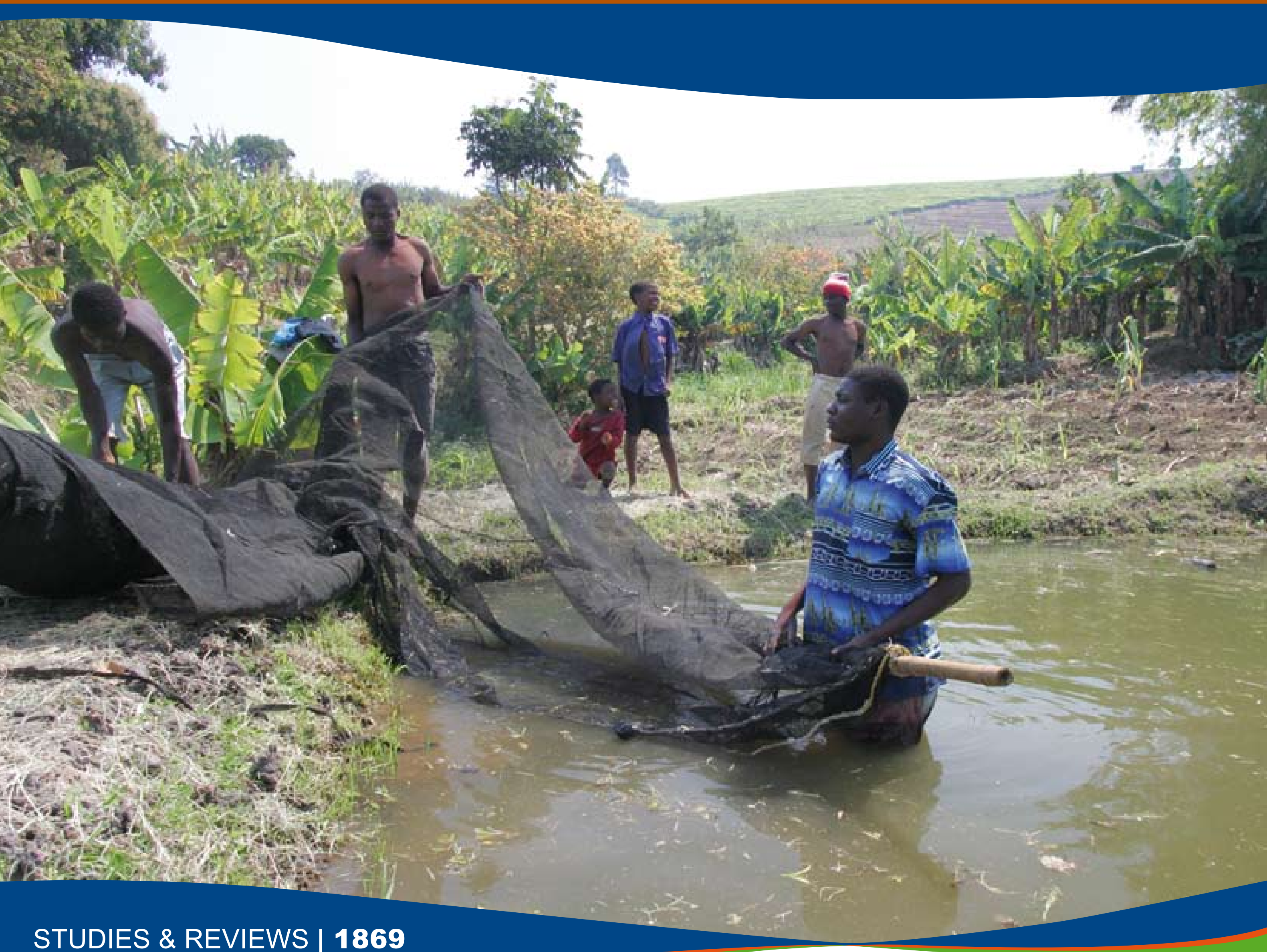

STUDIES & REVIEWS | **1869**

Recommendation Domains for Pond Aquaculture

Country Case Study: Development and Status of Freshwater Aquaculture in Malawi

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Recommendation Domains for Pond Aquaculture. Country Case Study: Development and Status of Freshwater Aquaculture in Malawi

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LIST OF ABBREVIATIONS

BA	bachelor of arts
BSc	bachelor of science
CNRFFP	Central and Northern Regions Fish Farm Project
COMPASS	Community Partnerships for Sustainable Resource Management
DoF	Malawi Department of Fisheries
FAO	Food and Agriculture Organization of the United Nations
FCR	food conversion ratio
GoM	government of Malawi
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immuno-Deficiency Syndrome
IAA	integrated aquaculture-agriculture
ICLARM	International Center for Living Aquatic Resources Management
JICA	Japan International Cooperation Agency
MALDECO	Malawi Development Corporation
MDG	Millennium Development Goal
MWK	Malawi kwacha
NAC	National Aquaculture Centre
NASP	National Aquaculture Strategic Plan
NGO	nongovernmental organization
ODA	United Kingdom's Overseas Development Aid
PIAD	Presidential Initiative on Aquaculture Development in Malawi
RESTORE	Research Tools for Natural Resource Management, Monitoring and Evaluation
TA	traditional authority
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

NOTE: In this report, "$" refers to US dollars ($1 = MWK140 in February 2008).

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This report is largely based on previously published data, and particular recognition must be given to preceding analyses of aquaculture in Malawi by Andrew et al. (2003), Hecht and Maluwa (2003), and Dey et al. (2007). We would like to thank all the Recommendation Domains for Pond Aquaculture Project team, especially Dr Madan Dey for discussion on the scope and structure of the case study, Dr Kam Suan Pheng for comments on an earlier draft, staff of the WorldFish Center in Malawi for their support in gathering information for this assessment, and the WorldFish Center interns Mr Bastien Bandi and Ms Brie Finegold in Cairo for their help in collecting information from Food and Agriculture Organization data sources.

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FOREWORD

This monograph is a result of a 3-year project to produce a decision-support toolkit with supporting databases and case studies to help researchers, planners and extension agents working on freshwater pond aquaculture. The purpose of the work was to provide tools and information to help practitioners identify places and conditions where pond aquaculture can benefit the poor, both as producers and as consumers of fish. By undertaking the project in four countries (Cameroon and Malawi in Africa, and Bangladesh and China in Asia), each at a different stage of aquaculture development, project researchers were better able to test the toolkit for wide applicability and utility.

Applying such a toolkit requires a clear understanding of the existing state of pond aquaculture in each country, the circumstances underpinning its development, and the factors driving its adoption or discontinuation. To achieve this, country case studies were conducted by extensive literature review supplemented with analysis of primary and secondary data.

This monograph is the case study for Malawi. Written in three parts, it describes the historical background, practices, stakeholder profiles, production levels, economic and institutional environment, policy issues, and prospects for aquaculture in the country. First, it documents the history and current status of the aquaculture in the country. Second, it assesses the technologies and approaches that either succeeded or failed to foster aquaculture development and discusses why. Third, it identifies the key reasons for aquaculture adoption.

I hope that this monograph will help development practitioners and researchers interested in aquaculture development in Malawi. The WorldFish Center and its research and national partners[1] are grateful to the Federal Ministry for Economic Cooperation and Development, Germany, for funding the project. We also thank all other partners, including fish farmer respondents, who have contributed to this effort.

Dr Stephen Hall
Director-General
The WorldFish Center

[1] Research partners: University of Kassel and the University of Hohenheim, Germany; National partners: The Institut de Recherche Agricole pour le Développement in Cameroon, Fisheries Department in Malawi, Department of Fisheries in Bangladesh and Chinese Academy of Fishery Sciences.

1. INTRODUCTION AND COUNTRY PROFILE

Within the discipline of fisheries science and conservation, Malawi is most closely associated with the unrivalled freshwater biodiversity of Lake Malawi, home to an estimated 500-1,000 fish species including a large number of endemic Cichlid species. However, in stark contrast with this ecological bounty, the nation of Malawi, which exerts the most fishing pressure on Lake Malawi,[1] is currently ranked as one of the poorest countries in southern Africa[2] (UNDP 2005) in which an estimated 480,000-1,400,000 people are directly affected by HIV/AIDS (UNAIDS 2006). The nation has few mineral resources and is landlocked, and its primary sources of foreign revenue come from the sale of tobacco, sugarcane, cotton and tea (CIA 2008). While Malawi has historically benefited from extensive capture fisheries on Lakes Malawi, Malombe and Chilwa; the Shire River (Figure 1); and numerous smaller rivers, lakes and lagoons, the declining availability of fish per capita from these sources heightens the need for greater investment in aquaculture in this nation.

Malawi is noted as having deep historical associations with capture fisheries, and fish constitutes an important component of the daily diet for urban and rural Malawians alike. However, in the last 20 years, the consumption of fish per capita has declined significantly due primarily to population growth. Whereas estimates of the consumption of fish per capita were around 13-14 kilograms (kg)/year in the 1970s, recent estimates place it between 4-7 kg/year (Jamu and Chimatiro 2005, FAO 2005a). Declining per capita access to fish notwithstanding, fish still accounts for an estimated 28% of total animal protein consumed in Malawi (Jamu and Chimatiro 2005), which is one of the highest dependencies on fish for animal protein in the Southern African Development Coordination Conference region (Gopa Consultants 1989). Indeed, particularly for many poorer Malawians, fish may be the only regularly available source of animal protein. In this cultural context, demand for fish far outstrips supply, and all fish that is landed or produced is consumed, regardless of species or size.

Over the course of the past half century, poorly regulated fishing of many fish stocks, combined with increasing numbers of people entering the fishing industry, has created the

Figure 1: Map of Malawi

Source: CIA 2008.

1 Lake Malawi forms a significant portion of Malawi's eastern border with Tanzania and Mozambique, where the lake is known as Lake Nyassa and Niassa, respectively. However, much of the Mozambican and Tanzanian shorelines are characterized by steep mountains and narrow littoral zones, while much of the Malawian lakeshore is easily accessible and reaps the benefits from the biological productivity occurring in its wide littoral zones.

2 Among the several indices that the United Nations and World Bank use to rank nations, the Human Development Index ranks Malawi 165th out of 173 nations.

impression among policymakers that wild fish stocks are overexploited.

The trends of fish tonnage landed from Malawi's three most significant fisheries in Lakes Malawi, Malombe and Chilwa are shown in Figure 2. Some key points are highlighted here:

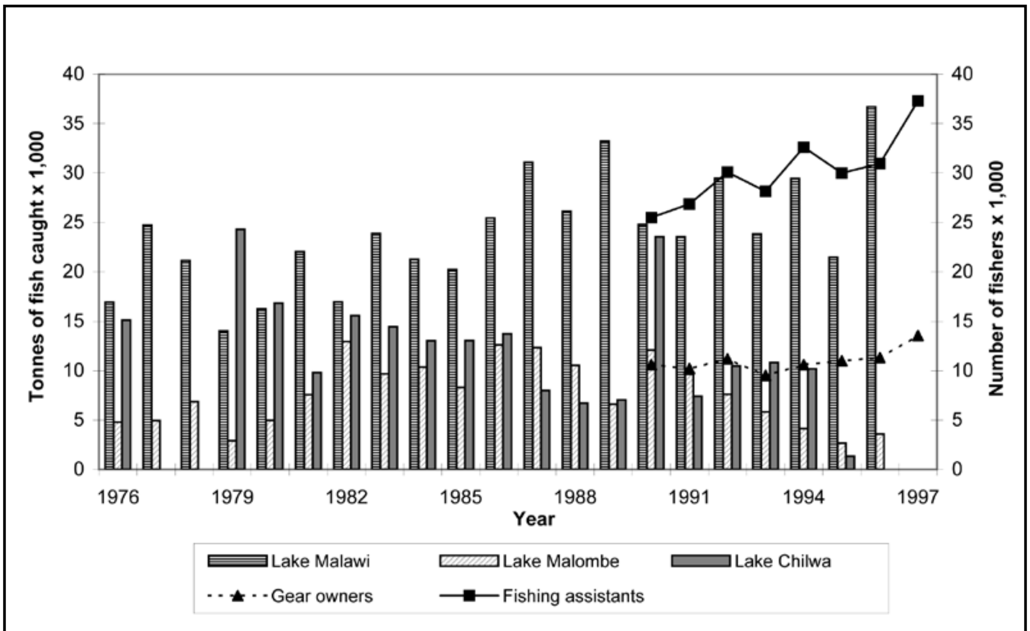
- Lake Malombe's valuable chambo *(Oreochromys* spp.) fishery collapsed during the early 1990s due to overfishing.

- Lake Chilwa's fisheries are vulnerable to cyclical droughts, which dry out the lake almost completely, but fish stocks have always rebounded from remnant populations.

- Lake Malawi's overall fish captures show an apparent continued increase, but an analysis of capture data indicates that an increasing proportion of landed captures consists of the pelagic usipa *(Engraulicypris sardella)* and utaka (*Copadichromis* spp.) (Weyl et al. 2001, Manase et al. 2002). Meanwhile, the Malawian government is concerned that the once vibrant chambo fishery may be approaching a point of "imminent collapse" (PIAD 2006), and the numbers of fishing gear owners, fishing assistants, gears and vessels continue to increase.

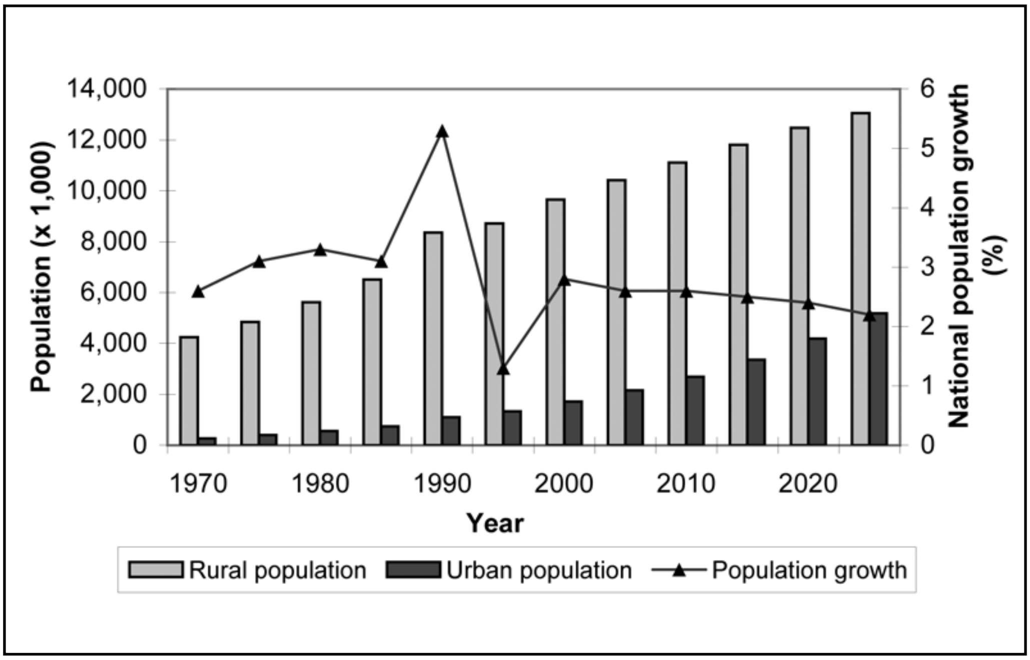
In contrast with stagnant fish-capture rates, the national population is expected to continue growing (albeit at a declining rate, down to 2.2% per annum by 2025, as shown in Figure 3), thereby further reducing the amount of fish available per person from capture fisheries (UNSTATS 2008). Fish was at one time estimated to constitute around 70% of all animal protein consumed by Malawians nationwide (Bland and Donda 1994), but, as discussed above, annual per capita consumption of fish has since declined. This decrease is in sharp contrast with global trends, which saw fish consumption increase by an average of 40% during 1960-1997, reaching 16 kg per person (WHO/FAO 2002). Many poorer households cannot realistically compensate for such a decrease in the availability of fish through purchases of animal protein from more expensive sources and therefore face a significant threat to nutrition. Furthermore, this trend is of particular concern for people living with HIV/AIDS, who require up to 50% more protein than others to sustain their health (Mumba and Jose 2005).

Figure 2: Fish catches and number of fishers in Malawi's key fisheries



Source: Bulirani et al. 1999.

Figure 3: Malawi's national population growth (1970-2025)



Source: UNSTATS 2008 (Population Division estimates and projections).

Options are limited for combating the livelihood and nutritional crises in Malawi. Malawi has one of the highest population densities in southern Africa, but the lack of significant mining, manufacturing or service sectors means that 85% of Malawi's population depends primarily on agriculture-based employment (WTO 2002), with 66% of the rural population below the national poverty line (NEC 2000).[3] Benson et al. (2005) argue that since, on average, 73.5% of all household expenditure (including the cash equivalent of in-kind consumption) in rural Malawi goes to meeting household food requirements (according to the 1997-98 Integrated Household Survey), conditions of poverty are generally synonymous with food insecurity. As the shortage of arable land limits agricultural expansion, the best hope for improving rural Malawian livelihoods comes from increasing the productivity of the existing rural resource base.

In relation to the total fish captured from Malawi's lakes and rivers (40,000-65,000 tonnes [t]/year), the contribution of aquaculture to date is still very small (SSC 2005). However, the proportion of chambo — the most important high-value fish species in Malawi — in fish landings has decreased sharply over time, from a relatively stable 19,000-23,000 t/year in the early 1980s (roughly 1/3 of all fish landed by weight) to 4,400-5,500 t/year in the late 1990s (roughly 1/10 of all fish landed by weight) (SSC 2005). Between 1980 and 2001, fish production from small-scale aquaculture increased by 7.4% and is judged to currently produce an annual income of $1,363 per hectare per year (FAO 2005a).

For small-scale farmers in Malawi currently engaged in pond aquaculture, fish farming contributes on average 10% to total household income (Dey et al. 2007, Andrew et al. 2003). Consequently, the potential for aquaculture to fill national demand for high-value chambo could be significant, but the expansion of this sector continues to depend heavily on funding from nongovernmental organizations (NGOs) and donor agencies.

3 The Malawian national poverty line is well below the international poverty line of $1 a day and was set at $0.41 per person per day (or MWK10.47) based on the Integrated Household Survey conducted in 1998 (NEC 2000). It was updated to MWK44.29 ($0.32) following a second such survey conducted in 2004-05.

2. ECOSYSTEMS AND AQUACULTURE PRODUCTION SYSTEMS

Twenty percent (24,405 square kilometres) of Malawi's total area is covered by water, namely by Lakes Malawi, Malombe, Chilwa and Chiuta (FAO 2005a). These lakes, together with the Upper and Lower Shire River, provide the majority of Malawi's fish resources.

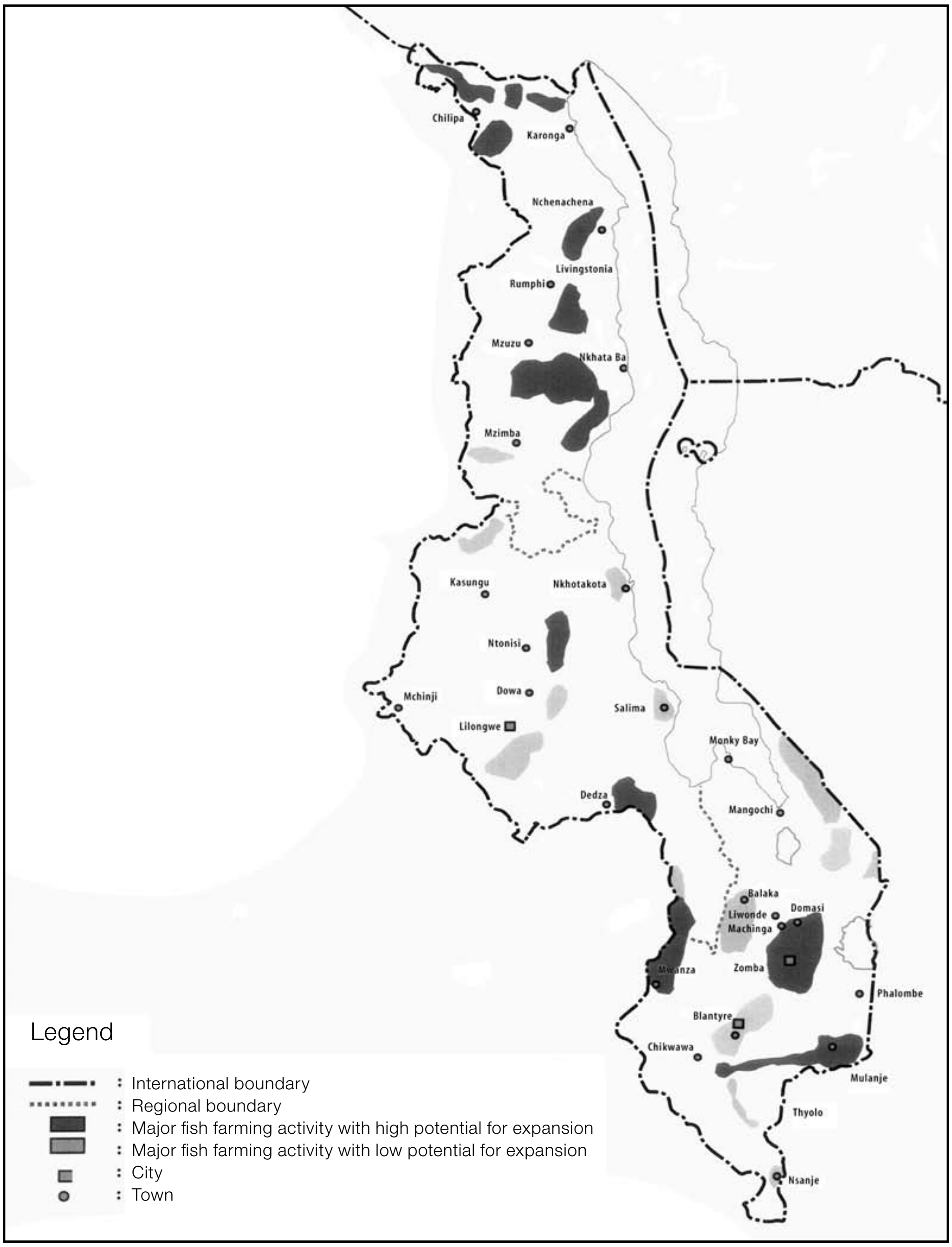
Malawi is divided into four main physiographic zones: (1) the Highlands (altitude 1,600-3,000 metres [m]), (2) the Plateau (altitude 1,000-1,600 m), (3) the Rift Valley Escarpment (altitude 600-1,000 m) and (4) the Rift Valley Plains (altitude 30-600 m). The Highlands and the Plateau cover extensive areas in the Central and Northern administrative regions and are drained by rivers coursing through broad, grass-covered valleys called *dambos*, which are susceptible to flooding. The Rift Valley Escarpment and the Plains are made up of sediments derived by erosion, making them rich farming areas. Rainfall distribution is strongly related to topography, with highlands and exposed slopes receiving high rainfall. On average, more than 90% of the land area receives over 800 millimetres of rain per annum, while some mountain areas get as much as 1,800 millimetres (Alcom 1994).

It is estimated that more than 11,650 square kilometres, or 11.65 million hectares (ha), of land in Malawi is currently used for aquaculture or has potential for such use (Brooks 1992). Many of the most promising areas for pond culture are in the dambos that drain the plateau zones of the country. As these seasonally flooded areas are frequently poorly suited for agriculture, a World Bank study identified 35,000 ha of underutilized dambo land that could be used for small-scale irrigation (and by extension fish farming) (SSC 2005). Many of these areas are identified in Figure 4. When compared with the 208 ha of fishponds the Malawi Department of Fisheries (DoF) currently estimates to exist, the potential for expanding fish farming is clearly not limited by access to appropriate land resources (though benefits so far have sometimes been limited by poor pond site selection).

In Malawi, most of the land that is not privately owned by agricultural estates falls under customary tenure, which may present certain limitations for expansion of aquaculture (as discussed in section 4.6). Aside from access to land, the potential for aquaculture is highly dependent on the availability of adequate and reliable water supplies, and in some areas competition from other agricultural uses may restrict the expansion of aquaculture. Additionally, scientists currently have a limited understanding of the impacts that climate change will have on fish farmers' access to sufficient water supplies in different dambo regions of Malawi.

Earthen pond culture is the main production system practised in Malawi. Although aquaculture is currently at an early stage of development, private corporations and fishing communities have started pilot projects to determine the feasibility of establishing both large- and small-scale cage-culture ventures in and around Lake Malawi (Windmar et al. 2008). Additionally, significant areas under rice cultivation present the possibility of managing rice paddies for extensive aquaculture, though this option is largely unexplored as yet.

Figure 4: Areas with potential for aquaculture expansion in Malawi



Source: ICLARM and GTZ 1991.

3. AQUACULTURE DEVELOPMENT IN MALAWI

3.1 HISTORICAL AQUACULTURE DEVELOPMENT INITIATIVES

Although the first introductions of rainbow trout (*Onchorhynchus mykiss*) into the cold water of the Mulunguzi Stream on the Zomba Plateau took place in 1906, colonial Nyasaland[4] received relatively little development of aquaculture during the first half of the 20th century (Tweddle 1982, Hecht and Maluwa 2003). Indeed, throughout Malawi's history, the majority of fish consumed has come from capture fisheries, and even prior to the arrival of colonialism, there are records of some inland communities maintaining close trading relationships with lakeshore communities to exchange staple foods and labour for fish (Withers 1952, Williams 1969, White 1987). Rivers and streams were actively fished by lakeshore and inland communities alike, spurring the development of elaborate technologies and institutions regulating access to these key fisheries (Russell et al. 2008). For these reasons, many Malawians have strong cultural traditions of fish consumption. Fishing is key to the identity of the Tonga of northern Malawi, whose conceptualization of household welfare is closely associated with fish capture (Hoole 1955, van Velsen 1964).

Traditional patterns of trade and access to fish underwent dramatic changes in the first 2 decades of the 20th century. During this period, population growth in the commercial capital (Blantyre), administrative capital (Zomba), and large plantations (Tyolo and Mulanje) — all located in the Southern Highlands of Nyasaland Protectorate — increased demand for fish from Lake Chilwa. However, when this lake dried up completely in 1913-15 and 1920-22 (Lancaster 1979), and with the build up of British and South African troops in Zomba and Blantyre during World War I, fish-trading networks increasingly incorporated Lake Malombe and southern Lake Malawi to meet the growing demand for fish (McCracken 1987).

In 1938-39, two colonial surveys of rural nutrition and fisheries highlighted the importance of fish in the economy, but the outbreak of World War II in 1939 disturbed the surveys' follow-up activities. These studies found that, while markets had developed in association with plantations and cities in the south, many inland areas were poorly connected with the lakeshore in terms of fish-trade networks (Bertram et al. 1942). Indeed, many fishers along the rest of the lakeshore made little effort to capture large enough amounts of fish for sale, simply aiming to supply local consumption. Bertram et al. (1942) recommended the active development of transportation and marketing infrastructure in inland areas and cited the urgent need to improve post-harvest practices so that larger amounts of fish could be sold inland. Additionally, they suggested the active stocking of inland impoundments.

In 1950, the colonial government created the Game, Fish and Tsetse Control Department and stationed a trout warden named A.V. Gifkins at Nchenanchena in the Northern Region, where he established a fish hatchery for rainbow trout (Tweddle 1982, Hecht and Maluwa 2003). From this base, a number of northern watersheds were stocked with rainbow trout and later brown trout (*Salmo trutta)*. Gifkins also established several fishponds at Tipwiri and Nchenanchena, which he stocked with *Oreochromis shiranus* and *Tilapia rendalli* from Lake Malawi (see Annex A for a list of common and scientific names of fish). Feeding the tilapids with maize bran, Gifkins achieved a production rate of up to 2.76 kg/ha/year, spurring local interest in fish farming (Hecht and Maluwa 2003). Hereupon, the Game, Fish and Tsetse Control Department established a training centre and an extension programme aimed at training local farmers in aquaculture. The extension work covered large parts of the Northern Region highlands, and within 4 years (1954-58), 52 smallholder fishponds were operational in Livingstonia, Nchenanchena, Mzuzu, Chikwina and Nkhata Bay (Hecht and Maluwa 2003).

4 Covering the same area as today's Republic of Malawi.

However, rising political tensions and the onset of violence in the Northern Region cost Nchenanchena its role as the focal point for tilapia culture in February 1959. Gifkins was evacuated and reassigned to Domasi (near Zomba in the Southern Region), where he built a new fish culture station. That same year, the Domasi Experimental Fish Farm began to distribute fingerlings of *T. rendalli* to four farmers in the Southern Region, and it became the main experimental and demonstration unit for aquaculture in the country. Fish farming in the Northern Region received another brief period of investment in 1961-62; by the end of 1962, 141 smallholder fishponds were being maintained in the Northern Region (Hecht and Maluwa 2003).

Following independence in 1963, investments in aquaculture focused particularly on the Southern Region, which was the most populous part of the country. In the 1970s, donor assistance for the development of aquaculture began when the United Nations Development Programme (UNDP) funded the Kasinthula Pilot Fish Farm at Chikwawa in the Lower Shire Valley. The pilot farm was developed to test the viability of large-scale aquaculture and provide fish and fingerlings to local fish farmers. This project had little success, however, due to low government funding and the absence of supporting policies for the promotion of large-scale aquaculture (ICLARM 2001).

The next outside investments in aquaculture were made by Oxfam and the United Nations Children's Fund (UNICEF) in Zomba District during 1974-79, and by UNICEF in Mwanza District during 1981-90 (see Annex B for a list of major aquaculture projects). The success of this latter project in promoting small-scale fish farming in Mwanza shifted the focus of the aquaculture development strategy from large-scale to small-scale fish farming. This strategy was replicated by the establishment of satellite stations throughout Malawi. These satellite stations were developed during 1989-94 through support from the United Kingdom's Overseas Development Aid in Mulanje (catering for Mulanje, Phalombe and Thyolo districts in the Southern Region) and the European Union, which funded the construction of six satellite stations in the Central and Northern regions (ICLARM 2001).

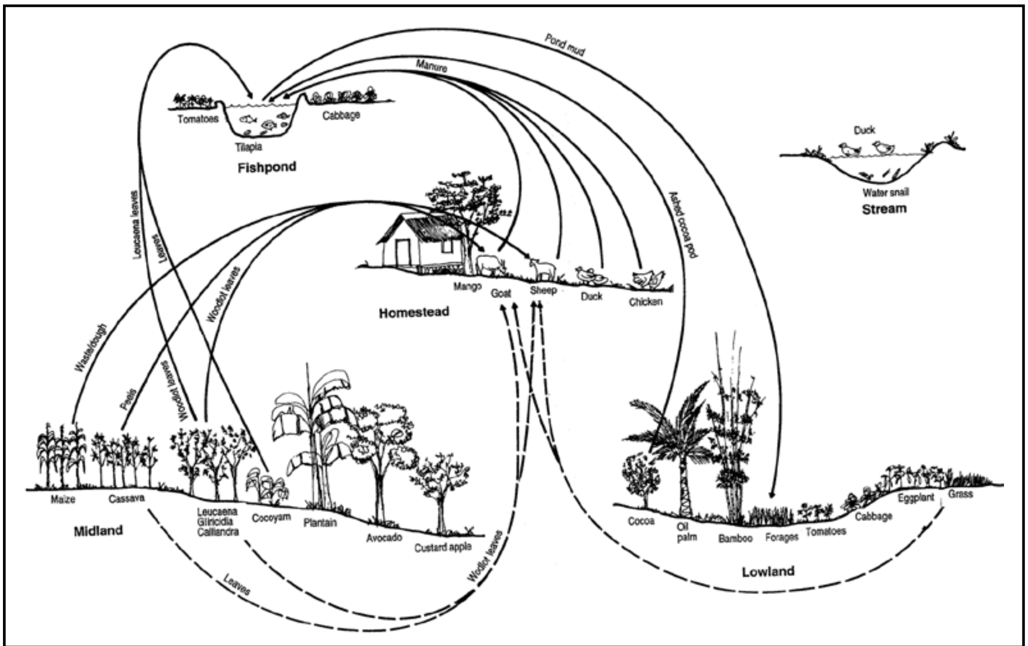
In 1983, the project preparation report for the Central and Northern Regions Fish Farm Project of 1989-95 stressed the need for a research and demonstration farm in Mzuzu because the ponds at Tipwiri station had lain abandoned for many years and the few remaining farmers' ponds in the region were only marginally productive (Hecht and Maluwa 2003). During the early part of the project, the facility was constructed and made operational through its research and extension activities, and the project had a major impact on small-scale fish farming in the Northern Region (Dickson and Brooks 1997, Hecht and Maluwa 2003).

The International Center for Living Aquatic Resources Management (ICLARM, now known as The WorldFish Center) established a research centre in Malawi in 1986, and between 1986 and 1995 collaborated with the Malawian government and the University of Malawi on a range of biological and socioeconomic research activities, funded by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) (ICLARM 2001). This led to the development of ICLARM's integrated aquaculture-agriculture (IAA) approach, by which farmers were helped to improve efficiency and productivity in all agricultural activities through the recycling of nutrients and wastes (Figure 5).

The IAA process is elaborated upon in an excerpt from Dey et al. (2007) in Box 1.

Initially these methods were disseminated by extension personnel from the Malawi-German Fisheries and Aquaculture Development Project to farmers in Mwanza, Zomba and Namwera. However, despite achieving high yields at research stations, the on-farm yields and productivity of these technologies remained low. In 1991, it became clear that the classical top-down approach to technology development did not result in increased productivity and fish production, and thereafter the research focus was changed from a station-based approach to an on-farm participatory extension approach (ICLARM 2001). The lessons learned during this period led to the elaboration

Figure 5: Schematic representation of nutrient recycling in integrated aquaculture-agriculture



Source: Prein 1994.

Box 1: The integrated aquaculture-agriculture approach

The approach focuses on the development and diffusion of integrated aquaculture-agriculture (IAA), in which existing resources (in the form of organic wastes and by-products) on and around the farm are utilized as much as possible as nutrient inputs to the pond and also to other agricultural enterprises. The organic wastes and by-products are not used exclusively for the pond, but from the ponds (in the form of pond mud and nutrient-rich water) to other enterprises such as vegetable production around the pond. Fishponds require fertilization, and because they also function as a bio-digester (or an "aquatic rumen") they lend themselves ideally to be the central catalytic component of IAA systems.

The most common pond inputs are plant-based residues and processing wastes such as leaves, straw, peels, husks, bran and pulp. Livestock manures are used mainly if these are penned and no other use exists, or if these can be obtained in bulk from other sources away from the farm (e.g., chicken farms). Other on-farm wastes are kitchen scraps and slaughter wastes.

Prior to engagement with the concept of recycling through IAA, farmers are often unaware of the nutrient management opportunities. The IAA system leads to improved environmental soundness (Lightfoot et al. 1993, Lightfoot and Noble 2001) and synergisms among various subsystems (e.g., crop production, aquaculture, etc.), resulting in a higher output of desired products from natural resources under farmers' control.

Source: Dey et al. 2007.

of an approach to aquaculture technology development and transfer described as a "farmer-scientist research partnership" (Brummett and Williams 2000).

During 1970-2002, aquaculture in Malawi received substantial technical and financial support from a variety of sources. As many of these projects were based in Domasi, they contributed to strengthening capacity in the Domasi Experimental Fish Farm, which was renamed the National Aquaculture Centre (NAC) in 1991. In 1990, the country had 12 government stations and substations, one of which was operated by Bunda College of the University of Malawi, which is located near the national capital, Lilongwe, in the Central Region. These facilities collectively operated more than 180 experimental ponds (Hecht and Maluwa 2003).

During the late 1990s, however, direct donor support to aquaculture development declined due to a number of factors including changes in donor priorities and donors' perception that large investments already made in the sector had failed to pay (ICLARM 2001).

3.2 CURRENT RESEARCH AND DEVELOPMENT IN AQUACULTURE

Since 1996, smallholder fish-farming initiatives in Malawi have been supported only through the Border Zone Development Project funded by GTZ (Hecht and Maluwa 2003). However, despite the withdrawal of development funds from the sector, aquaculture continued to develop, in particular in southern Malawi, where partnerships between research and extension resulted in incremental and sustained increases in fish production and whole farm productivity (ICLARM 2001). This was further supported by around 60 NGOs and donor projects that have supported investments in pond construction. Eight NGOs (Action Aid, World Vision International, CARE, Community Partnerships for Sustainable Resource Management [COMPASS], Oxfam, Concern Universal, Christian Service Commission and United States Peace Corps) have adopted pond aquaculture as an integrated component of their food security programmes. A large number of NGOs and donor agencies, most of which have come into being during the last decade, are sources of funding for small-scale aquaculture activities. Table 1 shows the organizations that have supported the largest number of fish farmers and contributed to the greatest total acreage of ponds, as well as listing the agencies that have supported larger-scale fish-farming ventures.[5]

Despite incomplete data records, it is quite clear that a large proportion (up to two-thirds) of all fish farmers have received some form of support from NGOs or donor agencies. Some of the NGO-supported projects were conducted in close collaboration with NAC and WorldFish, while others were largely independent in their extension approaches. In 2005, WorldFish initiated a programme for conducting monthly DoF-organized meetings for all major NGOs involved in aquaculture in Malawi (Phiri and Nagoli 2005).[6] The NGOs present at the first meeting planned to replicate some of the approaches and lessons learned from World Vision's Chingale Integrated Fish Farming Project to their respective projects. Unfortunately, no further meetings were held, though DoF regularly monitors NGO activities.

In 2002, the Japan International Cooperation Agency (JICA) agreed to conduct and support the Master Plan Study on Aquaculture Development in Malawi, whose main objective was to develop a national strategic sector plan as a road map for future aquaculture development in

5 Institutional limitations (discussed below) mean that the DoF aquaculture database should be taken as indicative of broad trends rather than used for detailed data analysis.

6 Eight NGOs and donor agencies participated in this first meeting, with NGOs paying participants' costs of attendance: World Vision International – Chingale Integrated Fish Farming Project (Zomba); Concern Universal – Sustainable Livelihoods Programme (Ntcheu and Dedza) and Smallholder Flood Plains Development Programme (Karonga, Nkhotakota, Balaka and Machinga); ActionAID (Mwanza); Oxfam – Integrated Aquaculture-Agriculture (Thyolo and Mulanj, and will expand to Chiradzulu); Evangelical Lutheran Development Project (Phalombe, Dowa and Nkhata Bay); Self Help International; Salvation Army; and government of Malawi-European Union micro-projects.

Table 1: Fish-farming initiatives in order of number of farmers

Fish-farming initiatives in order of number of farmers		**Fish-farming initiatives in order of total pond area**			**Fish-farming initiatives in order of average pond area per farmer**		
Source of funding	Farmers	Source of funding	Farmers	Total pond area (m^2)	Source of funding	Farmers	Average area (m^2)/farmer
Self-funded	2,537	Self-funded	2,537	565,470	MASAF	50	8,258
Oxfam	1,442	MASAF	50	412,924	Chinese government	1	3,000
World Vision	834	HIPC	634	250,086	WESM	2	975
HIPC	634	World Vision	834	192,981	DFID	2	900
ActionAid	315	Oxfam	1,442	159,042	CRECCOM	2	851
European Union	197	DoF	125	51,890	COMPASS	1	795
CARE	176	ActionAID	315	43,240	Integration of Irrigation and Aquaculture Project	13	712
DoF	125	CARE	176	30,177	Salvation Army	4	700
FAO	91	European Union	197	24,220	Africare	6	625
MASAF	50	JICA	46	17,985	CHAM	12	600
JICA	46	FAO	91	17,492	Self-funded	2,537	223
Others	320	Others	320	98,787	Others	4,136	206
Total	6,767	Total	6,767	1,864,293	Total/Average	6,767	275

CHAM = Christian Health Association of Malawi, CRECCOM = Creative Centre for Community Mobilization, COMPASS = Community Partnerships for Sustainable Resource Management, DFID = Department for International Development of the United Kingdom, DoF = Department of Fisheries, FAO = Food and Agriculture Organization of the United Nations, HIPC = Highly Indebted Poor Countries, JICA = Japan International Cooperation Agency, MASAF = Malawi Social Action Fund, NGO = nongovernmental organization, WESM = Wildlife and Environmental Society of Malawi.

Source: DoF database, updated 2006.

the country. The project was launched in January 2003, and the National Aquaculture Strategic Plan (NASP) was finalized in 2005. The NASP suggested best approaches and actions to be undertaken by DoF to ensure the sustainable development and growth of smallholder and commercial aquaculture in the country during the decade starting in 2005. Supported by the 2006 Presidential Initiative on Aquaculture Development in Malawi (PIAD), one of the NASP's major strategy themes is to promote private sector investment in all aspects of the aquaculture input supply, fish production, marketing and extension chains (Chimatiro and Chirwa 2006, PIAD 2006).

In recent years, WorldFish has continued a variety of research and capacity-building programmes. These include support to

- the national selective breeding and disseminating programme for *O. shiranus* seed,

- Organization of Petroleum Exporting Countries (OPEC) International Development Fund activities related to famine mitigation through aquaculture and testing community revolving credit funds for aquaculture,

- activities funded by the United States Agency for International Development (USAID) to continue to improve IAA and research plant-based feeds together with Concern International, and

- the Aquaculture Without Frontiers programme to test farmer-to-farmer extension approaches.

An additional initiative funded by the USAID-sponsored COMPASS II programme, which awaits approval from the Ministry of Agriculture's Technology Clearing Committee, is the Malawi Gold Standard programme for aquaculture. This collaborative programme, involving COMPASS II, WorldFish, University of Malawi and DoF, builds on the lessons learned from IAA experiences and seeks to help small-scale fish farmers scale up production toward more commercialized fish farming. In addition to giving instructions for increasing fish production to fish farmers, the Malawi Gold Standard provides training on business practice and mediates access to commercial bank loans (Jamu et al. 2006). While this programme still awaits official government sanction, the private sector has started buying instructional materials and begun implementation on its own.[7]

7 The whole information kit, including the Chichewa handbook and English-language manuals for fish-farming trainers, business management, farming and instructional videos, costs MWK3,000 ($21).

4. POLICY ENVIRONMENT

4.1 DEPARTMENT OF FISHERIES

DoF has responsibility for managing and developing both capture fisheries and aquaculture. It has been housed within a variety of ministries over time, but since 2007 it has been integrated into the Ministry of Agriculture. DoF has six functional sections: (1) Management and Administration, (2) Planning, (3) Monitoring and Evaluation, (4) Aquaculture, (5) Extension and Development, and (6) Research and Training (FAO 2005b). Until recently, all government ministries were organized in a highly centralized bureaucracy, in which all directives came from the headquarters in Lilongwe. However, soon after the nation's transition from a single-party state to a democracy in 1993, the nation embarked on an extensive decentralization programme.

4.2. DECENTRALIZATION POLICIES

Through the 1998 National Decentralization Policy and the Local Government Act, the government committed to decentralizing many government activities, including policymaking, administration and tax-collection, to newly established district assemblies. In district assemblies, elected ward councillors represent local constituents, and traditional authorities and members of Parliament hold non-voting positions. These policies were intended to increase the effectiveness, efficiency and downward accountability of government. Along with many other government agencies, DoF is supposed to devolve most of its programmes to the districts. Consequently, each district fisheries office is to become an independent agency whose policy direction and budget are received from the district assembly, to which it is accountable, and who are able to make independent agreements with NGOs and donor agencies (Seymour 2004).

The first local government elections were held in November 2000, but the Ministry of Finance failed to provide district assemblies with funds, citing concerns over their capacity for financial accountability (Seymour 2004). Following the end of the district assemblies' first 5-year tenure, the central government did not call for new district assembly elections in 2005, and since then the district assemblies have not been able to function with any legal mandate. In its own assessment of the decentralization process, the Ministry of Local Government and Rural Development describes the process in unambiguous terms:

> After 5 years of implementation there has in fact been very little real devolution. At every point the heavy hand of central government is inhibiting the chances for locally accountable and empowered Assemblies. Structures, systems, senior staff are all decided by the Centre. The elected councillors — the core of the local government system — are largely marginalised. They are unable to properly represent their constituencies, their senior staff are not accountable to them, the TAs [traditional authorities] retain the allegiance of the people, the [members of Parliament] compete with them, they are sidelined in the planning and budgeting processes and some donor funded programmes promote either themselves or alternative community based structures at the expense of the councillors role. At the same time, Assemblies have few competent staff to manage the complex activities brought about by decentralisation. Overall the resulting system at District level is more akin to one of deconcentration/delegation than devolution (GoM 2005a).

The government established the National Decentralization Committee (2005-09) to address issues of capacity building in district assemblies, and some advances have been made on this front. However, as of March 2008, the government still had not provided any indication of when district assembly elections would be held, and currently most direction continues to be given by centralized ministries.

4.3 GOVERNMENT RESEARCH ON AQUACULTURE

The government of Malawi determines research priorities through a participatory process involving international donors.

Aquaculture institutions are supported by the government and international organizations to initiate, direct and carry out aquaculture research. On-farm research is implemented by NGOs together with the government, and several donor agencies provide support for it. Through the IAA framework developed by WorldFish, farmers are involved as partners in research and technology development and carry out experiments (FAO 2005b). NAC plays a leading role in Malawi in research and development and is supported in this by 12 aquaculture satellite stations located around the country, from which on-farm research and extension services to farmers are conducted (FAO 2005a).

In addition, the government of Malawi has developed a number of research and academic institutions that provide support to the development of fish farming in Malawi (Table 2).

Bachelor and master of science degrees in biology or aquaculture are currently offered by two constituents of the University of Malawi system, Bunda College of Agriculture with 775 students and Chancellor College with 2,407 students (www.unima.mw). Malawi Polytechnic also offers degrees with some applicability to aquaculture research and has 2,229 students. The University of Mzuzu is planning to introduce BSc degree programmes related to aquaculture. The number of students entering these universities in fields of potential applicability to aquaculture research is shown overleaf in Table 3.

The total university population of the University of Malawi is 6,357, with roughly 1,000 new entrants per year. In addition, DoF operates the Malawi College of Fisheries, where graduates who are selected specifically to fill government positions receive a certificate in aquaculture following a 2-year training programme.

Key partners in national research programmes related to aquaculture and fish genetics in Malawi are WorldFish and JICA.

Table 2: Institutions involved in aquaculture research in Malawi

Institution	Area of research/highest degree
National research institutions	
National Aquaculture Centre	Reproduction and fish breeding, technology transfer, feeds and feeding
Chancellor College (University of Malawi)	Fish genetics
Bunda College of Agriculture (University of Malawi)	Feeds and feeding, technology transfer and fish species screening
International collaborating research institution	
WorldFish Center	Reproduction and breeding, technology development and transfer
Japan International Cooperation Agency	Development of indigenous fish species for aquaculture and of the National Aquaculture Strategic Plan
Food and Agriculture Organization	Development of technologies for utilizing small water bodies
National training and academic institutions	
Bunda College of Agriculture (University of Malawi)	MSc in Aquaculture & Fisheries Science, BSc in Aquaculture & Fisheries Science
Chancellor College (University of Malawi)	MSc in Environmental Science, BSc in Biological Sciences (fish genetics)
Malawi College of Fisheries (Department of Fisheries)	Diploma in Fisheries Management, Certificate in Fisheries Management

Source: Chimatiro and Chirwa 2006.

4.4 GOVERNMENT EXTENSION SERVICES

Since the 1950s, techniques of pond construction have been actively disseminated in Malawi by centralized extension services. However, reflecting the national government's transition towards democracy and donor agencies' changing development paradigms, Malawi's government extension services underwent radical changes in the early 1990s from a top-down approach to a participatory, on-farm approach, later including farmer-to-farmer extension methods.

Hecht and Maluwa (2003) point out that participatory extension methods provide better returns than the top-down extension method. However, a number of studies have discussed challenges in introducing participatory outreach methods given how poorly paid, motivated, trained and supervised DoF field staff are on average (Banda et al. 1999, Kamperewera and Wilson 2003, Russell 2003, Hecht and Maluwa 2003).

Andrew et al. (2003) and Dey et al. (2007) both agree on the pivotal impact that access to extension information has on the adoption of IAA livelihood strategies. Supporting the perceptions of others, data collected by Andrew et al. (2003) throughout Malawi found significant regional differences in the modes of extension information delivery experienced by IAA households (some of which are reproduced in Table 4). They found that the most successful fish farmers (achieving fish yields exceeding 20 kg/year) have the greatest access to DoF extension staff, while only slightly more than half of the smaller-scale and failing fish farmers have access to this information. Ex-fish farmers indicated the lowest use of these services (29%).[8]

Table 3: Aquaculture-related university degrees in Malawi

University of Malawi applicants accepted in 2005			
Bunda College of Agriculture	Women	Men	Total
BSc in Agri-business Management	5	6	11
BSc in Agriculture	15	41	56
BSc in Irrigation Engineering	4	6	10
BSc in Aquaculture and Fisheries Science	4	7	11
BSc in Environmental Science	4	8	12
BSc in Natural Resources Management	4	7	11
Chancellor College			
BSc (all fields)	11	30	41
BA in Public Administration	5	4	9
Bachelor of Social Sciences (all fields)	25	29	54
Malawi Polytechnic			
BSc in Environmental Health	5	15	20
BSc in Environmental Science and Technology	5	15	20
University of Mzuzu (planned)			
BSc in Fisheries Management			
BSc in Surveying, Land Administration and Management			
BSc in Water Resource Management & Development			

Sources: www.mzuni.ac.mw/Enviro.htm, www.sdnp.org.mw/edu/eduniv.html.

8 Average fish yield for fish farmers from three classes according to scale was as follows (Andrew et al. 2003): producers of 0-19 kg/year, 538 kg/ha and 4 kg/pond; producers of 20-59 kg/year, 1,793 kg/ha and 22 kg/pond; and producers of >60 kg/year, 2,317 kg/ha and 39 kg/pond.

The small number, limited mobility and poor motivation of many DoF staffers makes it unsurprising that most fish farmers rely on more than just extension staff for information. Hecht and Maluwa (2003) found a high reliance among new fish farmers in the Northern Region on information from practising fish farmers. Andrews et al. (2003), on the other hand, found neighbouring fish farmers to be second after DoF extension staff nationally, though they also found farmer-to-farmer exchanges of information and expertise to positively correlate with pond productivity. The value of advice from neighbours is readily understandable as the common livelihood context may increase the relevance and credibility of their innovation recommendations (Banda 1989). These factors illustrate the need to promote farmer-to-farmer extension methods, the formation of fish farmers' clubs and the "lighthouse concept" of supporting highly successful fish farmers to disseminate extension messages.

Additional important sources of extension information are on-farm training courses, which Andrew et al. (2003) found to be the most significant difference between small-scale farmers who achieve higher production levels (>20 t/year) and those who achieve lower production levels (0-20 kg/year). Finally, a large proportion of fish farmers rely on the government extension radio programme Usodzi wa Lero,[9] and again the most productive fish farmers report the greatest use of this medium (Andrew et al. 2003). Indeed, in the Southern Region, Petry (1996) found that 74% of the fish farmers listened to it every week. Overall, the most productive fish farmers make greater use of alternative sources of information (neighbours, radio programmes and training programmes) than do less-productive fish farmers, but new fish farmers' overwhelming dependence on DoF extension highlights the continuing need for these extension services and for DoF support in developing local information-exchange networks (Andrew et al. 2003).

The most significant difference in terms of access to information between fish farmers in different regions was the relatively high access to DoF extension enjoyed by fish farmers in the Northern and Southern regions (in most districts over 50% and in three districts over 70%). In contrast, less

Table 4: Sources of information for fish farming (% of respondents)

Respondent status	No harvest	0-19 kg	20-59 kg	> 60 kg	Entrant	Ex-fish farmer
Family member	6.3	5.7	8.5	20.0	4.5	5.9
Neighbours	30.4	24.1	31.9	40.0	9.1	5.9
Observation	34.2	42.4	44.7	25.0	31.8	26.5
Farmers' club	21.5	13.9	21.3	25.0	13.6	0.0
DoF extension	57.0	52.2	72.3	70.0	63.6	29.4
NGO project	16.5	28.2	14.9	25.0	27.3	0.0
Reading material	0.0	2.0	6.4	0.0	4.5	0.0
Radio	25.3	22.0	31.9	40.0	9.1	2.9
School	3.8	2.4	0.0	5.0	9.1	2.9
Training	13.9	14.3	34.0	30.0	13.6	2.9
N = 563						

DoF = Department of Fisheries, NGO = nongovernmental organization.

Source: Adapted from Andrew et al. 2003.

9 Usodzi wa Lero, which translates to "modern fishery", is a weekly 15-minute radio programme for disseminating fisheries-related information. It was initiated by the Malawi-German Fisheries & Aquaculture Development Project, sponsored by GTZ, and was first aired on the most popular government-run radio station, MBC 1, on 20 July 1995 (Mueller and Saukani 2002).

than half of fish farmers in any district in the Central Region had access to DoF extension personnel. However, the IAA households in Dedza and Mchinji districts in the Central Region have, instead, relatively high access to extension services provided by NGO projects. Andrew et al. (2003) concluded that, unfortunately, despite the high numbers of people adopting fish farming as a result of NGO-sponsored projects, poor advice on pond size, site selection and integrating fish farming with other activities has frequently resulted in low productivity and rapid declines in interest.

Some of the most successful fish farmers' IAA strategies appear to be significantly influenced by household demographic characteristics that are impossible to recreate among new IAA households. Today's successful IAA households benefit from having had more time to experiment and more access to adult labour, higher education, and probably significant starting capital from other livelihood activities or migrant labour. This may illustrate how extension services need to focus on supporting the majority of fish farmers. Whereas better-educated fish farmers may be more successful due to their higher levels of education and should therefore be better able to make use of information that they read or hear, poorly educated fish farmers who are less effective agricultural producers to begin with may need even more extension staff visits, training opportunities or mentoring by nearby fish farmers. Particular attention needs to be paid to helping them understand the gains from increasing efficiency in all livelihood activities (Dey et al. 2007).

Regardless of IAA household productivity levels or sources of extension information (whether DoF or NGO) — and although respondents may have been motivated by their hopes of attracting more assistance — Andrew et al. (2003) found widespread dissatisfaction from small pond sizes, poor fish growth, poor harvests and a lack of technical support. Therefore, all representations of high and low access to extension information must be seen in relative terms, and Hecht and Maluwa (2003) underscore the low motivation among field staff of the inadequately financed and supported DoF. Furthermore, the analysis by Andrew et al. (2003) is based on a sampling from communities in areas that have been identified as highly suited for aquaculture and are therefore biased in favour of areas where aquaculture has already achieved some success. Given the resource and staffing limitations in DoF, access to extension personnel for rural residents living in areas not identified as ideally suited for aquaculture can be expected to be minimal.

4.5 MACRO-LEVEL POLICIES FOR AQUACULTURE

Malawi's National Fisheries and Aquaculture Policy (2001) is an integral part of national development objectives aiming to improve the government strategy for poverty eradication. Its foci are on increasing income and employment, improving fish supply and distribution by targeting marketing and quality, and involving the private sector in the development of the fisheries industry. The policy provides operational guidelines for aquaculture development, which include the development of protocols for managing and conserving the genetic diversity of farmed fish. Further, an additional control mechanism has been formulated to protect aquatic biodiversity (FAO 2005a).

Recognizing the impacts of poverty, overdependence on natural resource-based subsistence livelihoods, and poor community capacity for water management, the policy specifically identifies upland aquaculture as a future means toward Malawi's achievement of Millennium Development Goal (MDG) 7b: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources. In addition, a number of other objectives associated with addressing MDG 1 (halve the proportion of people living in extreme poverty) have direct implications for rural aquaculture development, namely (GoM 2005b)

- empowering the poor to have access to loans and credit, and facilitating the establishment of credit cooperatives and/or village banks;

- improving access to agricultural inputs among the poor through targeted input and starter pack programmes;
- reducing the price of fertilizer and other agricultural inputs for poor rural farmers;
- developing viable small, medium and large irrigation schemes to supplement rainfed agriculture;
- introducing water harvesting by constructing village earthen dams;
- providing financial support for the capitalization of village-based credit schemes;
- encouraging crop diversification and livestock intensification to decrease over-reliance on maize meal;
- introducing new agricultural sector reforms to develop and strengthen the capacity of smallholder farmers to increase their output;
- increasing business management training and skills development for poor farmers; and
- facilitating private sector reform programmes to increase employment and job-creation opportunities.

The Malawian government's strategy for achieving the MDGs "focuses on new wealth creation by pursuing growth strategies based on private sector development and modernized agriculture for food security, and export diversification" (GoM 2005b). A number of achievements already listed by the Malawian government toward attaining the objectives above illustrate this (GoM 2005b):

- New agricultural programmes have been initiated to improve the agricultural sector, including intensified production of other cash crops such as cotton, wheat and cassava.
- Adopting a microfinance policy and forming a microfinance network has increased the number of people accessing loans.
- The MWK5 billion (then $36 million) Malawi Rural Development Fund was established to disburse loans to the poor in rural and urban areas.
- The "One Village One Product Scheme" was established to encourage people to specialize in value-adding processes.
- The volume of starter packs increased from 17 kg to 31 kg per household.
- Four-hundred treadle pumps were freely distributed to smallholder farmers through members of Parliament in 187 constituencies to increase the area under irrigation.
- Abandoned irrigation schemes covering 40,000 ha were rehabilitated for smallholder production of maize, rice and vegetables.
- A MWK5.2 billion universal fertilizer subsidy was introduced targeting smallholder farmers.
- The formation of small-scale mining clubs and agro-processing cooperatives was initiated.

Building on the MDGs, the Malawi Growth and Development Strategy of 2005 (GoM 2005c) expands on the role that the government envisages for small-scale aquaculture. This document recognizes that one significant factor keeping the nation's rural population poor is its extensive use of natural resources, and it sees as key to reducing both poverty and natural resource degradation the intensification of rural production systems. Though not identified as valuable for intensifying agricultural production systems, small-scale fish farming is nonetheless listed as one of the key strategies for ensuring fish availability for food and nutrition security and income generation.

To help DoF achieve its mission in relation to aquaculture in line with the MDGs and the Malawi Growth and Development Strategy, JICA funded the development of the National Aquaculture Strategic Plan (NASP). In this plan, DoF and its partners have identified a number of strategic themes aimed at addressing key contextual constraints that currently limit the growth and productivity of aquaculture in Malawi (Table 5). Among others issues, this document elaborates on the government's vision for enhancing economic opportunities for commercial fish farmers and integrating NGO capacity to disseminate information and fish-farming inputs (SSC 2005). However, to protect endemic species of fish in Lake Malawi, the NASP has also established safeguards against the use of exotic fish species in aquaculture (FAO 2005a).

A number of national policies have direct impacts on the National Fisheries and Aquaculture Policy. For example, the Ministry of Agricultural and Livestock Development underscores in its Agriculture and Livestock Development Policy (1995) the aim of increasing livestock production by encouraging farmers to adopt aquaculture. In the National Water Resource Policy (2004) the need is mentioned to integrate fisheries and aquaculture into overall water development. The National Environmental Policy (2004) strives for the sustainable utilization, production and conservation of aquatic biodiversity (FAO 2005a).

The regulatory mechanisms for developing aquaculture are provided under the Fisheries Act, which attempts to ensure both the protection of the environment and the interests of the investor. The Fisheries Act gives responsibility to DoF for

Table 5: Strategic themes and strategies proposed in the NASP

Themes	Current situation	Strategies
Strategic Theme 1 Integration of aquaculture into rural livelihoods	Contribution by aquaculture to sustainable livelihoods is limited.	1. Providing the opportunity for all stakeholders to develop their capacity to enhance the integrated livelihoods approach, which includes aquaculture
Strategic Theme 2 Enhanced economic opportunity for commercial fish farmers	There are no small-scale dedicated fish farmers in Malawi. There are two emerging large-scale commercial aquaculture operations.	2. Enhancing institutional capacity of NAC to develop medium- to large-scale commercial fish farming technologies 3. Providing an appropriate credit, business training and technology package for small and medium-scale commercial fish farmers 4. Creating a regionally competitive and investor-friendly environment through a sound policy, clear procedure and legal framework 5. Ensuring aquaculture activities are environmentally responsible and sustainable 6. Establishing links and information flows between producers and fish traders to enhance access to markets
Strategic Theme 3 Competent local government, NGOs and producer organizations	Low levels of recognition and poor technical skills relating to aquaculture in local government and NGOs	7. Sensitizing and building the capacity of local government on their primary responsibilities in aquaculture development 8. Developing alliances between DoF and NGOs to promote unified approaches in aquaculture extension 9. Fostering fish producers' organizations that help farmers increase production and access financing, markets and services
Strategic Theme 4 Smart and practical DoF	Ineffective and inefficient service delivery by the DoF	10. Building healthy DoF financial resource 11. Realizing efficient DoF operation 12. Promoting quality DoF staff and information

DoF = Department of Fisheries, NAC = National Aquaculture Centre, NASP = National Aquaculture Strategic Plan, NGO = nongovernmental organization.

Source: System Science Consultants Inc. 2005.

issuing aquaculture permits and enforcing compliance with the regulations set up to govern the management of aquaculture. The Fisheries Act stipulates that all aquaculture activity on 4 hectares or larger requires a permit,[10] the creation and maintenance of exact records, and proper monitoring to reduce the risk of spreading diseases (Schedule 14 of the Fisheries Conservation and Management Regulations 2000). The main regulations governing aquaculture are outlined in Part X, Section 38-43, of the Fisheries Conservation and Management Regulations (2000). Finally, regulatory mechanisms are put in place to protect the operator of an aquaculture unit if mistakes are made in implementing the law (FAO 2005b).

In 2006, aquaculture received additional political visibility with the Presidential Initiative on Aquaculture Development (PIAD 2006). In this document, Dr Bingu Wa Mutharika, the president of the Republic of Malawi, renewed the "focus of the Government of Malawi in bringing economic growth through active participation of various stakeholders to increase fish production from aquaculture from the current 500 metric tonnes to over 5,000 metric tonnes by 2011".

4.6 LAND AND WATER TENURE POLICIES

The Malawi Land Act (1965) recognizes three categories of land: private, public and customary, whose administration is governed by the Ministry of Lands and Valuation (GTZ 1997). Private land is defined as land for which individuals hold either freehold or leasehold title documents. All land that is occupied, used or acquired by the government of Malawi, including agricultural estates purchased for resettlement, forestry reserves and lapsed leasehold land, falls under the category "public land". Customary land is all held, occupied or used according to customary tribal law (ICLARM and GTZ 1991).

The largest proportion of agricultural land in Malawi, about 80%, falls under the classification of customary land. The president is chief trustee custodian of these areas, but they are administered by the traditional authorities (TAs) and their subordinate group village heads according to local custom (ICLARM and GTZ 1991). These chiefs allocate the land to particular individuals or families who cultivate it but cannot sell it to people outside of their kinship group (GTZ 1997). This principle of usufruct (use) rights to land is common to many parts of Africa and provides some balance between the rights of individuals and the needs of the larger community. However, as discussed below, not every community member has equal rights to land or other natural resources in a community. This has significant impacts on the ability of potential small-scale farmers to use land as collateral for the bank loans needed for start-up investments.

In the Northern Region of Malawi (particularly among the Tumbuka, Ngonde and Ngoni ethnic groups), kinship is predominantly patrilineal, in that it follows the male line, and patrilocal in that women move to live in the man's village upon marriage. As fish farming, like livestock rearing and the growing of most cash crops in Malawi, falls primarily under the control of men (though women and children may supply much of the labour), there are greater incentives in these areas for men to invest in land enhancements such as the planting of trees and the excavation of fishponds.

However, among most of the ethnic groups in the Central and Southern regions (particularly the Chewa, Yao and Lomwe ethnic groups) and the Tonga in the Northern Region, descent is largely matrilineal, and residence is uxorilocal (matrilocal), which may significantly limit a man's ability and willingness to invest in fishponds. In these societies, upon marriage, a man takes up residence in his wife's village, where all the land belongs to a group of related women. The man cannot make any claim over resources other than through his wife, and any inheritance in land use naturally passes to the daughters, who will remain

10 Of the 7,000-8,000 fish ponds in Malawi, according to the DoF fish pond database, this regulation is relevant to only the 30 fish ponds funded by the Malawi Social Action Fund programme.

in the village. Some policymakers in Malawi have suggested that men's lack of decision-making power in their wives' matrilineal villages, and their inability to pass their investments on to their own sons due to uxorilocal settlement patterns, discourages long-term activities such as tree planting or fishpond digging (Hansen et al. 2005).

However, these forms of tenure are highly idealized. In reality, land and resource tenure customs have always been able to accommodate newcomers' needs, and the disincentives described above for men to invest in fish farming are negative only if seen through the lens of an individualist, patrilineal society. An opposing viewpoint may be that, by depending on matrilineage approval, any use by men of the community resources may better reflect the needs of the community as a whole rather than that of the family or individual. Indeed, Ruddle (1996) found social recognition of the validity of a claim to be more important than the nominal social structure, meaning that customary law not uncommonly provides long-term security to a male cultivator in a matrilineal society. Ruddle argues that, in Malawi, other limiting factors such as labour scarcity may be a greater reason for the failure to make long-term investments.

Meanwhile, many traditional (if idealized) norms are weakening. Education, urban migration, the growth of a cash economy with its emphasis on individualism, and overpopulation relative to the availability of arable land have brought significant changes. Additionally, perceptions of modernity and the Western or Christian emphasis on the nuclear family have brought profound differences in how individuals organize their households and livelihood strategies (GTZ 1997). These changes in Malawian society were reflected in the Malawi National Land Policy (2002). In this policy, the Malawian government recognized the trends towards privatizing land rights in the customary sector and created a customary estate of "private usufructuary rights in perpetuity" on land managed by smallholders (GoM 2002). It also incorporated the concepts of nuclear households and gender equality and "protects the right of inheritance directly by the children and the surviving spouse … without discrimination on the basis of gender" (GoM 2002).

Despite the apparently emancipatory language of this policy, Ferguson and Mulwafu (2005) have raised concerns whether women in matrilineal areas will be able to protect their customary claims to land if they are forced to negotiate this with their husbands. Additionally, they question whether women in the patrilineal north will be able to realize their newly found rights. This is supported by findings from various parts of Africa, where transitions from negotiated customary rights to formalized rights have frequently resulted in outcomes that are particularly disadvantageous to poorer, more marginalized populations, ethnic minorities and women (Cleaver and Toner 2006, Nijenhuis 2003, Cotula and Cissé 2006, Beeler 2006, Kone 1985, de Bruijn and van Dijk 2006, Raynaut 2004).

The principal law governing the ownership and use of water in rural areas of Malawi is the Water Resources Act (1996), which is administered by the Water Resources Board within the Ministry of Irrigation and Water Development. Kafakoma and Silungwe (2003) report that people in Malawi perceive water as a God-given resource that belongs to every person in the community: "Rural communities believe that water can be used for any purposes including irrigation (small or large scale) without any need to get a water right from government. [However,] Section 5 of the Water Resources Act stipulates that any person has the right to use public water without a water right *for domestic purposes only* (emphasis added)." This means that one is legally required to obtain water rights from the Ministry of Water Development for any activities like fish farming and irrigation. However, the authors found that 90% of farmers interviewed were unaware of this regulation and had no idea how they could obtain the water-use rights (Kriesemer and Grötz 2008).

Though poorly documented in relation to pond aquaculture development in Malawi, conflicts over access to water are increasingly becoming an issue of concern in rural communities where pond culture is practised.[11] In some areas where fishponds receive their water from irrigation schemes, fee-based systems regulate access to water supplies, with fish farmers at a disadvantage as they pay a higher rate than do rice farmers. During times of limited water availability, fishpond farmers use the higher cost to argue that they should have preferential access. As fish farmers are among the more livelihood-secure households of their communities (see section 7.1), such preferential access could increase the vulnerability of poorer households that do not farm fish.

However, most fish farming does not depend on irrigation schemes but competes directly with other users of communal water resources. Ferguson and Mulwafu (2004) have documented that women's priorities in water use frequently differ significantly from those of men. They are the primary gender group engaged in growing food crops (as opposed to cash crops) and are tasked with fulfilling most household needs for water such as for washing and drinking. Despite women's greater influence in matrilineal communities, cultural gender norms of modesty and conflict aversion, combined with poorer levels of education among rural women, may also prevent women from effectively engaging in public debates over the uses of rural resources. Consequently, in view of the growing rural populations in Malawi and existing shortages of water for domestic use in the dry season, a gender-sensitive perspective on access to water should be incorporated into aquaculture decision making and development programmes.

In relation to growing interest in cage aquaculture, additional aspects of access rights to Malawi's water bodies come into question. Under Malawi's Land Law, its water bodies are resources held in public trust for the nation as a whole and therefore cannot be sold or leased. In the case of small-scale community-based cage-culture projects on smaller water bodies, cage-culture operators should be able to gain permission from the local TAs within whose jurisdiction the water bodies lie (Windmar et al. 2008). For Lake Malawi, however, the government has not yet established a legal basis for granting exclusive access to portions of the lakeshore, and risks for potential investors in large-scale cage culture remain significant.

Both small- and large-scale cage-culture projects may be prone to conflict for several reasons. Firstly, any high concentration of fish raised in a confined area presents an excellent target for theft that cannot be proven once the fish is brought to shore. Additionally, feed supplied to cages is equivalent to a fish-aggregation device. Consequently, fishers seek to fish close to the cages, possibly causing conflicts over access to these choice fishing grounds. Given the evidence of TAs' corruptibility in relation to other local fishing institutions, (Russell et al. 2008) the chiefs' permission cannot be taken as a guarantee of community acceptance or support for a cage-culture project.

With the need for a better understanding of the ecological and socioeconomic side effects of cage-culture projects, the Malawian government has so far issued only one cage-culture license, to the Malawi Development Corporation (Windmar et al. 2008). Before investors will be willing to invest significantly in cage culture, the government needs to provide clear regulations and guidelines as to the locations, size and density of cage-culture operations permitted, in order to avoid conflicts with other users of water bodies, and to create a clear legal basis by which small-scale fishers' access to certain water bodies may be limited.

11 Joseph Nagoli, WorldFish Center, personal communication 27 March 2008.

5. NATIONAL AQUACULTURE PRODUCTION

5.1 CURRENT AQUACULTURE PRODUCTION SYSTEMS

The physical production process consists of pond construction, acquisition of water, stocking, feeding, fertilizing, harvesting and routine pond maintenance. But implicit is the foregoing decision to adopt fish farming, with its attendant demands for pond management; routine investments in resources, labour and capital; and institutional support to sustain the complete process (Ruddle 1996).

The season most conducive for fish breeding and growth in Malawi is from November to February, during the peak of the rainy season. Unfortunately, this is also the lean period in terms of food production, causing many Malawian households to harvest fish prematurely.

Most ponds in Malawi are fed by an inlet channel but have no outlet. Seepage and evaporation largely determine the amount of water remaining in the pond. As the majority of fish farmers are unable to completely drain their ponds, they can harvest only part of their fish crop. Recently, a few fish farmers have installed inlet and outlet pipes made of polyvinyl chloride or bamboo (Hecht and Maluwa 2003).

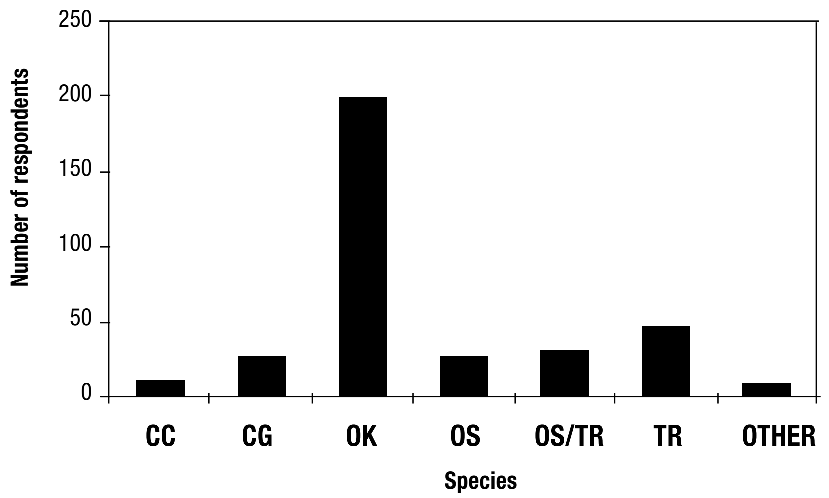
According to Malawi Gold Standard guidelines (Jamu et al. 2006), an ideal production calendar for Malawi requires ponds to be stocked in mid-December and harvested in mid-March, allowing a second production cycle to run from April to August and leaving the months of critical water shortages (September to November) for pond renovation. However, most fish farmers in Malawi currently have only a single production cycle of at least 6 months in duration, spanning most of the months when water is available. Rather than maximizing the final harvest, therefore, regular partial harvests are the norm, as discussed below.

SPECIES CULTURED

The main species currently farmed in both smallholder and commercial aquaculture operations in Malawi are the three tilapia species — *Tilapia rendalli* (chilunguni), *Oreochromis shiranus* (makumba), *O. karongae* (chambo) — and the catfish *Clarias gariepinus* (mlamba). The three tilapia species account for 93% of the production, catfish for 5%, and exotic species such as common carp, black bass (*Micropterus* sp.) and trout 2%. Interestingly, while the FAO (2005b) sector review indicates that the two most popular cultured species in Malawi are *O. shiranus* and *T. rendalli*, accounting for more than 90% of the total fish production by aquaculture, a household survey (Figure 6) by Andrew et al. (2003) found *O. karongae* to be the single most commonly farmed fish (by roughly half of fish farmers), while *T. rendalli, O. shiranus, C. gariepinus* and *T. rendalli/O. shiranus* combinations were each practised by around 10% of fish farmers (see also Hecht and Maluwa 2003). Noble and Costa-Pierce (1992) found the most productive cichlid combination among fish farmers in Malawi to be that of *T. rendalli* and *O. shiranus.*

Among those fish farmers selecting *O. karongae* and *C. gariepinus*, preference was largely defined by fish size, which is closely associated with the sale price (Andrew et al. 2003, Hecht and Maluwa 2003). In contrast, the selection of *T. rendalli*, *O. shiranus* and *T. rendalli/ O. shiranus* combinations appears to be largely defined by rapid breeding and easier access to fry (Andrew et al. 2003, see also Hecht and Maluwa 2003), a perception that is supported by research (Maluwa and Dickson 1996). However, these preferences are also affected by the lower average water temperatures in the Northern Region, which result in significantly lower growth of *O. shiranus* there than in the Southern Region (Hecht and Maluwa 2003). Consequently, as Hecht and Maluwa (2003) reported, some farmers in the Northern Region have shifted from *T. rendalli/O. shiranus* combinations to *T. rendalli* monoculture for the higher yield obtained per unit of area and the production of larger fish. Additionally, *T. rendalli* is selected by some fish farmers for its superior flavour (Andrew et al. 2003, Hecht and Maluwa 2003), although the juveniles suffer low survival rates. Andrew et

Figure 6: Fish species preferred by fish farmers in Malawi



CC = *Cyprinus carpio*, CG = *Clarias gariepinus,* OK = *Oreochromis karongae,* OS = *Oreochromis shiranus,*
TR = *Tilapia rendalli.*

Source: Andrew et al. 2003.

al. (2003) found that the choice of species did not appear to be related to the size of farmers' fishponds (Andrew et al. 2003).

To protect Malawi's fish biodiversity, the Fisheries Conservation and Management Act (1997) restricts the introduction of exotic species (Hecht and Maluwa 2003). One of the fast-growing exotic species, common carp (*Cyprinus carpio*), was introduced into Malawi in 1976, but in 1992 further importation and distribution to farmers was prohibited. Contrary to expectation, the common carp breeds successfully in smallholder ponds and is still being produced in some ponds in the Lower Shire area (Msiska and Costa-Pierce 1996, Andrew et al. 2003). It is selected and maintained as a preferred species predominantly for it size and price and, to a lesser extent, for its flavour (Andrew et al. 2003).

Since the establishment in 1959 of the Domasi Experimental Fish Farm (now known as NAC), the majority of research has focused on the genetic improvement of *O. shiranus* and *O. karongae*, developing suitable technologies for the production of *Clarias gariepinus*, and testing the suitability of various indigenous cyprinid species (Kaunda 2003).

STOCKING DENSITIES

In the culture of tilapiine fish, a major issue is their precocious breeding, which causes severe stunting, and farmers' lack of knowledge and resources to control the number of fingerlings in their ponds. Extension services have promoted a fingerling stocking density of 2-3 fish per square metre (m^2) to accommodate the inferior nutritional content of the commonly used farm by-products in Malawi, principally maize bran and green manure (discussed below). However, Hecht and Maluwa (2003) recommend a stocking density of 4-5 fish/m^2 to compensate for the high mortality rates resulting from transport and transfer stress. Additionally, high levels of predation provide an incentive to use higher stocking densities and cheaper fingerlings.

Based on a market analysis of fish demand conducted by WorldFish in connection with the development of the Malawi Gold Standard programme, production targets the small to medium-sized tilapia (100-150 grams [g]) that are more affordable for poorer consumers. This programme recommends a fish-stocking density of 5 fish/m^2 and educates fish farmers on how to improve fish growth with more nutritious fish feeds that incorporate protein-rich ingredients such as soybean and/or fertilizers (COMPASS II 2007).

Most fish farmers in Malawi do not record the number of fish stocked or harvested. Hecht (1996) found during a rapid assessment of fish-farming practices that 87% of the farmers interviewed in the Southern Region and 100% of those interviewed in the Northern Region had no idea about the number of fish in their ponds.

FINGERLING PRODUCTION AND DISTRIBUTION

Hecht and Maluwa (2003) report that before 1994 all farmers were largely dependent on DoF hatcheries for fingerlings. However, the interventions by the major aquaculture projects have reduced farmers' dependence on these hatcheries, as they encouraged fingerling exchanges within and between fish farmers' clubs and farmer-to-farmer sale of fingerlings. At the same time, subsidies for fingerlings from DoF hatcheries have been reduced in recent years. While Andrew et al. (2003) concluded that NGOs play a valuable supporting role in fingerling dissemination in areas where the DoF is underrepresented, the greater relative reliance of more effective fish farmers on fingerlings provided by DoF and self-raised fingerlings may support concerns regarding the quality of fingerlings that some NGOs provided, having sourced them mainly from other farmers. Indeed, the less-productive fish farmers in this same study were shown to rely to a greater degree on purchases from other farmers and NGO projects.

Andrew et al. (2003) speculate that increased reliance on poor-quality fingerlings from these other sources partly explains poor production levels. Hence, government hatcheries still appear to have a role in providing quality fingerlings, because relatively few farmers in Malawi can consistently produce them. Hecht and Maluwa (2003) recommend that DoF hatcheries focus on appropriate transferable techniques such as hand sexing[12] and catfish fingerling production, the genetic improvement of seed stock, and proper feeding methods. Whereas tilapids may be bred relatively easily by small-scale farmers, on-farm production of catfish fingerlings remains a major challenge because advanced techniques are needed to induce the species to reproduce in ponds.

Government estimates put the fingerling production capacity of the two largest DoF hatcheries at NAC and Kasinthula at over 1 million fish per year. NAC therefore reckons that fingerlings are available at any time for distribution to farmers throughout the country (Hecht and Maluwa 2003). In reality, the lack of effective transportation hampers fingerling distribution from government hatcheries, and hence fingerling distribution depends on NGO involvement (GTZ 1997). Access to quality fingerlings is particularly challenging in areas where farmers are widely dispersed, which was raised as a significant limiting factor to fish farmers' productivity by Andrew et al. (2003), who found that fingerling scarcity was reported by 25% of ex-fish farmers as the main reason for their discontinuation. Hecht and Maluwa (2003) concur in concluding that this is a key area where more government support is needed.

The current poor production level partly reflects the poor quality of fingerlings provided both by NAC and small-scale farmers. The fingerlings tend to be harvested from mixed-sex production ponds and frequently comprise fish that grow suboptimally or are the off-spring of early-maturing tilapia.[13] Consequently, small-scale farmers receive supplies of fish with undesirable traits such as early maturation and slow growth rates.

12 Though a labourious technique, this method allows a farmer to visually differentiate between male and female fish once they reach a size of at least 20 g. A 100% male population grows 25-30% faster than a mixed population. An alternative to this method, which some scientists argue for, is the more effective hormonal sex reversal, which turns all fish in the pond into males.

13 Lars Windmar, WorldFish Center, personal communication 27 March 2008.

Given the low numbers and scattered distribution of small-scale fish farmers, domestic demand for fingerlings is not now sufficient to interest significant investment by the private sector.[14] Only two privately owned larger-scale hatcheries are in existence; one was established in Zomba with technical assistance from the USAID-funded COMPASS II programme,[15] and the other is a communally owned fish hatchery of the Khosolo community in Mzimba District, which was established in association with ActionAid's fish-farming programme (Phiri and Nagoli 2005).

FEEDING, POND INPUTS AND FERTILIZATION

As illustrated in Table 1, the largest NGO-funded fishponds in Malawi reach sizes of up to 8,258 m^2, but the average pond acreage owned by individual fish farmers is typically around 200 m^2. Ponds are typically rectangular. Among those fish farmers who stock *O. shiranus* and/or *T. rendalli* (roughly 30% of fish farmers), ponds are constructed and filled to a maximum depth of 1.0-1.5 m, while those fish farmers who specialize in *O. karongae* (about 50%) may have maximum pond depths approaching 2.0-2.5 m.

Over 90% of all fish farmers use primarily maize bran (*madeya*) as fish feed. This feed ingredient has been recommended by extension services since the 1940s, but it has low gross protein content (2-3%) and a poor food-conversion ratio (FCR) of 12-20:1 (Hecht 1999).

While the availability of madeya is usually good, it can vary by region or season, and when there is a general shortage of maize (the Malawian food staple), maize bran may need to be consumed directly by poorer families. Additionally, while the optimal feeding rate is 5% of body weight per day, such high volumes are rarely available to farmers, so a rate of 3% of body weight per day is the practical recommendation of the extension service (Hecht and Maluwa 2003). The slow growth rate of fish and low pond yields reflect the poor nutritional value of the feed.

The fish farmers with the highest pond productivity are also the most food secure and usually have maize bran or other animal feed (intended mainly for chickens) available to use as fish feed throughout the year. Farmers who are less successful in their general agricultural production may experience a shortage in maize bran, particularly during the rainy season. With the exception of the most productive IAA households (producing >60 kg of fish per year), access to nutritional inputs is identified as a key constraint by all fish farmers surveyed by Andrew et al. (2003) — and notably by 38% of ex-fish farmers.

Besides madeya, other farm by-products that have significantly higher FCR would be better fish feed (Table 6). A more focused extension effort is needed to educate IAA households regarding the nutritional value of their various farm by-products. Hecht and Maluwa (2003) argue for controlled FCR and digestibility studies of possible substitute farm by-products.

The period of peak fish growth happens to coincide with the period when farm households face difficulty maintaining food

Table 6: Selected farm by-products and their nutritional value

By-product	Crude protein (% of dry mass)
Maize bran	2.1
Stover	6.3
Cassava leaves	25.9
Sweet potato leaves	19.4
Grasses	7.0-11.0
Banana leaves	9.9
Pawpaw leaves	26.8

Source: Hecht and Maluwa 2003.

14 Lars Windmar, WorldFish Center, personal communication 27 March 2008.

15 Lars Windmar and Joseph Nagoli, WorldFish Center, personal communication 31 March 2008.

self-sufficiency. This is the time, particularly during the warm months of the rainy season from December to February, which is the crop-growing season and when stored food is depleted. Competing demands for by-products during this lean period reduce the amount and variety of feed inputs available for fish production. Andrew et al. (2003) argue that, in many cases, increases in fish production can therefore be expected only if agricultural production broadly improves. Similar conflicting needs are encountered by households' limited supplies of manure, aggravated by most small-scale farmers' inability to afford inorganic fertilizer in large quantities, if at all.

Aside from issues of availability, evidence exists that farmers are still not fully aware of the benefits of using such alternative inputs as composted maize stover, cassava leaves, sweet potato leaves, buffalo bean grass, antelope grass leaves, giant grass leaves, napier grass, mulberry leaves, *Leucana* leaves, banana leaves, pawpaw leaves, cabbage leaves, leftover homestead food such as *nsima* (traditional maize porridge) (Hecht and Maluwa 2003), and ash from kitchen fires (Jamu and Costa-Pierce 1993), or of the importance of adhering to scheduled feeding times (Hecht and Maluwa 2003, Andrew et al. 2003). Additionally, Hecht (1999) documented the success in northern Malawi of an innovation brought about by the Border Zone Development Project that promotes feeding fish cooked home-grown soybeans. Hecht documented an FCR of 3:1 and found that profit margins from the sale of fish fed on soybeans was 34% higher than for fish fed on maize bran.

The achievement of higher production rates by recycling nutrients is a core objective of WorldFish's IAA programme (Brummett 1994), and, as discussed below, has been shown to increase incomes from both farming and fish culture (Dey et al. 2007). Smallholders are advised by DoF extension to improve growth rates and yields by applying agricultural and household by-products totalling 35 kg of dry matter/ha/day, increasing with standing stock up to a maximum of 120 kg/ha/day. Although such amounts of dry matter are normally available on small-holder farms, according to Brummett (1997), a lack of labour, or competition for it with other farm activities, limits the amount actually put into the pond. As access to extension information is higher in the south, it is no surprise that vegetable stover is more commonly used as food for *T. rendalli* in the Southern Region (83%) than in the Northern Region (52%) (Hecht and Maluwa 2003).

Farmers who own livestock such as cattle, pigs and chickens make some use of manure to enhance pond productivity, but most of these resources are used to fertilize agricultural crops. Furthermore, most farmers do not own enough livestock to obtain sufficient manure quantities to fertilize their ponds (i.e., they do not have enough chickens or do not rear chickens in a confined space for collecting the manure) (Hecht and Maluwa 2003). Hecht and Maluwa (2003) suggested, therefore, that actively promoting the use of inorganic fertilizers would be a more practical and feasible solution. For many farmers, the cost of purchasing fertilizer is prohibitive, but since 2007 fertilizer prices have been subsidized by the government and kept at 25% of the market price. Despite this, and probably due to the lack of high-quality seed and feed, most fish farmers apparently are still unwilling to invest valuable inorganic fertilizer in their fishponds.[16]

Harrison (1991) mentions problems convincing farmers to use manure in their ponds in Malawi. In some cases, this is not for lack of organic material but rather because the farmers do not want their ponds to have a murky brown colour (Harrison 1991). Msiska (1987) documented a traditional belief among some Malawian fish farmers that manure directly consumed by the fish would impart unwanted flavours to the fish and diminish its commercial value.[17] While culture-specific tastes may differ, and

16 Lars Windmar, WorldFish Center, personal communication 27 March 2008.

17 While fish directly ingest some manure, the bulk of it dissolves in the water or drops to the bottom of the pond and supplies nitrogen and phosphorous needed to stimulate the growth of plankton, which is the main source of food for tilapia.

although consumer perceptions regarding "manure-fed" fish may indeed affect prices, taste tests by Moav et al. (1977) and Eves et al. (1995) suggest that manure-fed fish are actually preferred over pellet-fed fish.

ACCESS TO CREDIT

Regardless of the type of aquaculture system used, some capital is needed to start fish farming. The decision to construct a fishpond requires the farmer to invest significantly at the outset in wheelbarrows, buckets, hoes and hired labour for pond construction, as well as purchase fish seed, supplementary fish feed and pond fertilizer. Once the pond is in operation and the basic tools have already been purchased, capital expenditures are low as pond maintenance, feeding and harvesting can be managed with family labour and resources available on the farm (e.g., by-products).

Labour and pond inputs may be obtained either for cash or through payment in kind or by reciprocity. However, cash payments have opportunity costs, and reciprocity relationships have been described as declining as rural poverty intensifies. Additionally, most rural African households have limited capital to invest, in the form of either cash or physical assets, and formal credit is rarely available to small-scale farmers. Households that start fish farming in Malawi typically need an infusion of initial start-up capital (Ruddle 1996).

However, poorer fish farmers who lack start-up capital and have little access to income from migrant remittances[18] may be unable to afford the feeds, fertilizers and labour needed to recover their costs, either in cash or in kind. This conclusion is supported by the findings of Andrew et al. (2003) that a disproportionate percentage of recent ex-fish farmers are under the age of 30. Consequently, unlike the case with many of the effective fish farmers today, the expansion of fish farming to populations who lack the household labour or capital needed may require significant investments by NGOs and donors in micro-credit schemes.

An attempt to facilitate access to credit was integrated into the Malawi Gold Standard programme. Fish farmers who successfully established a business plan according to Malawi Gold Standard recommendations were able to access credits for their fish-farming business as of 2007. The two banks involved were the National Bank of Malawi and the National Building Society Bank, who gave credits of up to $7,000 at an annual interest rate of around 19%.[19] Unfortunately, the banks suspended the loan programme in January 2008 in response to loan defaults by some fish farmers who appear to have used the loans for investments primarily unrelated to fish farming. A careful analysis of this programme is needed, but a number of factors have already been raised as probable contributors to its failure:

- high interest rates set by the banks;[20]
- unrealistic expectations regarding fish growth rates, given poor farmer access to improved fish feeds;[21] and
- the lack of technical and supervisory support for fish farmers by extension staff at all stages of production.[22]

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18 Many Malawians travel abroad regularly in search of well-paying jobs and either send remittances to their relatives back home or return themselves to invest them. This started in the early 1900s as Africans were forced into the service and plantation sectors in order to pay colonial taxes in cash (White 1987, Ng'ong'ola 1990). Poor working conditions on Nyasaland's plantations rapidly induced growing numbers of Malawians to seek jobs in the better-paid mining and service sectors outside Malawi, in particular in the Rhodesias (today Zimbabwe and Zambia), South Africa, Belgian Congo (today Democratic Republic of the Congo), Mozambique and Tanzania (Tew 1950, Coleman 1974, McCracken 1977, Mandala 1990, Ng'ong'ola 1990, McCracken 2002). Remittances from this migrant labour would later become a key source of investment in a variety of livelihood activities that required significant initial capital. Since the 1990s, the ability of Malawians to travel abroad in search of work has become increasingly limited because of changes in demand for migrant labour and national policies, and migration is therefore less of an option today than it was in the past (Russell et al. 2008).

19 Joseph Nagoli, WorldFish Center, personal communication 31 March 2008.

20 Lars Windmar, WorldFish Center, personal communication 4 March 2008.

21 Lars Windmar, personal communication 4 March 2008; Randall Brummett, WorldFish Center, personal communication 26 March 2008.

22 Daniel Jamu, WorldFish Center, personal communication 27 March 2008.

5.2 CURRENT PRODUCTION LEVELS OF SMALL-SCALE FISH FARMING

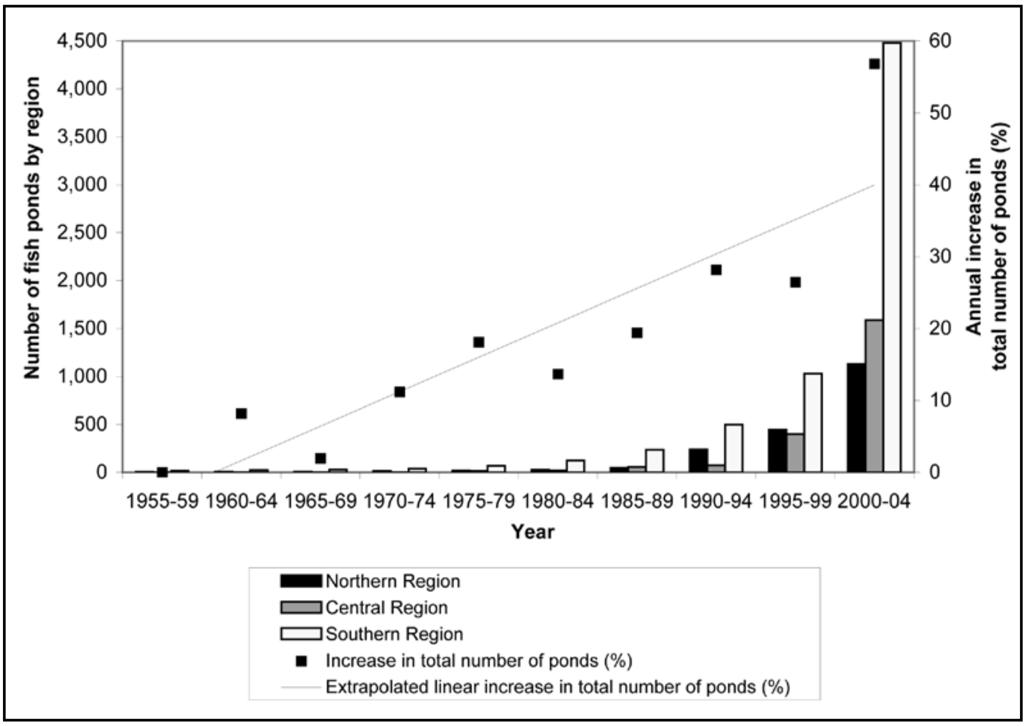
The aquaculture sector is currently estimated to provide about 2% of the nation's fish production and, among fish-farming households, to contribute up to 17% of household income, depending on the fish-farming activities pursued (Andrew et al. 2003).

DoF is tasked with maintaining a database with the number of fish farmers, the number of ponds and their surface area, funding sources, primary species cultivated, and the operational status of fish aquaculture in Malawi. However, the collection of such data is difficult (e.g., complicated by double-counting of people who use both traditional and modern names), and there are significant financial and logistical limitations that result in inaccuracies and gaps in the database. The figures should therefore be taken as indicators for the developing trend rather than as absolute values. Despite these caveats, it is clear that the number of ponds has increased significantly in recent decades from less than 100 in the 1960s to over 7,000 in 2005 (DoF database, PIAD 2006).[23] The trends in fish production for the three regions and the overall annual growth rate of fishpond construction are shown in Figure 7.

Given the challenges and shortcomings in data collection, estimates of overall fish-farming production in Malawi vary significantly (Table 7). In 2002, NAC estimated total aquaculture activity in the country to produce 800 tonnes of fish, with varying yields, depending on the level of intensification, from around 500 kg/ha/year to 2,316 kg/ha/year (NAC 2003).

However, several authors have commented that NAC estimates of annual production rates for 2002 of 197 kg per farmer and 85 kg per pond are unrealistically high. In 2003, based on their estimate of yield in

Figure 7: Trend in number of fishponds in Malawi (1955-2004)



Source: Department of Fisheries Database of Aquaculture, last updated 2006.

23 The extent to which all of these ponds are operational and well managed cannot be judged with any accuracy from the DoF database.

Table 7: Estimates of annual fish production in Malawi

Source	Year	National Production (tonnes/year)	Mean Productivity (tonnes/ha/year)
NAC (2003), cited by FAO (2005b)	2002	800	3.9
FishStat (2008)	2002	642	na
Hecht and Maluwa (2003)	2002	246	0.7-1.2
Andrew et al. (2003)	2003	50-117	0.7
PIAD (2006)	2005	500	na
Dey et al. (2007)	2005	1,000	na

FAO = Food and Agriculture Organization, FishStat = FAO Fisheries and Aquaculture Statistical Collection, ha = hectare, na = not available, NAC = National Aquaculture Centre, PIAD = Presidential Initiative on Aquaculture Development.

the Northern Region of Malawi (1.2 t/ha), Hecht and Maluwa (2003) extrapolated to a total national production figure of 246 t/year. That same year, Andrew et al. (2003) collected data from nearly 600 fish farmers throughout the country and arrived at an estimated total national fish production of 50-117 t/year. Chimatiro and Chirwa (2006) suggest that one reason for over-estimation by NAC and other sources is the small sample of target group farmers used as a basis for extrapolating productivity for the whole country. This is compounded by the almost complete absence of record keeping among fish farmers (Andrew et al. 2003, Hecht and Maluwa 2003) and poor funding and support for extension staff (discussed in section 4.4).

The most recent government statistics report the existence of 7,000-8,000 fishponds covering an estimated total area of 208 ha (PIAD 2006, DoF database). However, at least 980 of these ponds were not operational in 2005, and there is no information about the status of operation for another 1,800 ponds (DoF database). Pond sizes range from 105 to 8,460 m^2, but, as illustrated in Table 1, the vast majority of fishponds are 150-250 m^2 in surface area.

5.3 LARGE-SCALE COMMERCIAL AQUACULTURE

The mid-1990s saw several attempts at large-scale commercial aquaculture, which were assessed by the JICA-funded Aquaculture in Malawi Project (SSC 2005) as having failed “due to lack of proper financial planning, lack of commercial fish farming expertise, the absence of commercial aquaculture expertise at government stations and inadequate fingerling production capacity (quality and quantity)”. More recently, two larger-scale commercial fish farms were established in 2004, one by Malawi Development Corporation (MALDECO) Aquaculture in Mangochi District and the other by GK Aquafarms in the Lower Shire.

MALDECO is a subsidiary of Press Trust, the largest business empire in Malawi, and it operates the only large-scale mechanized fishing fleet on Lake Malawi. Declining catches of chambo have induced the company to diversify into cage culture. According to a study by Windmar et al. (2008), it has already invested several million US dollars in the development of juvenile production facilities, a feed mill and 48 imported salmon-type on-growing cages (circumference 50 m, depth 5 m, volume 995 m^3).[24] The cages are moored offshore of Mangochi District on Lake Malawi, and initial production projections were for 3,000 t/year. However, due to the technical challenges associated with developing any new, large-scale production system, current production rates reach only about 500 t/year (Windmar et al. 2008). MALDECO has indicated that it needs to achieve production rates of around 1,500 t/year to break even.

24 Details of these investments are not available, but each cage purchased from the Danish company Hvalpsund Net is estimated to have cost around $24,500, or roughly MWK3.43 million (www. hvalpsund-net.dk).

GK Aquafarms is located at Kasinthula in the southern district of Chikwawa. This company was recently granted a concession to rehabilitate 10 disused government-owned fishponds with a total surface area of 12 ha. The primary fish species being cultured are *O. mossambicus* and common carp (CTA 2007, FAO 2005a). The stocking rates in outgrowing ponds are 3-4 fish/m^2, and feeds include madeya, soy and beer production by-products. Feeds provided to breeding stock contain up to 42% crude protein (Jamu et al. 2006).

Additional planned investments in commercial aquaculture production are by Rift Valley Fisheries, which plans to produce 1,120 tonnes of tilapia in a recirculation system, and African Novel Resources, which has developed an ambitious plan to produce 12,000 tonnes of chambo in cage-culture facilities but does not yet have the funding or permits required to start (Windmar et al. 2008).

5.4 SMALL-SCALE CAGE CULTURE

In addition to the large-scale cage-culture initiatives undertaken by MALDECO and African Novel Resources, a number of organizations started experimenting in 2007 with pilot projects on small-scale community-operated cage culture. These are described by a recent assessment in Windmar et al. (2008), and include one project funded by JICA and two USAID-funded projects implemented by COMPASS II and Total Land Care. These projects are all in their infancy, however, and limited data regarding their feasibility or profitability is available.

JICA is developing, in collaboration with DoF, an experimental small-scale cage-culture project on Lake Malawi, in which it is testing the suitability and profitability of using cages manufactured with different materials and fish fed with different feeds. The volume of these cages is 80 m^3. The cost of the cages ranges between $1,429 and $1,695. They are stocked with *O. karongae* and *O. shiranus*, and the optimum rearing density is assessed by Windmar et al. (2008) at over 20 kg (final weight) per cubic meter. The cost of the cages ranges between $1,429 and $1,695. Over a 10-year period, the total cost of production per kilogram of fish (65% of which is the cost of feed) is estimated at $1.84 (MWK258). The combined cost of a boat, cages and nets is equivalent to $0.19/kg produced. Although this programme is in its infancy, given that 2007 prices for chambo approached $4/kg, the JICA design may be economically feasible for the private sector. Challenges remain, however, posed by poor fish growth rates to date.

The USAID-funded Compass II programme in collaboration with DoF is funding a small-scale community-based cage-culture project on Lake Chikukutu in Nkhotakota District. These cages are made exclusively from locally available materials, have a volume of 13.5 m^3 and are produced at a cost of around $250 each (MWK35,000). Unfortunately, this project has had poor results from the poor quality of feed (maize bran and green vegetation) and fingerlings. Regardless, Windmar et al. (2008) judge this water body to be well suited for small-scale cage culture. The USAID-funded Total Land Care project is following the Compass II cage design for a small-scale cage-culture trial in Chia Lagoon in Nkhotakota District. This project has faced its own challenges from the heavy turbidity of the rivers flowing into the lagoon and the large floating islands of vegetation, which have destroyed several cages. These factors prompt Windmar et al. (2008) to judge Chia Lagoon as poorly suited for cage culture.

Based on these very preliminary results, Windmar et al. (2008) judge the imported salmon cages used by MALDECO and the two different JICA cages to be the most feasible designs for use on Lake Malawi. The rough weather conditions encountered on Lake Malawi render the low-cost cages tested by Compass II and Total Land Care arguably unsuitable for that location, but they may be suited for smaller and more protected water bodies and some portions of Lake Malombe.

6. ECONOMICS OF AQUACULTURE PRODUCTION

This analysis is limited to the small-scale pond-based IAA system that is most widely practised in Malawi, as the large-scale, commercial pond culture, and both small and large cage-culture projects, are still in their infancy. Additionally, this background study does not look into the comparative profitability and livelihood gains that may be achieved by promoting other livelihood-diversification innovations or food production systems.

6.1 CHARACTERIZATION OF FISH-FARMING HOUSEHOLDS

A socioeconomic survey of fish farmers in Malawi by Andrew et al. (2003) provides a significant amount of data to supplement previous perceptions. Fish farmers were subdivided into three groups based on their total annual fish production (0-19 kg/year, 20-59 kg/year, and >60 kg/year). In addition to drawing comparisons among these groups, where applicable, researchers compared them with novice fish farmers, ex-fish farmers and residents of the same area that did not farm fish. Most of the fish farmers surveyed (54%) fell into the first category (producing 0-19 kg/year), and the more productive fish farms were owned by a minority of farmers (10% fell into the 20-59 kg/year class, 4% in the >60 kg/year class). The remaining fish farmers had no production that season.

Andrew et al. (2003) found that engagement in pond aquaculture was motivated primarily by household consumption needs, and to increase household income. Unsurprisingly, livelihood outcomes differed significantly depending on the amount of fish produced. Although quantification of outcomes is difficult because fish farmers keep almost no records, in addition to the challenges posed by strategic responses or faulty recall, overall livelihood patterns were reasonably consistent throughout the study. Andrew et al. (2003) described the more effective fish farming group as follows:

> The more productive fish farmers also tend to be the more productive farmers in general. These fish farmers also tend to be older [and] have larger families, more available adult 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 [and larger numbers of small livestock], have more diverse livelihood strategies and are less food insecure than less productive households. In terms of fish production, they produce more fish [both per hectare and per pond], have larger or more ponds and are more likely to feed their fish manure, compost and vegetable matter than the less productive farmers [who primarily feed fish with relatively nutrient-poor maize bran].

In addition to the characterizations above, several other observations are worth noting. Andrew et al. (2003), Dey et al. (2007) and Hecht and Maluwa (2003) all found that, on average, fish-farming households have more and better land under cultivation than households that do not farm fish. Andrew et al. (2003) showed that this was true regardless of the scale of aquaculture production. Their privileged position in rural communities also extended to their greater access to perennial water supplies over other farming households (Hecht and Maluwa 2003, Andrew et al. 2003). Within the group of fish farmers, unsurprisingly, larger-scale fish farmers consume a lower proportion of their harvested fish than do smaller-scale fish farmers, and smaller-scale fish farmers chose to harvest their ponds more frequently for household consumption (Andrew et al. 2003).

Despite fish farmers' relatively privileged positions in rural society, Andrew et al. (2003) highlighted several commonalities between the more- and less-effective fish-farming households that may also underscore commonly perceived sources of livelihood vulnerability in Malawi's rural areas. For example, while larger-scale fish farmers consume much smaller portions (27%) and sell larger proportions (53%) of their harvested fish than small-scale fish farmers

(44% consumed and 34% sold), the timing of harvests are uniformly driven primarily by immediate household protein and financial needs. Few farmers in either group appear to time their harvesting to optimize profits derived from market demand (7% among small-scale fish farmers and 10% among large-scale). Additionally, the high use of fishing hooks in addition to seines for harvesting underscores the high prevalence and importance of partial harvesting strategies throughout the year among all fish farmers. Overall, IAA production strategies appear to prioritize household and community food security and nutrition needs over maximizing cash income.

As village chiefs are in a privileged position to summon the labour and capital resources needed for fish farming, when compared with many rural households (Devereux 1999), their patronage relationships deserve separate mention.

Traditionally, the prestige and influence of the village chief is reinforced by his or her success at ensuring village welfare, which is rooted in their abilities as mediators and adjudicators, and as brokers for local development projects, but also significantly by lingering traditional beliefs in the spiritual powers of the chiefs (Wilson 1939, Kalinga 1985, Mills 1989, Russell 2007). While there are many examples of chiefs known to abuse their positions of power for the furtherance of personal or familial interests, there are also numerous examples in which constituents have held chiefs accountable (with actual or threatened loss of influence) if they were perceived to fail in their obligations to their community.[25] As part of this patronage relationship with their villages, chiefs would generally regard their fish farming as a contribution to the fulfilment of that obligation through gift-giving and subsidized fish sales to community members.

Andrew et al. (2003) also documented the importance among all fish farmers of investing significant proportions of their fish harvest to maintain local kinship and reciprocity relations, which is estimated to consume 12-14% of their annual catch. As discussed above, and argued by Andrew et al. (2003), such investment in local relationships "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".

6.2 LIVELIHOOD BENEFITS OF AQUACULTURE PRODUCTION

Given the dramatic disparities between different estimates of national production (discussed in section 5.2), the most reliable assessments of the impacts of aquaculture in Malawi stem from household studies documenting livelihood, profitability and productivity outcomes corresponding to different levels of technology uptake.

In their study comparing productivity and incomes between IAA households and other farming households, Dey et al. (2007) found that, on average, participation in aquaculture increased household incomes directly through sales of fish by an average of 10%. Andrew et al. (2003) found that the share of household income from aquaculture varied between 1.6% and 27.7% with the share of income from aquaculture below 17.0% in most cases. Fish marketing therefore makes a relatively small contribution to household income and, for most fish farmers, is one out of several income-earning activities. However, the total agricultural incomes of

25 A chief's influence over constituents depends on a combination of formal and informal sources of legitimacy. While the commercialization of rural society is sure to include chiefs, Russell (2007) and Russell et al. (2008) document a number of historical and contemporary case studies in which rural constituents in Malawi's fishing communities forced chiefs to uphold community interests. In the 1950s, when chiefs attempted to legally introduce fishing licenses and set fish prices around Lake Malawi, rural constituents resisted in response to chiefs' vested interests in the fishery (McCracken 1987, Hara 2001, Chirwa 1996). In recent years, chiefs have repeatedly tried, in return for bribes, to allow migrant fishers to fish in Lake Chilwa using destructive fishing gears, leading the constituents to forcibly remove the migrants and physically punish the chiefs (Njaya et al. 1999, Donda 2000, John Wilson personal communication July 2006). Even a chief who has demonstrated a remarkable ability to motivate his community to accept a variety of self-imposed restrictions on fishing and trading activities, when he seemed unwilling to address their concerns over witchcraft, the constituents collectively withheld their contributions to community development activities as a way to force their chief to act upon an issue of importance to them (Russell 2007).

fish farmers were 60% higher than those of other farmers (Dey et al. 2007). Furthermore, in terms of productivity, IAA households earned 133% more income per hectare of farmland than did other agricultural households, particularly from improved year-round production of vegetables (Brummett and Noble 1995, see also Jamu et al. 2006). It is clear that, in addition to pre-existing inequities in access to land and water resources, the introduction of the WorldFish and DoF participatory IAA extension programme has brought about significant improvements in livelihood, food security and land productivity.

While five out of six farms in the 1980s were documented as conducting no recycling of materials at all, the integration of aquaculture into farmers' livelihoods brought about the establishment of an average of eight bio-resource flows (Brummett and Noble 1995). Fish farmers are therefore able to grow high-value vegetables on and near the banks of ponds or in the residual moisture of ponds during times of drought (Dey et al. 2007, Jamu et al. 2006). The use of nitrogen from fishpond sediments (as opposed to inorganic fertilizer) has also been shown to double nitrogen use efficiency in farming (i.e., producing twice the amount of biomass) (Jamu 2003, Brummett and Noble 1995, Chimatiro and Scholz 1995).

In addition to benefits from resource flows, fish farmers have gained significant social capital through their participation in WorldFish and DoF capacity-building for IAA (Hecht and Maluwa 2003). As described by Dey et al. (2007), this approach

> explicitly includes farmers in technology development and encourages adopters to experiment and adapt the technology to suit their individual situation and needs. This enhanced knowledge enables them to take a leading role in community organizations (e.g., the establishment of fish farmers' clubs), and in teaching other interested farmers and neighbours about integrated aquaculture.

Consequently, while some IAA households held significantly elevated social status in their communities, as reflected in their greater access to better land and water resources, other community members have been empowered to take up leadership roles in their communities because of their ability to serve as models and advisors in IAA. Additionally, the establishment of fish farming clubs has enabled some communities to gain access to further development and capacity-building programmes funded by donors and NGOs (Dey et al. 2007).

Finally, IAA households have gained significantly in terms of the returns from their investments in labour. Andrew et al. (2003) found that most non-fish farmers sell their labour during the months of October to March, when household supplies of staple crops (generally maize, rice or cassava) are at their lowest, meaning that payment for labour is also at its lowest. Most IAA households' labour expenditures throughout the year on pond maintenance and transferring nutrients between systems turns out to be more remunerative than labour invested in off-farm activities during the lean season (Dey et al. 2007). Interestingly, fish farmers producing over 60 kg of fish per year, who generally also have the largest families (i.e., the most labour), were completely freed from the annual boom-bust labour cycle, and at least 25% of these respondents reported participating in off-farm activities throughout the year at times of their choosing rather than to meet livelihood needs.

In addition to the direct economic benefits gained from fish sales, the social and economic benefits of reciprocal gift giving and subsidized sales have been found to be very important in structuring the ways in which pond-cultured fish are sold in Malawi. A common phenomenon in subsistence-oriented agrarian societies, this "moral economy" (Scott 1976) of expected acts of reciprocity, though not inherently moral, tends to provide rural inhabitants with a safety net that protects them from temporary shortages of resources (Devereux 1999). Indeed, roughly half of all fish farmers in one study of Zomba District preferred reciprocal exchange (primarily of produce and labour) and subsidized sales over strictly economically oriented sales. These exchanges were seen as being more profitable in the end, and some farmers ration sales to ensure equity among their customers (Mills 1989). Ruddle (1996) and Devereux (1999) have documented a weakening of rural households' desire to maintain these networks, as traditional rural society has gradually commercialized in the last decade. This trend has been associated with the increased incidence of violence and theft, which undermines trust.

Though less central now than in the past, the moral economy continues to play a large role in rural livelihoods, social networks and economies. However, while fish farmers are able to help their communities improve nutritional levels and are saved the effort of investing in specialized marketing strategies and fish processing, the returns on investment remain low in terms of income. Small-scale aquaculture appears primarily to help rural populations mitigate the effects of poverty rather than actively empower them.

The descriptions of IAA households above indicate that they are less vulnerable throughout the year and more resilient to a range of shocks than are households that do not farm fish. This is illustrated by the finding of Andrew et al. (2003) that, irrespective of the scale of fish farming, aquaculture closely correlates with a tendency toward livelihoods that are more diversified than those of other households. Additionally, the increased production of fish among IAA households was found to be associated with lower expenditures on staple foods and higher expenditures on education and discretionary purchases. These tendencies are similarly reflected by Dey et al. (2007), who found that IAA households consume every type of animal protein (smoked fish, fresh fish, chicken and meat [beef, pork and goat]) more regularly than households that do not participate in fish farming — and, alarmingly, that households that do not farm fish consume only marginally more beans than fish-farming households.

7. MARKETING AND COMMODITY CHAINS

7.1 DOMESTIC MARKETS IN MALAWI

In many African countries, local demand for fish is high and projected to increase in the future as a function of natural demographic progressions in which growing economic prosperity among middle and upper classes in both absolute and relative terms drives an increase in the amount of protein they consume. As discussed above, at present, most of the demand for fish is met by small-scale capture from Malawi's lakes and rivers. However, judging from the drastic declines in fish consumption per capita and the absence of cheap alternatives, it is safe to assume that demand well exceeds supply.

While the absolute amount of fish caught in rivers and lakes continues to climb, a variety of studies indicate that Malawi's fish assemblages have undergone significant qualitative changes associated with a phenomenon known as "fishing down the food chain". Whereas most of the fish targeted and captured in the past were in the tilapia group known as chambo, and potamodromous fish species such as mpasa (*Opsaridium microlepis*), sanjika (*O. microcephalus*) and ntchila (*Labeo mesops*), the numbers of these fish captured have steadily declined, and they are increasingly being replaced as a proportion of the catch by smaller, more pelagic species, such as usipa, utaka, kambuzi, mlamba and kampango (*Bagrus meridionalis*) of the catfish families. The chambo caught are increasingly juveniles.

The traditional preference for chambo in Malawi means that its price remains the highest among the main commercial fish species captured on Lake Malawi. Indeed, in absolute terms chambo prices rose the most of all species from 1994 to 2000, by 1,055% (Figure 8), though it must be noted that kampango prices increased by nearly the same percentage (1,050%). In contrast, the prices for utaka, usipa and kambuzi (all cheaper, smaller fish to begin with) rose by only 850%, 750% and 675% respectively in the same period. From these data and personal observations, it is clear that chambo has not occupied a significant place in the diets of poorer Malawian households for quite some time, and that households increasingly depend on smaller pelagic fish species. In 2007, the price of chambo rose to around $4/kg (MWK560), representing another 850% increase over 2000 prices.[26]

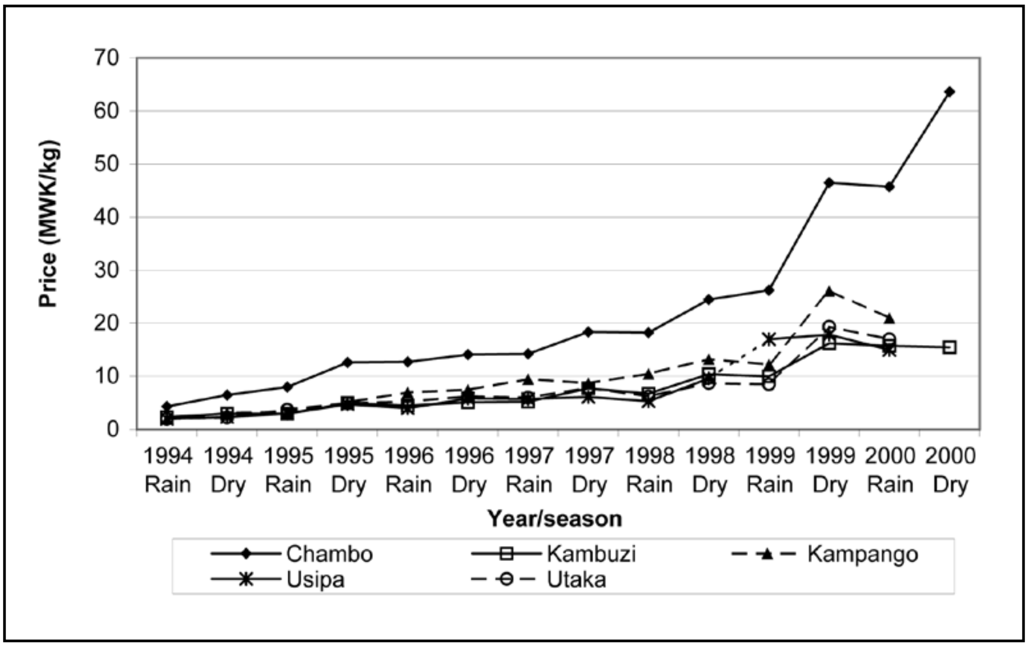
The catch data for 1994-2000 compiled by the Fisheries Research Unit of DoF for the southeastern arm of Lake Malawi provides evidence that actual rates of fish capture do not appear to have a strong influence on fish prices, as illustrated by Figure 9, which shows the catches and prices for three types of fish. However, in contrast with clear differences in fish prices of the species shown in Figure 9, Brummett (2000) studied fish prices in rural inland markets during the dry season of 1996 and found no significant differences in fish prices based on species, size and dry weight, and that only whether the fish was fresh, as opposed to smoked or dried, was significant in determining fish prices. The differences regarding the importance of fish species in determining fish prices possibly arises from competition among fish wholesalers on Lake Malawi's southeast arm for urban markets, while retailers in rural markets may face less market competition in pricing.[27] Additionally, trends across markets regarding the importance of fish species, size and state of preservation in rural markets may have been obscured in Brummett's study by high inter-market variability in prices.

Brummett's study highlighted another key point of particular importance to rural fish consumers and fish farmers: 78% of fish traders in rural markets chose to trade solely in dried or smoked fish because it was easy to transport and store. This may

26 Lars Windmar, WorldFish Center, personal communication 4 March 2008.

27 Randall Brummett, WorldFish Center, personal communication 27 March 2008.

Figure 8: Fish prices for key species at Lake Malawi (1994-2000)



Source: Fisheries Research Unit data.

also be partly explained by a tendency among poorer consumers to purchase several smaller fish rather than a single large fish to assure greater nutritional equity in the household.[28] Smaller fish in inland markets are mainly sold dried or smoked.

Although more research on fish prices at beaches and in markets is needed, the existing data suggest the presence of strong growth in demand for chambo and mlamba in urban markets from the upper and middle classes. It would appear, therefore, that demand provides significant incentives for fish farmers in rural areas to increase production of both tilapia and *Clarias* sp. for urban markets.

In addition to the incentives of increased income from aquaculture, rural upland areas[29] and urban centres face extreme seasonality in access to fish. While catches at the lakeshore remain abundant during the rainy season, relatively few fish traders visit the lakeshore because they need to invest labour in farming during this period, and trying to preserve fish under rainy conditions risks incurring significant losses (Russell 2007). This period of poor access to fish coincides with the months of greatest food and cash shortage, which is a likely explanatory factor for why the net change in fish prices is negative for several species when going from the dry to the rainy season, and why the overall increase in fish prices appears to occur almost completely during dry months, when people have more disposable income (Table 8).

Jamu and Brummett (2004) found that, regardless of the season, local rural demand for tilapia is so great that pond-reared fish rarely reach urban markets at all. For many fish farmers, the small scale of their production and the common tendency to partly harvest ponds throughout the year limits the quantities of fish sold at any one time. It is not clear to what extent availability and conditions of transportation, opportunity costs in terms of labour spent in travelling to

28 Randall Brummett, WorldFish Center, personal communication 31 March 2008. Brummett supports this argument by citing similar market-driven patterns in Zambia, where large-scale aquaculture producers elect to produce the small tilapias (50-80 g) demanded by poorer households.

29 This includes large portions of Mulanje, Thyolo, Mwanza, Mchinji, Kasungu, Ntchisi, Ntcheu, Lilongwe, Dedza, Dowa, Mzimba, Rumphi and Chitipa districts.

Table 8: Increase in fish prices (1994-2000), by type and season

		Chambo	Kambuzi	Kampango	Usipa	Utaka
Fish price (MWK/kg)	1994	4.3	2.3	2.0	2.0	2.0
	2000	63.6	15.5	21.0	15.0	17.0
Total % increase		1,055.8	675.0	1,050.0	750.0	850.0
% increase by season	Rainy	5.7	-14.6	-1.9	23.2	-16.1
	Dry	89.1	99.8	92.3	63.5	104.3

MWK = Malawi kwacha.

Source: Fisheries Research Unit data.

markets, and/or uncertainties in marketing fish in urban cities affect the prioritization of harvesting and marketing strategies.

Few fish farmers transport their fish over any significant distance. Rather, they sell most of their fish either at their farm gate or directly at the pond and frequently make their sales the day before the harvest is actually conducted (Andrew et al. 2003). In most cases, the fish farmers inform the community about an upcoming harvest, and customers arrive on the appointed day. Ninety-six per cent of all commercially oriented farmers sampled in Zomba District sell their fish on site.

Some farmers have built simple kiosks to regulate sales and to exert greater control over the sales event and avoid damage to the pond bank. Some farmers have removed their selling point from the pond side to their houses (Ruddle 1996). Beyond strictly local sales, around 24% of commercially oriented farmers in Zomba District have attempted to improve incomes by capturing niche markets. Some fish farmers have developed a market for fried tilapia served as a convenience food at roadside markets, bus stations, primary schools and hospitals, while others sell fresh fish to local secondary schools and hospital canteens and for use in school biology class experiments (Mills 1989).

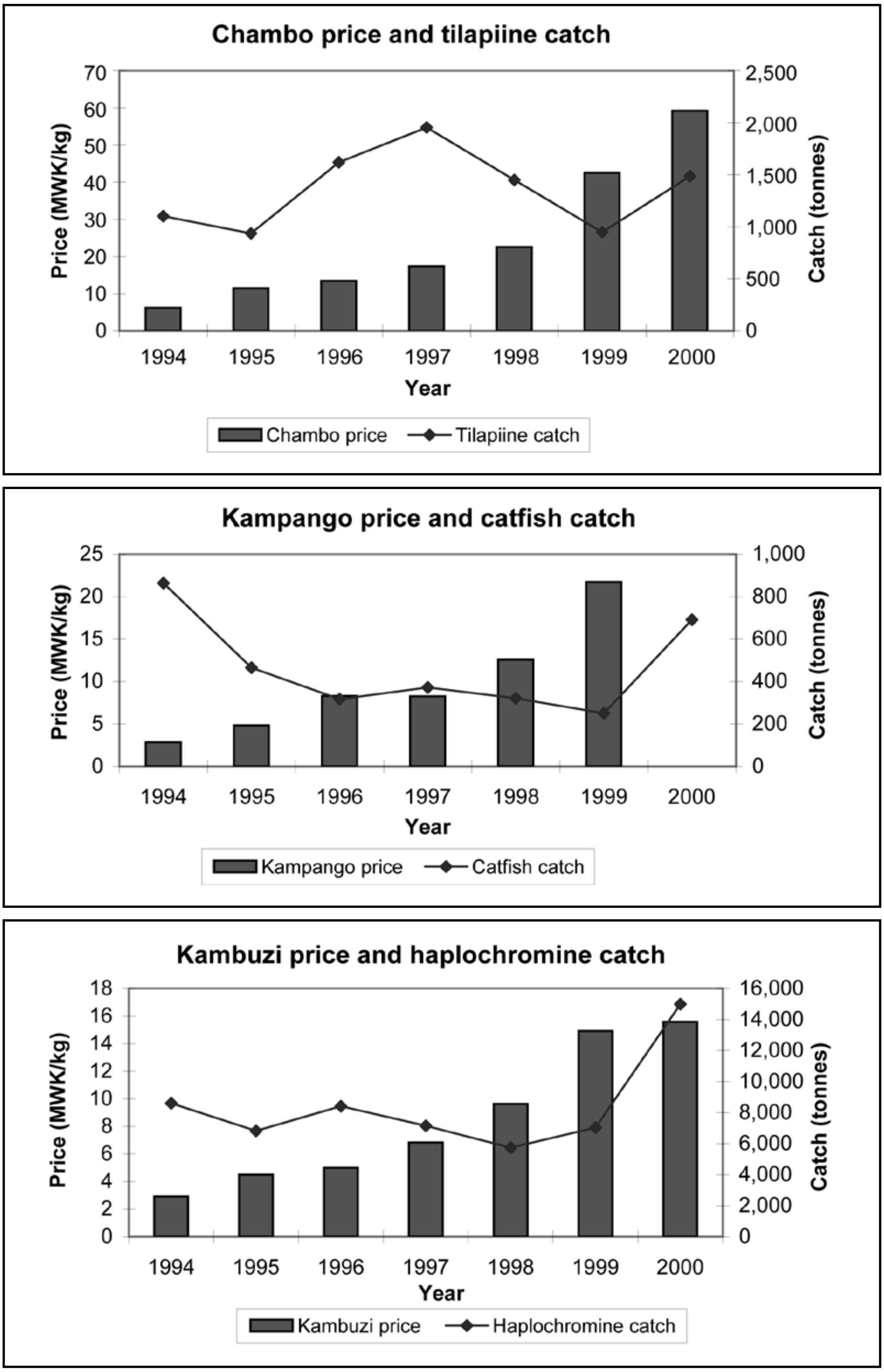
A study by Brummett (2000) found that the price per kilogram of pond-cultured tilapia was not significantly affected by their size, but freshness did have an impact. However, Hecht and Maluwa (2003) found that in recent years farmers did obtain a higher price per kilogram for larger fish.

In many areas the potential for increased earnings from fish farming is effectively limited by the condition of local infrastructure. Access to fish from Lake Malawi has improved significantly for consumers in most cities and district capitals with gradual improvement of the two main north-south roads in Malawi. However, aside from in these towns, trade in many rural areas continues to be limited by roads that may be impassable during the rainy season.

A number of fish-processing techniques are practiced in Malawi, including the use of dug-out smoking ovens and drying racks made of reeds and mats (FAO 2005a). Salt is usually not used in fish processing because it is very expensive (Hara 1993). However, in contrast with fish from the lakes and rivers, of which 50% is sun dried and 30% is smoked (Normann et al. 1997), harvested pond fish is usually sold fresh. Until recently only those fish traders operating in Mangochi District had ready access to ice from MALDECO ice plants (Normann et al. 1997). This is gradually changing, however, as the main soft drink wholesaler establishes in towns throughout the country distribution points and ice-making machines, which are used both to cool drinks and to improve the storage and transport of fresh fish (personal observation). As most pond-reared fish are currently sold locally, there is probably little interest in or need for ice, but recent improvements in access to ice may make a difference for any larger-scale fish-farming venture intending to transport tilapia to the cities.

Production outputs from commercial fish farms are sold in the urban areas and

Figure 9: Fish prices and catch in southeast arm of Lake Malawi (1994-2000)



MWK = Malawi kwacha.

Source: Fisheries Research Unit data[30].

30 As methods of data collection are not exactly comparable for these three categories, data should be closely correlated. Tilapids includes all cichlids of the genera *Oreochromys* and *Tilapia*; catfish includes all of the genera *Clarias, Bagrus* and *Bathyclarias*; and *Haplochromines* include those fish locally classified as kambuzi*,* mbaba, ncheni and utaka (SSC 2005).

centres of Blantyre, Lilongwe, Zomba and Mzuzu through department stores and selected food shops (FAO 2005b).

7.2 CONSUMPTION PATTERNS AND CONSUMER PREFERENCES

Fish consumers in Malawi usually prefer to buy their fish complete with head and tail. When preparing larger species for cooking, only the guts and scales are removed, and later the whole fish is consumed, including the soft parts of the head, leaving only the bones. In the case of smaller species of fish like utaka, usipa, matemba and kambuzi (see Annex B for scientific and common names) the bones are soft enough that consumers commonly ingest them together with the flesh.

A variety of methods for preparing fish of all sizes and species exists in Malawi (Hara 1993). Higher-income consumers usually prefer to buy fresh chambo from supermarkets and will look for fish at produce markets only if it is not available in these stores. People with lower incomes buy fish from markets and choose the best type available on a given day at a price they can afford. For the vast majority of the nation's population, however, chambo is a luxury, and they are more likely to buy dried or smoked catfish, utaka or usipa (personal observation). Also worth mentioning are institutional buyers such as hotels, catering services, hospitals, colleges, etc., which usually take fish in bulk from traders who have contracts to supply specified types and amounts at certain times (Hara 1993).

In general, Malawian consumers' preferences in fish type may be ranked as follows: (1) fresh chambo, (2) fresh fish of all other types except *Clarias*, (3) smoked or roasted chambo and kampango, (4) parboiled dried usipa, (5) smoked or roasted *Clarias*, (6) fried dried utaka or kambuzi, and (7) sun-dried fish in general (Hara 1993). Again, it must be noted that for the overwhelming majority of consumers, the purchase of fresh fish is a rare luxury (personal observation).

Traditions of total avoidance of fish as food do not seem to exist to any significant extent in Malawi, and the few cases deriving from religious beliefs, customary associations or putative health effects are fairly isolated (Reynolds 1993). Some religious groups such as Seventh-day Adventists and Muslims are forbidden to consume fish that do not have scales, but adherence to such strictures may not be absolute (Hara 1993, Russell unpublished data).[31] More common than traditions of avoiding fish per se are traditions of avoiding particular species of fish, which are often linked to certain clans, religious groups, gender categories, life stages or events (Reynolds 1993). Among the Lomwe tribe in Phalombe District, for example, it is believed that pregnant women should not eat mlamba (*Clarias gariepinus*) because it will cause abortions.[32]

It is reported that some people from upland areas do not like to eat fish of the genera *Clarias* and *Bagrus* (known locally as kampango), which lack scales, because it is commonly supposed that people are allergic to these fish.[33] Associating dermatological diseases with the consumption of fish was not uncommon among some groups in Africa and elsewhere in the past (Hutchinson 1906). However, people who originally come from fish-producing areas in Malawi do not seem to share this concern (Hara 1993), reflecting long-established scientific understanding that such diseases were probably more accurately associated with the consumption of poorly preserved fish (Hutchinson 1906). Such magico-religious factors have, however, hampered smallholder aquaculture development in some parts of Lilongwe District (ICLARM and GTZ 1991).

31 In 2000, Muslims were calculated to make up 13% of the population, with some 1.42 million adherents. Seventh-Day Adventists were estimated to make up less than 2% of the population, with 166,000 adherents (www.religiousintelligence.co.uk).

32 Robson Malichi-Gama personal communication 2006.

33 Robson Malichi-Gama personal communication 2006.

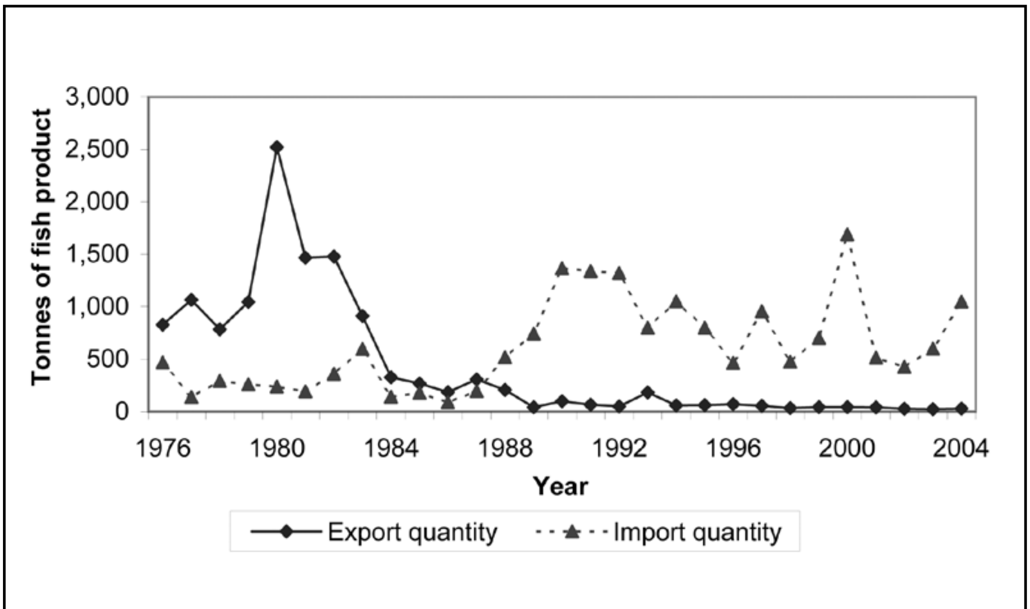
7.3 MALAWI'S FISH EXPORT MARKET

During colonial times, most fish caught by artisanal fishers was sold domestically, but up to 60% of the fish landed by the major Greek-owned commercial fishing operations on Lake Malawi was exported, in particular to Harare, then known as Salisbury (Bertram et al. 1942).[34] The colonial government's dislike of the Greek-owned business, pressure from nationalist politicians (who had their own fishing interests) and famine conditions in 1949 resulted in exports of fish being banned between 1950 and 1958 (McCracken 1987).

During the 1970s and early 1980s, Malawi exported significantly more fish than it imported, primarily in the form of dried, salted and smoked fish products (Figure 10) (FishStat 2008). However, despite Malawi reaching its peak of capture fishery production in 1987, approaching 90,000 tonnes of fish (Bulirani et al. 1999), exports of fish declined sharply in the mid-1980s because of growing domestic demand. Malawi's trade balance reversed between 1987 and 1988 as the country ceased to be a net exporter of fish products and became a net importer of them. FAO (2005a) reflects these conclusions, indicating that while relatively little Malawian fish has been exported, the last two decades have witnessed significant growth in fish imports, particularly from Zimbabwe, South Africa, Tanzania, Mozambique, Thailand, Namibia, Swaziland and China (Hara 2001). The largest demand for fish imports in the early 1990s was for oily fish meal used by newly established large-scale poultry industries. Then, since the late 1990s, the greatest demand for imported fish products became primarily for food fish either frozen, dried and salted (FishStat 2008). The perceived insignificance of export markets is reflected in an FAO report by Hecht (2006a) in which exports of fish for consumption are not mentioned at all.

Aside from fish for consumption, other fish exports since the 1960-70s worth mentioning are ornamental fish (Figure 11). Of particular importance in this trade are the colourful cichlid group called mbuna, which are found mostly along the rocky

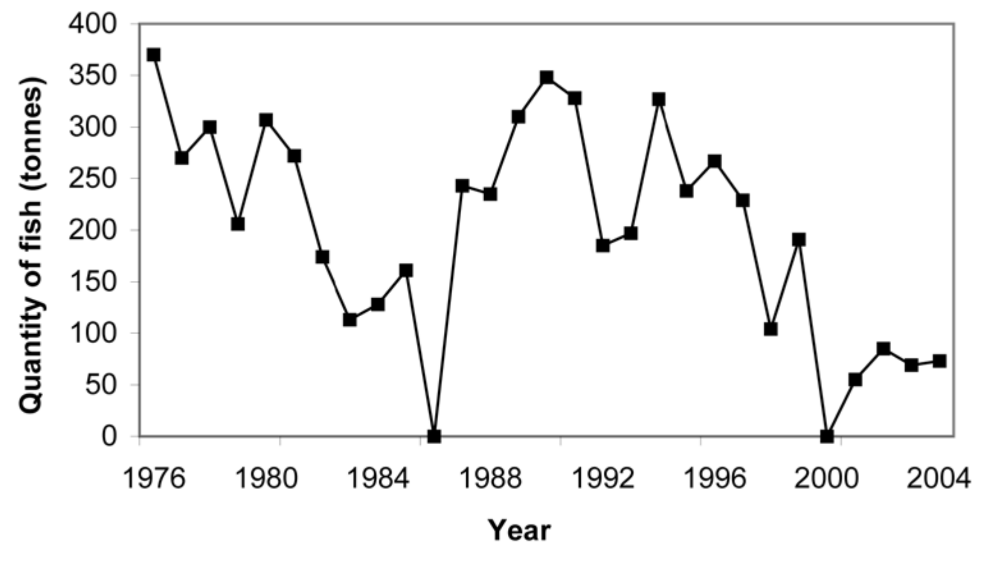
Figure 10: Malawi imports and exports of fish product (1976-2004)



Source: FAO FishStat 2008.

34 ICLARM and GTZ (1991) indicate up to 285 tonnes of fish were exported in 1958.

Figure 11: Exports of ornamental fish from Malawi (1976-2004)



Source: FAO FishStat 2008.

inshore portions of Lake Malawi (Reinthal 1993). In 1999, exports of ornamental fish from Malawi were valued at MWK8,476,768 ($60,548) (FAO 2005b). The primary importing nations in this aquarium trade in 2005 were Belgium, Denmark, France, Germany, Japan, Netherlands, Portugal, South Africa, Sweden, Switzerland, United Kingdom and USA (FAO 2005b). The demand for ornamental fish from Malawi is limited and declining, however, with the increased supply and variety of captivity-bred mbuna that can now be shipped more cheaply through postal airfreight services in North America and Europe.[35] Mbuna is not typically used as a food fish, though it is sometimes captured for bait, so the aquarium trade does not represent a significant threat to Malawi's consumptive needs (personal observation).

35 www.lakemalawi.com/faq.htm

8. CONSTRAINTS AND OPPORTUNITIES

With regard to Malawi's biophysical and environmental characteristics, large parts of the country (10-25% of the total land area) are considered suitable for pond aquaculture, and Malawi is blessed with a variety of water bodies that might harbour small- or large-scale cage-culture initiatives. Furthermore, historical access enjoyed by large parts of the population to fish from capture fisheries created a strong cultural demand for fish as a source of protein.

Despite the ongoing increase in small-scale fishery captures in Malawi, the declining availability for the preferred chambo species has resulted in remarkably high prices for this fish. Demand for all fish far outstrips supply, and fish farmers face few challenges in selling their fish right after harvesting. Transportation, storage and marketing system limitations, and local social pressures, mean most pond-reared fish ends up being consumed locally at prices well below the market. This is one reason that fish farming has not yet achieved its development potential in rural Malawi. Growing demand for fish throughout the country is starting to spur investments by the private sector in the development of medium- and large-scale fish-production technologies.

Over the past decade, significant improvements have been achieved in pond productivity through the development of IAA systems that make more efficient use of recycled farm inputs and outputs. However, at present, most of Malawi's small-scale fish-farming ponds appear to be poorly managed, stocked with low-quality seed, and fed insufficient inputs with low nutritional value. This is largely because of the government's poor capacity to disseminate information, technologies and fingerlings, as well as producers' poor access to inputs and markets. NGOs are increasingly taking up roles in dissemination, but developing the local production of higher-quality feeds and fingerlings remains a crucial step to unlocking aquaculture's potential in Malawi.

Fish farming is more complicated than most other agricultural innovations for farmers in sub-Saharan Africa. While farmers in some parts of Asia and West Africa have extensive traditional knowledge of water management, most southern African farmers rely entirely on rainfed agriculture. The concepts of water harvesting and crop irrigation have to be learned as preconditions for good pond management, and fish farmers need to be instructed in the regular provision of inputs to their fishponds. With regard to guaranteed access to reliable supplies of water and space, both pond and cage aquaculture have the potential to infringe on the access rights of other agricultural, household or small-scale capture fishery users. This is most likely to occur where aquaculture becomes heavily clustered.

Despite having undergone dramatic changes from the top-down extension practices of the past, promoters of aquaculture need to become more responsive to stakeholder needs in a number of areas. Households that are already effective in farming will tend to be good fish farmers. However, a large proportion of fish farmers have poor agricultural results overall, limiting any possible gains from IAA. To improve livelihood resilience among these small-scale IAA households, extension efforts need to be more effective in addressing inefficiencies throughout their farming systems.

The Malawi Gold Standard programme has attempted to address some of these technological and extension issues, but the benefits remain unrealized because of continued market constraints. For these households to significantly improve the productivity of their ponds through the Malawi Gold Standard programme, access to higher-quality inputs of feed and fingerlings are key requirements that still need to be addressed. Moreover, capacity-building in the development of transportation, storage and marketing systems is needed. Finally, among companies interested in large-scale aquaculture, all of the issues outlined above also need to be carefully examined, requiring a significant investment of time and resources.

Communication between farmers and promoters seems to be marked by a series of fundamental misunderstandings. Many farmers demonstrate the often described "receiver mentality" and expect the government or donors to provide for them. Moreover, there are not enough extension workers well trained in technology or methodology, and those currently working for the government require significant improvements in administrative support, supervision and resources (e.g., transport) if they are to be successful in their roles.

Malawi's rural population faces increasing livelihood pressures from the combined impacts of soil erosion, deforestation, HIV/AIDS and climate change, among other things. The need for greater availability of fish as a source of protein is clear. Given the absence of livelihood alternatives in urban areas, rural populations need to improve the efficiency of their use of land and water resources to maintain their livelihoods. While fish farming alone has not necessarily brought about large increases in cash incomes, through its integration into other farming activities it has had significant multiplier effects in land and water productivity (as described in section 6.2, see also Dey et al. 2007). IAA provides households with more secure livelihoods by improving their management of water supplies and control of erosion.

Relatively plentiful rainfall and a high dependence on subsistence agriculture makes Malawi one of the countries in southern Africa where aquaculture seems to be particularly appropriate, despite the many obstacles to the adoption and diffusion of fishponds discussed in this report. Weaknesses in access to information have been identified and are surmountable with increased funding and capacity building. The primary areas requiring investments are the development and local provision of higher-quality but low-cost feeds and fingerlings. With the expansion of interest in aquaculture in the private sector, these roles may increasingly devolve to them. In the end, there are few alternatives available to meet the nation's nutritional needs and to increase resilience for rural livelihoods other than the intensification of agriculture and aquaculture. Integrated aquaculture-agriculture has been shown to be able to make a significant difference to both.

9. REFERENCES

Alcom. 1994. Aquaculture into the 21st century in Southern Africa: Report prepared by the Working Group on the Future of ALCOM. ALCOM Report No. 15. Harare, Zimbabwe.

Andrew TG, Weyl OLF, Andrew M. 2003. Aquaculture master plan development in Malawi: Socioeconomic survey report.

Banda AZ, Kwaela P, Thinda MJ, Mauwa FE, Joshua B. 1999. KAP survey on participatory fisheries management. National Aquatic Resource Management Programme. Monkey Bay, Malawi.

Banda GA. 1989. An investigation of factors for the adoption of fish farming in a matrilineal social system: The case study of Zomba District. Institute of Social Research, University of Malawi, Zomba, Malawi.

Beeler S. 2006. Common pool resource management in the Niger inland delta of Mali: Strategies and potentials for conflict mitigation. International Association for the Study of Common Property annual meeting, Brescia, Italy, 23-25 March 2006.

Benson T, Chamberlin J, Rhinehart I. 2005. An investigation of the spatial determinants of the local prevalence of poverty in rural Malawi. Food Policy, 30(5-6): 532-550.

Bertram CKR, Borley HJH, Trewavas E. 1942. Report on the fish and fisheries of Lake Nyasa. London, Crown Agents for the Colonies.

Bland SJR, Donda S. 1994. Management initiatives for the fisheries of Malawi. Malawi Fisheries Department, Government of Malawi. p. 13.

Brooks AC.1992. Viability of commercial farming in Malawi. Central and Northern Regions Fish Farming Project European Union report.

Brummett RE. 1994. The context of smallholding integrated aquaculture in Malawi. International Center for Living Aquatic Resources Management, Manila. ICLARM Conf. Proc; no. 46, pp 3-5.

Brummett RE. 1997. Why Malawian smallholders do not feed their fish. Lilongwe, Malawi.

Brummett RE. 2000. Factors influencing fish prices in southern Malawi. Aquaculture 186: 243-251.

Brummett RE, Noble RP. 1995. Aquaculture for African smallholders. ICLARM Technical Report 46. International Center for Living Aquatic Resources Management, Manila, and German Agency for Technical Cooperation, Eschborn, Germany.

Brummett RE, Williams MJ. 2000. The evolution of aquaculture in African rural and economic development. Ecological Economics 33(2): 193-203.

Bulirani AE, Banda MC, et al. 1999. Fish stocks and fisheries of Malawian waters. Resource report 1999. Department of Fisheries, Lilongwe, Malawi.

Chimatiro SK, Chirwa BB. 2006. National aquaculture sector overview and prospective analysis of future aquaculture development – Malawi. Department of Fisheries, Lilongwe, Malawi.

Chimatiro SK, Scholz UF. 1995. Integrated aquaculture-agriculture farming systems: A sustainable response towards food security for small-scale poor farmers in Malawi. Presented to the Bunda College Aquaculture Symposium, Lilongwe, Malawi, 11 February.

Chirwa WC. 1996. Fishing rights, ecology and conservation along southern Lake Malawi. African Affairs 95(380): 351-377.

CIA. 2008. The World Fact Book: Malawi. Central Intelligence Agency. www.cia.gov/library/publications/the-world-factbook/geos/mi.html. Accessed 27 March 2008.

Cleaver F, Toner A. 2006. The evolution of community water governance in Uchira, Tanzania: The implications for equality of access, sustainability and effectiveness. Natural Resources Forum 30 (2006) 207-218.

Coleman G. 1974. The African population of Malawi: An analysis of the censuses between 1901 and 1966. Society of Malawi Journal 27(1): 27-41.

COMPASS II. 2007. Malawi Gold Standard: Creating income from natural resources. Fish Farming Trainer's Guide – Pond Aquaculture. Blantyre, Malawi.

Cotula L, Cissé S. 2006. Changes in "customary" resource tenure systems in the inner Niger delta, Mali. Journal of Legal Pluralism 52: 1-29.

CTA. 2007. Fish farming: Angles on aquaculture. Spore No. 132, December 2007, http://spore.cta.int.

de Bruijn M, van Dijk H. 2006. Changing population mobility in West Africa: Fulbe pastoralists in central and south Mali. African Affairs 102: 285-307.

Devereux S. 1999. Making less last longer: Informal safety nets in Malawi. Institute of Development Studies (IDS) Discussion Paper 373.

Dey MM, Kambewa P, Prein M, Jamu D, Paraguas FJ, Briones RM, Pemsl D. 2007. Impact of the development and dissemination of integrated aquaculture-agriculture (IAA) technologies in Malawi, pp 118-146. In: Waibel H, Zilberman D (eds.). International research on natural resources management: Advances in impact assessment. CAB International. 320 pp.

Dickson MW, Brooks AC. 1997. Fish farming in Malawi: A case study of the Central and Northern Regions Fish Farming Project. Stirling Aquaculture, Institute of Aquaculture, University of Stirling. Stirling, UK.

Donda S. 2000. Journey to sustainable fisheries management: Organisational and institutional limitations in fisheries co-management, the case of Lakes Malombe and Chiuta in Malawi. International Institute for Fisheries Economics and Trade, Oregon.

Eves A, Turner C, Yakupitiyage A, Tongdee N, Ponza S. 1995. The microbiological and sensory quality of septage-raised Nile tilapia. Aquaculture 132: 261-272.

FAO 2005a. Fishery Country Profile – Republic of Malawi. Food and Agriculture Organization, Rome.

FAO 2005b. National Aquaculture Sector Overview – Malawi. FIGIS National Aquaculture Sector Overview Fact Sheets search. Food and Agriculture Organization, Rome. (www.fao.org/figis/servlet/static?dom= country sector&xml=naso _malawi.xml) Accessed on 8 September 2006.

Ferguson AE, Mulwafu WO. 2004. Decentralization, participation and access to water resources in Malawi. Development Experience Clearinghouse, USAID (December).

Ferguson AE, Mulwafu WO. 2005. Irrigation reform in Malawi: Exploring critical land-water intersections. International workshop on African water laws: Plural legislative frameworks for rural water management in Africa, 26-28 January 2005, Gauteng, South Africa.

FishStat. 2008. FAO Fisheries and Aquaculture Statistical Collection. www.fao.org/fishery/statistics. Accessed on 25 March 2008.

Gopa Consultants. 1989. Southern African Development Coordination Conference (SADCC) regional fisheries survey. Gopa Consultants. Bad Homburg, Germany.

GoM. 2002. Malawi Land Policy. Ministry of Lands. Lilongwe, Malawi. www.malawi.gov.mw. Accessed on 9 November 2006.

GoM. 2005a. A strategy for capacity development for decentralisation in Malawi — Phase 1: Capacity assessment (first draft report, December 2005); Ministry of Local Government and Rural Development in association with Malawi-German Programme for Democracy and Decentralisation and the Royal Norwegian Embassy.

GoM. 2005b. Malawi and the Millennium Development Goals. Challenges and achievements: September 2000-September 2005. Government of Malawi.

GoM 2005c. Malawi growth and development strategy. Government of Malawi (draft report 13 January 2005).

GTZ. 1997. Reporting on project appraisal mission: National participatory fisheries management programme (Malawi), Part 2, Final Report. Deutsche Gesellschaft für Technische Zusammenarbeit GmbH, Eschborn, Germany.

Hansen JD, et al. 2005. Tree planting under customary tenure systems in Malawi: Impacts of marriage and inheritance patterns. Agricultural Systems 84: 99-118.

Hara M. 1993. Fish marketing and consumption in Malawi. In: Reynolds JE (ed.). FAO Fisheries Technical Paper 332: Marketing and consumption of fish in eastern and southern Africa. Food and Agriculture Organization, Rome. pp 63-83.

Hara MM. 2001. Could marine resources provide a short-term solution to declining fish supply in SADC inland countries? The case of the horse mackerel. Food Policy 26: 11-34.

Harrison E. 1991. Socioeconomics of aquaculture in Africa. A review of the literature. University of Sussex. Sussex, UK.

Hecht T. 1996. Smallholder aquaculture in the border zone of the Nyika National Park and the Vwaza Marsh game reserve, Malawi. Department of Ichthyology and Fisheries Science, Rhodes University, Grahamstown, South Africa.

Hecht T. 1999. Border Zone Aquaculture Development Project and NARMAP Fisheries Management Project backstopping report 1 for 1999. Department Ichthyology and Fisheries Science, Rhodes University, Grahamstown, South Africa. 47 pp.

Hecht T. 2006a. A synopsis of sub-Saharan African aquaculture. A report prepared for the Fisheries Department Group (RAFI-FIRI) of the FAO Regional Office for Africa. In press. CIFA report Food and Agriculture Organization, Rome. Rhodes University, Grahamstown, South Africa.

Hecht T, Maluwa A. 2003. Situation analysis of aquaculture in Malawi. Envirofish Africa (Pty) Ltd, Grahamstown, South Africa, and National Aquaculture Centre, Domasi, Malawi.

Hoole MC. 1955. Notes on fishing and allied industries as practised amongst the Tonga of the West Nyasa District [1934]. Nyasaland Journal 8(1): 25-38.

Hutchinson J. 1906. On leprosy and fish eating: A statement of facts and explanations. Archibald Constable and Co., London.

ICLARM. 2001. ICLARM's impact on aquaculture development in Malawi. International Center for Living Aquatic Resources Management, Penang, Malaysia.

ICLARM, GTZ. 1991. The context of small-scale integrated agriculture-aquaculture systems in Africa: A case study of Malawi. ICLARM Contribution No. 576. International Center for Living Aquatic Resources Management, Manila, Philippines.

Jamu DM. 2003. Identification of sediment processes regulating nitrogen use efficiency and retention in integrated aquaculture-agriculture systems. Final report submitted to the African Career Awards, Rockefeller Foundation, Nairobi.

Jamu D, Chimatiro SK. 2005. Sustainable agro-pisciculture in Malawi. In: Agriculture and Rural Development: Contributing to International Cooperation, 12/2, 45-46.

Jamu D, Costa-Pierce BA. 1993. Use of firewood ash in small scale aquaculture. Journal of Aquaculture in the Tropics 8: 167-175.

Jamu D, Nagoli J, Kambewa P, Kaluwa B. 2006. The Malawi Gold Standard production system information and training programme. COMPASS II, WorldFish Center, University of Malawi (draft report). 56 pp.

Jamu J, Brummett RE. 2004. Opportunities and challenges for African aquaculture. In: Gupta MV, Bartley DM, Belen AO (eds.). Use of genetically improved and alien species for aquaculture and conservation of aquatic biodiversity in Africa. WorldFish Center, Penang, Malaysia. pp 1-9.

Kafakoma R, Silungwe C. 2003. Water ownership and access rights in Malawi: Customs, practice and statutory laws. Operational research report submitted to COMWASH Project, Malawi. 31 pp. www.sarpn.org.za/ documents/d0001327/ P1588-Water_ownership_access_Malawi. pdf. Accessed on 27 March 2008.

Kalinga O. 1985. A history of the Ngonde Kingdom of Malawi. Mouton Publishers, Berlin. 99 pp.

Kamperewera A, Wilson JGM. 2003. An analysis of CBNRM implementation strategies in Malawi. National Stakeholders' Consultative Workshop, Zomba, Malawi.

Kaunda EKW. 2003. Aquaculture research and training in Malawi: An overview. JICA Master Plan Study. JICA, Tokyo.

Kone A. 1985. Traditional fishing rights in the central delta of the Niger and the lake region: Conflicts and recommendations with a view to equitable and rational management of fishery resources. CIFA/85/Symp/CP.2.

Kriesemer SK, Grötz PA. 2008. Fish for all? The adoption and diffusion of small-scale pond aquaculture in Africa with special reference to Malawi. Book Series: Kommunikation und Beratung 81, Margraf Publishers, Weikersheim, Germany.

Lancaster N. 1979. The changes in the lake level. In: Kalk K, McLachlan AJ, Howard-Williams C (eds.). Lake Chilwa: Studies of change in a tropical ecosystem. The Hague, Dr W. Junk Publishers. pp 41-58.

Lightfoot C, Noble RP. 2001. Tracking the ecological soundness of farming systems: Instruments and indicators. Journal of Sustainable Agriculture 19(1): 9-29.

Lightfoot C, Bimbao MP, Dalsgaard JPT, Pullin RSV. 1993. Aquaculture and sustainability through integrated resources management. Outlook on Agriculture 22(3): 143-150.

Maluwa AO, Dickson MW. 1996. Comparison of the growth of *Oreochromis karongae* and *O. shiranus* in fishponds in Malawi. In: ICLARM Conference Proceedings, 41, Manila, Philippines. pp 108-111.

Manase MM, Mwenekibombwe LK, Namoto W, Mponda O. 2002. Analysis of catch and effort data for the fisheries of southeast arm of Lake Malawi. Fisheries Bulletin 52, 17 pp. Government of Malawi, Department of Fisheries.

Mandala EC. 1990. Work and control in a peasant economy: A history of the Lower Tchiri Valley in Malawi, 1859-1960. University of Wisconsin Press, Madison, Wisconsin.

McCracken J. 1977. Underdevelopment in Malawi: The missionary contribution. African Affairs 76(303): 195-209.

McCracken J. 1987. Fishing and the colonial economy: The case of Malawi. Journal of African History 28(3): 413-429.

McCracken J. 2002. The ambiguities of nationalism: Flax musopole and the northern factor in Malawian politics, c. 1956-1966. Journal of Southern African Studies 28(1): 67-87.

Mills GG. 1989. Entrepreneurship in small-scale fish farming in the Zomba District, Malawi. Department of Sociology, Chancellor College, University of Malawi, Zomba, Malawi.

Moav RG, Wohlfarth G, Schroeder J, Hulata G, Barasch H. 1977. Intensive polyculture of fish in freshwater ponds; 1. Substitution of expensive feeds by liquid manure. Aquaculture 10: 25-43.

Msiska OV. 1987. Aquaculture and rural development in Malawi. In: Proceedings of the FAO/SIDA technical workshop on aquaculture for local community development, 27-30 October 1987, Lusaka, Zambia. pp 75-84.

Msiska OV, Costa-Pierce BA. 1996. Growth performance of *Oreochromis lidole, O. squamipinnis, O. shiranus and O. karongae*, new candidate species for aquaculture in open waters and fishponds in Malawi. In: Pullin RSV, Lazard J, Legendre M, Kothias JBA, Pauly D (eds.). The Third International Symposium on Tilapia in Aquaculture, ICLARM, Manila, Philippines.

Mueller S, Saukani A. 2002. Usodzi Walero radio programme evaluation. NARMAP Survey Report 7: 19.

Mumba P.P, Jose M. 2005. Nutrient composition of selected fresh and processed fish species from Lake Malawi: A nutritional possibility for people living with HIV/AIDS. International Journal of Consumer Studies 29(1): 72-22.

NAC. 2003. National Aquaculture Centre Annual Report 2002/2003. Malawi Department of Fisheries. National Aquaculture Centre, Domasi, Malawi.

NEC. 2000. Profile of poverty in Malawi, 1998. Poverty analysis of the Malawi Integrated Household Survey, 1997-98. National Economic Council, Government of Malawi, Lilongwe.

Ng'ong'ola C. 1990. The state, settlers, and indigenes in the evolution of land law and policy in colonial Malawi. International Journal of African Historical Studies 23(1): 27-58.

Nijenhuis K. 2003. Does decentralization serve everyone: The struggle for power in a Malian village. European Journal of Development Research 15(2): 67-92.

Njaya FJ, Donda SJ, Hara MM. 1999. Fisheries co-management study: Case of Lake Chiuta, Malawi. Paper presented at the ICLARM/IFM/NARS international workshop on fisheries co-management, Penang, Malaysia.

Noble RP, Costa-Pierce BA. 1992. Aquaculture technology research for smallholder farmers in rural Malawi. In: Aquaculture and schistosomiasis. National Research Council, National Academic Press, Washington DC. pp 11-25.

Normann AK, et al. 1997. Fisheries co-management in Africa. In: Normann AK, Nielsen JR, Sverdrup-Jensen S (eds.). Proceedings from a regional workshop on fisheries co-management research. 20 March 1997, Boadzulu Lakeshore Resort, Mangochi, Malawi.

Petry A. 1996. Status of small-scale aquaculture in the Southern Region of Malawi 1996. Malawi-German Fisheries & Aquaculture Development Project. Zomba, Malawi.

Phiri Y, Nagoli J. 2005. Proceedings of the first NGO consultative meeting on aquaculture development. WorldFish Center, Zomba, 30 June 2005.

PIAD. 2006. Presidential Initiative on Aquaculture Development in Malawi. Ministry of Mines, National Resources and the Environment, Department of Fisheries, Lilongwe, Malawi. pp 1-9.

Prein M. 1994. Farmer participatory development of integrated agriculture-aquaculture systems for natural resource management in Ghana. In: Brummett RE (ed.). Aquaculture policy options for integrated resource management in sub-Saharan Africa. ICLARM Conference Proceedings 46, ICLARM & GTZ, Manila, Philippines & Eschborn, Germany. pp 18-20.

Raynaut C. 2001. Societies and nature in the Sahel: Ecological diversity and social dynamics. Global Environmental Change 11: 9-18.

Reinthal P. 1993. Evaluating biodiversity and conserving Lake Malawi's cichlid fauna. Conservation Biology 7(3): 712-718.

Reynolds JE. 1993. Marketing and consumption of fish in eastern and southern Africa: An overview. In: Reynolds JE (ed.). Marketing and consumption of fish in eastern and southern Africa: Selected country studies. Food and Agriculture Organization, Rome. pp 1-26.

Ruddle K. 1996. Household and community factors affecting development of small-scale fish farming in Africa. In: Bailey C, Jentoft S, Sinclair P (eds.). Aquaculture development: Social dimensions of an emerging industry. Westview Press, Boulder, Colorado, USA. pp 211-231.

Russell AJM. 2003. Report on the fisheries extension staff training workshop on community based fisheries management, 11-12 December 2003. Michigan State University, Mzuzu, Malawi.

Russell AJM. 2007. Understanding the nature of "success": An analysis of fisheries co-management regimes on Lake Malawi. PhD dissertation, Department of Fisheries and Wildlife, Michigan State University, East Lansing, Michigan, USA.

Russell AJM, Dobson T, Wilson JGM. In press. Fisheries management in Malawi: A patchwork of traditional, modern, and post-modern regimes unfolds. In: Taylor WW, Schechter MG, and Leonard NE (eds.). International governance of fisheries ecosystems: Learning from the past, finding solutions for the future. American Fisheries Society, Bethesda, Maryland, USA.

Scott J. 1976. The moral economy of the peasant. New Haven: Yale University Press.

Seymour T. 2004. Decentralisation and CBNRM: Framework for a review of progress, challenges and opportunities. COMPASS II technical report.

SSC. 2005. National Aquaculture Strategic Plan (NASP), 2006-2015. Master plan study on aquaculture development in Malawi by System Science Consultants Inc. Main report. Japan International Cooperation Agency, Tokyo.

Tew M. 1950. Peoples of the Lake Nyasa Region. Oxford University Press, London.

Tweddle D. 1982. The fishes of the Malawi Northern Region game reserves. Nyala 7(2): 99-108.

UNAIDS. 2006. Report on the global AIDS epidemic 2006. Geneva, Switzerland, Joint United Nations Programme on HIV/AIDS.

UNDP. 2005. Human development indicators report. United Nations Development Programme, Rome.

UNSTATS. 2008. United Nations Common Database. http://unstats.un.org/unsd/cdb/cdb_help/cdb_quick_start.asp. Accessed on 22 February 2008.

van Velsen J. 1964. The politics of kinship: A study in social manipulation among the lakeside ethnicity Tonga of Nyasaland. Manchester University Press, UK.

Weyl OLF, Banda MC, Manase MM, Namoto W, and Mwenikombe LH. 2001. Analysis of catch and effort data for the fisheries of south west arm of Lake Malawi 1976-1999. Government of Malawi, Fisheries Bulletin No. 46.

White L. 1987. Magomero: Portrait of an African village. Cambridge University Press, Cambridge, UK.

WHO/FAO. 2002. Joint WHO/FAO expert consultation on diet, nutrition and the prevention of chronic diseases. World Health Organization technical report series 916. Geneva, Switzerland.

Williams TD. 1969. Commodity distribution in Malawi: A case study. In Stewart IG (ed.). Economic development and structural change. University of Edinburgh Press, Edinburgh, UK. pp 83-103.

Wilson G. 1939. The constitution of the Ngonde. Rhodes-Livingstone Institute. Northern Rhodesia. pp 41-42.

Windmar L, Kambewa P, Jamu D, Macuiane M, Kambewa E, Kanthunzi W. 2008. Feasibility study for a community driven fish cage model in Lake Malawi. WorldFish Center, Domasi, Malawi.

Withers FM. 1952. Seine net fishing in Nyasa (from notes supplied by John Hutchinson). Nyasaland Journal 5(1): 26-32.

WTO. 2002. Continued structural reforms could improve the growth prospects and dynamism of Malawi's economy. Trade Policy Reviews press release: PRESS/TPRB/188, 8 February 2002. World Trade Organization.

Annex A: Common and Scientific Names for Fish Species

Common Name *(Chichewa)*	**Scientific Name**	Aquaculture or Fishery
Tilapia	*O. mossambicus*	Aquaculture
Black bass	*Micropterus* sp.	Aquaculture
Brown trout	*Salmo trutta*	Aquaculture
Chambo	*Oreochromys* spp. *(O. lidole, O. saka, O. squamipinnis)*	Fishery
Chambo	*Oreochromys karongae*	Aquaculture
Chilunguni	*Tilapia rendalli*	Aquaculture
Common carp	*Cyprinus carpio*	Aquaculture
Kambuzi/ chisawasawa	*Lethrinops* spp.	Fishery
Kampango	*Bagrus* spp.	Fishery
Makumba/mkututu	*Oreochromis shiranus*	Aquaculture/Fishery
Matemba	*Barbus paludinosus*	Fishery
Mbuna	(collective name for many colourful cichlids found primarily at rocky inshore)	Fishery/ Aquaculture
Mlamba	*Clarias gariepinus*	Aquaculture/Fishery
Mpasa	*Opsaridium microlepis*	Fishery
Ntchila	*Labeo mesops*	Aquaculture/Fishery
Rainbow trout	*Onchorrhynchus mykiss*	Aquaculture
Sanjika	*Opsaridium microcephalus*	Fishery
Usipa	*Engraulicypris sardella*	Fishery
Utaka	*Copadichromis* spp.	Fishery

Annex B: List of Fish-Farming Projects in Malawi

Project Name	Duration	Objective(s)	Main activities	Major achievements	Comments
Food and Agriculture Organization (FAO) Kasinthula Project	1970-1976	Demonstrate commercial viability of aquaculture in Malawi.	· 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	· Introduction of common carp · Successful stimulation of commercial aquaculture at Kasinthula and the Sugar Corporation of Malawi · Use of *O. mossambicus* and common carp at Domasi	1. The introduction of common carp has been a controversial issue in Malawi. 2. While Kasinthula stimulated (short-lived) commercial aquaculture at the Sugar Corporation of Malawi, it has not had the resources to demonstrate the commercial viability of aquaculture.
Mulanje/ Phalombe Overseas Development Assistance Project	1987-1990	Mitigate large deficit in animal protein consumption in the district by demonstrating and stimulating integrated aquaculture-agriculture practices.	· Construction of a station at Chisitu · Promotion of integrated fish-farming practices and training of farmers	· Established 146 fish-farming families, each producing an estimated 2 tonnes per hectare per annum in 1992 · Trained Department of Fisheries (DoF) personnel to continue the work after the completion of the project	
International Center for Living Aquatic Reources Management (ICLARM)/ Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ) Aquaculture Project	1986-1995	Collaborative biological and socioeconomic research to develop and demonstrate a more appropriate system of aquaculture in Malawi and to develop Domasi as the lead research centre	· Development of National Aquaculture Centre (NAC) infrastructure · Development of low-tech farming technologies · High level of staff training · On-farm and on-station farmer-participatory research and development	· Development of aquaculture research facilities · Six staff trained from BSc to MSc level · A basket of technologies defined for dissemination to farmers through extension service · Establishment of a library and information service for aquaculture · Development of research and development protocols and technologies for fish farming experimentation · Initiation of research extension teams and training in aquaculture field data collection from farmers using Research Tools for Natural Resource Management, Monitoring and Evaluation (RESTORE) database · Introduction of seasonal fish farming in small water bodies (Thamandas in the Lower Shire) · Initiation of selective breeding of tilapia at NAC	1. The long-term involvement of the GTZ/ ICLARM project, as well as the Malawi-German Fisheries & Aquaculture Development Project and Japan International Cooperation Agency (JICA) projects (see below) and the present support of the WorldFish Center, has established Domasi as the undisputed lead aquaculture 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.

Malawi-German Fisheries & Aquaculture Development Project	1989-1995	Improve the standard of living of fisher and fish farming communities	· Test integrated aquaculture systems · Develop extension methods and materials · Develop and test potential estate (commercial) aquaculture models	· 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	
Central and Northern Regions Fish Farming Project (CNRFFP)	1989-1995	Phase 1: Establish the technical and economic parameters for developing fish farming in the Central and Northern regions of Malawi. Phase 2: Not implemented	· Establish cost-effective extension service · Train farmers · Train DoF staff · Determine the technical and economic viability of fish farming · Evaluate the potential for developing small water bodies	· 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	1. The Mzuzu station has unquestionably contributed to the promotion of smallholder fish farming, particularly in the Northern Region and, to a lesser extent, in the Central Region. 2. The CNRFFP is a classic illustration of the need for the DoF to develop innovative initiatives and plans for the maintenance of infrastructure as well as of research and extension activities after donor support has ceased.
JICA Aquaculture Project	1996-present	Screen indigenous cyprinids for suitability in aquaculture and to promote on-farm cooperative research.	· 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 new and current species	· Ongoing major infrastructure development at NAC, comprising hatchery, offices, laboratories, guesthouse and staff housing · Hatchery techniques for cyprinids defined, and mass production of fingerlings begun · Feeds developed for different sizes of fish, and rearing techniques for current and new species being developed · Initiation of genetic manipulation for improved tilapia experiments for all-male tilapia production · Initiation of on-farm trials and continuation of integrated on-farm fish farming	1. Though good work has been done, there is an impression that the project was not adequately planned to meet needs for the development of the sector.

Border Zone Development Project	1996-2002	The aim of the aquaculture component of this multifaceted development project was to enhance pond production through improved management and integration of fish farming with other agricultural activities in the Nchenachena, Mpompha and Livingstonia areas.	· 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	· Fish production of core group of farmers significantly enhanced through farm integration	1. The project 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 to achieve success.
JICA Master Plan study	2003-2005	Development of the National Agriculture Strategic Plan		· Establishment of the Innovative Fish Farmers' Network	
COMPASS II		Malawi Gold Standard production system		· Trainers' guide · Fish farmers' handbook · Business management plan	

Source: Modified after SSC 2003.

This document describes the historical background, practices, stakeholder profiles, production levels, economic and institutional environment, policy issues, and prospects for aquaculture in Malawi. It is an output from a 3-year project that produced a decision-support toolkit with supporting databases and case studies to help researchers, planners and extension agents working on freshwater pond aquaculture. The purpose of the work, carried out in Cameroon and Malawi in Africa, and Bangladesh and China in Asia, was to provide tools and information to help practitioners identify places and conditions where pond aquaculture can benefit the poor, both as producers and as consumers of fish.

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