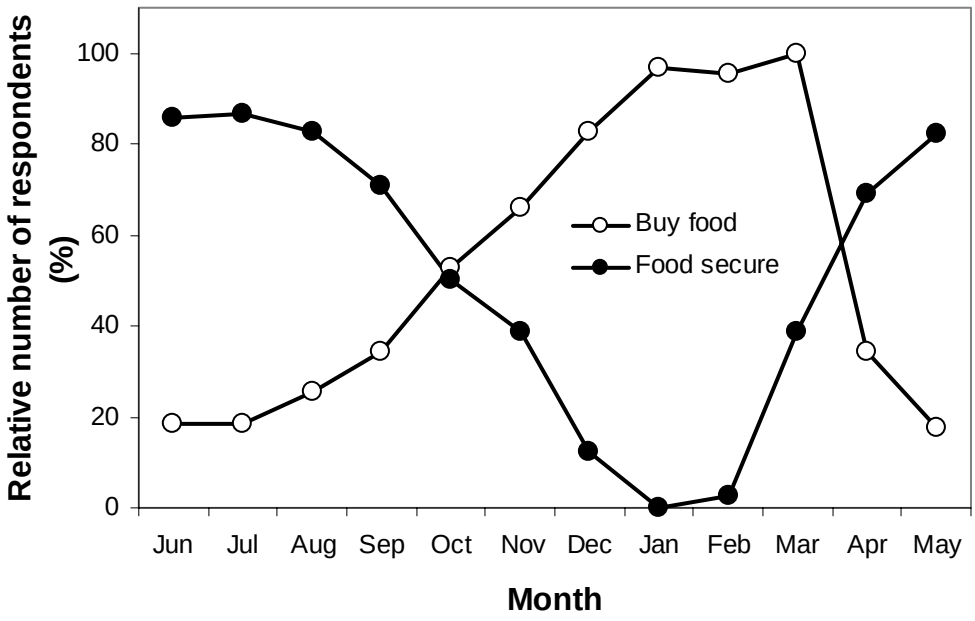


Figure 4 Proportion of households which either produce sufficient food from on-farm sources (food secure) or need to buy food for the different months

Ganyu is a well known practice in Malawi and is defined here as the practice of providing labour to other households to assist with agricultural and other domestic activities. In Malawi poor households are known to hire out their labour as a means to secure income or food. Table 58 shows that less than 50% of all households surveyed engaged in ganyu at some time during the year. It is notable that a higher proportion of the non fish farmers engaged in this practice as compared to the fish farming households. This may suggest that fish farming households were more food secure from their own on-farm resources as compared to non fish farming households. Surprisingly however, a higher percentage of the most productive fish farmers engaged in ganyu than all the other categories except the non fish farmers. The reasons for this become clear when the periods of involvement in ganyu are examined.

Table 58 % of households in the different farming categories engaging in Ganyu at some time during the year

Status	No	Yes
No Harvest	70.5	29.5
0-19	71.8	28.2
20-59	85.1	14.9
60+	65.0	35.0
New	75.0	25.0
Ex Fish farmer	75.8	24.2
Non Fish Farmer	59.8	40.2

Table 59 suggests that the months when households are most likely to engage in ganyu is from October through to February, coinciding with the months of greatest food shortage at a household

level. Clearly this activity is important for ensuring that these households have sufficient food during this period, either through obtaining cash to purchase food or through receiving food in lieu of wages.

As suggested in Table 58 above, a higher proportion of productive fish farming households engage in ganyu than the other categories of farmer. However the seasonality of these activities is shown to differ between the groups in Table 59 below. The more productive fish farmers tend to engage in ganyu throughout the year while the other categories engage more in this activity during the months of food shortage. A possible reason for this is that the more productive farmers have more able-bodied members of the household and dependents, leading to situation where excess labour is available for provision of labour to other off-farm activities. Engaging in ganyu throughout the year also indicates that it is not an action taken through desperation (food insecurity from on-farm sources) but rather an extra livelihood activity that sustains these households throughout the year.

Table 59 % of respondents from the different farming categories engaged in ganyu in each month of the year

Status	No Harvest	0-19	20-59	60+	New	Ex FF	Non FF	Combined
Jun	4	4	0	25	8	0	4	4
Jul	4	4	0	25	8	0	4	4
Aug	3	5	0	25	8	0	8	5
Sep	9	7	0	25	13	0	9	7
Oct	11	11	2	30	17	6	14	11
Nov	13	13	4	25	21	12	15	14
Dec	25	16	6	30	21	9	19	17
Jan	24	20	11	35	17	15	25	21
Feb	18	19	11	30	8	12	25	19
Mar	9	11	4	25	0	3	13	10
Apr	5	5	2	25	0	0	6	5
May	5	4	0	25	4	0	6	5

4 Discussion

4.1 General attributes of fish farmers

The questionnaire survey was limited to smallholder farmers who owned ponds located at or near their homestead. However, it should be noted that other systems of owning, using and organising ponds exist within the country. These include ponds that are communally owned by a group or club, and those that are located at a common geographical point but where ponds are individually owned by members of the club. These different initiatives were assessed separately from this survey and need to also be considered as possible options for future development of aquaculture in Malawi.

As far as this questionnaire survey is concerned, the results are generally internally consistent and clear. The more productive fish farmers also tend to be the more productive farmers in general. These more productive farmers tend to be older, have larger families, more labour, more dependents, higher education levels, and more skilled employment experience. They also have access to and cultivate more land of all types, have better access to water, produce a more diverse range of agricultural produce, have more diverse livelihood strategies and are less food insecure than less productive households.

In terms of fish production, they produce more fish, have larger or more ponds and are more likely to feed their fish manure, compost and vegetable matter than the less productive farmers. Production

per farm does not seem to be related only to the intensity of fish farming activities (ie. kg/ha/yr), but also to the area of pond available to raise fish. This points to the critical need for farmers to improve management of their ponds in order to produce more fish per unit area. Given the awareness that many farmers have of the technologies required to increase this production, and yet the poor management practices observed in general, even among those farmers producing more fish, consideration should perhaps be given to increasing overall national pond surface area while at the same time determining appropriate methods to ensure that farmers adopt better management routines. It should also be recognised that poor management practices are often a result of the difficulty that many farmers have in obtaining sufficient inputs at the right time to ensure good fish production.

The survey has indicated that the various categories of farmers are relatively evenly spread across the country. Even though variations in biophysical, political and economic characterisitics occur in the different regions of Malawi, it is apparent that household level factors such as access to labour, availability of pond inputs and the level of agricultural diversification have a stronger influence over farmers than the geographic variations. It is interesting to note however that the less productive farmers from the Southern Region generall produce more fish per household than in the other regions. This is likely to be as a result of longer sustained involvement in fish farming in this region, as well as the proximity of environmentally suitable areas in accessible distance from the NAC and their activities. Similarly the less productive farmers in the Northern Region produce more fish per household than in the Central Region, a factor perhaps explained by the presence of the Mzuzu Research facility in the North.

As mentioned, other household factors seem to play a more dominant role in determining the level of agricultural production at a household level. One of the significant findings from the survey is the relationship between age of the household head, and the level of agricultural production. In summary, as the age of the household head increases, so too does their household size, availability of labour, diversity of income sources and as shown in Table 60 below, area of land cultivated and overall value of agricultural production.

Table 60 The average value of total agricultural production (in Malawian Kwacha), and average area of land cultivated by age category

Age Cat	Count	Average Value Agric Production	Average Area of land cultivated
80-9	5	97,478.58	8.33
70-9	26	108,583.37	7.17
60-9	38	86,080.11	6.09
50-9	107	78,185.70	5.49
40-9	101	67,069.47	5.26
30-9	133	66,505.95	4.84
15-29	99	59,903.33	3.70

Fish production in households tends to follow the same trends as that for general agricultural production.

The value of fish production per household also follows the same age trend but is not as marked as for the whole sample. The more productive the fish farmer, the older he is likely to be, the larger his household will be, the larger the area of land they will cultivate, the more agriculturally productive his household will be, the more diverse his households livelihood strategy will be.

This would suggest that it may be appropriate to focus the provision of aquaculture development support on the older, better off households. However, such a strategy may not ensure that fish production is maintained in the long term. It provides no guarantee that fish production in any household will be maintained after the household head/fish farmer dies. The high numbers of young household heads amongst ex-fish farmers, and low numbers of young farmers amongst the more productive farmers suggests that these young farmers experience particular problems (possibly labour, food security and skill constraints) that make it difficult or problematic for them to maintain the production of fish from an inherited pond.

It may be pertinent to accept, therefore, that fish production in each household is likely to fluctuate in the long term in synchrony with the overall household cycle. Production will be low when the household is young and small, but will gradually increase as the household increases in size and children become able to contribute to household labour. Production will probably begin to decline again when the adult children begin to leave the household and the household head eventually dies. Strategies for sustained improvement of fish farming activities need to include consideration of how to reduce the household cycle effects described above.

Two fundamental groups of active fish farmers are apparent on a national level:

a. Those that have ponds but receive only minimal production from them. These farmers benefit mostly from direct contribution to household food production through the availability of fresh fish.

b. Those that have ponds who receive a tangible income from fish production. These farmers benefit both from the cash that that is generated, and also from the availability of fresh fish to the household.

The vast majority of fish farmers fall into the first category. This has major implications for the planning process for aquaculture development. While increasing production of fish within these households should not be discounted, in reality, limited access to pond inputs within this group is likely to constrain significant increases in fish production by these farmers. It is clear however, that even these low levels of production form an important part of household livelihoods through providing an additional option for spreading agricultural risk and increasing the overall value of the farming system. There may also be benefits in investing in this activity to ensure that returns are available at a later stage as the farmer gets older.

4.2 The importance of diversification

The survey has indicated that in almost all cases fish farming forms part of a variety of activities that are combined to maximize the food security of the small holder household. This suggests that fish farming needs to be viewed as part of the overall agricultural system being employed at the farm level rather than an activity that can be considered alone. It should be recognized that ponds are constructed in areas where water is available, and this also allows other agricultural products to be grown in the immediate surrounds of the pond. The pond and the products of the surrounding areas are intimately connected in two ways:

a. the pond acts as a water storage system and adds to the capacity for dry season agriculture either through seepage or active irrigation systems
b. The agricultural productivity of the dimba around the ponds enhances agricultural production in general and contributes to the required pond inputs to increase fish yield

These two points are fundamental to understanding the opportunities and constraints to increasing overall farm production by including aquaculture as an additional livelihood on the farm. This survey has also indicated that the constraints facing small holder aquaculture are similar to those facing small holder agriculture in general. It is suggested that without understanding these interrelationships, the challenge of improving both small holder productivity of fish per unit area, and the spreading of aquaculture activities to new geographical areas in Malawi, will be difficult to meet.

Although our survey showed that fish from aquaculture formed a maximum of around 17% of value of total household productive activities, the contribution in terms of increased diversification may be more significant. Although the hidden value of access to fish from fish ponds in not obvious (difficult to measure), it is clear that fish farming improves the level of diversification at household level. Table 51 (page 46) indicates that, at least for the more productive fish farmers, a greater range of livelihood sources are accessed than non fish farmers. In general it is shown in Table 60 below that the more diverse farmers tend to rely more on an even spread of income sources which reduces risk of failure of any one of the income generating activities engaged in.

Table 61 Diversity of income sources for all categories of farmer compared to the proportion that each source contributes to overall household income

No of Income Sources	Types of Income Sources						%of category	%total sample
	Fish	Export crops	Livestock	Off-farm	Fruit&Veg	Foodcrops		
1	1.6	1.6	0.0	24.2	22.6	50.0	100.0	11.6
2	4.1	6.6	3.8	18.8	29.6	37.1	100.0	40.7
3	7.1	7.4	10.0	16.4	28.8	30.2	100.0	33.0
4	12.7	10.8	14.6	15.8	22.3	23.8	100.0	11.4
5	16.7	7.8	17.8	17.8	20.0	20.0	100.0	3.2

Export crops = tobacco and cotton
Livestock = sale of livestock, chickens, milk and eggs
Food crops = cereals and cassava
Vegetables = green vegetables, tomatoes, potatoes, etc
Off-farm = full-time, part-time, formal and informal employment, entrepreneurs, craftsmen, pensions, rents, etc.

It is important to determine if more diverse farmers are actually better off than less diversified farmers in terms of value of overall farm livelihoods. This could not be determined as part of this survey due to the difficulties of obtaining accurate income data from questionnaire surveys. There is an urgent need for a dedicated cost/benefit analysis/study by a resource economist to fully investigate and determine the value that fish ponds add to the household. This would ***provide a basis by which the integration of ponds can be given a value***.

If it is shown that more diverse farmers are also better off, then there is a strong argument for encouraging integration of aquaculture as an additional livelihood strategy. It is also apparent that even if the proportion of contribution of fish to household livelihood does not change over time, the increased diversity leads to greater overall value of household livelihoods. Integration of aquaculture may also allow additional diversification due to the fact that water is stored on the farm and other crops may be grown as a result of this that could not be grown before. Therefore the overall food security of the household is improved by incorporating fish ponds into the farming system. The indirect value of this factor should not be underestimated. It may not be appropriate to simply measure the impact of small holder aquaculture in terms of the amount of fish produced.

The above factors indicate that the importance of the spread of fish farming activities to households on a national basis should be emphasised rather than only concentrating on increasing fish

production per unit area. In other words, it may be more beneficial to end up with a scenario where more households are producing small quantities of fish than fewer households producing larger quantities of fish.

4.3 Future projections for small scale aquaculture

The current survey has provided a excellent baseline upon which planning for future development of small holder aquaculture can be based. Clearly this sector is currently contributing insignificant amounts of fish on a national level (less that 1%) as compared to the capture fisheries. Although this contribution is likely to increase in the future with active intervention it is unlikely to ever meet the required shortfall in fish supply that is expected in the next 20 years. Therefore other approaches need to be taken to meet these national demands over time. As indicated in other reports from the Master Plan study, these options may include increased fish imports, commercial aquaculture, and utilisation of new stocks within the capture fisheries. However, as suggested in the section above it is apparent that the value of aquaculture integration at a household level is significant in terms of ensuring food security at household level. This value, although difficult to quantify, can be further explored if future scenarios are considered.

As a starting point it is interesting to consider future projections in terms of the number of ponds and fish production that could be expected based on historic trends. Figure 5 shows how the number of ponds in households covered in the survey have increased over time. It is clear that a dramatic increase in the rate of new pond establishment has occurred since the 1980's, with the most dramatic increase in pond numbers occurring from 1999 to the present. Figure 6 suggests that an annual increase of about 15% in pond numbers has occurred since 1965.

If this rate of annual increase is projected into the future (Figure 7), starting at an estimated current national pond count of 4 000, then up to 80 000 ponds may be constructed by 2025. This assumes that it will be possible to maintain a 15% growth rate per annum until that time. Clearly, significant infrastructural and institutional support would be necessary to allow this kind of growth to occur. It is likely that greater reliance would be placed on support from fellow farmers as the overall number of fish farmers increases. On a national level, the survey team are of the opinion that there is sufficient new suitable pond sites to allow this increase to occur over time. Apart from the active promotion of aquaculture by Government and NGOs, it is also likely that a multiplier effect would be activated with new farmers constructing ponds due to the increasing awareness of this option through the observation of neighbours.

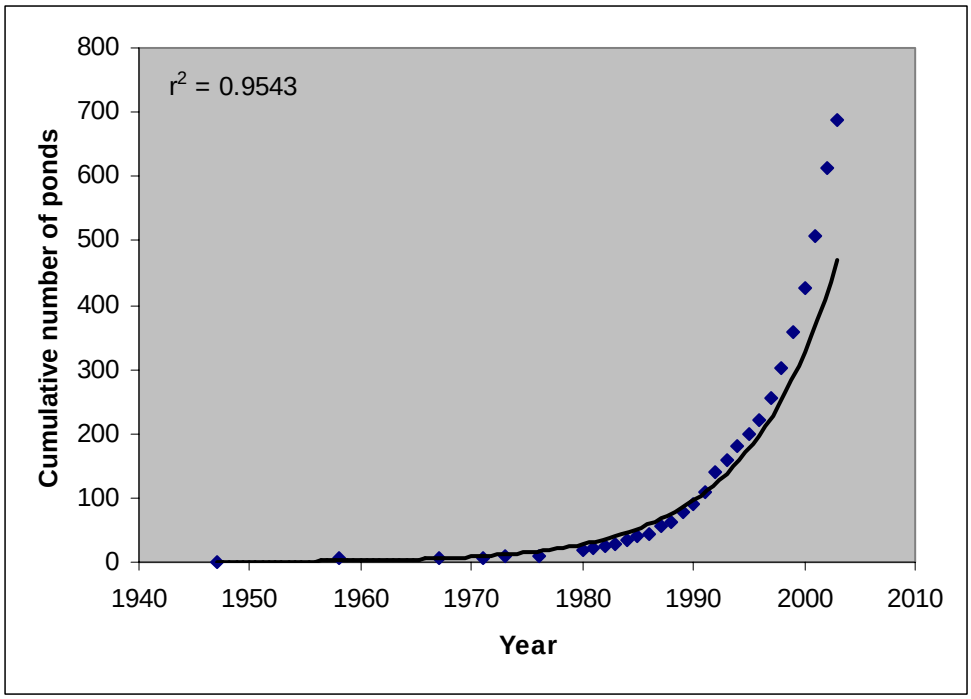


Figure 5 Cumulative number of ponds since 1947 in households covered in the survey

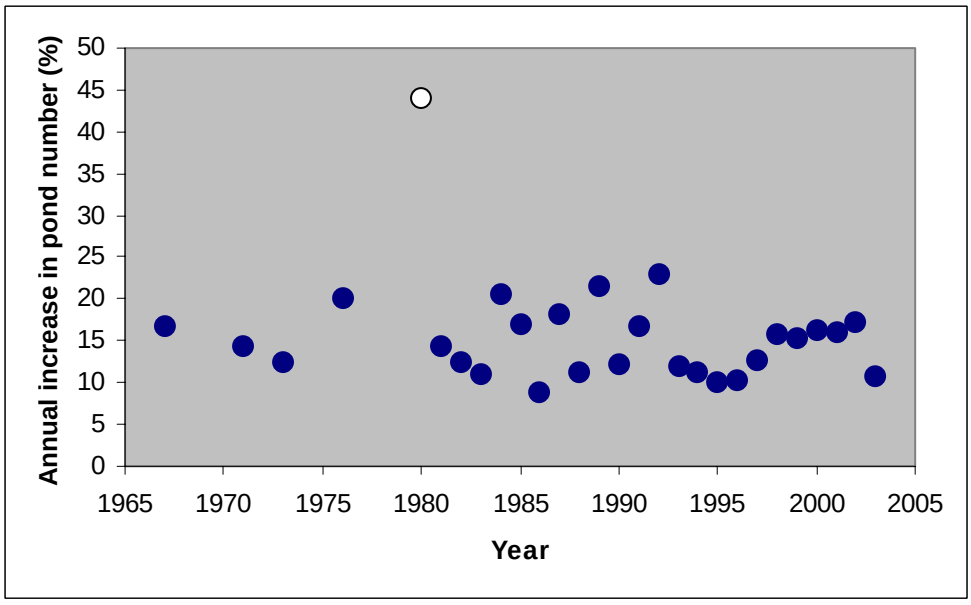


Figure 6 Annual increase in the number of ponds since the 1960's in households covered by the survey

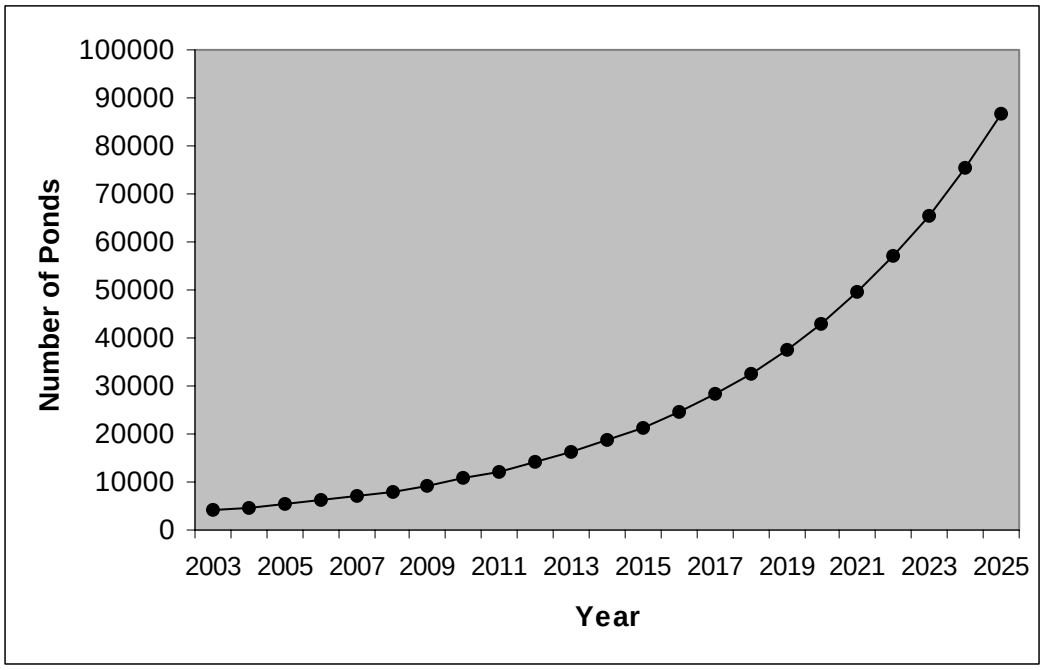
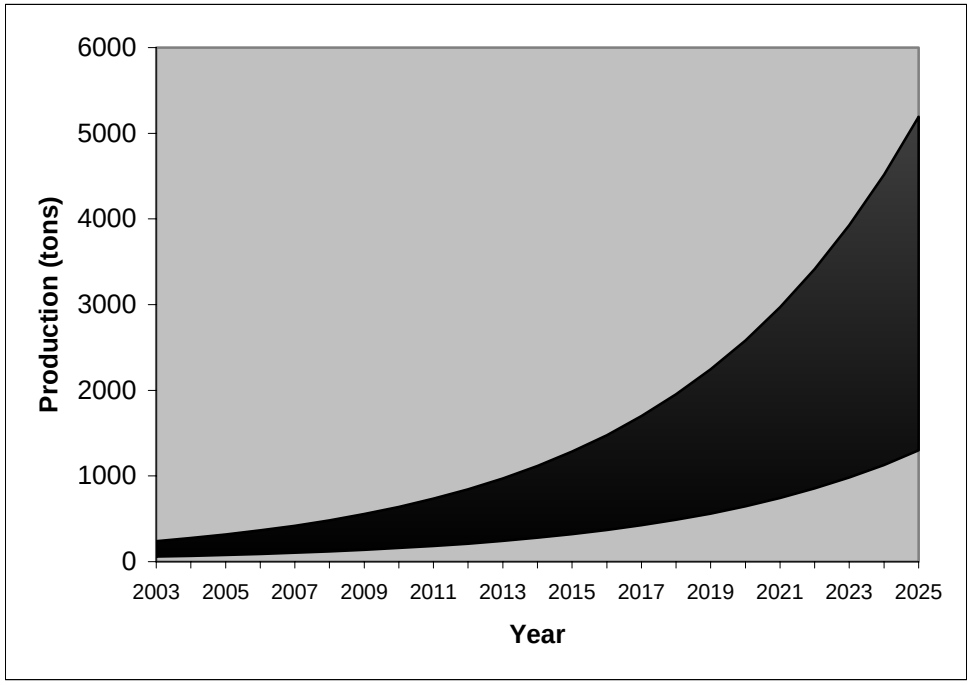


Figure 7 Projected increase in the number of ponds on a national level to 2025 based on the annual increases evident in the survey sample

In order to estimate the potential fish production related to the projected increase in pond number to 2025, pond number was multiplied by two different levels of production per pond. The lower estimate shown in Figure 7 relates to a production of around 15kg/pond/yr, slightly above the current average determined during this survey. The upper estimate is based on a



theoretical maximum production per pond of 60kg. Potential production based on increase in pond number over time would probably fall between these two estimates. From Figure 8 it can be seen that a national production of around 2 500 tons could be realised by 2025 if the pond numbers continued to increase at the current rates and if production per unit area is improved over time. Should production per pond remain at the current levels national fish production would be in the region of 1 200 tons by the year 2025 if pond numbers reached 80 000.

Figure 8 Projected national fish production in tons from small holder fish farmers to 2025. The lower estimate is based on current fish production per hectare (or 15kg/pond/yr), while the upper estimate is based on a theoretical maximum level of 3 tons of fish per hectare (or 60kg/pond/yr)

4.4 Have the survey objectives been addressed?

It is pertinent at this point to relate the results obtained from this survey to the original objectives and to determine to what extent these have been addressed.

1. To determine the current contribution of aquaculture to rural livelihoods on a local and national level

It was found that aquaculture formed from between 1% and 17% of overall household income, depending on the level of fish farming activities practiced. This value was determined by placing a monetary value on all fish produced, including those that were consumed within the household, or distributed to friends and family, and combining this value with actual income earned through the sale of fish. Even though the contribution of fish to overall household livelihoods was relatively low, the real value of this activity is believed to come from added diversification of livelihoods. This allows for an additional source of protein, further spreading of risk to the household as well as allowing water to be utilized more effectively on the farm, to improve overall agricultural production. It was found that the higher producers of fish are also more diverse in their livelihood strategies. It is concluded that fish farming cannot be considered as separate from the overall farming system at the

small holder level, and that constraints and opportunities for the production of fish are intertwined with overall farm characteristics.

The overall production of fish from ponds on a national level was lower than the existing estimates. This information suggests that while smallholder fish farming can contribute significantly to improved rural livelihoods if expanded to new geographic areas, this contribution is difficult to measure, and is not reflected in value of fish, and is unlikely to address projected shortfalls in national fish supply.

It is apparent that this objective has been sufficiently addressed for the purposes of this Master Plan, except that a cost/benefit analysis is required to determine the total direct use value of ponds and fish.

2. To determine why certain farmers have adopted fish farming as an additional livelihood activity

Generally, the awareness that fish farming could form an additional option for small holder farmers was high in all areas surveyed. However, the non fish farming sector of the survey sample provided good insights as to why this option had not been more widely adopted.

Reasons cited included lack of access to further information and technical support on how to proceed with fish farming, suggesting poor coverage of existing extension services. Commonly, a lack of the basic resources such as suitable land and water for ponds was also cited. In these cases it is not surprising that farmers were not prepared to give up these limited resources for new activities which could put their existing farming system at risk. Also, the perceived return on investment from fish farming after observation of neighbours was not always sufficient to encourage farmers to enter into a new activity, even if they had been informed by extension officers of the potential benefits of fish farming. This lack of examples of fish farming success in certain areas is considered to be a major constraint to the adoption of this activity, and further effort should perhaps be geared towards exposing farmers to success stories in other areas. The lack of good examples may also explain the response of many farmers that they lack the financial, labour and on farm resources to start fish farming. It is suggested that if the perceived incentives were great enough, most (but not all) farmers would be able to mobilize sufficient resources for pond construction. The lack of convincing examples of fish farming would deter many farmers from entering into a yet unproven new activity, unless the farmer has a more innovative character by nature and better access to resources. The relatively high proportion of fish farmers that have given up these activities would also act as a deterrent to potential new entrants.

It was apparent that the majority of non-fish farmers interviewed were relatively unproductive farmers in general. It is believed that those farmers who already showed an element of innovation prior to being exposed to the idea of fish farming were more likely to become involved in a new activity, if provided with certain basic information. Indeed, it was shown that the better fish farmers were also better farmers in generaI. However, it is unclear if this fact was a result of the incorporation of fish farming into their farming system, or if they were initially better farmers before starting fish farming activities. It is likely that many of these more productive fish farmers would have taken up fish farming with little outside encouragement due to greater levels of innovation in general. However, the question arises as to why certain less diverse and productive farmers adopted fish farming and others did not. The answers to this are not entirely clear, but it is thought that for many farmers these may relate to issues other than a perception that fish farming would improve their livelihoods directly. For example, perceived project related benefits such as the procurement of agricultural implements, or increased social status through being involved in a fish farming project, may have influenced certain farmers to adopt these activities initially. It should also be noted that fish ponds are sometimes obtained through inheritance and not necessarily through the choice of the current household head.

Finally, it is evident on a national level that greater numbers of farmers have adopted fish farming in areas that have received focused attention either from Government or NGOs. In addition it is known that many project related initiatives have selected project participants based on certain criteria that were believed to make the farmer more suitable for support than their neighbour. In these cases the choice of adopting fish farming is taken out of the hands of certain farmers as they are not offered the opportunity of becoming involved.

It is believed that this objective has been addressed adequately.

3. To determine why some farmers have intensified aquaculture activities more than others

The categorisation process for farmers carried out after this survey was completed allowed the differences between groups to be extensively examined. A disproportional amount of effort was placed in determining the underlying reasons for these differences. It was believed that it was of critical importance to understand why differences exist between fish farmers if strategies are to be designed to develop small holder fish farming in Malawi in general.

As indicated elsewhere in this report, the more productive fish farmers also tend to be the more productive farmers in general. These more productive farmers tend to have larger families, more labour, more dependents, higher education levels, and more skilled employment experience. They also have access to, and cultivate more land of all types, have better access to water, produce a more diverse range of agricultural produce, have more diverse livelihood strategies and are less food insecure than less productive households.

In terms of fish production, they produce more fish, have larger or more ponds and are more likely to feed their fish manure, compost and vegetable matter than the less productive farmers. Production per farm is not only related to the intensity of fish farming activities, but also to the area of pond available to raise fish.

The question arises, as mentioned before, whether the more successful fish farmers are more successful simply because they were initially successful farmers or because they have benefited from some kind of intervention that has enabled them to succeed. Clearly farmers with inputs are more capable at fish farming. The majority of fish farmers visited were producing below 20 kg/fish/yr and a combination of poor pond management and limited pond area appear to be the main reasons for this.

It is apparent that outside influences, besides innovative characteristics and an interest in fish farming, have had some effect on the degree to which fish farming has been adopted by different farmers and in different areas of the country. Proximity to extension centers and NGO project focus areas has had an effect on both the level of pond management occurring and the extent of pond surface area that farmers have access to. Generally, it appears that the longer that fish farmers have received sustained outside support, the higher production per unit area that they are achieving. This is indicated by the higher production of the smaller fish farmers in the Southern Region, who have been exposed to more aquaculture promotion over a longer period of time than in the other regions.

There are exceptions to these rules though. Many areas surveyed which had received NGO intervention showed that the number of farmers adopting fish farming was positively effected, but that production levels were extremely low, leading to significant numbers of fish farmers giving up fish farming shortly after the project intervention ended. It is believed that poor advice on pond size and site selection has often resulted in these very low levels of fish production and poor sustainability of fish farming practices. It is also apparent that in all areas some farmers have adopted the technology of integrating fish farming into their livelihoods better than others. It is

suggested that this is an expected phenomenon, as any community will have a small proportion of individuals who are better able to take advantage of new opportunities than others.

This objective has been thoroughly addressed during the survey.

4. To determine why some farmers have given up fish farming

This is related to the objective above, and it is quite clear from the survey that there are issues such as low yields that have encouraged farmers to abandon their activities. By identifying the reasons for stopping fish farming it is easier to determine the real constraints to fish farming and plan to overcome these if possible. Reasons cited by ex fish farmers ranged from low production, through lack of technical and financial support through to excessive predation by wild animals. As indicated previously, the survey suggests that the lack of observable examples of success has been a major constraint to the successful adoption of fish farming by new farmers. This is also believed to be an important factor leading to gradual loss of interest by the ex fish farmers. In addition, the scarcity of extension support and the poor quality of the messages carried by extension staff is considered to be responsible for many farmers giving up. It is also apparent that age and inheritance issues are important factors contributing to non continuation of fish farming activities.

It is generally the resource poor (ie. physical, environmental, labour, skills) farmers that require the greatest support from outside agencies in order for them to succeed at a newly introduced activity. These farmers would find it most difficult to produce tangible quantities of fish, or realize other associated benefits, and would therefore be the first to be discouraged. Because this group of farmers are likely to be slower at absorbing new technologies and turning them into productive activities, it is questionable whether major investment should be made to encourage adoption of fish farming without also providing good support services to them. In an environment where support is likely to continue to be limited, it may be appropriate to focus more of these limited resources on farmers who have greater potential of successfully adopting fish farming into their farming system. Perhaps greater emphasis should be placed on developing a more effective system of farmer-to-farmer extension and support to enable the resource poor farmers to adopt fish farming, should they decide that even relatively low levels of production are acceptable to them.

The reasons for giving up fish farming are diverse, and it is believed that there is no overriding contributing factor. Further study would be required to fully understand the complex nature of why certain people will succeed at a new activity while others will fail. It is therefore believed that this objective has not been fully addressed during this survey. The proposed cost/benefit analysis may shed more light on this.

5. To collect the primary information required to determine the potential, and key factors (biological, environmental, institutional, cultural, human capacity) required for increasing aquaculture production, either through improving the production of existing farmers, or through increasing the number of farmers, or both

This study has described in detail the characteristics of fish farmers of various levels in an attempt to identify the underlying reasons for the different levels of adoption of fish farming into the small holder farming system. This process has provided useful information on the factors limiting aquaculture in Malawi and the potential to expand fish farming practices.

Clearly, the basic requirements of suitable land and water resources need to be met before aquaculture can proceed. These requirements exist in many parts of Malawi, and some kind of aquaculture activity has been developed in most of these areas accordingly. Malawi has favourable environmental conditions for aquaculture as long as water is wisely managed through the dry season. Temperatures are suitable for acceptable growth performance in a range of indigenous species.

The lack of pond inputs is a major constraint to expansion in Malawi, with access to sufficient quantities of manure being perhaps the most significant. Bearing this in mind, it will be very difficult to increase production per unit area for the majority of small holder fish farmers unless agricultural production in general is improved. It is therefore unlikely that fish farming at this level will contribute significantly in meeting projected shortfalls in fish supply. It is believed that commercial aquaculture has a role to play here, while the greatest potential for small holder aquaculture is through improving livelihood and food security at the household level. This can happen in two ways; through increasing the number of farmers who utilize aquaculture as an additional source of livelihood, and through improving the degree to which aquaculture is integrated into the overall agricultural system. In order for this to occur a fundamental change is required in the approach taken in extension and support for aquaculture. Rather than this being treated as an add-on activity, aquaculture needs to be integrated fully into the farming system. The benefits of this flow two ways. Firstly, ponds lead to improved water storage and management on the farm allowing greater diversity and quantity of crops to be grown during the dry season. At the same time, this greater production of crops provided more farm by- products suitable for inputting into the pond.

If greater levels of integration can be achieved and result also in greater diversity of on-farm activities it is believed that rural livelihoods can be improved significantly. Although not shown conclusively in this survey, there are indications that more diverse farmers may be better off. If this is the case, it would back up the contention that the potential for small holder fish farming in Malawi lies in improving levels of integration.

The data from this survey has also suggested that there is a requirement to review the existing institutional framework surrounding aquaculture. There is a need to consider the most effective way of ensuring the desired increased levels of agricultural integration. The relationship between the different government departments involved in natural resource management needs to be revisited to mobilize limited resources in the most effective manner. It also seems appropriate that priority areas need to be selected in the country towards which support should be directed to best effect. Related to this is the need to develop appropriate material and techniques for transferring knowledge in these focus area. Also, greater reliance on indigenous systems of knowledge sharing is indicated, with mechanisms for stronger farmer-to-farmer communications and extension, critically required.

The survey has also provided a realistic description of farmers with differing potentials which should inform decisions regarding the type of farmer that certain approaches should include. Limited resources should perhaps be channeled to farmers who have the characteristics that would enable them to absorb new technologies and ideas and to influence others with whom they come into contact, rather than providing diluted inputs to large numbers of low potential farmers.

It is believed that this objective has been adequately addressed in this study.

6. To validate the current national aquaculture production statistics

It was apparent from the outset of the study that there were inconsistencies in the existing records of numbers of fish farmers and ponds in Malawi. This led to difficulties in the determination of a realistic figure for national production from small holder aquaculture. It was necessary to obtain updated information on these statistics as part of the survey so that planning for the future could be based on the most recent data.

It was impossible to obtain a list of all active fish farmers as part of the survey, although comparison between our sample and the reported lists of farmers from the sampled areas provided some indication as to the accuracy of these existing lists. It is estimated that the total number of farmers and ponds has been over estimated in the past, and the DoF has initiated a process of gathering updated lists through their extension system. Hopefully this will be complete during the course of the Master Plan Study and can be incorporated in the final report.

The survey provided good information on production per farmer and per unit area, which allowed estimation of averages for the different categories of farmer, districts and regions (see section 3.4.1).

From this information it was possible to up-calculate to national production based on the existing farmer lists supplied by NAC. Three different methods of calculating national production were used. Firstly, using mean production per pond (from this survey) and the estimated total number of ponds provided by NAC (2002). Secondly, based on mean production per hectare and the total pond area, and thirdly based on the total number of fish farmers estimated by NAC (2002). Based on these methods it was estimated that national fish production from small holder aquaculture ranged from between 50 to 120 tons per year.

It should be noted that these estimates are based on information obtained from farmers who recalled past harvests rather than from written records, which in most cases were not kept by farmers. The estimate includes all fish harvested in major harvests in addition to those harvested periodically (partial) as a contribution to household food requirements. Even with the subjective estimates provided by farmers the estimates arrived at are believed to be close to the real situation based on observation of pond conditions, and the fish biomass they contained during the survey.

The discrepancies evident between the estimates based on this study and those made by NAC should not be cause for concern as both indicate a relatively low contribution as far as national fish production is concerned. It is however important that standardised protocols are developed for the collection of statistical data so that small holder aquaculture development can be monitored effectively into the future. This standardised procedure will receive attention during the current Master Plan project. A cost/benefit analysis may also uncover some other criteria that could be used to monitor the effectiveness of aquaculture development interventions.

It is believed that the objective of verifying the existing national aquaculture statistics has been partially met as a result of this survey. However, further information on farmer and pond numbers need to be collected by the DoF before this objective can be fully met.

Attachment

Attachment 1

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Attachment 2

Stakeholders consulted during questionnaire preparation and survey

Name	Affiliation	Area	Region
1. Dr E. Kaunda	Bunda College	Bunda	Central
2. Mr Kapanda	Bunda College	Bunda	Central
3. Mr A. Maluwa	NAC	Domasi	South
4. Mr S. Unyolo	NAC	Domasi	South
5. Dr U. Weyl	BZDP	Mzuzu	North
6. Mr M. Froud	BZDP	Mzuzu	North
7. Mr A. Charman	BZDP	Mzuzu	North
8. Mr J. Kamanga	Fish Farmer	Rhumpi	North
9. Mr M. Msiska	Fish Farmer	Rhumpi	North
10. Mr. M.T. Msiska	Fish Farmer	Rhumpi	North
11. Mr M. Kampata	Fish Farmer	Mchinji	Central
12. Mrs J. Kaunda	Fish Farmer	Zomba	South
13. Mr Binali	Fish Farmer	Zomba	South
14. Mr Kawengwere	Fish Farmer	Mulange	South
15. Chiembekezo Club	Fish Farmers	Mulange	South
16. Dr Chinkunta	Farmer	Dowa	Central
17. Mr Chokani	Farmer	Mchinji	Central
18. Mr S. Madlasi	Fish Farmer	Mchinji	Central
19. Mrs J. Kazembe	DoF	Zomba	South
20. Mr A Bulerani	DoF	Lilongwe	Central
21. Mr S. Chimitero	DoF	Lilongwe	Central
22. Mr M. Banda	DoF	Monkey Bay	South
23. Dr S. Donda	DoF	Lilongwe	Central
24. Mr O. Kachinjika	DoF	Lilongwe	Central
25. Mr Lungu	DoF	Nchenachena	North
26. Mr Kumblikano	DoF	Mzuzu	North
27. Mr M. Nyerende	DoF	Mzuzu	North
28. Mr Nindi	DoF	Zomba	South
29. Mr Bato	DoF	Zomba	South
30. Mr Kapute	DoF	Chisitu	South
31. Mr Malizeni	DoF	Mwanza	South
32. Mr Chirwa	DoF	Kasinthule	South
33. Mr Katunga	DoF	Nchisi	Central
34. Mr Makwinja	DoF	Nkhotakota	Central
35. Mr Thengo	DoF	Chisitu	South
36. Mr Kachilonda	DoF Mpwepwe	Mangochi	South
37. Mr Njobvu	DoF Mpwepwe	Mangochi	South
38. Mr J. Chamveka	DoF Mpwepwe	Mangochi	South
39. Mrs J. Jere	World Fish Centre	Domasi	South
40. Dr. D. Jamu	World Fish Centre	Domasi	South
41. Mr Mark Prein	World Fish Centre	Panang	
42. Mr M Dey	World Fish Centre	Zomba	South
43. Mr Mangulenge	Dept Agriculture	Mwanza	South
44. Mr Chiwamba	Concerm Universal	Dedza	Central
45. Mr Chisale	CARD	Mchinji	Central
46. Dr Pala	Potential Investor	LLW	Central
47. Mr D. Dula	World Vison	Nchisi	Central
48. Dr Eda	JICA	Domasi	South
49. Mr J.H. Magasa	Maldeco	Mangochi	South
50. Mr John Balarin	DANIDA	LLW	Central

Attachment 3

ADiM Questionnaire

Enumerators to explain to the selected respondents who they are, who they represent, what they want to do, why and how the information will be used. Need to provide respondents with a guarantee of their anonymity.

1. QUESTIONNAIRE NUMBER: …….

To be numbered according to the following details:

Region	District	Enumerator	Number
N= Northern C= Central S = Southern	(Code)	A D B E C F	

2. DETAILS OF ENUMERATOR

Name: …….

Date of interview: ……..

3. DETAILS OF RESPONDENT – HEAD OF HOUSEHOLD

3.1 Name: …….

3.2 Gender:…….

3.3 Age:…….

3.4 Highest level of education (highest certificate or grade):…….

3.5 Previous occupation: ……

3.6 Location (Village and T/A):……..…….

3.7 District: ……

3.8 Region: ……

4. HOUSEHOLD STRUCTURE

(Include all members who are largely dependent on the household head for finances and food)

CATEGORY OF HOUSEHOLD/S MEMBERS	Male	Female
4.1 Number of children under the age of 15 years		
4.2 Number of elder persons (70+ years) in the household		
4.3 Number of adults (between ages of 15 and 70 years) who are largely unable to assist the household with its farming activities due to ill health or disability		
4.4 Number of able bodied adults (15-70 yrs) **present** in the household		
4.5 Number of adult members of the household who are **absent** and dependent on the household for support		

5. HOUSEHOLD ACCESS TO, AND USE OF LAND AND NATURAL RESOURCES

5.1 ACCESS TO AND USE OF GRAZING RESOURCES

5.1.1 Indicate the number of the different types of livestock the household has and uses to provide for their food and income requirements:

Livestock type	Number
Cattle	
Goats	
Sheep	
Donkeys	
Pigs	
Chickens (& other birds)	
Other:	

5.1.2 Do you have access to grazing land?

Yes	No

5.1.2 If yes, is this land communally owed or your own?

Communal	Own

5.1.3 Indicate the quality of the grazing land available to the household:

Poor	Good	Excellent

5.2 ACCESS TO ARABLE LAND AND USE OF THIS LAND

Enumerator to draw a rough diagram of farm layout together with respondent so that the different areas on the farm in the following table can be easily identified.

(Due to different measures [hectares and acres] of land area the enumerators need to be able to estimate areas of land independently from the respondent)

Note that 1 hectare = 2.4 acres

FARM MAP

Fill in information on map first and then transfer to the table

5.2 continued….

Characteristics 5.2.1	Arable Area 1	Arable Area 2	Arable Area 3	Arable Area 4	Arable Area 5	Arable Area 6	Arable Area 7
Size/Area (acres)							
Soil Quality							
Soil moisture							
Irrigated Y/N							

5.2.2	Indicate below the proportion (%) of field (or area) planted to each crop during this 2002/3 growing season (more than one crop can be grown in any field). Also, the quantity of each crop harvested from each land area per year should be indicated. Care should be taken to determine the measure that these quantities are represented in. For example, 50kg or 90kg bag of maize.													
	%	prod	%	prod	%	prod	%	prod	%	prod	%	prod	%	prod
Summer Maize														
Winter Maize														
Cassava														
Millet														
Sorghum														
Wheat														
Beans														
Soya beans														
Pigeon peas														
Ground-nuts														
Peas														
Pumpkins														
Pineapple														
Veg-etables														
Tobacco														
Coffee														
Bananas														
Mangos														
Cotton														

Soil moisture: 1 = Sodden (marshy), 2 = damp, 3 = dry
Soil Quality: 1 = Excellent, 2 = good, 3 = poor

5.2.3 Number of fruit trees growing:

Fruit trees	Number of trees growing
Banana stands	
Mango	
Pawpaw	
Citrus	

5.2.4 Unused land

Characteristics	**Unused land**	**Rented to someone else**
Size/Area (acres)		
Soil Quality		
Soil moisture		
Potential for irrigation	Y/N	

5.3 ACCESS TO WATER

5.3.1 Do you have access to water for cultivation and/or ponds?

Yes	No

5.3.2 Where do you source this water from:

Individual furrow from a river/stream	From a shared irrigation furrow	Furrow from a spring	Well	Goundwater seepage

5.3.3 Indicate the relative amounts of water you have access to for irrigation and/or ponds during each month of the year.

		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Relative Amount	Irrig.												
	Ponds												

To indicate relative amount, ask respondent to rank the water supply for each month from 0 – 2. (0 being no flow and 2 being the strongest flow)

5.3.4 If the supply of water is variable, what are the factors that cause this variability?

Rainfall (flood/drought)	Stream flow	Competition from other users	Seepage from furrow	Evaporation

5.3.5 Is there enough water available to support additional ponds and/or larger areas of irrigated cultivation?

Yes	No

5.3.6 If there is enough water to allow expansion, what would be the preferred use for this water?

1. Irrigated cultivation	2. Fish Ponds	3. Other

6. HOUSEHOLD LIVELIHOODS AND WEALTH INDICATORS

6.1 Indicate in the table below the sources of income obtained by the households and the relative proportions that each of these sources contribute to total household income.

6.2 Indicate in the table below the period of the year in which each source of income is received or generated.

Source of household income	Tick if Yes	Contribution to total annual household income (%) [6.1]	Period during which this income is received [6.2]
1. Full-time formal employment			
2. Part-time formal employment			
3. Owner business (artisan, shop-keeper, taxi driver, etc)			
4. Casual/temporary off-farm employment			
5. Seasonal farm employment for money			
6. Pension or Welfare grant			
7. Remittances			
8. Sale of tobacco			
9. Sale of coffee			
10. Sale of fruit and vegetables			
11. Sale of food crops (Maize, cassava, beans, groundnuts, pumpkins, etc)			
12. Sale of cotton			
13. Sale of cattle, sheep or goats			
14. Sale of pigs and chickens			
15. Sale of milk and eggs			
16. Sale of hides and skins			
17. Sale of fish			
18. Rent			
19. Other			
Total		(100%)	

6.3 Indicate the proportion of income spent on the following items:

Expenditure Items	Proportion of annual income spent (%)
1. Education (fees + uniforms, etc)	
2. Transport	
3. Maize, cassava or rice for household consumption	
4. Fish for hh consumption	
5. Other foods for hh consumption	
6. Building materials	
7. Clothing & blankets	
8. Furnishings and domestic utencils	
9. Tools and inputs for productive activities	
10. Luxuries (non-essential items)	
11. Labour	
12. Rents	
13. Other	

6.4 Does the household have the following assets: (tick those they have)

Radio/music player	2. Bicycle	3. Motor Vehicle	4. Tractor
Net for fish harvesting	6. Wheel-barrow	7. Iron sheets on house	8. Hoes (number?)
9. Oxcart	10.	11.	12.

7. FOOD SECURITY

7.1 Are there periods during the year when the household members have nothing or very little food to eat from on-farm production?

Yes	No

7.2 If yes, please indicate these periods in the table below and rank the degree of on-farm food shortage from 0-3.

Zero (0) = no lack of food, 1 = a lack of protein (relish) but no shortage of other foods, 2 = no staple but other sources of relish and vegetables, 3 = no staple food or other sources of food. Enumerators to be instructed on the relative levels of protein in different foods.

7.3 Please also indicate in the table when it is necessary to buy staple foods such as maize, cassava or rice for household consumption. (Tick months when staple food needs to be bought)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Own food												
Buy												

7.4 Does the household engage in Ganyu?

Yes	No

7.5 Indicate the periods of the year when Ganyu is engaged in.

Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May

7.6 Based on the discussions held with the farmer and observation of the household, enumerators are to provide a general opinion as to the level of food security that a household enjoys. (This is used simply to back-up the information recorded in 7 above and does not replace it.)

1. Food secure	2. Partially food secure	3. Food insecure

8. FISH FARMING ACTIVITIES

8.1 HISTORY

8.1.1 Are they currently involved in fish farming?

Yes	No

If no:

8.1.2 Have they been involved in fish farming before (during earlier period)?

Yes	No

If yes:

8.1.2.1 During what time period did they engage in fish farming?

……

8.1.2.2 Why did they stop fish farming?

……

If they have not been involved in fish farming before and are not currently engaged in fish farming:

8.1.3 Are there any particular reasons why they not involved in fish farming?

……

……

8.1.4 **If** the farmer indicates that he/she is planning to start fish farming – ask him/her to show what preparations they have made and make a note of these.

……..

……..

ONLY CURRENT OR PREVIOUS FISH FARMERS TO ANSWER THE FOLLOWING QUESTIONS

If they are currently involved in fish farming:

8.1.5 Why did they first become involved in fish farming?

1. Fish farming Project	2. Self-motivation	3. Inheritance	4. Other

8.1.6 Are you a member of a fish farming club?

Yes	No

If they are currently or were previously involved in fish farming:

8.1.7 From whom/where did they get the information and advice they needed to start and maintain fish farming?

Source of Information	Tick
1. Father/Grandfather/Uncle/Guardian	
2. Discussion with neighbours	
3. Observation of neighbours	
4. Fish Farmers Club	
5. Fisheries Extension Officer	
6. Project/NGO Name Project:	
7. Reading material	
8. Radio	
9. School	
10. Fish farming training From whom?:	

Respondent may indicate more than one source of information

8.1.8 Who in the household is mainly responsible for the fish farming activities?

1. Head of Household	2. Another household member

If the person mainly responsible for the household's fish farming activities is **not the head of the household (respondent)** please provide the details of the person responsible in the table below:

Person Responsible for Fish Farming	Characteristics
1. Age	
2. Male / Female	
3. Highest level of education	
4. Relationship to household head	

8.2 FISH PONDS

To be answered by those currently involved in fish farming as well as those who may have been engaged in fish farming in the past (but not currently).

Characteristics	Pond 1	Pond 2	Pond 3
8.2.1 How did you get a pond?			
8.2.2 Year of construction			
8.2.3 Cost for each (MK)			
8.2.4 Length of pond			
8.2.5 Breath of pond			
8.2.6 Date of last stocking			
8.2.7 Number of each species put into pond at last stocking	TR = OS = CG= OK = CC =	TR = OS = CG= OK = CC =	TR = OS = CG= OK = CC =
8.2.8 Month and year of last large harvest			

How did you get a pond? 1 = inherited; 2 = self constructed; 3 = constructed with paid labour; 4 = Project constructed; 5 = taken over from somebody else (though sale, gift or transfer, etc)
Species: TR = Tilapia rendalli (Chilinguni); OS = Oreochromis shiranus (Makumba); CG = Clarias gariepinus (Mlamba) OK = Oreochromis karongae (Chambo), CC = Cyprinus carpio

8.2.9 Do you want to expand your fish farming operations?

Yes	No

8.2.10 If you wanted to construct more ponds in the future, would you be able to access land with a continuous water supply?

Yes	No	Unsure

8.3 FISH FARMING OBJECTIVES

8.3.1 What are, or were your objectives for your fish farming activities?

	Type of Objective	Tick
1.	To provide the households with a source of protein	
2.	To diversify the household's food sources.	
3.	To produce fish for distribution to family, friends and neighbours for the purpose of building and strengthening social relationships	
4.	To produce fish for sale to generate income	
5.	To increase the social status of the household/person	
6.	Because you are interested in it (Hobby) or want to experiment with new productive activities	
7.	For educational and community development purposes.	
8.	Other	

8.4 SOURCES OF FINGERLINGS

8.4.1 Where have they obtained fingerlings?

Source of fingerlings	Tick	Species
1. Donations from neighbours/kin		
2. Purchase from neighbours		
3. Purchase from other fish farmers (Who?)…….		
4. Purchase from Department of Fisheries (Where?)……		
5. Self-production		
6. Other		

8.4.2 and 8.4.3. Indicate in the table below whether it is difficult to get access to different types of fingerlings or not and why.

Species	8.4.2 Difficult Y/N	8.4.3 Why?
1. TR		
2. OS		
3. CG		
4. OK		
5. CC		

8.4.4 What is the your preferred species for fingerlings?……

8.4.5 Why? …….

8.5 HARVESTING OF FISH

8.5.1 Which fish harvesting methods do you use?

1. Break dyke/total pond drainage	2. Seine nets (less than 1 inch)	3. Seine nets (more than 1 inch)	4. Hook & Line	5. Basket	6. Reed fence	7. Other

8.5.2 If you have harvested using a net, do you own this net or did you hire/borrow it?

Own Net	Hired/Borrowed Net

From whom did you hire or borrow the net? ……..

……

8.5.3 Do you keep records of your fish harvests?

Yes	No

8.5.4 Enumerator to ask if he can have a look at these records and rank the quality of these records.

Good	Poor	No Records

8.5.5 Fish harvests over the last 5 years, and size of harvests.

Harvest Number	Years															
	2002/3			2001/2			2000/1			1999/2000			1998/9			
	Month of harvest	Pales	kg	Month of harvest	Pales	kg	Month of harvest	Pales	kg	Month of harvest	Pales	kg	Month of harvest	Pales	kg	
1.																
2.																
3.																

8.5.6 Does the price that you receive for the same weight of small and large fish differ when you sell your fish?

Yes	No	Don't know

8.5.7 If yes, for which do you receive a higher price?

Large	Small

8.5.8 If you partially harvest fish from the pond/s for home consumption, how often do you catch fish in this way for each month of the last year?

Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May

For each month indicate whether partial harvesting takes place on a daily, weekly, monthly or irregular basis, or not at all. D = Daily, W = weekly, M = monthly, I = irregularly. No fishing = N

8.5.9 How many fish do you catch at any one time when you partial harvest for home consumption?

…….

8.5.10 What is the average size of the fish caught when you partial harvest for home consumption? (enumerator to obtain measure in hands and record in cm)

…….

8.6 DECIDING WHEN TO HARVEST

8.6.1 On what basis do you decide when to harvest your fish? (Indicate yes or no against reasons in table below)

8.6.2 Rank these reasons. The most important reason for deciding to harvest is ranked as number 1, the second most common reason is ranked number 2, etc.

Basis of decision	**Y/N** 8.6.1	**Rank** 8.6.2
1. The need for protein for the household		
2. The lack of availability of lake fish		
3. The absence of other sources of food (protein or other)		
4. The need for money		
5. The need for fish for a social occasion (celebrations)		
6. The period when you can get the largest number and size of fish		
7. The period of greatest demand for fish (by neighbours and potential buyers) due to cash availability		
8. Awareness of impending threats to the fish stocks (floods, water shortages, predators, fish feed shortages, etc)		
9. Other		

8.7 USE OF FISH HARVEST

8.7.1 If you harvest fish using a net or by draining the pond, what proportion of the harvest is usually used for the following purposes:

Use of harvest	**Proportion Used (%)**
1. Household food consumption	
2. Distribution to family and friends	
3. Sale to other villagers at pond	
4. Sale to market	
5. Other	

8.8 FISH FEEDING ACTIVITIES DURING THE LAST YEAR

8.8.1 Indicate the relative amount of each food source fed to fish in each month. Rank the supply of each feed source for each month from 0–2. (2 being the largest quantity of feed)

Food Source	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1. Manure (type)…….												
2. Compost												
3. Maize bran												
4. Rice bran												
5. Cassava												
6. Soya												
7. Leaves/ Grass												
8. Vegetable matter												
9. Other:												
10. Period(s) when farmer thinks fish are most well fed												

Manure types: Goat = 1; chicken = 2; cow = 3; pig = 4; rabbit = 5; other = 6

8.9 PERCEPTIONS OF FISH FARMING ACTIVITIES

8.9.1 Are you satisfied with your current fish production?

Yes	No

8.9.2 If no, why?

……

……

8.9.3 What specific issues do you think need to be addressed in order for you to be more successful at fish farming?

……

……

END OF QUESTIONNAIRE
THANK YOU VERY MUCH FOR YOUR TIME

NOTES

Attachment 4

An Example of the planning tables developed prior to enumerators entering a new survey area

Area	Village	No. of farmers	Survey Day				Interviews	
			Day 1	Day 2	Day 3	Day 4	Fish farmers	Non-Fish farmers
Mphompha	Chiwondola	11	Sapstone, Weston & Timothy				9	3
	Uzumala	12		Sapstone, Weston & Timothy			9	3
	Usowoya	4			Sapstone		3	1
	Kanga	16			Weston & Timothy		6	2
	Chiwondola	11				Sapstone, Weston & Timothy	9	3
	Jintajembe	11				Jacky, Max & Dick	9	3
Total							45	15

Attachment 5

Post survey report back session with enumerators, DoF Headquarters, Lilongwe, 9 June 2003, 09h30 – 12h30

1. **General comments on questions in questionnaire**

   Question 5.1.2: It was noted that grazing was not always available for livestock and that in some cases, for example in some households in Mulanje, goats were fed in the Khola (Kraal)

It was also noted that ownership of grazing land did vary between area. For example in the North clans often owned quite large pieces of land and therefore needed limited use of communal grazing while in the South where land is more limited grazing was often on communal land.

Question 5.2: Comments on the recording of data on production from arable land included the following:

a. Kalongonda is a type of green bean
b. Nzama is a nut/bean that grows on the ground
c. The estimation of cassava production was generally inconsistent (flour versus tubers etc) and it is suggested that area under cassava is used to estimate production using Dept Agriculture production estimates (from Emmanuel)
d. The estimation of bananas, sugarcane and vegetables was also difficult to determine. In some cases the Kwacha value of the harvest was used. This needs to be converted back to kgs using the latest Dept Agriculture market price figures.
e. It was noted that the production of beans was unusually low in Mwanza last season due to heavy rains
f. Max used NS to mean unspecified in this question while Jackie used unspec.as an abbreviation

Question 5.3.6: In some cases the desire to expand fish pond size and number may have been related to perceived benefits that the farmer anticipated should he indicate a desire to expand

Question 6.4: The number of hoes recorded is probably related to the size of the family rather than a wealth indicator

Question 7.3: It was suggested that months of food availability could be devided into three period rather than monthly for the analysis as follows:

a. Feb-March (Harvest of Dimba crops)
b. April-August (Harvest of rainy season crops)
c. September to Jan (harvest of Dimba crops)

It was felt that food security was needs to include the ability to buy in food as certain times rather than only rely only on farm production. A household is food secure as long as they have the capacity (from on farm and off farm sources) to provide sufficient food for their needs throughout the year

Question 8.1.2.2 It was noted that Max sometimes used the space under 8.1.3 to fill in the answer for 8.1.2.2 if he did not have enough space. Need to check up on this in the data entry.

Question 8.4.4: It was suggested that farmers often indicated that Chambo was their preferred species of fingerling not from their own experience in their ponds, but because they believed that the species would grow large like the Chambo seen in the market derived from the lake

2. General impressions of aquaculture in Malawi

a. It was felt that many farmers had been convinced by extension or project staff to get into aquaculture rather than initiating this on their own based on seeing successful examples of fish farming in their area
b. Social effects such as divorce leads to discontinuation of fish farming activities in some cases.
c. In general it was felt that the Southern Region had adopted fish farming most successfully
d. It was also noted that farmers in those areas nearer field stations seemed to be more successful at fish farming
e. Generally it was felt that fish farming was not an activity that is suitable for the poorest of the poor due to the fact that inputs are severely limited.
f. Generally it was noted that fresh fish rather than processed fish is the preferred choice for consumption if the household could afford it.
g. It was suggested that fish farmers would often give fresh fish to friends and family to increase their status rather than selling for cash. This obviously has a hidden value as improved status would lead to favours in return which might be more important than cash in hand at the village level.
h. It was noted that in some areas farmer to farmer extension has worked well as compared to the normal government extension service

3. Impressions of what constitutes a model farmer

a. Agricultural integration is necessary to provide sufficient pond inputs.
b. The production of fingerlings for yourself was considered to be key factor determining success
c. Successful fish farmers are often able to read and write
d. Successful fish farmers often supply fingerlings to others
e. Polyculture systems where a number of fish species are grown together in the same pond was thought to be important to success
f. It was felt that more than one pond was necessary to ensure success
g. Greater diversity of fish species used in separate ponds is a character of successful fish farm
h. Succesful fish farmers carry out small-scale research on their farm on their own
i. Prior training in aquaculture is usually required to ensure success
j. Successful fish farmers often provide farmer to farmer extension services

4. Farmers surveyed who were identified as more innovative than others (more successful)

a. Mr Nikoloma – Thyolo
b. Mr Twaibu - Zomba

c. Village Headman Binali – Zomba
d. Mr Luwemba – Zomba
e. Mr Baula – Mulanje
f. Mr Moyenda – Mwanza
g. Mr Mkhutumula – Mwanza
h. Mr Zembere – Mchinji
i. MR Mavumbanya – Livingstonia

5. Constraints to aquaculture development

a. Species used are not ideally suited to the farming area in some cases
b. Inadequate extension staff in terms of numbers and ability
c. Predation of fish
d. Fish farming has in the past been dependent of project or technical support rather than being an easy technology to adopt on ones own
e. Extension has not targeted the correct category of farmer in the pst leading to a high level of dropouts
f. Pond construction is normally not a problem but subsequent requirements such as fingerling purchase, nets and other inputs are constraints to the average farmer
g. There is a lack of examples of fish farming success in many local areas which would serve to encourage farmers to pursue fish farming seriously
h. O.shiranus does not perform very well and therefore discourages farmers
i. Fingerling shortage is a constraint to expansion
j. Some ponds are sited in unsuitable localities (flooding, drying)
k. Low literacy levels may be a constraint to development of fish farming
l. The content of extension support (messages) may not be appropriate
m. Theft of fish from ponds often discourages fish farmers

ADiM Working Paper 4

Socio-economic Survey on Fish Farmers' Club in Chingale, Zomba

Prepared by

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Socio-economic Survey on Fish Farmers' Club in Chingale, Zomba

Contents

Attachment

1. Introduction

1.1 Background

The socio-economic survey was carried out in both February 2004 and February 2005 within the framework of the Master Plan Study for Aquaculture Development in Malawi (ADiM). The ADiM Study Team implements the pilot project in order to verify the proposed development strategies of the Master Plan. The pilot project is comprised of two components. Of those two, one is targeting the farmers' clubs in Chingale area where we carried out the socio-economic survey as a part of the baseline survey as well as the evaluation survey for the pilot project. The socio-economic survey is complementary with the technical survey on aquaculture, also implemented by the Study Team at the same period.

The objectives of surveys were to understand the situation in Chingale area as well as to verify the feasibility of the pilot project for the National Aquaculture Strategic Plan (NASP).

The verification of the pilot project is discussed on the Working Paper 5. In this paper, we, therefore, look at the socio-economic situation of farmers who are members of the clubs in Chingale area. Donors and NGO are actively involved in Chingale area. We believe understanding the social-economic situation of farmers will provide us an overview of rural livelihood in Chingale area and be referred as a bench mark for the further study.

1.2 Target area

The socio-economic survey targeted an area where the World Vision Malawi (WVM) implements an agricultural development programme in the west part of the Zomba district, namely the Chingale ADP. Chingale ADP is further explained in Attachment 2. An area popularly known as Chingale is located in TA Malumbe some 18 km Northwest of the Municipal town of Zomba, Zomba district, between the Shire river and the Zomba mountain, bordered with Machinga District.

The population of TA Malumbe is 116,283 in 1998 and the percentage of the population whose level of daily consumption is below the poverty line in TA Malumbe is between 64.3 and 70% (Benson *et al.* 2002). Te poverty level of the people in TA Malumbe is considered to be about the national average which is 64.3%.

There are 12 Group Villages led by Group Village Headmen in TA Malumbe. WVM targets 4, namely Mbukwite, Fikira, Nkasara and Masaula which are the poorest among these 11[1].

[1] The area covered by 4 group village headmen were divided into 6 and managed by 6 group village headmen as of February, 2005.

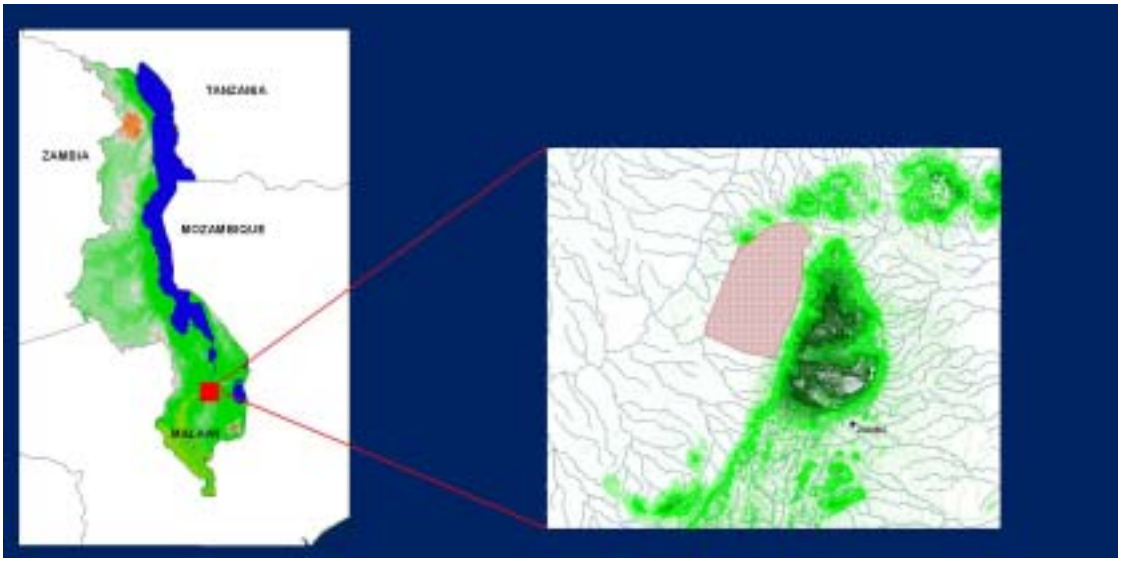


Figure 1.1 Location of Chingale ADP (L.Scott, 2004)

1.3 Target group

The baseline socio-economic survey targeted farmers in six farmers' clubs with individually owned collected fishponds in Chingale ADP. The evaluation socio-economic survey targeted farmers in two farmers' clubs, namely Mawila and Teuka farmers' clubs.

Names of the club and number of its members are listed in Table 1.1. Location of the Farmer Clubs (L.Scott, 2004) are shown in Figure 1.2.

Table 1.1 Names of farmers' clubs and number of club members interviewed

Name of Farmer Clubs	Number of member HH in each club (February, 2004)	Number of member HH in each club (February, 2005)
Mawila	35	37
Limbikani	33	32
Teuka	34 (39 individuals)	50 (55 individuals)
Mkamwalekani	14	14
Namilola	23	25
Fikira	15	20

Source: Socio-economic questionnaire for the baseline and evaluation surveys (2004 and 2005)

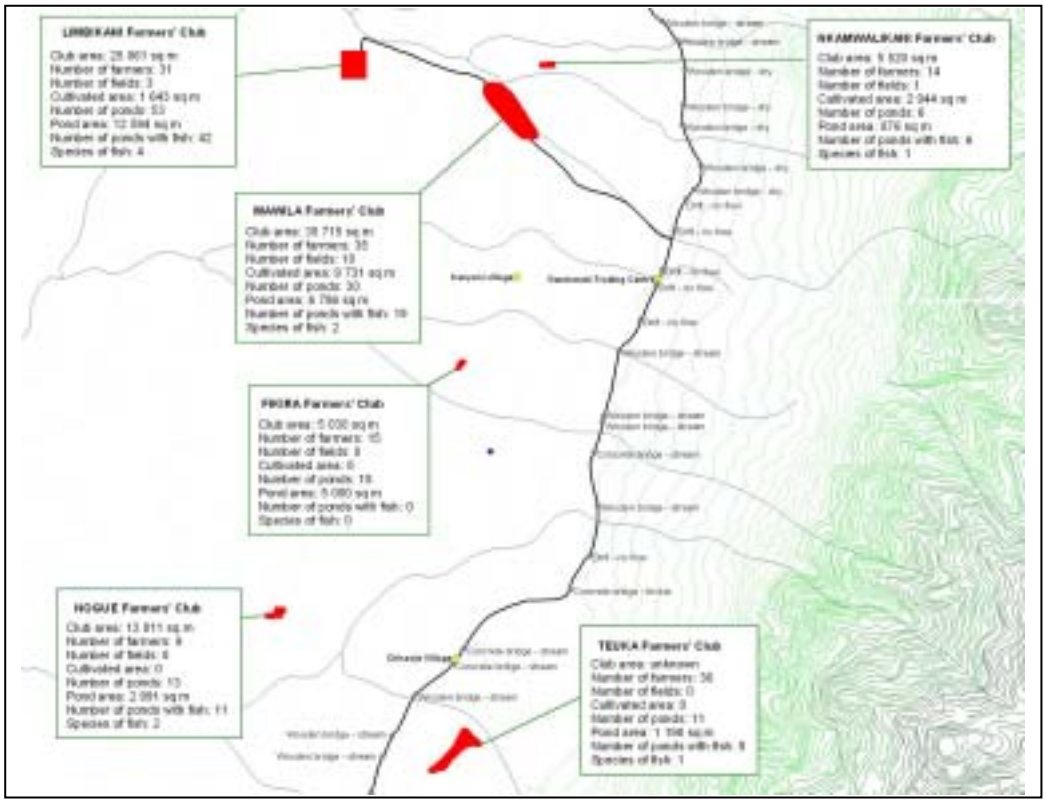


Figure 1.2 Location of farmers' clubs (L.Scott, 2004)

2. Methodologies

2.1 Methods

Methods of the baseline survey for socio-economic aspects are;

1. Socio-economic questionnaire (6 clubs, total of 121 questionnaires),
2. Group discussion in each club,
3. Key informant/ unstructured interview with chairperson and secretary, and
4. Discussion with WVM.

Apart from above methods used for the socio-economic survey, technical survey and geographical survey were implemented as a part of the baseline survey.

Methods of the evaluation survey for socio-economic aspects are;

1. Socio-economic questionnaire (2 clubs, total of 72 questionnaires),
2. Group discussion in each club,
3. Key informant/ unstructured interview with chairperson and secretary, and
4. Discussion with WVM.

Apart from above methods used for the socio-economic survey, technical survey was implemented as a part of the evaluation survey.

Each method is explained in the paragraphs below with further detail.

(1) Socio-economic Questionnaire

For the baseline survey, questions were asked to 121 household heads in 6 farmers' clubs using a

socio-economic questionnaire. Numbers of interviewees from each club are shown in Table 2.1. Questionnaire contained questions asking attributes, agriculture and aquaculture activities, income and expenditure, club activity, and food security. Interviews were carried out ADiM team members together with enumerators hired by WVM. The questionnaire is attached as Attachment 2. Aiming at understanding 'successful' clubs, majority members of both Mawila and Limbikani farmers' clubs were subjected to the interview. 80.0% of Mawila farmers' club members and 90.9% of Limbikani Farmer Clubs responded to the questionnaire. As a newly established farmers' club, Teuka farmers' club was selected and therefore 91.2% of its member was subjected to the interview.

For the evaluation survey, 72 household heads in two farmers' clubs were interviewed using the socio-economic questionnaire. Most of the questions in the questionnaire overlap with those asked in the baseline survey. Those questions which are obvious that no changes are observed The questionnaire is attached as Attachment 3. For the evaluation survey, two farmers' clubs, one 'successful' farmers' club and one newly established farmers' club were questioned.

Table 2.1 Number of HH interviewed and % interviewed from total club member in each club

Name of farmers' clubs	Baseline survey		Evaluation survey	
	Number of HH interviewed	% interviewed from total club member	Number of HH interviewed	% interviewed from total club member
Mawila	28	80.0%	31	83.8%
Limbikani	30	90.9%	-	
Teuka	31 (35 individuals)	91.2%	41	74.5%
Mkamwalekani	13	92.9%	-	
Namilola	11	47.8%	-	
Fikira	8	53.3%	-	
Total	121		72	

Source: Socio-economic questionnaire for the baseline and evaluation surveys (2004 and 2005)

(2) Group discussion in each club

The group discussion in six clubs were implemented for both baseline and evaluation surveys. In the group discussion, information on club's history and activities were discussed and the SWOT analysis was carried out.

(3) Key informant/ unstructured interview with chairperson and secretary

In order to understand overall nature of each club, a member of ADiM implemented an unstructured interview with a club chairperson and a secretary. The interview included questions on the foundation date, number of members, club land, and club regulations.

(4) Discussion with WVM

ADiM members held an informal discussion with WVM development facilitators and WVM project manager who is responsible for the Chingale ADP.

2.2 Limitation of the Survey

The time limitation was always present. There was slight difference in interpretation among enumerators. At the same time, there seemed to be an exaggeration or distortion of information given by farmers because of excessive expectations towards donors.

3. Results

The quantitative data used for the explanation of the socio-economic situation in Chingale area is basically based on the data obtained during the baseline survey. Data obtained during the evaluation survey and other statistical data from existing documents are used to supplement the explanation. The qualitative information is based on the discussion, key informant interview, and observation.

3.1 Background

Six farmers' clubs are located within a sphere of 30km^2 diameter. The difference in climate and topography is therefore insignificant. However, they do differ in foundation year, its members, club areas and etc. Characteristics of each club in February 2004 are shown in Table 3.1. The site maps of Mawila, Limbikani, Mkamwalekani, and Fikira are shown in Attachment 5, 6, 7, and 8 respectively as of February 2004.

Table 3.1 Characteristics of each club in February 2004

	Mawila	Limbikani	Teuka	Mkamwalekani	Namilola	Fikira
Year established	2001	2000	April 2003	2003	2003	2001
Number of member HH*	35	33	34 (39 individuals)	14	23	15
Average age of club members**	46.61	42.73	46.65	42.62	46.82	47.25
% of women in club**	14.3%	60.0%	42.9%	0.0%	18.2%	25.0%
Club area (m^2)***	35,715	25,061	unknown	5,520	13,811	5,030
Cultivated area (m^2)***	9,731	1,643	0	2,944	0	0
Pond area (m^2)***	6,786	12,594	1,198	876	2,991	5,000
No. of Fish ponds***	30	53	11	6	13	18

* Figures are based on the unstructured interview with chairperson and secretary (2004)

** Figures are generated based on the questionnaires answered (2004)

*** Figures are based on the survey carried out by Lucy Scott (2004)

Farmers' clubs in Chingale are formed in order to receive loans and other services provided by WVM under one of the schemes within Chingale ADP, aiming at agricultural business enhancement. All club members basically belong to the Chingale Small-holder association and club members pay MKw200 of annual fee to the association through the club. The structures of Chingale ADP and the Smallholder association are shown in Attachment 9 and 10.

Mawila and Limbikani farmers' clubs are founded in 2001 with support from WVM. Like the other clubs, they initiated as the clubs for receiving loans from WVM. Currently, however, they themselves actively engage in activities and established collective fishponds and club owned farm land for their future sustainability. Mawila farmers' club actively works on not only aquaculture but also agriculture on communal land. Limbikani used to focus more on fish farming. In 2004, 83.3% of its member possesses fishponds. However, Limbikani farmers' club has gained some extra land from their village headman and has been extended their activities into not only fish

farming but also various other farming practises.

Talking about aquaculture in Chingale area, the idea came from MAGFAD[2], a project funded by GTZ. However, after the project phased away, it was not possible for DoF extension staff to cover all area targeted under MAGFAD and fish farming in Chingale area was not too active.

When WVM carried out needs assessment for ADP, there was a suggestion from farmers for reactivating fish farming activities in Chingale area. Farmers independently restarted fish farming activities when the project manager wrote a proposal for a project to support fish farming under Chingale ADP.

The proposal was accepted by WV US and approximately US$ 353,390 was funded for 3 years from October 2001 to September 2004. Within the project, the Chingale Integrated Fish Farming Committee (CIFF) was established under Small-holders farmer association in 2001 aiming at further promotion of fish farming in Chingale ADP. Its major activities are to provide (1) loans on fingerlings/ fertiliser/ goats/ bananas; (2) trainings on basic aquaculture, feeding, record keeping, etc.; (3) study tour; (4) support in cements, pipes and minimum farming equipments; (5) technical advices, and (6) regulations and rules, etc.

Some of the members of Mawila and Limbikani farmers' clubs play an important role in CIFF together with Mr. Khaoreya, the development facilitator of WVM. The project itself has phased out, but the activities are still continuously implemented by Chingale ADP.

As of June 2004, 19 clubs are members of CIFF as listed in Table 3.2.

Table 3.2 Current members of CIFF (as of 20th June 2004)

	Club name	Member number	Pond number	Village headman
1	Mawila	37	32	Mtuluma
2	Limbikani	35	57	Mtuluma
3	Mkamwalekani	15	7	Mtuluma
4	Teuka	53	17	Nkasara
5	Namilola	67	26	Fikira
6	Fikira	16	18	Fikira
7	Nkeyani	12	12	Fikira
8	Tiyanjane	23	41	Fikira
9	Chisanje	10	18	Fikira
10	Takomana	33	35	Fikira
11	Chitsanzo	8	7	Nkasara
12	Titukuke	31	3	Mbukwite
13	Howe	5	6	Fikira
14	Jusu 1	2	5	Fikira
15	Kwikanga	6	7	Fikira
16	Nkasala	20	22	Nkasala
17	Kapungu	18	3	Nkasala
18	Nakatope	15	6	Nkasala
19	Nkawa	31	7	Mbukwite
TOTAL		437	329	

Source: Key informant interview with WVM (2005)

The farmers' clubs such as Teuka, Mkamwalekani, Namilola, and Fikira started fish farming in 2003. Fikira farmers' club started its club activities in 2001 with support from WVM whereas Teuka

[2] Malawi-German Fisheries and Aquaculture Development

Farmer Club just initiated its activities in 2003. Fish farming activities in each club are further discussed later in this paper.

3.2 Family member

Average family size among six clubs is 5.1. Teuka has the smallest family size among 6 clubs which is 4.6, whereas Mkamwalekani has the biggest of 5.7 (Table 3.3).

In Malawi, 75% of the population believes in Christianity (2003, CIA website). In Chingale ADP, since the major tribe in the area is Yao which majority believes in Islam, 69.3% of interviewees were Muslims. Among 6 clubs, Limbikani, Teuka and Namilola have the higher percentage of Muslims, which is above 80%.

Literacy level in Chingale ADP is 60.8% which is slightly below the national average of 62.7%.

Table 3.3 Average Family Size and Religion among six Farmer Clubs

	Average family size	Muslim	Percentage of Muslim (%)
Mawila	5.6	16	57.1%
Limbikani	5.1	25	89.3%
Teuka	4.6	26	86.7%
Mkamwalekani	5.7	5	38.5%
Namilola	4.8	9	81.8%
Fikira	5.0	5	62.5%
Total	5.1		69.3%

Source: Socio-economic questionnaire for the baseline survey (2004)

3.3 Agriculture

3.3.1 Nature of Land Tenure

Village headmen share land which belongs to the village, so-called customary land, with its villagers. When a new person moves into the village, the villager with shared customary land discusses with the village headman and provides a portion of land to the new comer. Therefore longer the villager stays in the village, he/she tend to share bigger and better land.

The average size of the customary land owned by interviewees is 2.24 hectare which is bigger than the average of in Malawi. However often interviewees are not aware of the size of land they share. Therefore the credibility of the figure is low.

Over 90% of interviewees possess both upland and lowland (98.1% and 94.5% respectively) and cultivate agricultural crops in both lands. 50% of farmers practises irrigation system one way or another in their lowland.

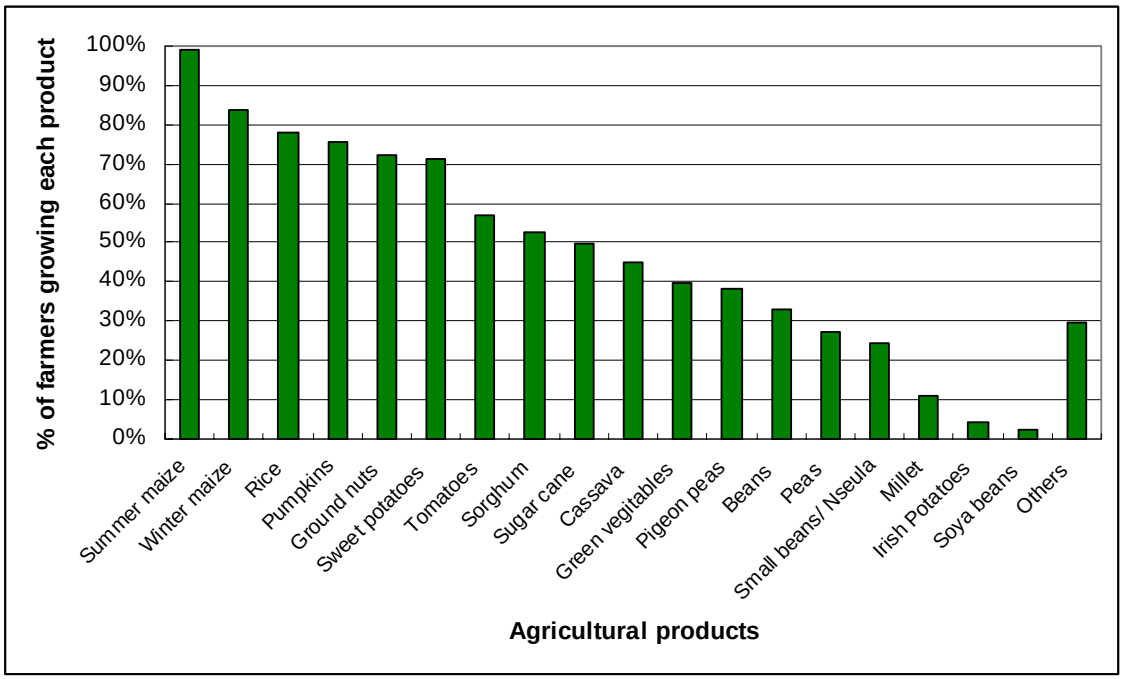
3.3.2 Agriculture Production

The major agricultural crop is summer maize which 99.2% of interviewees cultivates, followed by winter maize (83.9%), rice (78.0%), pumpkin (75.4%), groundnuts (72.0%), and sweet potatoes (71.2%) (Figure 3.1). Yet, 12.8% of interviewees answer they sell summer maize, 13.1% for winter maize. In other words, over 85% of interviewees does not sell maize but consume at home.

46.7% of interviewees, however, sell a part of their rice, 43.5% for groundnuts, and 53.6% for sweet potatoes. Those products sometimes are bartered with maize. WVM promotes groundnut cultivation through providing seeds on loan or organising its market.

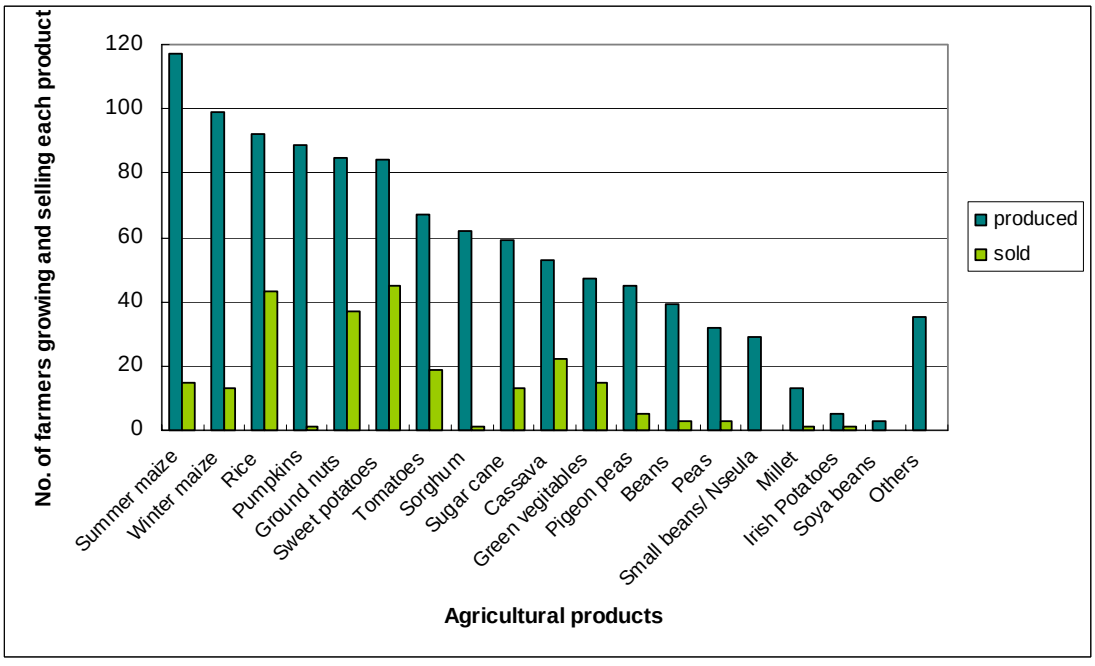
Pumpkins are commonly grown but not often sold (1.1% says they sell pumpkins). Farmers are

consuming pumpkin leaves for major relish for nshima.



Source: Socio-economic questionnaire for the baseline survey (2004)

Figure 3.1 Agricultural Products grown in Chingale Area



Source: Socio-economic questionnaire for the baseline survey (2004)

Figure 3.2 Agricultural Products grown and sold in Chingale Area

The total annual production of maize and rice for each club is shown in Table 3.4. The figures shown are the amount harvested during the harvest season. Many framers go into the field and pick

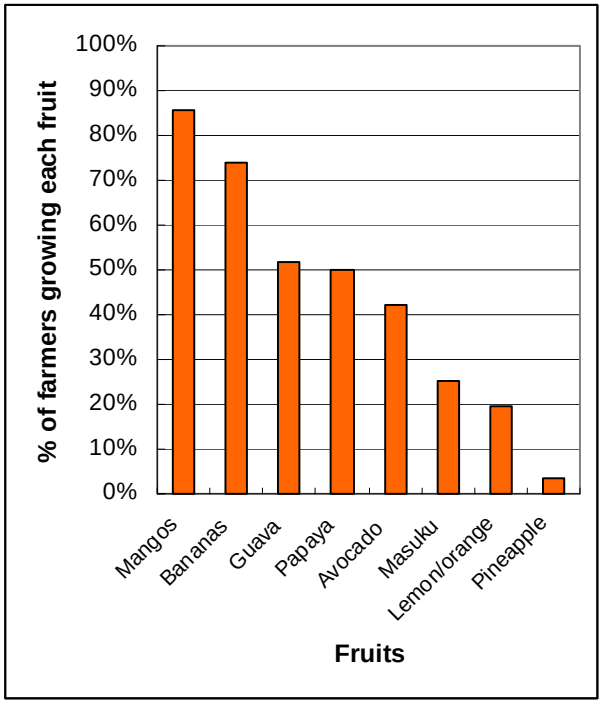
up some before the harvest season when they have shortage of food. Such amount is not reflected in the figures.

Table 3.4 Total Annual Production of Maize and Rice for an Individual (kg/year)

Name of Farmer Clubs	Maize	Rice
Mawila	593	370
Fikira	578	663
Namilola	489	176
Teuka	434	166
Mkamwalekani	350	283
Limbikani	330	291
Average	462	325

Source: Socio-economic questionnaire for the baseline survey (2004)

Many of interviewees possess fruits trees in their land. Major fruits trees are mango (85.6%), banana (73.7%), and guava (51.7%) (Figure 3.3). Farmers sell a portion of their fruit production, 15.8% for mango, 18.4% for banana and 28.0% for avocado. Through the quantity is small, the sales of fruits certainly contribute to the household income. However the condition is different from maize. Since fruits are seasonal and cannot be preserved for long, farmers fail to either consume all or find an appropriate market.



Source: Socio-economic questionnaire for the baseline survey (2004)

Figure 3.3 Fruits grown in Chingale ADP

The farmers cultivate average of 12.7 agricultural products including fruits. On the other hand, the average of 2.6 products are partly converted to cash. This shows the most of the agricultural products cultivated by farmers are consumed at home.

When clubs are compared, members of the Mawila farmers' club have the biggest number whereas

members of the Limbikani farmers' club have smallest number of agricultural products cultivated in their farm land (Table 3.5).

Table 3.5 Number of Agricultural Products grown and sold

Name of Farmer Clubs	No. of Agricultural Products grown	No. of Agricultural Product sold
Mawila	14.19	3.93
Limbikani	11.70	1.90
Teuka	12.10	1.57
Mkamwalekani	12.38	1.54
Namilola	12.27	3.00
Fikira	13.75	3.75
Average	12.73	2.61

Source: Socio-economic questionnaire for the baseline survey (2004)

3.3.3 Livestock

The most common livestock kept among interviewees is goats which scores 62.0%. Then chicken follows with a possession rate of 48.8%. WVM actively implements loans of goats and chickens (hybrid) to club members. Therefore livestock possession rate is high in Mawila and Limbikani where WVM has active intervention whereas the rate is low in Teuka farmers' club where WVM just started its intervention. The major reason for the law possession rate for chickens compared to goats is that there was a wide spread of New Castle disease which caused death of many chickens towards the end of 2003. The average number of goat and chickens per household are 2.1 and 8.4 respectively.

Table 3.6 Possession of Livestock of individuals in each Club

Name of Farmer Clubs	Goats	Sheep	Chickens	Rabbits	Pigeons	Others
Mawila	92.9%	0.0%	67.9%	10.7%	0.0%	0.0%
Limbikani	83.3%	0.0%	66.7%	0.0%	6.7%	0.0%
Teuka	25.8%	3.2%	19.4%	0.0%	9.7%	3.2%
Mkamwalekani	76.9%	0.0%	38.5%	0.0%	0.0%	15.4%
Namilola	18.2%	0.0%	63.6%	0.0%	27.3%	9.1%
Fikira	50.0%	0.0%	25.0%	0.0%	50.0%	12.5%
	62.0%	0.8%	48.8%	2.5%	9.9%	4.1%

Source: Socio-economic questionnaire for the baseline survey (2004)

3.3.4 Aquaculture

The possession rate of fishponds of each club is shown in Table 3.7.

83.3%[3] of Limbikani farmers' club members possess their own fishponds in February 2004. The number of fishponds is 45. All members except those who recently joined the club have ponds.

57.1% of members possesses fishponds in Mawila farmers' club. There are 30 fishponds in the

[3] Some has two or more ponds. Therefore, even though the number of ponds is bigger than the number of club members, there are still some members who do not possess any ponds.

club land including those without water in February 2004. They are planning to distribute at least a pond for each member in near future. During the pilot project, both clubs increased the numbers of ponds as shown in Table 3.7.

Table 3.7 Change in pond numbers for each club

Name of Farmers' Clubs	No. of ponds (Feb. 2004)	No. of ponds (Feb. 2005)
Mawila*	30	33 (4 new ponds, 2 were merged)
Limbikani	45 were mapped (53 were reported)	51 were mapped (6 are new)
Teuka**	11	22 (11 newly constructed, 11 owned by farmers when joined)
Mkamwalekani	6	9 (2 still need to be filled with water)
Namilola	13	N/A
Fikira	18	20 (1 is under construction)

Source: Socio-economic questionnaire for the baseline and evaluation surveys (2004 and 2005)

In Limbikani farmers' club, amongst those who possess fishponds, 80.0% obtained some cash from fish farming between February 2003 and February 2004. Whereas in Mawila farmers' club, 58.3% obtained some cash from fish farming in the same period. Both Limbikani and Mawila farmers' club members are gaining more cash from sales of fingerlings compared to table sized fish (Table 3.11). Further information on income from fish farming is provided in "3.5 Income."

Teuka, Mkamwalekani, Namilola, and Fikira farmers' clubs started introducing fish farming towards the end of 2003. Therefore there was not income from fish farming when the baseline survey was implemented. Amongst those four, Teuka is the last club started introducing fish farming into their club. They initiated digging the pond, and managed to increase the pond number from 11 to 22 (Table 3.7). In Fikira farmers' club, due to the severe seepage, the most of the ponds were not able to hold water in February, 2004. CIFF, then, actively has supported the club and they managed to renovate their ponds.

Table 3.8 Possession of Fishponds in each Club

Name of Farmer Clubs	No. of member who possess pond	No. of member who has no pond	% of member possessing pond	% of pond owners earning profit
Mawila*	13	11	54.2%	69.2%
Limbikani	25	5	83.3%	80.0%
Teuka**	9	20	31.0%	0.0%
Mkamwalekani	9	4	69.2%	0.0%
Namilola	11	0	100.0%	0.0%
Fikira	7	0	100.0%	0.0%

Source: Socio-economic questionnaire for the baseline survey (2004)
*Because of data reliability, we selected 24 interviewees from 28 total interviewed
** Because of data reliability, we selected 29 interviewees from 31 total interviewed

3.4 Households assets

For radio, bicycle, and iron sheets, Mawila farmers' club has relatively higher possession rate than other clubs (Table 3.9). Hoes are generally possessed in high percentage in any clubs.

Table 3.9 Household assets possessed by members of each club

Name of Farmer Clubs	Radio	Bicycle	Iron sheet	Hoes	Glass window	Dining table
Mawila	89.3%	53.6%	3.6%	100.0%	14.3%	17.9%
Limbikani	63.3%	46.7%	3.3%	96.7%	23.3%	20.0%
Teuka	32.3%	41.9%	3.2%	100.0%	6.5%	29.0%
Mkamwalekani	69.2%	46.2%	0.0%	100.0%	15.4%	7.7%
Namilola	72.7%	45.5%	0.0%	100.0%	9.1%	0.0%
Fikira	75.0%	37.5%	0.0%	100.0%	12.5%	37.5%
	63.6%	46.3%	2.5%	99.2%	14.0%	19.8%

Source: Socio-economic questionnaire for the baseline survey (2004)

3.5 Income

3.5.1 Cash Income in General

Among six farmer clubs, Mawila has the highest cash income. Mawila and Limbikani farmers' clubs scored over MKw 10,000 annual cash income in February, 2004 (Table 3.10). Then Fikira farmers' club follows with MKw 9,846. It is important to note that the reliability of the figure is not high. Farmers had trouble remembering incomes past 12 months, and were sometimes reluctant to tell the truth. At the same time, many farmers barter a lot of their agricultural products with other farmers. We need to be aware that the figure does not cooperate prices for products which farmers bartered. Yet, having the same conditions among all six clubs, it is worth noting that Mawila and Limbikani have higher cash income.

There is positive correlation between total income and income from agriculture production (Correlation coefficient: 0.97) and other income including carpenter, teaching, and etc. (Correlation coefficient: 0.69) (Figure 3.4 and Figure 3.5).

On the other hand, there is negative correlation between total income and income from piecework, known as 'ganyu' in local language (Correlation coefficient: -0.52) (Figure 3.6). In another words, farmers with little source of income tend to depend their income on ganyu.

Table 3.10 Total Income and Income from Different Activities

Name of Farmer Clubs	Income	Income from agriculture	% of income from agriculture	Income from ganyu	% of income from ganyu	Rent or other income	% of income from others
Teuka**	3,674	1,413	38.5%	1,188	32.3%	1,073	29.2%
Mkamwalekani	4,490	2,520	56.1%	1,469	32.7%	502	11.2%
Namilola	7,732	5,654	73.1%	960	12.4%	1,118	14.5%
Fikira	9,846	6,473	65.7%	690	7.0%	2,683	27.2%
Limbikani	12,269	7,422	60.5%	1,379	11.2%	3,468	28.3%
Mawila*	14,743	12,285	83.3%	677	4.6%	1,781	12.1%
Average	8,793						

Source: Socio-economic questionnaire for the baseline survey (2004)
*Because of data reliability, we selected 24 interviewees from 28 total interviewed
** Because of data reliability, we selected 29 interviewees from 31 total interviewed

Figure 3.4 Relation between Total income and income from Agriculture Production
(Correlation coefficient: 0.97)

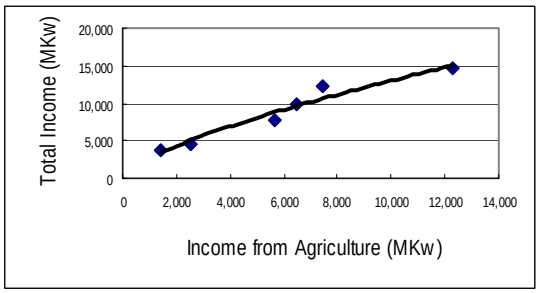


Figure 3.5 Relation between Total income and income from Ganyu
(Correlation coefficient: -0.52)

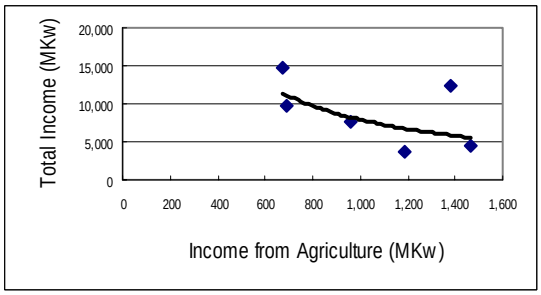
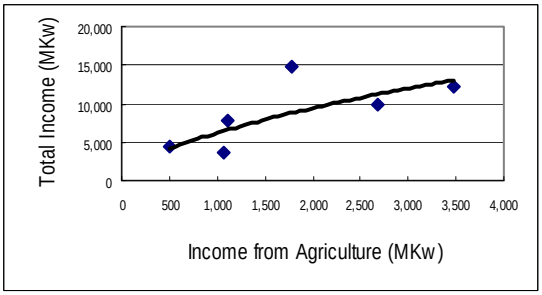


Figure 3.6 Relation between Total income and income from Others
(Correlation coefficient: 0.69)



3.5.2 Income from Aquaculture

Members both from Mawila and Limbikani farmers' clubs who have cash income from fish farming have higher total annual cash income compared to the average annual cash income of members from those two clubs (Table 3.11). The average cash income from fish farming between February 2003 and February 2004 was MKw1,688 which is 9.4% of total cash income. More farmers are engaged in selling fingerlings. The average income from selling fingerlings is MKw1,507 whereas income from sales of table fish is MKw908. The activities of WVM have promoted fish farming in Chingale ADP which induced high demand on fingerlings within the area. At the same time, WVM introduces markets for fingerlings in other area.

Table 3.11 Income from Fish Farming

Name of Farmer Clubs	Income average	People made profit from fish farming	Income average for those who had income from fish farming	Average income from fish farming	Income from table fish		Income from fingerlings	
					%	Average income from table fish	%	Average income from fingerlings
Mawila	*14,743	37.5%	19,677	1,736	11.1%	580	100.0%	1,671
Limbikani	12,269	66.7%	16,253	1,640	35.0%	1,236	90.0%	1,342
Average	13,506		17,965	1,688		908		1,507

Source: Socio-economic questionnaire for the baseline survey (2004)
*Because of data reliability, we selected 24 interviewees from 28 total interviewed

3.5.3 Overall economical transaction

In 3.5.1, we discussed about the farmers' income restricted to their cash transaction. However, in order to understand their overall economical transaction, we need to know how much agricultural products they consume from their own yard and translate such volume into the monetary value.

3.5.4 Farmers' perception towards their income status

Mawila, Limbikani, Namilola, and Fikira farmers' club members are considering their income status of last 12 months is better than that of the previous year in the baseline survey. For Mkamwalekani farmers' club, those who said "less" and those who said "more" came to the equal number. Whereas there were more members of Teuka farmers' club who said they had less income last pear compared to the previous year. However, there are more members of Teuka farmers' club who considered their income has increased (32%) than those who think their income has decreased (26%) in the evaluation survey.

Table 3.12 Comparison of the Income Status from Last 12 months

Name of Farmer Clubs	Less	Same	More	Greatly improved
Mawila	33.3%	7.4%	55.6%	3.7%
Limbikani	10.0%	23.3%	60.0%	6.7%
Teuka	38.7%	35.5%	25.8%	0.0%
Mkamwalekani	38.5%	23.1%	38.5%	0.0%
Namilola	36.4%	0.0%	63.6%	0.0%
Fikira	37.5%	0.0%	50.0%	12.5%
	30.0%	19.2%	47.5%	3.3%

Source: Socio-economic questionnaire for the baseline survey (2004)

3.6 Expenditure

Farmers are spending the highest percentage of expenditure for seeds when agriculture related expenditure is concerned (43.3%) (Table 3.13). Then it is followed by fertilizer (39.3%). A bag of 50kg fertilizer cost about MKw1,500 in general when the baseline survey was implemented. However, the price goes up every year which makes farmers difficult to access to enough fertilizer if not any. In February 2005, the approximate price of a bag of fertiliser was MKw2,500. WVM give out loans for fertilizer. Yet there are farmers who cannot pay the deposit and therefore not be able to access to the loan. Some farmers get fertilisers from the starter packs they receive from the Government and the Blantyre synod.

Table 3.13 Expenditure on Agriculture Related

	Mawila*	Limbikani	Teuka**	Mkamwalekani	Namilola	Fikira	Average %	Average Expenditure
Seeds	41.7%	36.7%	51.7%	50.0%	54.5%	25.0%	43.3%	451
Fertilizer	79.2%	33.3%	37.9%	33.3%	27.3%	25.0%	39.3%	1,750
Pesticides	45.8%	6.7%	10.3%	8.3%	0.0%	12.5%	13.9%	253
Transport	8.3%	6.7%	0.0%	0.0%	0.0%	12.5%	4.6%	522
Labour	25.0%	30.0%	3.4%	8.3%	18.2%	12.5%	16.2%	1,460
Food for livestock	20.8%	6.7%	3.4%	0.0%	0.0%	0.0%	5.2%	379
Other	8.3%	46.7%	0.0%	25.0%	18.2%	0.0%	16.4%	824
Average								1,465

Source: Socio-economic questionnaire for the baseline survey (2004)
*Because of data reliability, we selected 24 interviewees from 28 total interviewed
** Because of data reliability, we selected 29 interviewees from 31 total interviewed

For the general expenditure, % of members ever purchased listed items past 12 months are shown in Table 3.14. Over 85% of farmers are purchasing soap, lotion, salt, and kerosene. On the other hand, over 85% of farmers are not purchasing cooking oil, sugar and fire wood. Farmers buy cooking oil and sugar when they have extra cash income. Most of farmers collect their own fire wood.

Table 3.14 Expenditure on Non-agriculture Related

	Mawila*	Limbikani	Teuka**	Mkamwalekani	Namilola	Fikira	Average %	Average Expenditure
Housing	33.3%	46.7%	55.2%	25.0%	45.5%	25.0%	38.4%	909
Daily goods	100.0%	93.3%	86.2%	91.7%	100.0%	100.0%	95.2%	1,958
Salt	100.0%	90.0%	96.6%	66.7%	81.8%	87.5%	87.1%	637
Oil	25.0%	36.7%	0.0%	8.3%	0.0%	25.0%	15.8%	237
Sugar	25.0%	20.0%	3.4%	16.7%	9.1%	12.5%	14.5%	276
Firewood/ Charcoal	0.0%	3.3%	0.0%	8.3%	0.0%	0.0%	1.9%	20
Kerosene	100.0%	96.7%	96.6%	100.0%	100.0%	100.0%	98.9%	836

Source: Socio-economic questionnaire for the baseline survey (2004)
*Because of data reliability, we selected 24 interviewees from 28 total interviewed
** Because of data reliability, we selected 29 interviewees from 31 total interviewed

3.7 Food security

The percentage of farmers who consider themselves food insecure exceed those who consider themselves food secure. The most food unsecured club was Teuka whereas the most food secured club was Namilola. Yet, it should be noted that farmers tend to explain themselves food insecure especially in front of donors as they expect to receive some assistance.

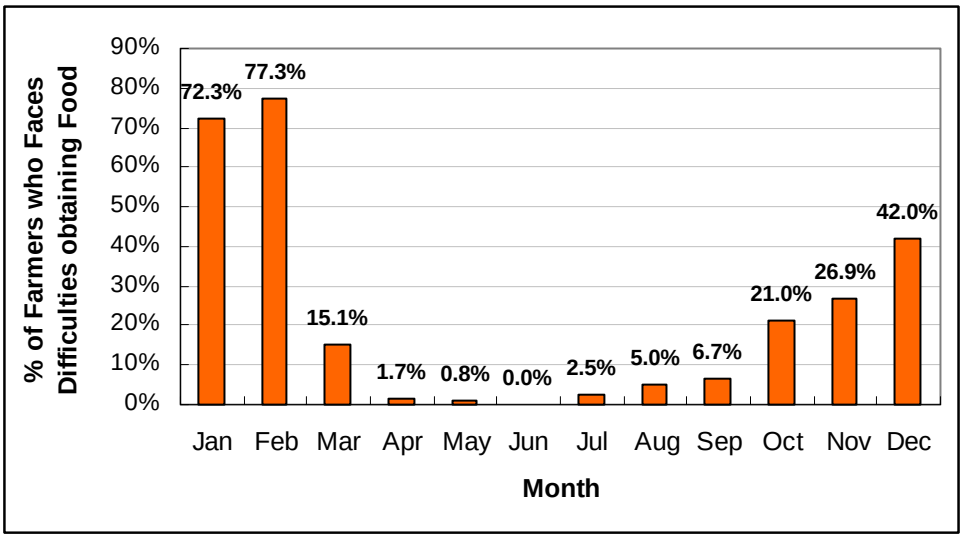
Table 3.15 Percentage of Food Security in each Club

Name of Farmer Clubs	Food Secure (%)	Food insecure (%)
Mawila	21.4%	78.6%
Limbikani	10.7%	89.3%
Teuka	3.2%	96.8%
Mkamwalekani	7.7%	92.3%
Namilola	27.3%	72.7%
Fikira	25.0%	75.0%
Average	14.8%	85.2%

Source: Socio-economic questionnaire for the baseline survey (2004)

Serious food shortage occurs in January (72.3%) and February (77.3%). Farmers plant maize, their staple food, in November to December when the rainy season starts. Yet, often they fail to retain their maize stock from the previous year to the new harvest in March of the following year.

The half of interviewees (50%) did not have any maize stock when the interview was carried out in February.



Source: Socio-economic questionnaire for the baseline survey (2004)

Figure 3.7 Percentage of Farmers who face Difficulties obtaining Food in each Month

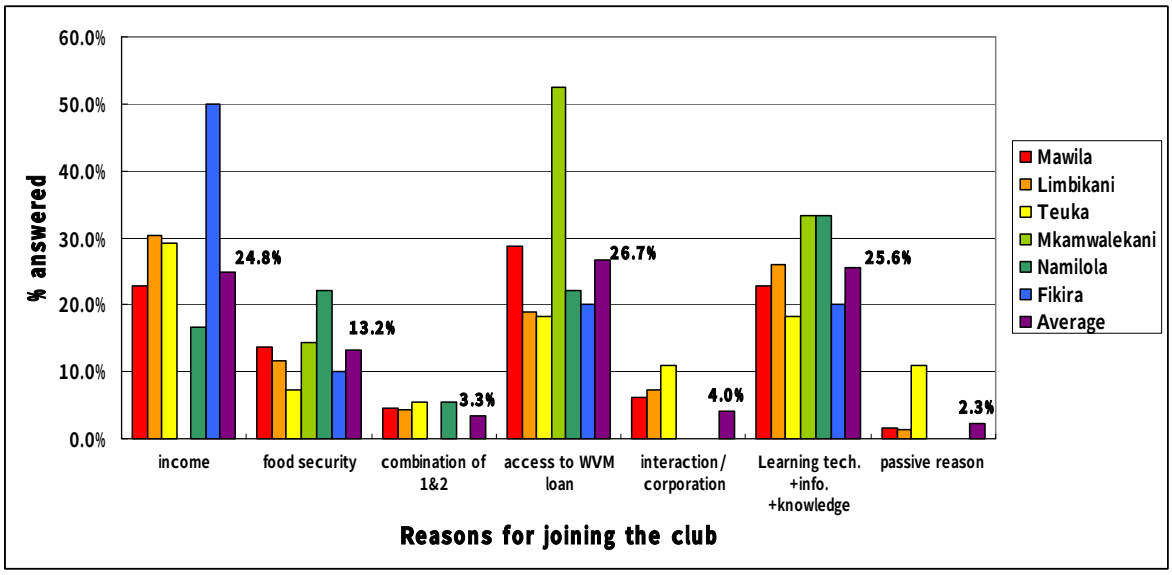
3.8 As a club member

The initial objective of the establishment of many farmer clubs in Chingale ADP is to access loans from WVM which is clearly reflected in the answers of the question asking the reasons for joining the club. Farmers also reasons income generation (24.8%) and knowledge gaining (25.6%) for joining the club.

Table 3.16 Reasons for Joining the Club

Name of Farmer Clubs	income	food security	combination of 1&2	access to WVM loan	interaction/ corporation	Learning tech. + info. + knowledge	passive reason
Mawila	22.7%	13.6%	4.5%	28.8%	6.1%	22.7%	1.5%
Limbikani	30.4%	11.6%	4.3%	18.8%	7.2%	26.1%	1.4%
Teuka	29.1%	7.3%	5.5%	18.2%	10.9%	18.2%	10.9%
Mkamwalekani	0.0%	14.3%	0.0%	52.4%	0.0%	33.3%	0.0%
Namilola	16.7%	22.2%	5.6%	22.2%	0.0%	33.3%	0.0%
Fikira	50.0%	10.0%	0.0%	20.0%	0.0%	20.0%	0.0%
Average	24.8%	13.2%	3.3%	26.7%	4.0%	25.6%	2.3%

Source: Socio-economic questionnaire for the baseline survey (2004)
* Multi-answers were welcomed



Source: Socio-economic questionnaire for the baseline survey (2004)

Figure 3.9 Reasons for Joining the Club

3.9 Support

Apart from the support WVM provides, the Government and the Blantyre synod supply starter packs. 80% of interviewees answered that they have received at least one starter pack from either the government or the church organisation in the baseline survey. Though it differs from an organisation to the organisation, the starter pack normally contains a bag of 25kg of fertiliser and a bag of 5kg of seeds (maize, beans or some other kinds). For the evaluation survey, there were some farmers who have received food under the 'Food-for-Work' project supported by the World Food Programme partnering with local NGO.

4. Discussion

When six farmers' clubs are compared, a club with higher interaction with WVM tends to generate higher income. This represents that WVM plays an important role in the development of farmers' livelihood in Chingale ADP. On the other hand, clubs in Chingale are still groups for receiving supports and have not yet grown into self-developing entities.

WVM is planning to phase out in 2011. WVM should carefully plan their activities in order to promote those clubs to be self sustainable.

For individual farmers, we have observed that having several sources of income can reduce the risk and lead to an increase of income. Having a variety of agricultural products or/and having extra business will provide an opportunity for further income generation. Aquaculture can also be another source of income for farmers in Chingale ADP. Some more findings are listed below under the categories of agriculture, aquaculture, collaboration between NGO and DoF, and capacity building.

4.1 Agriculture

Though the number of agricultural products is not small, the number of products sold is limited. Some products are consumed at home, yet some are simply not sold because of market accessibility. Introduction of simple technologies for processing agricultural products (e.g. dried mangoes) can preserve and add value to some of products left rotten at village. Transporting products with club members enables farmers to provide products to consumers in demand with some quantity.

4.2 Aquaculture

The bigger cash income is coming from sales of fingerlings. Since WVM and donors are actively supporting fish farming in Chingale ADP, there is high demand on fingerlings within the area and they act as the middlemen. WVM also supports farmers to purchase fingerlings on loan basis. Therefore this demand is considered to be temporal and farmers themselves need to find markets and ways to access to the markets in future.

Fish farming can certainly generate extra income for farmers. Yet, as of today, the farmers in Chingale ADP are more or less satisfied with having ponds but not having fish. In other words, not many farmers are aware of conditions and numbers of fish they have in their fish ponds –'blind saving'. How to improve the quality of what is inside the ponds is the next step to be taken by the farmers' clubs in Chingale area.

4.3 Collaboration between NGO and DoF

There has been a clear demarcation between the extension area of DoF extension staff and an area where WVM implements activities. However in order to Chingale farmers' clubs to develop appropriate fish farming and its integration with other agricultural activities for sustainable future, further involvement of DoF extension staff in WVM's activities is critical. DoF extension staff can provide fish farming technology whereas WVM development facilitators can provide agricultural support which to be integrated with fish farming. WVM can also support DoF extension staff financially when their service meets their project objective. Active involvement of government staff into the project can also be one of the exit strategies for WVM.

4.4 Capacity Building

Dependency is a big issue in Chingale farmers. Some farmers say that they do not have to work too hard to buy fertilizers because they are sure that they will at least get starter packs which keeps them survive. WVM as well as donors should be aware of this situation and activities should always aim to develop their ownership and independency.

5. Conclusion

The continuous monitoring of farmers and various actors involved in Chingale area can provide us a good example of rural development.

Attachment

Attachment 1

References

Mwendo-Phiri *et. al* (2003) Chingale Integrated Fish Farming Project (MWI-31-175989) FY2003 Fourth Quarter Progress Report, October 2003

Todd Benson *et. al* (2002) Malawi: An Atlas of Social Statistics, National Statistical Office Government of Malawi, Zomba, Malawi/ International Food Policy Research Institute, Washington D.C. USA

WVM (1996) Chingale Area Development Programme Baseline Survey Report 1996

Attachment 2

Description on Chingale ADP

(by Mr. Mwendo, the Project Manager of Chingale ADP)

Chingale Area Development Program (ADP) by WVM

Chingale ADP proposes a road map for development of coming 14 years in Chingale area. The program encompasses various sectors which need support. In order to achieve its goal, the program also incorporates numbers of projects to supplement the program.

Funded by: WV USA

Budget: Approximately US$ 382,000/ year

Duration: First phase for 5 years, October, 1997 to September, 2002

Second phase for 9 years, October, 2002 to September, 2011

The baseline survey was implemented in 1996 and Chingale ADP initiated in 1997.

Target area: An area covered by 4 village head men, namely Fikira, Nkasala, Mbukwite, Masaula. Since Fikira and Masaula split into two group villages, since FY05 ADP literally covers an area covered by 6 village head men. Yet, the geographical size of the area has not changed.

There are 165 villages under above mentioned 6 group village head men.

Target people: 30,000 in 1996, latest census from 2003 shows number has expanded to 57,000.

Staff: There are 24 staff involved in activities in Chingale ADP

Project Manager:	Mr. E. Mwendo-Phiri
Accountant:	Mr. K. Kafotokoza
17 Field Staff:	5 agriculture development facilitators
	12 customer service assistants
Secretary	
Office assistant	
3 Security guides	
1 Driver	

Under ADP, 8-10 projects have been implemented. Some of them are listed in the table below.

Name	Sponsor	Budget	Duration
Chingale Integrated Fish Farming	WV US	US$ 353,390	2001 - 2004
Chingale Seed Project	AusAID	US$ 320,000	1998 - 2001
Chingale Irrigation Project	WV US	US$ 100,000	1999 - 2000
Chingale Bucket and Drip Irrigation	WV US	US$ 216,000	2003 - 2004
CBO (targeting four villages)		MKw 650,000	2004 – 2007
Rain water harvest	MEET	US$ 38,900	2004 - 15 month
Youth development project	WV US	US$ 30,000	2004 - 2007

Attachment 3

Socio-economic questionnaire for the baseline survey

ADiM Baseline Questionnaire Survey for Chingale, Malawi

1. QUESTIONNAIRE NUMBER _____

2. DETAILS OF ENUMERATOR

2.1 Name: _____

2.2 Date of interview: _____

2.3 Time of interview: Start _____ Finish _____

3. DETAILS OF RESPONDENT – HEAD OF HOUSEHOLD

3.1 Name: _____

3.2 Gender: _____

3.3 Age: _____

3.4 Marital status: _____

3.5 Religion: _____

3.6 Highest level of education (highest certificate or grade): _____

3.7 Literacy: Can you read and write?

Read	Write

3.8 Previous occupation: _____

3.9 Location (Village and T/A): _____

3.10 District: _____

3.11 Region: _____

3.12 Name of fish farming club: _____

3.13 Date when joined club: _____

3.14 Position in club: _____

4. LIST OF HOUSEHOLD MEMBERS

Name	Sex	Age	Occupation	Remarks
4.1 Household head				
4.2				
4.3				
4.4				
4.5				
4.6				
4.7				
4.8				

Filled in later by an enumerator

Category of household/s members	Male	Female
4.1 Number of children under the age of 15 years		
4.2 Number of elder persons (70+ years) in the household		
4.3 Number of adults (between ages of 15 and 70 years) who are largely unable to assist the household with its farming activities due to ill health or disability		
4.4 Number of able bodied adults (15-70 yrs) **present** in the household		
4.5 Number of adult members of the household who are **absent** and dependent on the household for support		

5. LAND AND LAND USE .....Tim's section 5

5.1 Indicate the size (hectares) and tenure system of land holding (excluding club land)

Tenure	Freehold	Leasehold	Customary
Size			

5.2 Size (Ha) of club land allocated to you?

	Ponds	Crops
Size		

5.3 What proportions of your land (non club land) is used for different purposes.

Land use	Percentage	Remarks
Dry land crops		
Dimba crops		
Fish ponds		
Other		
Unused • Dry • Dimba		

6. INNOVATIVE USE OF WATER RESOURCES

(e.g. irrigation, water storage or contingency plans for dry periods)

..... Tim's section 6

Record the type of irrigation system (if any) on the respondent's land (not club land) in existence and the manner in which water is directed to and around the farm. Also note if fish ponds (on the farm) assist crop production either through seepage, the use of pond sludge or through water storage.

7. CROP DIVERSITY ..... Tim's section 7

7.1 Tick off the crops grown over the last 12 months on your own farm and on club land

Crop	Own farm	Club land
Summer Maize		
Winter Maize		
Cassava		
Millet		
Sorghum		
Wheat		
Beans		
Soya beans		
Pigeon peas		
Ground-nuts		
Peas		
Pumpkins		
Pineapple		
Vegetables		
Tomatoes		
Tobacco		
Coffee		
Bananas		
Mangos		
Other fruits		
Cotton		
Irish potatoes		
Sweet potatoes		
Seed (type)		
Total		

7.2 What new crops have you introduced either on your own farm or club land over the last 12 months?

---

8. FERTILIZER AND MANURE.....Tim's section 8

8.1 Estimate the quantity of inorganic fertilizer purchased over the last 12 months and the proportions used for different purposes (eg. Maize, fish ponds)

Use	Quantity (estimate kgs)
Crops	
Fish ponds	

8.2 Estimate the quantity and type of manure used on the farm over the last year and the quantities used for different purposes. Indicate the proportion that was produced on the farm or purchased from elsewhere.

Manure type	Quantities used for different purposes		Quantity purchased
	Crops	Ponds	
Cattle			
Goats + sheep			
Pig			
Chicken & other birds			

8.3 Indicate the number of the different types of livestock the household has.

Livestock type	Number
Cattle	
Goats	
Sheep	
Donkeys	
Pigs	
Chickens (& other birds)	
Other:	

9. HOUSEHOLD ASSETS.....Tim's section 9

Does the household have the following assets: (tick those they have)

Radio/music player	Bicycle	Motor Vehicle	Tractor
Net for fish harvesting	Wheel-barrow (number?)	Iron sheets on house	Hoes (number?)
Oxcart	Plough	Glass in windows	Dining table

10. INCOME

10.1 How would you rate your income over the last year as compared to the year before?

Don't Know	less	same	more	Greatly improved

10.2 Indicate in the table below the sources of income obtained by the household over the last 12 months. Rank them from most to least important (10.2.1), and indicate the relative contribution of each to overall household income (10.2.2).

10.3 Indicate in the table below the period of the year in which each source of income was received or generated.

Source of household income	Tick if yes	Rank (10.2.1)	Contribution to total annual household income (%) (10.2.2)	Period during which this income is received (10.3)
Full-time formal employment				
Part-time formal employment				
Owner business (artisan, shop-keeper, taxi driver, etc)				
Casual/temporary off-farm employment				
Seasonal farm employment for money				
Pension or Welfare grant				
Remittances				
Sale of tobacco				
Sale of coffee				
Sale of fruit and vegetables				
Sale of food crops (Maize, cassava, beans, groundnuts, pumpkins, etc)				
Sale of cotton				
Sale of livestock				
Sale of milk and eggs				
Sale of hides and skins				
Sale of food fish				
Sale of fingerlings				
Rent				
Seed (type)				
Other				
Total			(100%)	

10.4 Actual income and expenditure on main agricultural production over last 12 months

10.4.1 Production and sales

Product	Quantity harvested	Quantity sold	Where sold or To whom	Value Sold (MK)
Summer maize				
Winter maize				
Cassava				
Groundnuts				
Rice				
Grains				
Beans and peas				
Green vegetables				
Tomatoes				
Fruit				
Irish potatoes				
Sweet potatoes				
Cotton				
Tobacco				
Soya beans				
Tea				
Coffee				
Table Fish				
Fingerlings				
Livestock				
Seed (type)				

10.5 Fish Sales

10.5.1 When did you sell your fish last time?

When (month)	Quantity	Amount (Kw)	At where	To whom
	Code	Code	Code	Code
			Pond side.....1 Village market.....2 Out of village.....3 Others.....4	Family member....1 Village people.....2 Trader.....3 Others.....4

10.5.2 How do you spend your last sales of fish?

10.5.3 Who decided to use the sales for above purpose?

10.6 Non-Farming Business (Sales of goods)

Did you operate any non farming business last 12 months?	Yes		No	

Example: Local beer, charcoal, bricks, mat, etc.

Type of business	Sales (Kw)	Input cost (Kw)	More information

10.7 Income from employment and rental income

10.7.1 Any income from employment or rent last 12 months?	Yes		No	

Name of household member	Type of income	Amount	Unit	Remarks

10.7.2 Does the household engage in Ganyu?

Yes	No

10.7.3 Indicate the periods of the year when Ganyu is engaged in.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

10.8 Income transfers

10.8.1 Did household receive any money or goods last 12 months?	Yes		No	

Item received	Amount	Unit	Remarks

10.8.2 Did household send any money or goods last 12 months?

Yes		No	

Item sent	Amount	Unit	Remarks

11. Household Expenditure

11.1 Rank the following expenditure items over the last twelve months, and indicate the proportion of income spent on the 5 most important items (this should not add up to 100% unless there are only 5 expenditure items):

Expenditure Items	Rank	Proportion of annual income spent (%)
Education (fees + uniforms, etc)		
Transport		
Maize, cassava or rice for household consumption		
Fish for hh consumption		
Other foods for hh consumption		
Building materials		
Clothing & blankets		
Furnishings and domestic utensils		
Farming inputs (eg. fertilizers and seeds)		
Luxuries (non-essential items)		
Labour		
Rent		
Medical		
Other		
Total		(100%)

11.2 Food Expenditure (last 7 days)

Item	**Quantity consumed**	**Unit**	**Value in retail price (Kw)**	**Source if it was purchased, how much you paid?**
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Sunday				

11.3 Expenditure on agricultural production

Item	**Expenditure (MK)**	**Remarks**
Seeds		
Fertilizer		
Pesticides		
Transport		
Labour		
Other		
Total		

11.4 Non-Food Expenditure

Item	Spent (Kw)	W	M	Y	Remarks
Housing cost					
Daily goods					Soap, Cream, razor, comb, hair wax
Salt, Oil, Sugar					
Firewood/Charcoal					
Kerosene					
Clothing					
Glassware & Tableware					
Furniture					
Medical & health					
Transport					
School fee & education					
Payment to services					
Others					

12. Saving and Credit

12.1 During last 12 months, did you borrow any money?

Lender	Check	More information	Code
1. Commercial bank			1
2. Moneylender (Katapila)			2
3. Trade man			3
4. NGO			4
5. Family member			5
6. Friend			6
7. Club member			7
8. Others			8

12.2 During last 12 months, has your personal cash saving increased?

Answer	Check	Code
1. No cash saving		0
2. Increased remarkable		1
3. Increased		2
4. Same		3
5. Decreased		4
6. Do not know		5

13. FOOD SECURITY

13.1 How many bags of shelled maize or other staple food did you produce after the last summer season?

Maize	Rice	Cassava

13.2 How many bags of staple food do you require for your household for the year?

Maize	Rice	Cassava

13.3 How many bags of staple food do you currently have in stock?

Maize	Rice	Cassava

13.4 Do you think that the quality of the diet of household members is better, the same, or worse in the last year as compared to previous years?

Don't know	Worse	Same	Better	Greatly improved

13.5 If there has been a change, describe this

13.6 Are there periods during the year when the household members have nothing or very little food to eat from on-farm production?

Yes	No

13.7 If Yes, indicate the months when food shortage is experienced, and

13.8 How many cooked meals are consumed per day in each month?

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Food shortage												
Meals/day												

Filled in later by an enumerator

13.9 Based on the discussions held with the farmer and observation of the household, enumerators are to provide a general opinion as to the level of food security that a household enjoys.

1. Food secure	2. Partially food secure	3. Food insecure

14. FARMER'S CLUB

14.1 About your club, indicate up to three things you **like the most**

1. _____
2. _____
3. _____

14.2 About your club, indicate up to three things you dislike

1. _____
2. _____
3. _____

14.3 What are you suggestions for improvement?

15. SUPPORT FROM OUTSIDE

15.1 What kind of support did you get last 12 months from the WV programme? (Cross check with WV information)

15.2 Did you have any other support

Resources	Description of support (when, period, contents, etc)
Starter Pack Programme (SPP)	
Agriculture Productivity Improvement Programme (APIP)	
Malawi Rural Finance Company (MRFC)	
Others	

16. Pond Activity Record

	Last day	Last week	Last month	Last 12 month
Feeding				
Manuring				
Grass cutting on the pond bank				
Pond/canal rehabilitation				
Stocking fingerlings				
Harvesting				
Others				

17. Utilization of Household resource

Show in %

Resource	Pond	chicken	Farm	Dump		Remarks (quantity, etc.)
Kitchen waste						
Animal manure						
Ash						
Madea						
Maize waste						

END OF QUESTIONNAIRE

Attachment 4

Socio-economic questionnaire for the evaluation survey

ADiM Evaluation Socio-economic Questionnaire for Chingale, Malawi

1. QUESTIONNAIRE NUMBER _____

2. DETAILS OF ENUMERATOR

2.1 Name: _____

2.2 Date of interview: _____

3. DETAILS OF RESPONDENT – HEAD OF HOUSEHOLD

3.1 Name: _____

3.2 Gender: _____

3.3 Age: _____

3.4 Marital status: _____

3.5 Religion: _____

3.6 Highest level of education (highest certificate or grade): _____

3.7 Literacy: Can you read and write?

Read	Write

3.8 Previous occupation[1]: _____

3.9 Location (Village and T/A): _____

3.10 District: _____

3.11 Region: _____

3.12 Name of fish farming club: _____

3.13 Date when joined club: _____

[1] Except farming

3.14 Position in club: _____

4. LIST OF HOUSEHOLD MEMBERS[2]

Name	Sex	Age	Occupation	Remarks
Household head 4.1				
4.2				
4.3				
4.4				
4.5				
4.6				
4.7				
4.8				

Category of household/s members	Male	Female
4.10 Number of children under the age of 15 years		
4.11 Number of elder persons (70+ years) in the household		
4.12 Number of adults (between ages of 15 and 70 years) who are largely unable to assist the household with its farming activities due to ill health or disability		
4.13 Number of able bodied adults (15-70 yrs) **present** in the household		
4.14 Number of adult members of the household who are **absent** and dependent on the household for support		
4.15 Number of orphans		

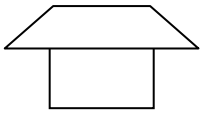
[2] List the names of household members whom the household head share the plate of food.

5. LAND AND LAND USE

5.1 Indicate the **size** (**hectares**[3]) and tenure system of land holding (excluding club land) and land actually being cultivated.

	Freehold	Rented land	Own land
Total land			
Cultivated land			

Draw a map



5.2 Do you have club land allocated to you? Yes ☐ No ☐

5.3 If you do, what is the **size** (**hectares**) of the club land?

Size

5.4 Number of ponds you possess

Number

5.5 Have you used ponds past 12 months? Yes ☐ No ☐

[3] Farmers may answer in acres. Enumerators need to check carefully the size of land and convert the size in to hectares. (1 hectare = 10,000m2 = 2.47 acres = 100 ares)

7. CROP DIVERSITY

7.1 Tick off the crops grown over the last 12 months on your own farm and on club land

Crop	Own farm
Summer Maize	
Winter Maize	
Rice	
Cassava	
Millet	
Sorghum	
Wheat	
Irish potatoes	
Sweet potatoes	
Beans	
Soya beans	
Pigeon peas	
Ground-nuts	
Peas	
Mseula(Small beans)	
Pumpkins	
Okura	
Green vegetables	
Cabbage	
Tomatoes	
Sugar cane	
Tobacco	
Coffee	
Cotton	
Seed (type)	
Pineapple	
Bananas	
Mangos	
Avocado	
Masuku(Sweet Apple)	
Guava	
Lemon	
Other fruits	
Total	

7.2 What new crops have you introduced on your own farm land over last 12 months?

8. FERTILIZER AND MANURE

8.1 Estimate the quantity of inorganic fertilizer (include the ones in starter pack) over the last 12 months and the proportions used for different purposes (e.g. Maize, fish ponds)

Use	Quantity (estimate kgs/year)
Crops	
Fish ponds	

8.2 Estimate the quantity and type of manure used on the farm and ponds over the last year and the quantities used for different purposes. Indicate the proportion that was produced on the farm or purchased from elsewhere.

Manure type	Quantities used for different purposes		Quantity purchased
	Crops (kg)	Ponds (kg)	
Cattle			
Goats + sheep			
Pig			
Chicken & other birds			
Compost			

8.3 Indicate the number of the different types of livestock the household has.

Livestock type	Number	How did you obtain? Purchased= 1 WVM's loan = 2 Given = 3 Others = 4 (specify)
Cattle		
Goats		
Sheep		
Donkeys		
Pigs		
Chickens (& other birds)		
Other:		

9. HOUSEHOLD ASSETS

Does the household have the following assets: (indicate numbers each household possesses)

Radio/music player	Bicycle	Mosquito net	Blanket
Net for fish harvesting	Wheel-barrow	Iron sheets on house	Hoes
Oxcart	Plough	Glass in windows	Dining table

10. INCOME

10.1 How would you rate your income over the last year as compared to the year before?

Don't Know	less	same	more	Greatly improved

10.2 Indicate in the table below the sources of income obtained by the household over the last 12 months. Rank them from most to least important, and indicate the relative contribution of each to overall household income.

Indicate in the table below the period of the year in which each source of income was received or generated.

Source of household income	Tick if yes	Rank	Contribution to total annual HH income (%)	Total income (MKw)	Period during which this income is received
1. Formal off-farm employment					
3. Owner business (artisan, shop-keeper, taxi driver, etc)					
4. Casual/temporary off-farm employment					
5. Seasonal farm employment for money (Ganyu)					
6. Pension or Welfare grant					
7. Remittances					
8. Rent					
9. Sales of farm product					
10. Other					
Total			(100%)		

10.4 If HH has income from on-farm activities, answer a question below.

10.4.1 Production and sales on main agricultural production over last 12 months

Product[4]	Quantity harvested (kg)[5]	Quantity sold (kg)	Where sold or To whom[6]	Value Sold (MKw)	Battered
Summer Maize (shelled)					
Winter Maize (shelled)					
Rice					
Cassava					
Millet					
Sorghum					
Wheat					
Irish potatoes					
Sweet potatoes					
Beans					
Soya beans					
Pigeon peas					
Ground-nuts					
Peas					
Mseula(Small beans)					
Pumpkins					
Okura					
Green vegetables					
Cabbage					
Tomatoes					
Sugar cane					
Tobacco					
Coffee					
Cotton					
Seed (type)					
Pineapple					
Bananas					
Mangos					
Avocado					
Masuku (Sweet Apple)					
Guava					
Lemon					
Other fruits					
Table fish					
Fingerlings (piece)					
Livestock (piece)					
Egg (piece)					
Money from club activities (Mkw)					
Others					

10.5 Fish sales

[4] Compare with 7.1

[5] One bag may weigh 30kg, 50kg, or 90kg. Needs to be addressed.

[6] CODE: By the house = 1; Local market = 2; Chingale turn off/ Chinseu/ Machinga/ Trading Center/ Malosa = 3; WVM = 4; Liwonde = 5; Business man = 6; Others = 7 (indicate)

10.5.1 Details of Fish Sales over last 12 months

When (month)	**Quantity** (fingerling in piece; table fish in kg)	**Amount (Kw)**	**At where** Pond side = 1 Village market = 2 Out of village = 3 Others = 4	**To whom** Family member =1 Village people = 2 Trader = 3 Others = 4

10.5.2 How did you spend the income from your sales of fish over the last 12 months?

10.7 Income from employment and rental income

10.7.2 Does the household engage in Ganyu?

Yes	No

10.7.3 Indicate the periods of the year when Ganyu is engaged in.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

10.8 Transfer of money or goods

10.8.1 Did household receive any money or goods last 12 months?

Yes		No	

Item received	**Amount** (calculate in MKw)	**Unit**	**Remarks (from whom)**

10.8.2 Did household send any money or goods last 12 months?

Yes		No	

Item sent	Amount (calculate in MKw)	Unit	Remarks (to whom)

11. Household Expenditure

11.3 Expenditure on farming inputs over last 12 months

Item	Expenditure (MK)	Remarks
Seeds		
Fertilizer		
Pesticides		
Transport		
Labour		
Feed for livestock		
Other		
Total		

11.1 Rank the following expenditure items over the last twelve months, and indicate the proportion of income spent on the 5 most important items (this should not add up to 100% unless there are only 5 expenditure items):

Item	Rank	Proportion of annual income spent (%)	Spent (MKw)	Week[7]	Month	Year
Farming inputs (from the previous Q)						✓
House maintenance (building materials)						
Daily goods (Soap, Cream, razor, comb, hair wax)						
Salt						
Oil						
Sugar						
Maize, cassava or rice for household consumption						
Fish for hh consumption						
Other foods for hh consumption						
Firewood/Charcoal						
Kerosene						
Clothing & blankets						
Shoes						
Glassware & Tableware						
Furniture						
Medical & health						
Transport						
Education (fees + uniforms, etc)						
Payment to services (church etc.)						
Funeral						
Tobacco, beer, etc.						
Rent						
Battery						
Matches						
Fee to the club						
Others						

[7] Tick one (e.g. if some one consumes 10Mkw of sugar per week, write down 10Mkw and tick under 'week')

12. Saving and Credit

12.1 During last 12 months, did you borrow any money?

Lender	Check	More information	Code
1. Commercial bank			1
2. Moneylender (Katapila)			2
3. Businessman			3
4. NGO			4
5. Family member			5
6. Friend			6
7. Club member			7
8. Others			8

12.2 During last 12 months, has your personal cash saving increased?

Answer	Check	Code
1. No cash saving		0
2. Increased remarkable		1
3. Increased		2
4. Same		3
5. Decreased		4
6. Do not know		5

12.3 How much do you wish to save a year?

13. FOOD SECURITY

13.2 How many bags of staple food do you require for your household for the year?

Maize (Kg)	**Rice** (Kg)	**Cassava** (Kg)

13.3 How many bags of staple food do you currently have in stock?

Maize (Kg)	**Rice** (Kg)	**Cassava** (Kg)

13.4 Do you think that the quality of the diet of household members is better, the same, or worse in the last year as compared to previous years?

Don't know	Worse	Same	Better	Greatly improved

13.5 If there has been a change, describe this

_____

13.6 Are there periods during the year when the household members have nothing or very little food to eat?

Yes	No

13.7 If Yes, indicate the months when food shortage is experienced, and

13.8 How many cooked meals are consumed per day in each month?

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Food shortage												
Meals/day												

14. FARMER'S CLUB

14.1 About your club, indicate up to three things you **like the most**

1. _____
2. _____
3. _____

14.2 About your club, indicate up to three things you dislike

1. _____
2. _____
3. _____

14.3 What are you suggestions for improvement?

14.4 How many hours per day/ per week do you spend for club activities?

15. SUPPORT FROM OUTSIDE

15.1 What kind of support did you get last 12 months from WVM, JICA, or others?

15.2 What were the most useful things that you learnt?

15.3 Have you implemented any of these new ideas? Which ones?

Club:
Individual:

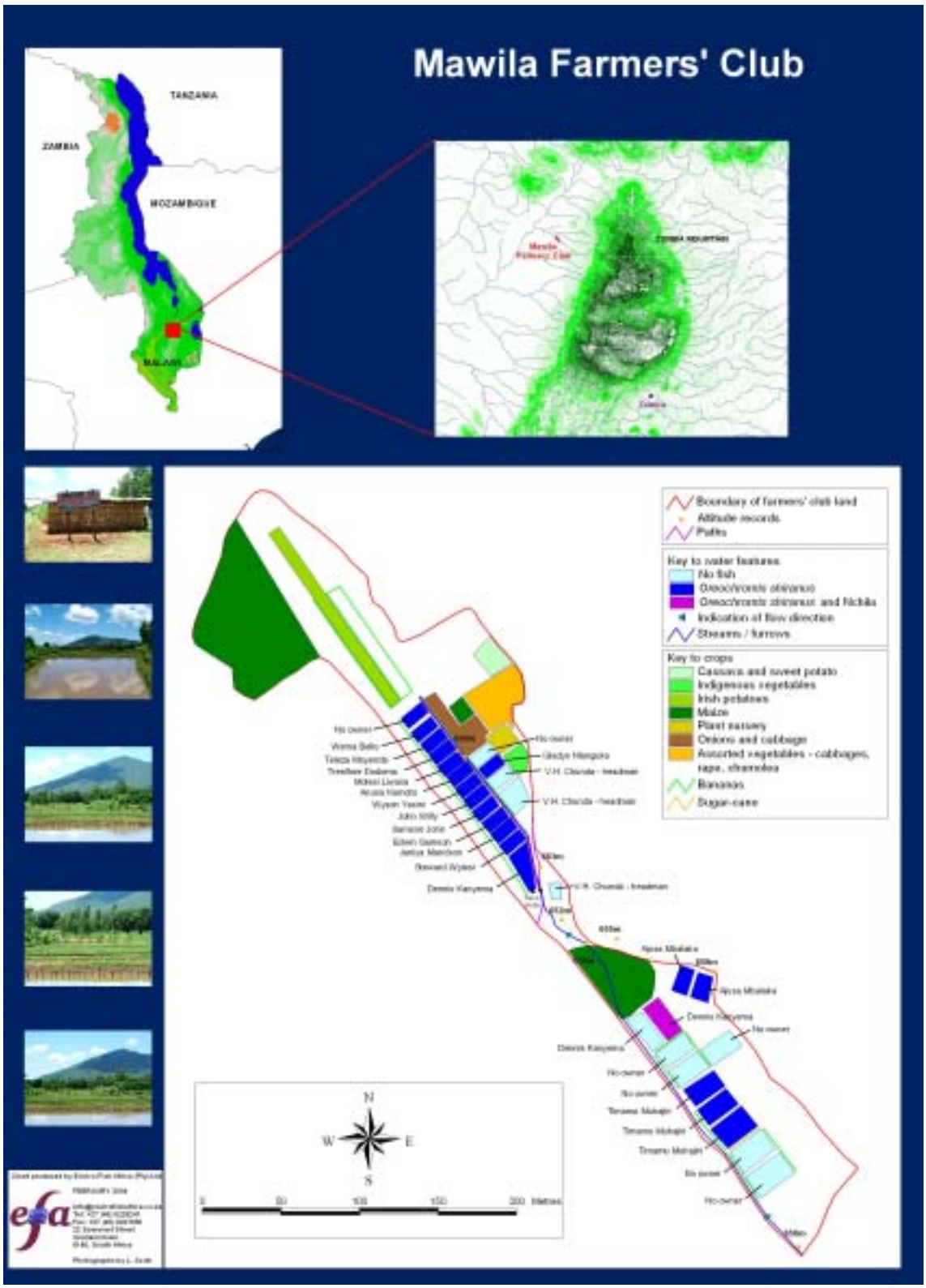
15.4 Did you have any other support?

Resources	Description of support (when, period, contents, etc)
Starter Pack Programme (SPP) by the Government	
Starter Pack Programme (SPP) by Blantyre CINORD	
Food for Work	
Others	

END OF QUESTIONNAIRE

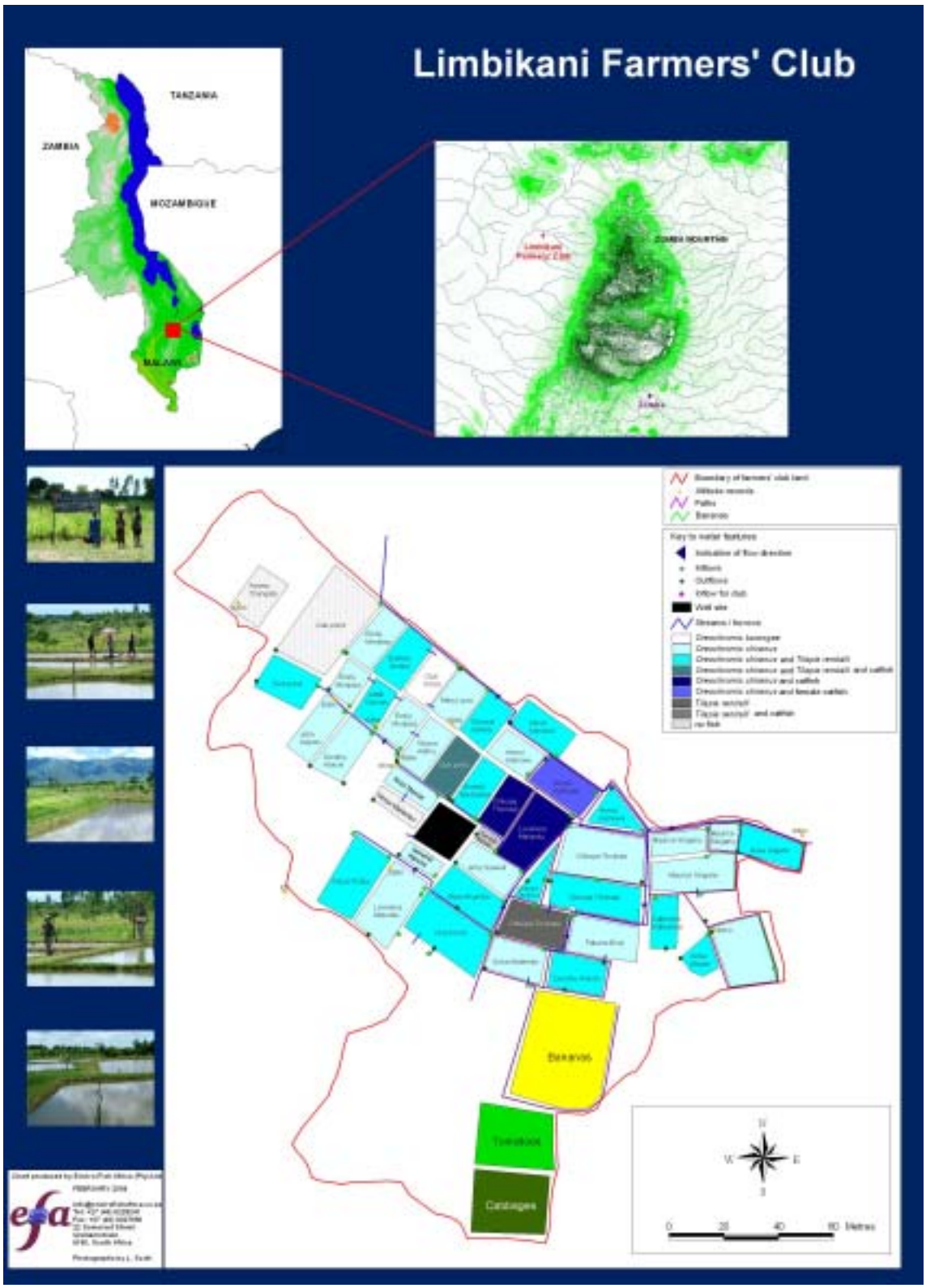
Attachment 5

Site Map of Mawilai Farmers's Club



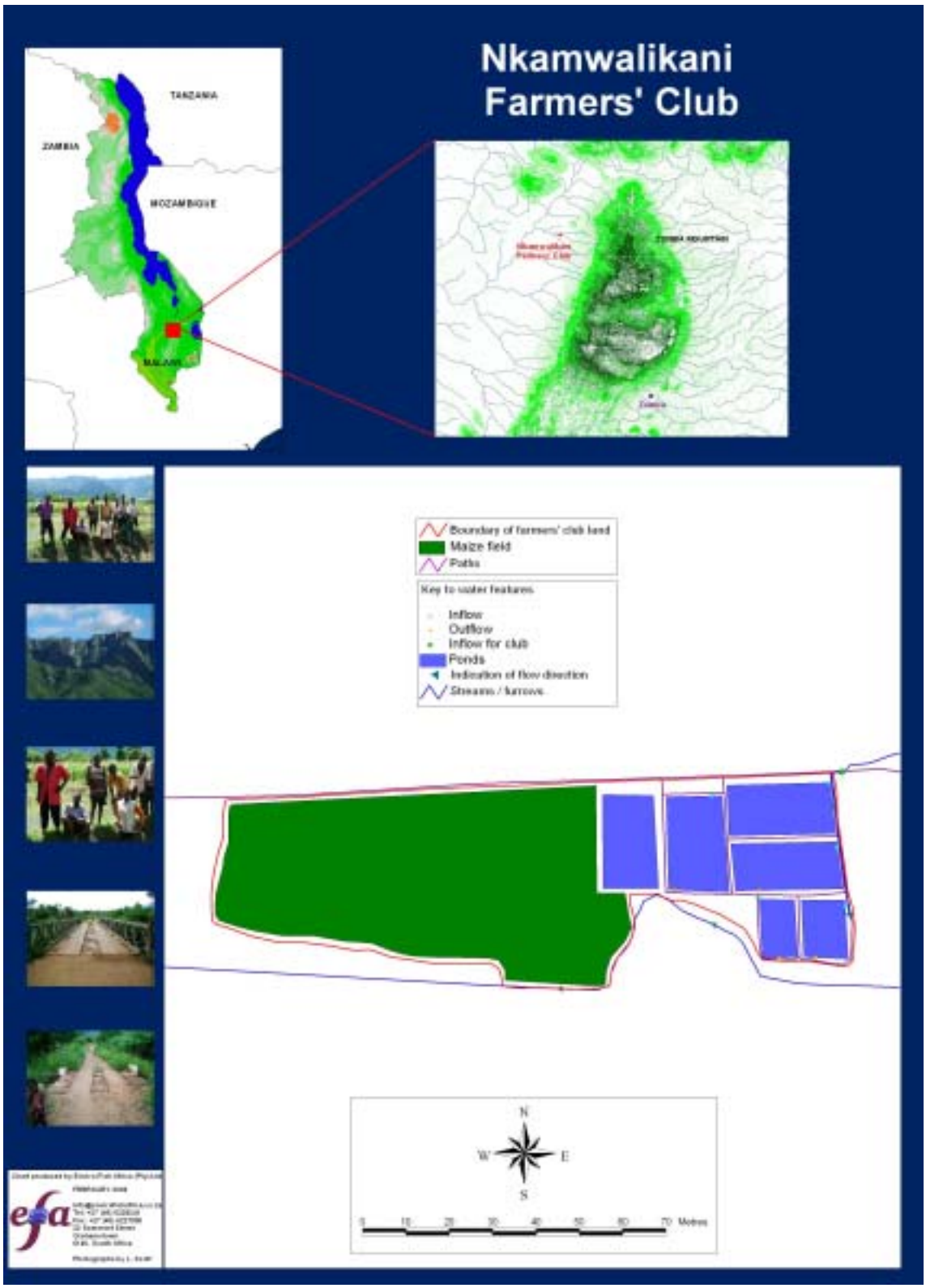
Attachment 6

Site Map of Limbikani Farmers's Club



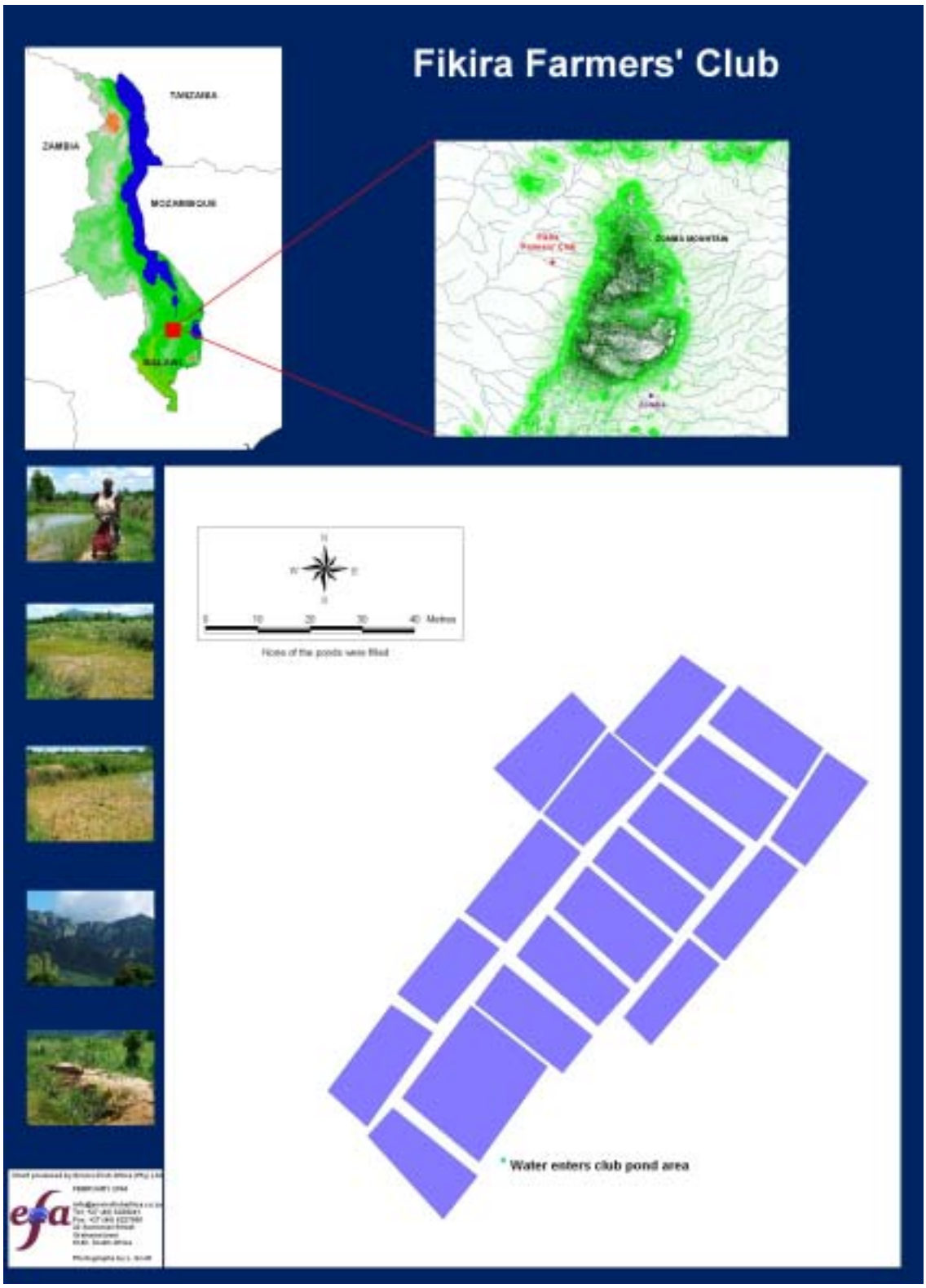
Attachment 7

Site Map of Mkamwalikani Farmers's Club



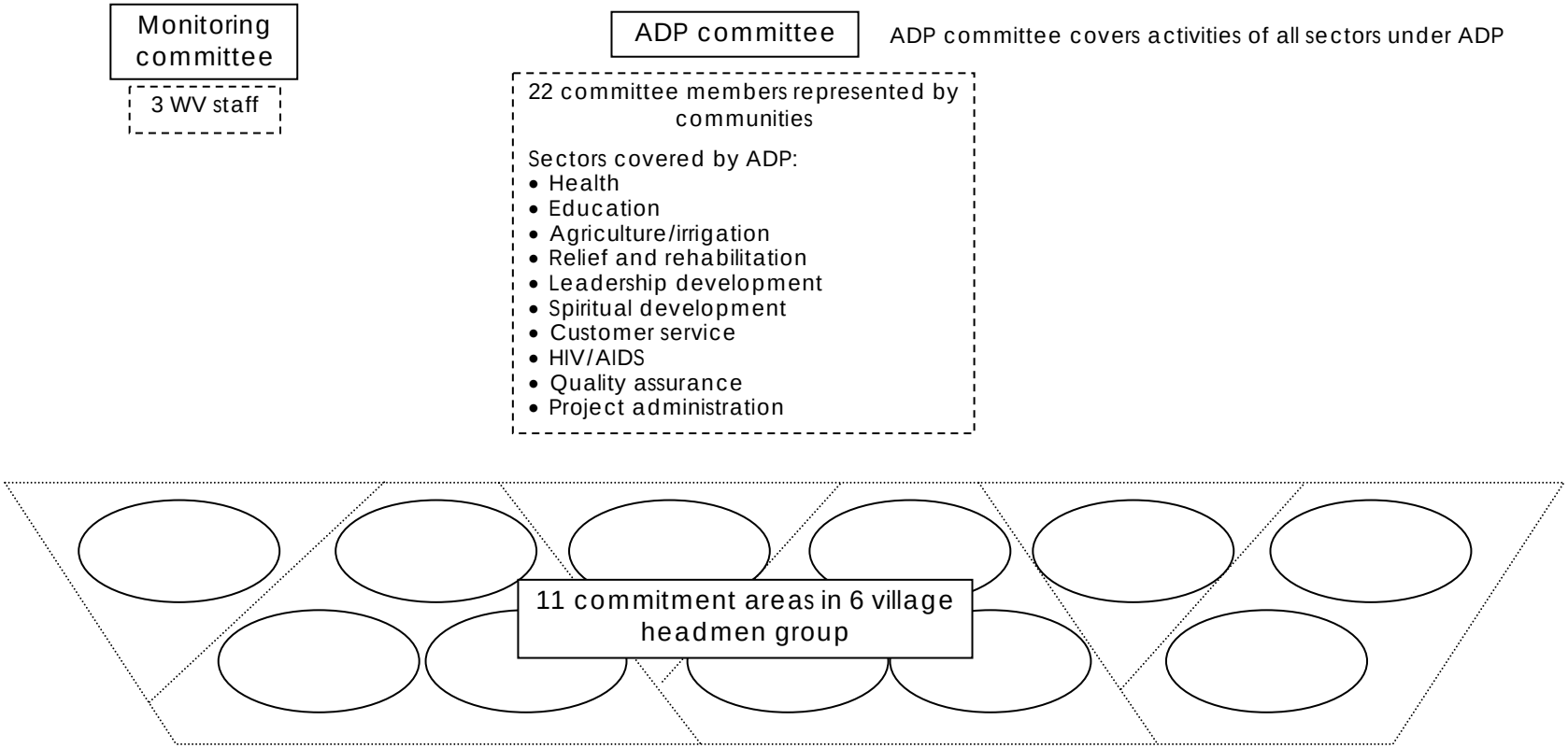
Attachment 8

Site Map of Fikira Farmers's Club



Attachment 9

How ADP is structured



Attachment 10

How Small-holders farmers association is structured