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Livelihood Diversification and fishing communities in Ghana's Western Region



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Ann Gordon
Alan Pulis



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For more information contact: Coastal Resources Center, University of Rhode Island, Narragansett Bay Campus, South Ferry Road, Narragansett, Rhode Island 02882, USA. Brian Crawford, Director International Programs at Email: brian@crc.uri.edu; Tel: 401-874-6224; Fax: 401-874-6920

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Cover Photo: Diversified coastal livelihoods, Western Region, Ghana

Cover Photo Credit: Ann Gordon

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Acronyms

ADVANCE	Agricultural Development and Value Chain Enhancement
CRC	Coastal Resources Center
GDP	Gross Domestic Product
GHC	Ghanaian Cedi (Currency)
GLSS5	Ghana Living Standards Survey: Fifth Round
GNI	Gross National Income
HIPC	Highly Indebted Poor Country
ICFG	Integrated Coastal and Fisheries Governance Initiative
ICT	Information and Communications Technology
MDRI	Multilateral Debt Relief Initiative
NGO	Non-Governmental Organisation
SFLP	Sustainable Fisheries Livelihood Programme
UNDP	United Nations Development Programme
URI	University of Rhode Island
USAID	United States Agency for International Development

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While every effort is made to ensure accuracy, any errors are solely the responsibility of the authors.

Executive Summary

This report was prepared by the WorldFish Center to provisionally identify livelihood diversification opportunities in coastal communities in Ghana's Western Region.

The best options for livelihood diversification generally relate to further development of existing activities. Occasionally, there may be opportunities to significantly ramp up an existing but hitherto small activity, in response to a sudden change in circumstances. Developing more generic livelihood skills (such as improved education, business development skills) coupled with the provision of generic business services (e.g., information centres, micro-finance) will improve individual abilities to identify and seize new livelihood opportunities in a range of sectors.

An overview of the coastal economy yields some insights as to where future growth might lie, which, when coupled with some knowledge of fishing community assets (land, finance, education, social networks), will give some indication as to where prospects are best. The existing foundation for the economy in Western Region can be summarised as fish, port services (Takoradi), gold (inland), tourism (coastal), timber (inland) and oil and gas (new) – plus a strong agricultural base. Those sectors with a significant coastal presence are: fish, oil and gas, tourism and port services.

Port services are not explored because most of them relate to Takoradi – rather than the many fishing communities with the greatest need for livelihood diversification

A large share of those living in fishing communities have a weak asset base – and are most likely to find livelihoods in micro-enterprise and labouring. Opportunities that require capital investment or land (sports fishing and aquaculture have been mooted) will not be options for (most people in) the fishing communities. Both could create employment opportunities but neither is likely to have high labour demands.

What opportunities does this situation offer for livelihood diversification in coastal areas? There appear to be three possible routes:

- a. generic support improve abilities to identify and seize livelihood opportunities (without being prescriptive about particular sub-sectors)
- b. tourism (growing), and
- c. oil and gas (new).

Tourism is growing and if planned and managed well, could create significant and well-distributed livelihood opportunities in the region. Oil and gas is potentially quite problematic since the goods and services it uses are rarely purchased locally – except when unskilled labour is used for construction. To generate local employment opportunities in the region, a concerted and early collaborative effort will be needed to learn from experience elsewhere and apply best practice in Ghana.

Fish is quite pervasive in Western Region's coastal economy – in the sense that it creates thousands of jobs, directly and indirectly related to fishing. A really explicit and focused effort (requiring a convergence of political will and action) to develop oil or tourism in a way that created significant local employment could encourage people to exit fishing, leaving a less-crowded sector, more amenable to gradual change (with a more educated younger generation shifting into other sectors and places).

1. Introduction

Background

This study has been undertaken for the *Integrated Coastal and Fisheries Governance (ICFG) Programme* - a four-year initiative (2009-2013) supported by the U.S. Agency for International Development (USAID). Implemented through a cooperative agreement with the Coastal Resources Center (CRC) University of Rhode Island (URI), key partners include the WorldFish Center, SustainaMetrix, Friends of the Nation, the Department of Fisheries, coastal districts in the Western Region and other key government, private sector and nongovernmental organizations (NGO) stakeholders along the coast and in the fisheries sector. Programme activities are concentrated in the coastal districts of Ghana's Western Region, where coastal communities and the local government are the intended primary beneficiaries.

The goal of the ICFG Programme is to support the Government of Ghana in achieving its development objectives of poverty reduction, food security, sustainable fisheries management and biodiversity conservation by contributing to the following vision:

Ghana's coastal and marine ecosystems are sustainably managed to provide goods and services that generate long term socio-economic benefits to communities while sustaining biodiversity.
(CRC, 2009)

The importance of fishing in the populous coastal economy is evident – supporting livelihoods not just in fishing activity itself, but also linked to all the goods and services on which fishing and fish marketing depend, as well as providing disposable income to spend on many other consumption items in the local economy. However, the open access nature of the fishery and lack of opportunities for livelihood diversification is contributing to growing pressure on marine resources and fish-based livelihoods. Thus, growing numbers of fishers' livelihoods are being increasingly squeezed in a vicious circle that signals an urgent need for livelihood diversification in fishing communities.



Figure 1: Fisheries cycle affecting fishers' livelihoods

Objectives

The programme's approach to livelihood diversification was foreseen as 2-pronged:

(1) punctual interventions in selected sub-sectors to promote commercial development and employment generation; and (2) the development of more generic skills to improve capacity and choices of individuals for livelihood diversification. This study addresses the preliminary information requirements associated with the former.

A specific component included within this study addresses the feasibility of aquaculture production within the coastal zone. In Western Region, as in other parts of Ghana, there is strong interest in aquaculture development, based on robust and growing domestic markets, and an increasing gap between supply and demand, resulting in rising real prices. If there is potential for aquaculture in the coastal zone, this could create an important avenue for livelihood diversification.

Thus the objectives of the present study are:

1. to identify a short-list of sub-sectors which have potential for livelihood diversification
2. to determine if aquaculture development in Western Region is feasible, and
3. if aquaculture is feasible, to indicate which technological and institutional options are likely to have best potential.

Programme of work and organisation of the report

The findings reported here are based on fieldwork by the WorldFish team together with the Sekondi-based CRC and Friends of the Nation teams, supported by secondary data where available (including the coastal district surveys undertaken by ICFG in early 2010). The WorldFish team was led by Ann Gordon (economist) with the sub-component on aquaculture led by Randall Brummett (aquaculture scientist). Critical inputs were also provided by Cambria Finegold (livelihoods specialist) and Katherine Snyder (social anthropologist and gender expert). Fieldwork (largely based on key informant interviews, focus group discussions and direct observation) was conducted between March and August 2010 and took place in Western Region coastal communities and key towns that serve those communities (including Takoradi-Sekondi, the regional capital, and markets on the Ivory Coast border). Meetings were also held with key informants in Accra (e.g., World Bank, USAID, GTZ and ACDI-VOCA staff, to probe perspectives on diversification opportunities, including those linked to the petroleum sector).

Following this introductory section, the report is organised as follows:

- section II provides an overview of the Ghanaian economy, along with a selective review of other initiatives and reports that address issues of economic growth and diversification; it also briefly reviews the evidence on economic multipliers associated with different sub-sectors and introduces some of the issues relating to pro-poor economic growth and the development of particular economic sectors;

- section III focuses on Western Region, reviewing the economy of the coastal districts and associated trends and opportunities; the findings from the aquaculture study are also introduced here (whilst the main report is attached at Annex 1); and
- section IV presents and discusses suggestions on specific sectors offering potential for further development and recommendations on actions for ICFG.

2. Economic context: the parameters of the diversification challenge

Ghana: an economic overview

Ghana has a population of 22.4 million. The average annual population growth rate between 2000 and 2007 was 2.2 percent. It has a population density of 103 people per km² making it a relatively densely populated country when compared with other sub-Saharan averages.

In 2007 Ghana had a GDP of US\$15.2 billion with an annual average growth between 2000 and 2007 of 5.5 percent (World Bank, 2009a). The ratio of public debt to GDP declined from 142.6 percent in 2001 to 52.1 percent by late-2008, as a result of the Highly Indebted Poor Country (HIPC) initiative and the Multilateral Debt Relief Initiative (MDRI) (MOFEP, 2009). After a period of virtual economic collapse in the late 70s/early 80s, in recent years, Ghana has earned plaudits for its economic and political reforms, which have helped create the policy environment and political stability needed for growth and investment.

Nevertheless per capita GNI was just \$450 in 2005 (World Bank, 2007a). In the 2009 UNDP Human Development Report (which reports on the Human Development Index for 2007), Ghana was ranked 152 out of 182 countries, with only a slight improvement over the previous year, placing it at the lower end of the “medium human development” countries. It has a life expectancy at birth of 56.5 years (57.4 for females, 55.6 for males), and an adult literacy rate of 65 percent (58.3 for females, 71.7 for males).

Between 1991 and 2006, Ghana nearly halved the national poverty rate to 28.6 percent (World Bank, 2007a) and absolute numbers of poor dropped too (despite population growth). However, inequality also increased with the emergence of a middle class registering large gains. There is also growing inequality between regions (the north is markedly poorer) and between men and women.

GDP in 2006 comprised 36% agriculture (including forestry and fisheries), 25% industry (including minerals – notably gold and oil) and 30% services¹. Over the last 30 years all of those sectors have contributed to overall average annual growth in GDP of 4.2% (all grew at about 5% per annum from 2001-2005), but the agricultural sector (including fisheries) grew slower than the other sectors until around 2000 when its annual growth rates reached 5% as compared with 2-4% over the previous 20 years. Fishing (i.e., primary production, excluding value added in post-harvest and marketing) contributed around 4% to GDP in 2006 (World Bank, 2007a) – so possibly around twice that when processing and marketing are taken into consideration too.

¹ The difference is accounted for by “indirect tax” -

Ghana's recent growth has been broadly shared and made impressive inroads on poverty reduction. However, the development challenge now is to sustain and extend that growth to address inequality (which has increased with growth) and particularly to reduce poverty among certain groups who consistently lag the overall positive trends. Notably (and summarizing a highly nuanced picture):

- the poor have gained less than the better-off
- the three northern regions continue to show markedly higher rates of poverty
- women earn less than men and poor women are economically the most vulnerable, and
- although the fall in poverty was more dramatic in rural areas than in urban Ghana, urban areas, particularly Accra, have much lower poverty rates than elsewhere.

Put more starkly, although the incidence of poverty has almost halved over the last 20 years, 28.6 percent of the population still live below the national poverty line². Setting this within the context of ICFG, it is important to note that although the problems facing the coastal fishing community are felt acutely in the local economy, within a national context other development challenges are seen as more urgent – particularly given very marked north/south differences (mean per capita annual expenditure ranges from 166-329 GHC in the three northern regions, compared with a national average of 644 GHC).

Fish-based livelihoods in coastal Ghana

It is useful to briefly review the role that marine fisheries plays in the Ghanaian economy. Fishing activity accounts for an estimated 4% of GDP (World Bank, 2007a). Fish capture, processing, marketing and associated services constitute a significant source of livelihood – certainly in coastal areas and around lakes and rivers, but in other areas too. There has been relatively little work done on multipliers in fisheries, but an SFLP³ study in Ghana suggested that one fishing job created 7 additional livelihoods. The household security effect is even wider – since each of these incomes will help support an extended family.

Although fishing is becoming more difficult, there is no doubt that it nonetheless remains a critical economic driver in coastal Ghana. Statements like the following are common:

“As many as 2.2 million people are dependent on the fisheries sector for their livelihoods including some 135,000 fishers in the marine sector...” (p5, Republic of Ghana Fisheries and Aquaculture Development Plan 2010-2015).

² World Bank, 2007a and Ghana Statistical Service, 2008, drawing on data from the 2005/2006 Ghana Living Standards Survey.

³ Sustainable Fisheries Livelihoods Programme – A DFID/FAO West Africa regional fisheries development programme (1999-2007).

The domestic market is the most important market for Ghanaian fish production, explaining in part the accessibility of this marketing system to thousands of small-scale processors and traders, as well as larger operators. Fish is extremely important in the Ghanaian diet, consumed throughout the country and accounting for 40-60% of animal protein supply. The marketing systems, although largely based on traditional products, are relatively well-developed and extend into neighbouring countries. For example, Ghana's artisanal sector is an important source of processed fish for the Nigerian market.

Perspectives on growth strategies for Ghana

Pro-poor growth

It is now well-established that agricultural growth is more effective in reducing poverty than non-agricultural growth. Since the poor remain largely concentrated in rural areas, and growth in other areas tends to deepen disparities between rural and urban areas, "...broad-based growth in the rural economy appears essential for reducing both absolute and relative poverty" (p29, World Bank 2007b). Moreover, studies in rural Africa (e.g., Delgado et al., 1998) suggest that local employment and income multipliers associated with agricultural trade are in the range of 2-3 (i.e., a dollar of new income from trade in a rural area will generate a further \$1-\$2 through multiplier effects). Local income and employment multipliers are strongest where recipients spend high shares of their income locally.

By extension, based on what can be observed in fishing communities and what is known about the goods and services that support the fishing economy, the value chains for traditional fish products very likely have strong income and employment multipliers. That would not necessarily be the case with a shift to more "modern" (ostensibly higher value) products – since these may rely on more non-local inputs. (Diao et al., 2003, have argued, for instance, that the income multiplier from horticulture in sub-Saharan Africa is only 0.71 – although the sub-sector may still generate strong employment effects). These nuances underline the importance of timely empirical work on these multipliers, in the current policy context that emphasises value addition opportunities in fisheries – as well as the need for livelihood diversification. There are critical questions relating to the scale and distribution of income and employment effects of any diversification strategy.

Underlying requirements for sustained growth

The World Bank (2007a) identifies three key areas where improvements are critical if recent strong economic performance is to be sustained:

- infrastructure
- agricultural productivity, and
- the investment climate.

Ghana's economy still depends heavily on its natural resources. Timber, cocoa, minerals, and fish represent 48 percent of GDP, 90 percent of foreign export earnings, and 70 percent of total employment. The World Bank argues that, as a small country, exports must play an increasing role in

Ghana's growth strategy – by expanding existing natural-resource based trade and developing non-traditional exports.

“... widely shared growth has to be led by agriculture but cannot be sustained by continued reliance on traditional commodity exports alone. Therefore, economic diversification is a centrepiece of this strategy. In particular, the agricultural sector would be diversified toward new and non-traditional raw and processed agricultural exports and, over time, is envisaged to be less dominated by cocoa. Outside agriculture, the strategy identifies other potential comparative advantage sectors, such as tourism; information and communication technologies; and labour-intensive light industries—based on textiles and garments as well as processed minerals. This pillar of the strategy requires a strong investment climate and a highly competitive private sector. In turn, this would depend on large expenditure outlays in the social sector. Human development is... of course important in its own right, but it also is critical for improved labour productivity and for diversifying into more knowledge and transaction-intensive private sector activities, such as horticulture and floriculture.” (World Bank, 2007a, volume 2, p143)

Identifying sector-specific opportunities for growth

The same World Bank report notes that whilst there is consensus on the need to diversify, there is little consensus on what to diversify towards. Based on an analysis of income potential, comparative advantage and “ease of diversification”, the authors nonetheless identify 3 groups with the strongest prospects for export diversification (p193 and p211, vol 2):

- in the short term, the quick wins would be fresh or processed produce that form the (1) horticultural and (2) fishery sectors which engage small producers who have the basic skills but need other complementary inputs such as public goods to attract investors and scale up. The experience of at least three Sub-Saharan African countries—Uganda, Kenya and Tanzania—demonstrates that with political commitment, this goal is achievable.

Scaling up the remaining four sectors is technically feasible but a policy challenge for Ghana:

- in the medium term, more complex processed products (salt and starch) and palm and vegetable oils; and
- in the longer term, wood and metals manufactures.

This report makes relatively little reference to the potential offered by the emergent oil sector. It does, however, caution against its possible pitfalls, which are identified as “Dutch disease” (a tendency for economic alignment with the oil economy, particularly currency appreciation, tending to make other sectors less competitive), inflation, weak capacity to manage the associated public revenues and corruption.

Reinforcing the point that there is little consensus on what to diversify towards, other initiatives have focused on other sectors. For example:

- a series of Presidential Special Initiatives since 2006 has resulted in Government of Ghana commitment to target the cassava starch, textiles and garments, palm oil and salt sectors for export promotion (essentially scaling up existing exports); subsequent World Bank analysis tentatively supports the choice of all these except textiles (whose suitability is less clear);
- the USAID-supported West Africa Trade Hub “works with people to improve transport, access to finance, business environment and ICT to make the West African businesses more competitive”; its website lists the following sectors in which it is active in Ghana: apparel, cashew, fish and seafood, home décor and fashion accessories, shea, speciality food and textiles;

Much of the work on value chains, currently so popular, represents an alternative approach to sector-specific development. These initiatives usually select particular value chains because of their importance to particular target groups, or because of their economic importance in a particular area, or because of their perceived potential for growth, based on recent trends or developments. An important characteristic of this work is that it builds, usually incrementally, on existing commercial development, and (with varying degrees of success) seeks to facilitate development by addressing critical constraints, rather than taking on roles that are best and more sustainably left to the private sector.

GTZ’s Market-oriented Agricultural Programme consists of three components:

- Promotion of selected agricultural value chains
- Increasing efficiency of the public sector
- Strengthening of private sector institutions

In agreement with the Ministry of Food and Agriculture, it promotes the following value chains: pineapple, citrus, mango, chillies pepper, grasscutter, guinea fowl, and aquaculture. The programme enables producers and processors to increase production volumes and to adjust the quality of primary and processed produce to suit market requirements. It furthermore advises the ministry on the implementation of decentralised organisational reforms, improvement of service delivery, and private sector support.

The USAID-funded (ACDI-VOCA-implemented) Agricultural Development and Value Chain Enhancement (ADVANCE) project also has three components: value chain competitiveness, market access and development and financial services. It supports work on: maize, sorghum, rice, soybeans, fruit and vegetables (e.g., mango, pineapple, chilli, Asian export vegetables), and poultry and aquaculture (including fish feed).

Strengthening broad-based enterprise development capacities

An alternative approach is to build and/or strengthen enterprise development capacities – to help would-be entrepreneurs seize and develop the opportunities they perceive – rather than focusing on particular sub-sectors.

This type of approach might focus on particular groups (e.g., women micro-entrepreneurs or medium-scale investors or collective action) to build individual business capacities and support the development of a favourable business climate. The former could include training in functional literacy and numeracy, basic book-keeping, business planning and rudimentary market research, or co-operative enterprise (or particular tasks that are amenable to collective action such as bulking up of crops, quality control, arranging transport – whilst preserving the business functionality of the individual entrepreneur). Actions that focus on the business environment could include working with Government to streamline bureaucratic processes and taxation, providing clearer information on relevant processes, fighting corruption, developing microfinance services, and so on.

Whether sector-specific or a more general approach is taken, there is increasing recognition that sustainable jobs and incomes are best promoted via facilitative approaches rather than the NGO (or project) taking on a particular role in the business chain (such as bulking up and marketing output to large-scale institutional buyers). More interventionist approaches tend to present a hand-over challenge resulting in a gap once the donor funding is withdrawn. Within that spectrum (facilitative to interventionist) there are many “shades” of activity whose merits are keenly debated within the business development community. For instance, there is a strong argument that all business development services, training and microfinance should be charged to the recipient at full cost (i.e., to create a market for those services which are needed to promote and sustain business development). Others, however, will implement programs with selective use of direct and indirect subsidies.

In general, vocational schools tend to be less popular now – since their increasing presence in the 60s often resulted in well-trained graduates without jobs to go to. There have been some interesting recent variants on this model, including, for instance, the “Dr Reddy’s” schools in India that target young people from informal urban housing areas and provide them not just with training but work experience placements too.

Improved access to education in general builds human capital contributing to a higher skilled labour force and this point has been stressed by the World Bank (2007a) in Ghana (see previous discussion of *underlying requirements for sustained growth*).

Gradual shifts and incremental change based on multiple factors

The reality is of course that it is very difficult to transform an economy quickly. Changes happen in large part gradually and incrementally in response to changing incentives. Thus, as pressure on fishing increases in coastal Ghana, whilst older fishers may stay in the sector, younger people (and particularly those who have more opportunities as a result of higher levels of educational achievement) will gradually shift into other sectors (assuming of course that those other sectors are not subject to a similar malaise). Those with better networks and information and those with more choices, by virtue of their access to other types of capital (financial capital or land) are likely to shift before those who are more disadvantaged. It’s possible that few people will move out of the sector – but new entrants may be fewer. Any process to promote livelihood diversification must take a long view and recognise the

importance of a range of factors (both “pull” and “push”) that will affect the speed and scale of any shift. Even for those that remain in the sector, if there is less entry or some departure, those remaining may experience an improvement in their livelihoods.

3. The Western Region Economy

Geographical overview

The Western Region covers an area of approximately 24,000 square kilometres, around 10 per cent of Ghana's total land area (GSS, 2008). It has a mean household size of 4.7 people, slightly lower than the national average (5.1) (GSS, 2008), and a population of 2.4 million. Population density is 99 people per square kilometre. The region's 3.2 per cent population growth rate is the third fastest in Ghana after Greater Accra (4.4%) and the Ashanti Region (3.4%) and higher than the national average.⁴ The total fertility rate (TFR) of 4.4% is also above the national average (4%) and the 4th highest in Ghana.

Households are predominantly male-headed and in all the districts except Juabeso-Bia, 90 per cent or more of the inhabitants are Ghanaians by birth. The Akans, who include the indigenous Wassas and Sefwis, and the migrant Fantes, constitute more than two-thirds of Ghanaians by birth in every district.

The region lies in the equatorial climate zone characterized by moderate temperatures. 75 percent of the land area falls within Ghana's high forest zone. It is the wettest part of Ghana with an average rainfall of 1,600mm per annum. It is bordered to the east by Central Region, to the west by Cote D'Ivoire, to the north by Ashanti and Brong-Ahafo regions and to the south by the Gulf of Guinea.

From west to east, its six coastal districts are Jomoro District, Nzema East Municipality, Ahanta West District, Sekondi-Takoradi Metropolitan and the newly created Shama District⁵ and Ellembele District. These districts are quite densely populated – significantly more so than the rest of the region - accounting for 37 percent of the total population (around 900,000 people) but a much smaller land area (perhaps only 20% or less). However, the coastal zone includes Sekondi-Takoradi which is an important urban area.

The economy of Western Region

The existing foundation of the economy in Western Region – and particularly the goods and services it trades - can be summarised as fish, port services⁶ (Takoradi), gold (inland), tourism (coastal), timber (inland) and oil and gas (new). It has a strong agricultural base, with the agricultural sector employing

⁴ The regional population growth rates are based on 2000 data, when the corresponding national population growth rate was 2.7 percent.

⁵ The former metropolitan district of Shama-Ahanta East was comprised of what is now the Sekondi-Takoradi Metropolitan and Shama district.

⁶ This term is being used in a very general sense to include all the goods and services that grow up around the presence of an important port; which provides services for a large hinterland.

nearly 60% of the economically active population in the region (Ministry of Food and Agriculture, 2010). The main crops harvested are rubber, coconut, and cocoa, accounting for the largest share of national production. Recently, coconut production has suffered due to Cape Saint Paul Wilt Disease which is destroying coconut plantations. Food crop production, on the other hand, is quite low, contributing less than 8% to national production (SRID, 2010) - which may be due to the lower revenues when compared to other crops (cocoa, coconut, etc.). The six major food crops cultivated in the area are maize, rice, cassava, yam, cocoyam, and plantain (Ministry of Food and Agriculture, 2010).

Fishing Community Assets

An understanding of the livelihood assets of fishing communities can provide some insights into opportunities for livelihood diversification. The discussion here focuses on five types of capital (physical, human, social, financial and natural) – following the sustainable livelihoods framework. Moreover, since our focus is on livelihood diversification opportunities, of a scale sufficient to absorb large numbers of small-scale fishers and other unskilled informal sector workers, whose livelihoods are currently derived (directly or indirectly) from fish, the discussion below focuses on the assets of the poor in the fishing communities. Clearly there are some people in those communities who have a stronger asset base and a wider array of opportunities for livelihood diversification.

Physical capital

In much of coastal Western Region, the road infrastructure is relatively good in that most communities are either on an all-weather road or a relatively short distance from such a road. The main east-west Accra-Cote d'Ivoire road follows the coast, much of it just a few kilometres inland. (It branches in the west, to different border crossings, but both are served by an all-weather road).

Access to household amenities is less consistent. GLSS5 (Ghana Living Standards Survey: Fifth Round, conducted in 2005/2006) indicates that 63% of Ghana's rural coastal households draw water from a well or from pipes, but 34% rely on "natural sources" (river, rainwater or pond)⁷ – compared with 19% for all Ghana. The GLSS5 indicates that only 29% of households in rural coastal areas have mains electricity for lighting (most use kerosene lamps) – compared with 49% for all Ghana. It also indicates that 27% of households in rural coastal areas have no toilet (i.e., use the bush or beach)⁸, compared with only 19% for all Ghana. From observations and information gathered locally, sanitary toilet facilities are indeed lacking in many of the fishing communities in Western Region. Similarly, the disposal of rubbish is also an issue raised by many communities.

⁷ The Ahanta West Human Development Report 2007 quoting ISSER household survey data indicates a much smaller percentage of only 6% reliant on natural sources for water, in the district as a whole.

⁸ Again, the Ahanta West Human Development Report 2007 presents a slightly better picture for both access to electricity (56%) and "no toilet" (20%).

Human capital

For men, Western Region achieves higher levels of school attendance (“proportion of adults who have been to school”) than all other rural areas (86.4% compared with 68.5%). Women’s school attendance is higher than the rural average (60.6% compared with 49.9%) but other regions nonetheless achieve higher rates (GLSS5). GLSS5 indicates that rural coastal areas achieve similar levels of adult literacy as the rural forest areas and higher rates than rural savannah areas (respectively 51.3% 51.4% and 24.1%). Interestingly it is the women’s literacy rates again that lower the overall performance of the coastal areas compared with the rural forest areas (male literacy is higher in rural coastal areas compared with other rural areas, but female literacy lower than that in rural forest areas). The gender gap in education tends to increase with higher levels of education. So, in rural coastal areas, attendance rates are very similar to age 15, but thereafter male attendance is higher.

Nonetheless, there is a perception in Western region’s fishing communities that educational opportunities are limited. Clearly for many there are perceived short-term financial trade-offs in keeping a child in school – both in terms of meeting schooling costs and in foregoing the income that the student might contribute to household revenues. However, these discussions reveal clearly that fishers recognise the value of better education, hoping this will expand their children’s employment opportunities – and many talk of making short-term sacrifices in order to keep their children longer in school.

Coastal communities are generally able to access health services in the Western Region. In the Jomoro district, 40% of the population must travel only one kilometre to access a health centre (Jomoro District Website). Malaria is the leading cause of morbidity in the region. In 2005, there were nearly 16,000 recorded cases of malaria in the Ahanta West district, 31 of which resulted in death. Measures to prevent the spread of the disease include the use of mosquito coils and nets, cleaning of overgrown weeds and bushes and desilting of stagnant water.

Data on the prevalence of HIV/AIDS is scarce. Most people in the Western region have heard about the disease and are aware that it can be transmitted from mother to child and that people who seem healthy may be infected (GLSS5). The Ghana Aids Commission was set up to combat HIV/AIDS across the country but faces a number of challenges in the region, namely the low use of contraceptives and the refusal to go in for voluntary counselling and testing (VCT).

With regards to child health, most children are vaccinated before the age of 6 (GLSS5). The infant mortality rate in the Ahanta West district was 4 per 1000 deaths in 2006 (HDR, 2007). Health insurance does not seem to be popular, with only a small percentage (c. 16%) of the population in the western region covered. This seems to be a common trend across the whole of Ghana (GLSS5).

Social capital

It is very difficult to generalise about social capital in fishing communities because this will vary from place to place, as well as with ethnic group and socio-economic status. Nonetheless, some points are clear:

- most fishing communities are linked to some extent with the traditional authorities via the Chief Fisherman (and Konkohene);
- ethnicity is an important descriptor in Ghana (and indicator of language too) – with many of the fishermen in Western Region (“settled” Fante migrants originally from Central Region) still regarded as outsiders and some fishing communities (e.g., Half-Assini) having different areas for different ethnic groups;
- from the perspective of social capital in relation to trade, the traditional roles and functions (Chief Fisherman and Konkohene) contribute to some extent to stability and conflict reduction; the trading networks of the women traders continue to be very strong – serving domestic and neighbouring country markets;
- nonetheless, changes in processing or handling (for instance a shift to higher value products or more use of cold storage) may see these traditions being marginalised
- there is clearly increasing conflict in fishing communities stemming in part from fishers from other areas fishing with destructive methods in local waters, thus presenting the traditional authorities and local community with a problem they are ill-equipped to tackle; similarly the traditional fish trading roles (particularly price-setting) are being eroded in some places (e.g., where landing fees are charged or where one trader commands a significant market share)
- it is also clear that “well-connected” fishers with semi-industrial vessels are able to escape penalty when fishing illegally, further exacerbating conflict and frustration in the traditional fishing communities;
- there are also concerns about the development of the petroleum sector and how this will affect fishing; much of the discussion on petroleum development is taking place at a senior level behind closed doors, although traditional chiefs are involved in these discussions.

This suggests that the social capital of the canoe fishers is weak – in as much as its strength lies partly in institutions that are under pressure and struggling to adapt to a new set of pressures (and a new set of rules?).

Financial capital

There are clearly considerable levels of investment within the fishing communities at present: boat-building (semi-industrials and large canoes) can be observed at or near almost all the landing sites; the increases in effort described in the WorldFish Western Region Fisheries Sector Review (September 2010) include investment in expensive new nets and larger outboards; and some of the fish mongers regularly purchase and trade large volumes of fish. Some of the boat-building (particularly of semi-industrial vessels) may reflect investment from outside the fishing community but certainly some of this investment is in part coming from within the coastal communities.

Own savings and family, as well as Rotating Savings and Credit Associations which are common amongst the women, seem to be the main sources of financial capital. Discussions in fishing communities in Western Region during the course of this work provided no examples of access to formal sources of credit and certainly many of the fishmongers lament the lack of affordable credit (apparently reflecting their wish to buy larger quantities of fish when the prices at the landings are low).

Yet many of the people whose livelihoods depend on fish are very poor – and they are able to participate in fishing (and portering, processing or petty trade in the fishing community) by virtue of the fact that these activities do not require capital investment. Someone else provides the boat and gear (and these people take larger revenue shares as a consequence), but most of the crew just contribute their labour. So for many, lack of access to financial capital would be a constraining factor in developing small business activities.

Natural capital

In general, fishing communities (particularly migrant communities) do not have small-holdings – although some communities have been allocated inland plots by local chiefs. Their main source of natural capital is the sea and the coastal lagoons and estuaries.

Implications of fisher assets for livelihood diversification

In sum, a large share of those living in fishing communities have a weak asset base – and are most likely to find livelihoods in micro-enterprise and labouring. Opportunities that require capital investment or land (sports fishing and aquaculture have been mentioned) will not be options for (most people in) the fishing communities. Both could create employment opportunities but neither of these is likely to have high labour demands.

This is worth discussing in more detail for aquaculture (see report attached at Annex 1). Aquaculture (which globally is growing whilst capture fisheries stagnate or decline) is often suggested as an option for fisherfolk whose livelihoods are under pressure, but this suggestion rarely stands closer scrutiny. Aquaculture is a farming activity, requiring land and relatively significant investment. More extensive aquaculture systems have strong synergies with agricultural activity (“integrated aquaculture agriculture”), with the by-products of each serving as inputs to the other. Traditional coastal fishing communities are rarely farmers as well and often have no (or very little) land. Cage culture (freshwater, marine or brackish) is possible but this also requires investment and can have an unfortunate side effect of blocking access to the “commons” (e.g., as seen in increased conflict on Lake Volta as the number of cage farms proliferates around the lake edge).

Outside investment in aquaculture (or investment by those who have sufficient funds to invest in increasingly well-equipped fishing boats) could be beneficial for fishing communities if it created significant local employment opportunities. However, although significant employment generation is sometimes alleged, labour use in aquaculture seems low. Brummett *et al.*, (2008) report that only 0.5-1 person year is required per tonne of fish produced in aquaculture production systems in sub-Saharan Africa. However, the evidence is patchy – particular in Africa where there's been very little work on this.

4. Livelihood diversification options for fishing communities in Western Region

Overview

The best options for livelihood diversification generally relate to further development of one or more existing activities. Occasionally, there may be opportunities to significantly ramp up an existing but hitherto small activity, in response to a sudden change in circumstances (a new road may improve market access or the discovery of oil and gas in Western Region may offer new livelihood opportunities). In the absence of sufficiently strong market incentives, any other encouragement to enter particular sub-sectors is risky and unlikely to succeed. Developing more generic livelihood skills (such as improved education, business development skills) coupled with the provision of generic business services (e.g., information centres, micro-finance) will improve individual abilities to identify and seize new livelihood opportunities in a range of sectors.

Nevertheless, an overview of the coastal economy yields some insights as to where future growth might lie which, when coupled with some knowledge of fishing community assets (land, finance, education, social networks), will give some indication as to where prospects are best. The existing foundation for the economy in Western Region – and particularly the goods and services it trades - can be summarised as fish, port services⁹ (Takoradi), gold (inland), tourism (coastal), timber (inland) and oil and gas (new). In addition it has a strong agricultural base. To some extent (depending on market conditions) its position as a trading frontier with Cote d'Ivoire may also offer opportunities¹⁰.

Assuming that there is unlikely to be any dramatic move away from coastal areas (although this could be expected to happen gradually, in response to perceived economic opportunities), it is useful to identify those sectors with a significant coastal presence: fish, oil and gas, tourism and port services. Notwithstanding the additional employment that may be created by the proposed new port

⁹ This term is being used in a very general sense to include all the goods and services that grow up around the presence of an important port; which provides services for a large hinterland.

¹⁰ With the exception of some possible smuggled pre-mix, there do not seem to be strong trading patterns with Cote d'Ivoire; rather, the trade that takes places seems to be just that between nearby markets, with similar goods trading in both directions.

facilities in Axim¹¹, port services are not further explored because they relate overwhelmingly to Takoradi – rather than to the myriad of small and large fishing communities where there is an acute need for livelihood diversification.

What opportunities does this situation offer for livelihood diversification in coastal areas? There appear to be three possible routes:

- a) generic support to improve abilities to identify and seize livelihood opportunities (without being prescriptive about particular sub-sectors)
- b) tourism (growing), and
- c) oil and gas (new).

Tourism

Tourism is already receiving attention and can create strong local multipliers through a range of locally-provided goods and services and through the highly-valued salaried employment opportunities it creates. These are not givens though – hotels may employ skilled people from other areas and buy-in goods and services from outside the area. Tourists may make most of their purchases in the hotel (a particular criticism of all-inclusive packages) or find few local goods (crafts) and services (guided tours and so on) on which to spend their money. Sometimes they may be deterred by over-aggressive vendors. It seems that Western Region attracts more visitors from within Ghana than from outside and this is also likely to have implications for the type of tourism services sought. The important point though is that the sector is growing and if planned and managed well, could create significant and well-distributed livelihood opportunities in the region.

Oil and gas

Oil and gas is more problematic. The highly specialised nature of the goods and services used in the sector, heavy dependence on an expatriate workforce (assumed to require certain housing, facilities and services more easily imported¹² than provided locally), as well as a tendency towards an “enclave culture” (fostered by rigs and the “3-weeks on / 3-weeks off” arrangements that are common) result in the sector almost always generating very significant income for the country – but having very weak local economic multipliers. In short, the goods and services the sector uses are rarely purchased locally –

11 A new port with a naval presence is proposed at Axim. Sciortino (2010) states that it should be designed exclusively for MCS assets and vessels supporting other sustainable activities, such as cage farming, off-shore services and eco-tourism. Offshore services could include logistics, warehousing and diving for the oil industry, as well as support for offshore cage farms, and whale-watching and sports fishing for ecotourism. Whilst this is likely to create additional employment opportunities, these sectors are also likely to be quite specialized and concentrated with few people.

12 Imported from abroad or from an urban centre within the host country

except when unskilled labour is used for construction activities. Plans to minimise shore-based infrastructure, using collection ships at sea rather than bringing oil ashore for processing, would further reduce the likelihood that oil exploitation will bring major economic benefits to fishing communities in the Western Region. The economic effect is further exacerbated when communities are negatively affected by the oil and gas development, either by livelihood impacts (e.g. from pollution or access restrictions) or through stress on infrastructure such as water supply or road networks.

There is increasing awareness of these issues and so-called “local content” clauses in oil company contracts are receiving increasing attention. It is understood that this has been a particular focus in the negotiations in Ghana. However, local content usually means “host-country content”. In Ghana, one could foresee a scenario where educated Ghanaians may secure some of the skilled (and unskilled) jobs and many of the services are contracted out¹³ to larger companies based in Takoradi. Whilst Takoradi may “pull” labour in from other places in Western Region, it is still hard to foresee significant livelihood opportunities opening up for fishing communities unless deliberate and early steps are taken to encourage this outcome.

This includes “really local” hiring policies, opportunities for training of locals for “semi-unskilled” jobs such as firefighting, and ensuring that recruitment procedures do not set unnecessarily high criteria (e.g. literacy for a job that doesn’t require reading or writing) that could rule out local candidates in favour of more educated urban ones. In addition to encouraging the creation of opportunities for local employment in unskilled positions (security, groundskeeping, drivers, etc), there is often potential for supporting local value chains. Some examples of goods and services that could be procured locally (but would require support to business development – or specific clauses on “really local” content in sub-contracts to Takoradi-based companies) include:

- supply of meals and food stuffs (on-site canteen or delivered)
- manufacture of uniforms
- manufacture of furniture
- transport (of goods and staff)

¹³ The structure of the oil and gas industry, in which the ‘operator’ directly employs a relatively small proportion of the workforce in a given operation and subcontracts discrete functions to other companies, further complicates attempts to ensure that local economic benefits are created. Those directly employed by the operator tend to be managerial staff and highly skilled technical positions, whilst activities as diverse as engineering, catering, construction, security, and transport are subcontracted to other companies, either nationally or internationally, which, in the absence of local content clauses in their subcontracts, operate totally independent hiring and procurement policies.

The pervasiveness of the fishing economy in the Western Region

A really important point to keep in mind here is the *pervasiveness* of fisheries in Western Region's coastal economy – in the sense that it creates thousands of jobs, directly and indirectly related to fishing. An explicit and concerted effort (requiring a convergence of political will and action) to develop oil or tourism in a way that created significant local employment could encourage people to exit fishing, leaving a less-crowded sector then more amenable to more plausible gradual change (with a more educated younger generation shifting into other sectors and places).

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Annex 1:

Preliminary Analysis of Aquaculture as a Livelihood Alternative in the Coastal Districts of Western Ghana

R. E. Brummett with Ann Gordon

WorldFish Center

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Acronyms

ARDEC	Aquaculture Research and Development Centre
ASS	Africa South of the Sahara
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organisation of the United Nations
FCR	Food Conversion Ratio
GAFCO	Ghana Agro Food Company Ltd
GHC	Ghanaian Cedi (Currency)
MOFI	Ministry Of Fisheries
NGO	Non-Governmental Organisation
ROI	Return on Investment
TCP	Technical Cooperation Program
WRI	Water Research Institute

1. Introduction

Background

The Coastal Resource Center in seeking to promote livelihood diversification in the coastal zone of Ghana's Western Region has two potential options: (1) to build broad-based enterprise development capacities; and (2) to identify punctual interventions in selected sub-sectors to promote commercial development and employment generation. The WorldFish Center's work on the identification of sub-sectors that offer potential for livelihood diversification includes a specific component on the feasibility of aquaculture production within the coastal zone (addressed by this report).

In Western Region, as in other parts of Ghana, there is strong interest in aquaculture development, based on robust and growing domestic markets, and an increasing gap between fish supply and demand, resulting in high real prices. If there is potential for aquaculture in the coastal zone, this could create an important source of livelihood for local communities faced with declining revenues from over-exploited fisheries. The objectives of this review and analysis are to: (1) determine if aquaculture development in Western Region is feasible and, (2) if so, indicate which technologies and institutional arrangements are most likely to foster sustainable growth of the sector.

Field work was undertaken by the author in May 2010 (see Appendices I and II), with support from the ICFG field team, as well as other WorldFish team members (notably Cambria Finegold and Ann Gordon).

Status and Trends in Aquaculture Development in Ghana

Aquaculture production statistics reported to FAO have been highly unreliable (FishStat 2009) and an effort to improve data collection has only taken effect since 2003. Growth of the Ghana's aquaculture sector since 2003 has, however, been remarkable, rising from about 300 tons to over 2,500 tons in 2009 with a current value of approximately \$3 million. Almost all of this is of tilapia, mostly *Oreochromis niloticus*. Accurate catfish (*Clarias gariepinus*, *Heterobranchus longifilis* and their hybrid) production data, important in the west, have never been collected.

Though estimates for the number of fish farmers in Ghana are as high as 2000, most of these are more or less small holder subsistence operations. The majority of production derives from a few larger-scale cage aquaculture ventures located in the Volta Lake, most notably Tropo Farms (>1000 MT reported), Crystal Lake Aquaculture (700 MT reported) and West Africa Fisheries (800 MT reported). Producer profit margins are rumoured to be around 250%. Driven by the availability of proven technology and high market prices for fresh fish, new investors, both local and foreign, are expressing interest in the sector. West Africa Fisheries is expanding to include a hatchery.

Constraining smaller-scale producers from making significant contributions to national aquaculture output are persistent and pervasive shortages of feed, seed and technical assistance. Government extension officers often lack sufficient resources and training, and with no significant sources of

alternative technological support, farmers are unable to overcome shortages of fingerlings and other inputs. At all production scales, thievery is widely cited as a major problem.

The Ghanaian Government's policy for the aquaculture sector reflects a pro-business attitude illustrated in the following guidelines and objectives from the Fisheries Act (2000):

- obtain optimum benefits for Ghanaians as owners of fish-related enterprises, as employees of the industry, as consumers of fish products and as beneficiaries of foreign exchange earnings from fish trade;
- enhance investment in a private sector-driven industry;
- improve Ghana's access to international markets.

It is noteworthy to observe that the current Act also conforms to the FAO code of Conduct for Responsible Fisheries.

Ghana's Strategic Framework for Aquaculture (Appendix III), stresses seven key approaches that government seeks to follow in supporting the sector:

1. Public sector (such as the Fisheries Commission) with involvement of appropriate private sector bodies including farmers associations should encourage inputs providers basically as private sector concerns.
2. Private sector institutions to be identified by government (Fisheries Commission) and encouraged to play their roles while public sector institutions reform, organize and structure their support to aquaculture enterprise.
3. Government and other aquaculture stakeholders should make concerted efforts to establish relevant and structured educational programmes.
4. Review of current aquaculture extension system for comprehensive improvement.
5. Resources must be identified from public and private sectors to support nationally determined research agenda for sustainable aquaculture towards aquaculture resources wise-use and for improved productivity of farmers.
6. Aquaculture related public institutions to formalize links in support of aquaculture development. Establish and strengthen fish farmer associations and their networking.
7. Basic agro-ecological zones of the country need to be ranked in relation to various aquaculture production systems.

2. Current Status of Aquaculture Development in Western Region

Existing pond aquaculture in Western Region

Few data exist, but according to the Regional Fisheries Commission, there are about 200 fish farming operations in the Western Region, most of which are located around Tarkwa. During previous visits, these were barely operational and unlikely to have been producing positive cash-flows. Judging from the sites visited within the project area (see Appendix II), it appears that only a handful of these are truly operational and possess potential for economic viability as currently configured. Most ponds are small, 150-400 m², and most operators have only 2-3 ponds. Total operational pond surface area is probably less than 3 ha and total output is surely less than 5 tons per annum. The food conversion ratio (FCR), a key indicator of system efficiency should be below 2.0 for pond aquaculture, but the reported value from farmers is closer to 5.0 (i.e., producers have to use large amounts of feed to produce fish).

On the other hand, there exists a core of enthusiastic farmers and basic knowledge of aquaculture in the region. The Regional Fisheries Commissioner is conversant in the essential technology and Mr. Aidoo, who may be able to develop a viable fish hatchery operation, has received formal training in Israel. The Rev. Afo-Kamgah in Bonyere previously worked for an NGO and in that capacity participated in training sessions at Bouaké, Côte d'Ivoire (in the 1980s) and (more recently) at the Crystal Lake farm on the Volta Lake.

Availability of Land

Although water of suitable quality and quantity is readily available in the zone, most of the land is seasonally inundated and/or desiccated and thus not easily adapted to pond aquaculture. Many areas feature sandy soils that do not hold water. As a result, the majority of would-be fish farmers in the area, some 88%, borrow or lease land from others, mostly non-relatives engaged through the market (Figure 1, Aeschliman 2005).

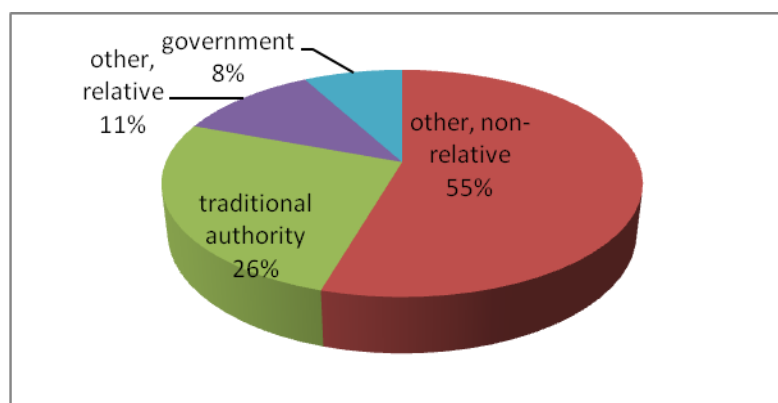


Figure 2: Aquaculture land ownership in Western Region, Ghana (Aeschliman 2005).

The total surface area of land suitable for pond-based fish farming in Western Region is presently unknown. Much of the forested and all existing and planned conservation areas are neither suitable nor desirable as areas of aquaculture development and serve a greater beneficial role as reserves of biodiversity and other ecosystem services. Local knowledge indicates that cage-based aquaculture may face problems with low current velocities and shallow water in lagoons, and will require modifications of existing technology (see below) to be directly implementable in the project area. Having said that, some culture-based fisheries activities for which technology is locally available (e.g., acadjas and mangrove oyster production) could be integrated into an ecosystem-based resource management strategy.

Private Investment

All of the farmers interviewed said they were interested in aquaculture primarily as a commercial investment. Nevertheless, one farmer reported that 60% of his most recent and successful catfish harvest was either consumed at home or given away. The remainder was, however, sold for a total amount of GHC 960, some GHC 6-7 per kg. In more rural settings, prices seem somewhat lower, about GHC 5.0 per kg. Reported tilapia prices are even better at about GHC 15 per kg, although these spot-market prices may not be useful in assessing longer-term economic viability.

Economic analysis of the best of the existing production systems (total investment ~GHC 5000), albeit based only on guesstimated production levels, seems to indicate that the system is unable to break-even (Table 1). However, both pond-based and cage-based fish production systems have proven profitable elsewhere in Ghana and these experiences could guide investments in the project area.

Table 1. Estimated partial enterprise budget for existing small-scale commercial aquaculture in the coastal districts of Western Region, Ghana. All prices Ghana Cedis.

	Number per Cycle	Unit Price	Total Cost	Amount	Percent of Total
Capital					
Pond Construction (m ²)	600	4	2400	240	10.18
Equipment			400	80	3.39
Stocking					
Fingerlings (number)	2500	0.5	1250	1250	53.01
Operations					
Feed (kg)	315	1.6	504	504	21.37
Labour (person 8 hr days)	12	22.5	270	270	11.45
Transport (return trips to market)	1.4	10	14	14	0.59
Total Production Costs (per cycle)				2358	100.00
Revenues				1260	
Fish Sales (kg)	210	6			
Productivity (kg/ha)	3500				
			Total Investment		
			4,838		
				-1098	Net Per Cycle
Cycles per Year	1			-1098	Net Per Year
Total Fish Production per annum (T)	0.21			-22.70	ROI

However, increasing total investment to about GHC 30,000 with associated increases in intensity and economies of scale, could produce economically viable outcomes (Table 2). Such increases are mostly a function of larger size of the exploitation and intensification permitting multiple cycles per year. Due to lack of data, determining whether or not capital and/or land resources might be available for wide scale

expansion of this magnitude is not presently possible. While some few investors could certainly take advantage of existing technology to develop viable enterprises, the existing user group would be largely excluded unless some very creative mechanism for training and financing could be identified.

Table 2. Estimated partial enterprise budget for minimally profitable small-scale commercial aquaculture in the coastal districts of Western Region, Ghana. All prices Ghana Cedis.

	Number per Cycle	Unit Price	Total Cost	Amount	Percent of Total
Capital					
Pond Construction (m ²)	5000	4	20000	667	8.44
Equipment			400	27	0.34
Stocking					
Fingerlings (number)	2500	0.4	1000	1000	12.67
Operations					
Feed (kg)	2625	1.5	3938	3937.5	49.87
Labour (person 8 hr days)	100	22.5	2250	2250	28.50
Transport (return trips to market)	1.4	10	14	14	0.18
Total Production Costs (per cycle)				7895	100.00
Revenues				10500	
Fish Sales (kg)	1750	6			
Productivity (kg/ha)	3500				
			Total Investment		
			27,602	0	Interest
				2605	Net Per Cycle
Cycles per Year	3			7816	Net Per Year
Total Fish Production per annum (T)	5.25			28.32	ROI

Availability and Cost of Inputs

In Ghana overall, one of the major constraints to successful aquaculture reported by producers is the poor and erratic quality of fish seed available for stocking (Brummett 2007). The Government has pilot tilapia hatcheries Accra (1993), Akosombo (1996) and Kumasi (1997). None of these functions at full capacity. The Accra centre, with a target of 180,000 per year, actually produces about 40,000. The Kumasi centre, with a target of 100,000 per year, produces only 4000. The Aquaculture Research and Development Centre (ARDEC) in Akosombo, operated by the Water Research Institute, is better, regularly meeting its production target of (a very modest) 100,000/year. Fish seed from government hatcheries is sold at subsidized prices. However, the hatcheries are under-funded so it could be argued that this policy helps fuel continuing underperformance.

Tilapias are the most sought-after species and the most reliable tilapia fingerlings are available from two, large-scale private hatcheries: Tropo Farm and Crystal Lake, both located in the far east of the country. These fingerlings are derived from a selected line of *Oreochromis niloticus* produced at the ARDEC. These fish are reported to grow about 25% faster than the local wild stock. Prices range from GHC 0.10 – 0.15 for mixed males and females up to GHC 0.12 – 0.20 for all males. The advantage of using all males is that they grow about 40% faster than mixed sex when producing fish of over 250g.

In Western Region, two private hatcheries attempt to supply the fish farming sector, one at Tarkwa (Mr John Kpemli, proprietor) and a newer one at Tikobo II (Mr. James Aidoo, proprietor) in Jomoro District (Figure 2). Both of these are small, with combined present output probably less than 100,000 catfish and tilapia per year. At Tikobo II, clarias broodfish are from a stock held at the Tarkwa Hatchery. Broodfish of *Heterobranchus longifilis*, a related catfish of the same family as clarias, were captured from the wild. The intention is to produce intergeneric hybrids of these two fishes, reported in the scientific literature to be faster growing than either pure species. When originally produced, it was thought that this hybrid was sterile and so relatively safe for use in aquaculture, where escapees can either displace or interbreed with wild fish. More recent data, however, indicate that the hybrid is in fact partially fertile, an important consideration in their use. At the time of the visit, none of these hybrids had so far been produced. Both the Tarkwa and Tikobo II hatcheries also produce and sell the non-indigenous tilapia (*O. niloticus*) derived from broodfish obtained at ARDEC. Prices for fingerlings from these hatcheries average GHC 0.20 per 2 cm tilapia fingerling, and GHC 0.30 for similar sized catfish fingerlings.



Figure 3: The hatchery of James Aidoo at Tikobo II. Note two hatchery buildings, well (extreme right) and head tank. The hatchery has electricity.

Largely as a result of the unavailability of high-quality tilapia fingerlings, most fish farmers in the area rely on locally captured fingerlings purchased from fishers operating on the Tano, Ankobra, Butre and other smaller rivers. Prices average between GHC 0.5 and 0.6 for an (estimated) 6-7g fingerling. All but one of the farmers (who produces only tilapia) interviewed usually stocked wild-caught catfish (*Clarias* and/or *Heterobranchus* spp.), three of which are reported (by local fish farmers) from rivers in the area: one possessing spots (possibly *Clarias anguillaris*, a species reported in the nearby Pra River), one greenish in colour and one with a creamy belly (possibly *Heterobranchus longifilis* and/or *Heterobranchus isopterus*). *Clarias* species reportedly (in the ichthyological literature) found in the area include also *Clarias buettikoferi*, *Clarias agboyiensis*, *Clarias ebriensis* and *Clarias laviceps*. Of these, the best growing are *C. anguillaris* and *H. longifilis*. None of these were available for inspection and confirmation of species in the local fish market at the time of our visit. Being only available during August-October, reliance on these wild-caught fingerlings seriously constrains aquaculture system flexibility, particularly intensification through multiple cropping.

As tilapias are the preferred fish in the market, farmers expressed a desire to concentrate future efforts on this group of species. The most popular tilapia for culture in Ghana, *Oreochromis niloticus* is, however, not indigenous to the coastal zone and rivers of Western Ghana. Two widespread and indigenous species, *Sarotherodon melanotheron* and *Tilapia guineensis*, might thus be considered preferred candidates from a biodiversity point of view. The University of Cape Coast maintains a stock of *S. melanotheron*, and the University of Ghana-Legon and WRI have tested both *S. melanotheron* and *T. guineensis* for aquaculture. Trials of three populations of *S. melanotheron* from west and central Africa found that by far the best growing in aquaculture is the Senegalese sub-species, *S. melanotheron heudelotii* (Giles et al. 1998). Within Ghana, the *T. guineensis* population from Akotogua on the Okye-Amins River to the east of Cape Coast seems the fastest growing under culture conditions (Agyakwa et al. unpublished data). Neither of these, however, is comparable to *O. niloticus* in terms of growth rate and, among Ghanaian specialists interviewed, there is little concern that its expanded use might pose a serious threat to indigenous biodiversity.

Another constraint to smallholder engagement in aquaculture in the project area is the high cost of feed. At present, there are at least eight brands of feed available on the market, seven of which are imported, mostly from the Netherlands, Brazil, Israel and Vietnam. The local animal (mostly battery chicken) feed producer, GAFCO, manufactures a floating fish food, but the milling is poor and the feed contains a large percentage of fines, making it unsuitable for cage aquaculture. A second local feedmill is expected to begin operations soon and is reportedly planning to produce aquafeeds. Determining the best of these for use in cages will be the subject of an upcoming trial to be sponsored by FAO and conducted by WRI.

The pond management system currently promoted by the Fisheries Commission involves the use of lime and fertilizers in addition to pelleted feeds. From observation of the ponds, this has resulted in highly over-fertile pond water which may be reducing growth rates, particularly of tilapias (due to low dissolved oxygen), and represents a waste of time and money. In general, ponds should be either fertilised and fed only in the case of low-quality “supplemental” feeding. The use of the existing high-quality feeds should preclude fertilization entirely. The budgets for these small pond investments, as modelled above, do not take these wastes into consideration.

The current price for imported floating feeds is about GHC 40 per 25 kg sack (GHC 1.6 per kg). GAFCO sinking feed sells for GHC 50 per 45 kg sack (GHC 1.11 per kg) and as small ponds are better than cages at utilizing nutrients, might represent a realistic alternative to more expensive imports. None of these are routinely available in Takoradi, however, so the Fisheries Commission (at Takoradi) is bringing from Accra an imported feed from Vietnam and making it available to local farmers at GHC 30 per 25 kg sack (GHC 1.2 per kg). This subsidized price cannot be considered reliable. To these prices, farmers must add GHC 5.0 per sack for transport from Takoradi.

Faced with cash-flow problems, most farmers use locally assembled feeds as a fall-back when purchased pellets are not an option. Maize meal, soybean cake, fish meal and what bran are the principal components. Coupled to the current practice of liming and fertilization, the use of such feeds can be profitable, but lower production per unit area and decreased overall efficiency of feeding mean that an economically viable scale of production based on these supplemental feeds will be larger than for a system based on manufactured pellets.

In as much as technological and/or organization can help to overcome the two other major constraints listed above, the lack of high quality technical assistance may be the most important limiting factor in expansion of the sector in the Western coastal zone. The Fisheries Commission has a number of staff on the ground in Western Region and seems to have senior management capacity in practical aquaculture. Local extension personnel, however, are considerably weaker and have little budget to support their work and the acquisition of knowledge. The elaboration of specific production recommendations would thus help farmers to directly improve their farming systems without having to depend upon future improvements in the capacity of the Fisheries Commission.

Markets, Market Services and Pricing

According to local informants among fish farmers and market women, all of the fish produced by farmers and those captured from the many rivers and lagoons are purchased directly from fishers and marketed locally by women who either sell them on to retailers (as is the case for most fish from the capture fishery) or retail directly through chop bars (as is the case for most purchased aquaculture products). Manu (2004), in a study of fish marketing structures in the Western Region identified this and other potential avenues for moving fish from producers to consumers (Figure 4). Estimated (by fish farmers) pond-bank prices vary between GHC 6.00 and GHC 10.00 per kg depending upon the size of the fish and local demand, with farmers located closer to larger markets getting better prices. The target size for fish in most West African markets is between 300 and 500g. Wholesale prices for fish from the capture fishery elsewhere in Ghana vary according to size class with >300 g fish sold at GHC 3.50 per kg, 250-300 g fish sold at GHC 2.80 and <200 g fish sold at GHC 1.50 per kg. These prices change frequently so estimates of profitability should be recalculated prior to each production cycle based on a careful analysis of current prices for both inputs and outputs.

Actual pricing is very difficult to ascertain through interviews as none of the fish buyers or sellers had any idea of the weight of the fish, dealing exclusively in terms of piles of small or individual larger fishes, and indicating their sizes by the width of the head.

It is somewhat difficult to interpret differing views presented by different groups (e.g., fisheries agencies, NGOs, foreign experts, fishers and fish mongers). Nevertheless, casual discussion with fish marketing women on the Tano Lagoon indicated that fish supply from the surrounding rivers and lagoons had been more or less stable over recent years. The preferred species group, overall, are the tilapias of which three species dominate the catch: *Sarotherodon melanotheron*, *Sarotherodon galilaeus* and *Tilapia zillii*. Fishers, on the other hand, indicated that average sizes were declining. Indeed, observation of the catch (Figure 3) indicates the use of relatively small mesh sizes in the dominant gill net fishery, and a large variety of small species and small individuals of larger species.



Figure 4: Mixed fish catch of small fish from the Tano Lagoon, Western Region, Ghana.

At present, the marketing chain is concerned about future fish supply from the capture fishery, but has not yet considered direct involvement in aquaculture as an alternative source. Asked about this, Mr. James Nkansah Denteh of Nyame Ye Cold Stores estimates that he can sell 2000 tonnes of tilapia fillets per day, including some to the mining companies. However, local Ghanaian producers are pricing themselves out of the wholesale market, demanding GHC 9.2 per kg compared to imported Chinese tilapia which can sell for GHC 3.2 per kg. Nevertheless, Nyame Ye would consider buying aquaculture products provided they are of good quality and the “right price”.

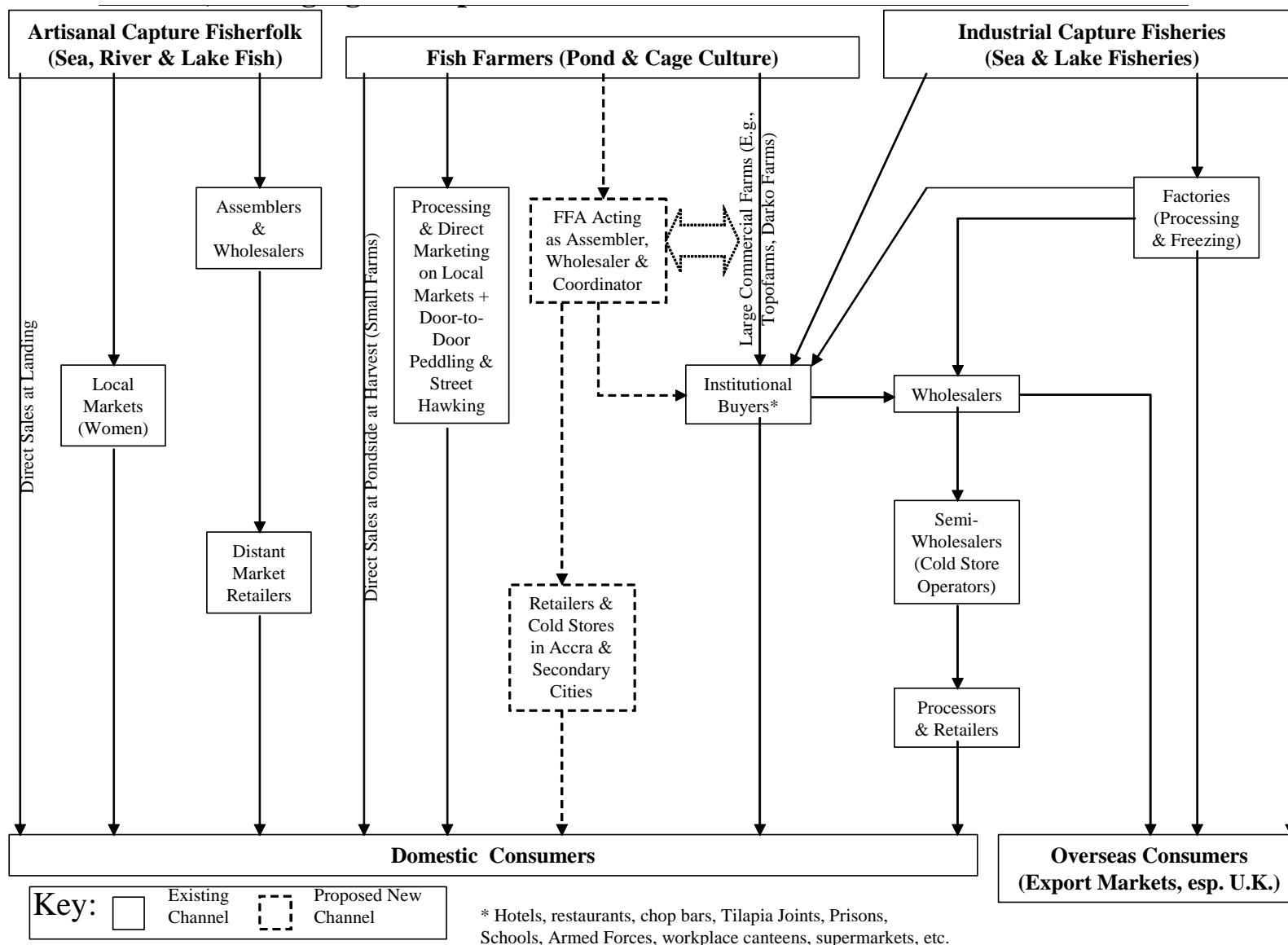


Figure 5. Existing and proposed new marketing chains for fresh fish in Western Region, Ghana (Manu 2004).

3. Technological and Institutional Options for Growth of Aquaculture in the Western Region

Producer Structure Options

There are three fish farmer associations in the region, one based around Half-Assini (12 members), another based around Elubo, Jomoro District (15 members) and a third in Ellembelle District (25 members). Within each of these are one or two active members with functional fish ponds, another half-dozen with rudimentary fish farms and about the same numbers with only intentions to dig a pond or build concrete tanks at some point when the technology is proven. The leadership within these associations seems to include responsible individuals, often community leaders, who might be able to help organize collective action on the part of the group that would enable cheaper purchase and storage of inputs and the negotiation of better market prices for outputs. Experience of such village-level community activities, from elsewhere, suggests that this approach will probably require a substantial amount of external support over an extended period of time to achieve independence.

Alternative producer structures could include some kind of satellite system, but this would have to be built from the ground up and would depend exclusively on attracting commercial investors of a sufficient scale that higher logistical costs can be offset by margins on increased volumes traded.

One important stakeholder in the value chain, Nyame Ye Cold Stores, the largest cold-store operator and fish wholesaler in the region, has expressed willingness to engage in marketing arrangements with serious farmers who can meet production targets and deadlines (see above).

Technologies – Existing and Possible

Pond aquaculture

All but one of the current farmers use earthen ponds as their main culture unit (Figure 5). The other uses concrete tanks (Figure 6). At present, average pond ownership is about 400 m² of total pond surface areas divided among 2.5 ponds. Average pond size is a small 162 m². Most of the existing ponds are dug directly into the water table and thus cannot be completely drained.



Figure 6: The best constructed small pond visited adheres to recommendations



Figure 7: Poorly managed concrete tanks produce very small quantities of catfish.

Current pond management recommendations include the use of lime and fertilizers in pond preparation followed by the use of pelleted feeds. Fish are (over) stocked at nearly 10 per m², (compared to a recommended 2-3 fish/m²) and harvested after 9 months of grow-out. (Please see additional detail in Annex IV).

Cage culture

The most successful aquaculture system in Ghana today is based on 48 m³ cages (Figure 8). Aquaculture cages can be purchased locally (contact WRI for latest list of suppliers) or built using the typical 15 mm multifilament stretched mesh netting used in the beach seine fishery. This material is cut to size and sewn together with heavy nylon thread to form the cage bag (in the shape of an inverted rectangular mosquito net). The typical sizes used in the Volta Lake is about 6 x 4 x 2 m deep (48 m³). Deeper cages have been tested, but do not seem to increase production. The cage-bag is then attached with nylon twine (18/ and above) to a pipe frame supported by oil drums or plastic barrels (sold with paint or alcohol) available in the market. A cover placed on top of the cage is essential to prevent bird predation. Decking bolted onto the metal frame makes feeding and working in and around the cage easier. Cages should be anchored in at least 8–10 m of water to facilitate reoxygenation and waste removal and organic decomposition. (See detail in Annex V).



Figure 8: Typical small cage system used in the Volta River and Lake.

A transition from the existing pond-based to cage-based aquaculture is technically feasible and could create opportunities for investors who do not have access to suitable land. Cage systems also offer the flexibility of being able to add and remove units in responses to changes in markets and availability of inputs. They do require, however, that the water to have sufficient depth and current to allow wastes from the cage to fall through and be swept away and for oxygen supply within the cage to be continually renewed. Also, the installation of cages can create conflict with exiting water resource uses, particularly in cases where pollution/eutrophication of the waterbody occurs as a result of nutrient loading from aquaculture. Site selection is thus of critical importance in environmental, economic and social sustainability of the venture.

Interest in investment opportunities in what many people feel is a relatively secure market, that of freshwater fish, is generally high in Ghana. One potential investor indicated a willingness to get involved, but only at a very large scale (GHC 5 million). To meaningfully assess the level of commercial interest in either pond or cage-based aquaculture systems and improve the quality of technical data available to permit sound investment decisions, the rural banking system should be engaged in some kind of information sharing exercise that would include opportunities for entrepreneurs to learn more about the potential of aquaculture as a business.

Atidzas

A third fish production technology of interest in the project area are atidzas (acadjas, as used elsewhere in the sub-region), the local name for the widespread, traditional West African practice of piling brush into shallow areas of lakes and small waterbodies (Figures 9 and 10). Wherever acadjas are employed higher yields, compared to open water fishing, have been reported (Welcomme, 2000; Addo, 2000.). For example, open water fishing in the Volta lake was reported as 0.0321 t/ha/yr (Braithwaite, 2003) while Welcomme's (1972) review of brush parks indicated that yields range from 3 to 28 t/ha/yr.



Figure 9: An example of an atidza brushpile made by fishers in the Volta Lake to demonstrate to researchers their construction.



Figure 10: An atidza being harvested by surrounding the brushpile with a net, followed by removal of the wood and capture of the fish.

How much of this increase is due to actual enhancement of productivity and how much is due to simply aggregating fish and making them easier to catch has never been adequately tested and debate over this issue has often led to conflict (Figure 11).

In Ghana, atidza technology is at the edge of fisheries laws and regulations; the practice is not directly banned but not viewed favourably because:

- i) atidzas are exploitative, attracting fish from open waters and aggregating them for harvest (by a private individual).
- ii) wood material required for *Atidzas* induces deforestation around water bodies with adverse ecological effects.
- iii) atidzas induce conflicts over space and access with other fishing gear users.

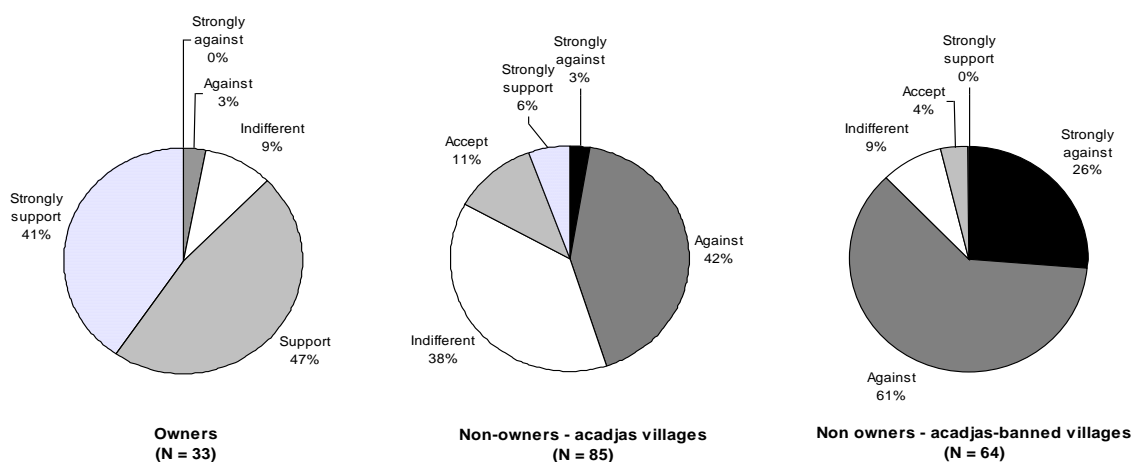


Figure 11: Perceptions pro and con atidza fisheries in the Volta Lake (E.K. Abban, unpublished data).

Nevertheless, acadjas are extremely popular among low-income fishing communities in Nigeria, Côte d’Ivoire, Benin and Togo and some approaches to conflict management may be gleaned from these experiences. In addition, the fact that there are no atidzas in the project area at present presents a rare opportunity to actually measure how they increase production, whether managed as fisheries themselves or as a component of a fisheries enhancement scheme (e.g., acting as fish sanctuaries). Assogba (2007) found that the use of bamboo to replace woody branches perform well in atidzas and last longer, reducing possible negative impacts related to deforestation.

Culture of mangrove oysters

A fourth possible aquaculture/fisheries technology that might be worth investigation is the culture of the locally common mangrove oyster, *Crassostrea tulipa*. Dr. Obodai at the University of Cape Coast is an expert in mangrove oyster culture and as seed for these organisms can be collected from the wild

and they need no artificial feeds, their production could represent an opportunity for the very poor. Marketing, however, could present problems as Ghanaians are not generally accustomed to eating oysters. Also, oysters bioaccumulate both heavy metals and bacteria. While the former of these contaminants are rare in coastal lagoons, faecal coliform bacteria counts are often very high and represent a threat to people growing and eating fish and shellfish in the area (Ricerca e Cooperazione 2001).

4. Conclusions & Recommendations

Conclusion

This analysis suggests that there are opportunities to further develop aquaculture in the project area, but given low current levels of investment and capacity, this would require a concerted effort, with considerable resourcing over a long period of time. At present, the rapidly expanding commercial aquaculture base in Ghana is located in the eastern part of the country.

The ICFG interest in aquaculture stems largely from an interest in opportunities for livelihood diversification (and significant employment generation) within the fishing communities. Whilst there may be some niche opportunities (for instance, with respect to Acadjas or oysters), aquaculture does not seem to offer a route for livelihood diversification on any significant scale in the coastal areas. These communities lack the capital and land for investment, whilst the labour requirements of viable aquaculture systems in sub-Saharan Africa tend to be low (0.5-1 person year but ton of fish produced) (Brummett et al., 2008).

Steps required if aquaculture were to be promoted in Western Region

Existing aquaculture in the project area is currently of too small a scale to be financially sustainable. The current level of investment is about GHC 5000. However, testable options for how it might be scaled up and/or diversified to create realistic livelihood alternatives exist.

Somewhat larger, properly managed pond-based systems could be profitable with investments of around GHC 30,000. Adaptation of existing cage aquaculture technology could create additional opportunities, but also only for somewhat larger-scale investors. Improved technical support and collective purchase of inputs and marketing of outputs could make these investments more attractive to lower-income investors.

The managed introduction of atidzas in the project area represents a unique chance to both better understand how these function to increase fisheries productivity, and also to minimize conflicts that have been reported from their unregulated use elsewhere.

Mangrove oysters could represent an alternative for very low-income communities, but in addition to basic technology adaptation and extension, will require substantial investments in marketing.

To better understand the true potential of these alternatives and lay the groundwork for project intervention, a series of activities could be considered:

- *Participatory research to estimate existing pond aquaculture system productivity.* The current analysis of system productivity and profitability is hampered by the lack of quantitative data on the weight of fish produced. Farmers and planners would benefit from a better understanding of where the existing system loses money and how it might be modified to improve profitability. Organized trials using spring balances to weigh fish with a “research committee” comprised of the more knowledgeable farmers could establish the terms and conditions of the trial and supervise its execution.

- *Trial of community-based atidzas for aquaculture and/or enhanced fisheries productivity.* Participatory trials in partnership with the Fisheries Commission and the ecology laboratory at the University of Ghana – Legon would provide a vehicle for ecological research and developing community consensus on the way forward.
- *Fish market study to determine optimal target species and sizes for aquaculture.* At present, the production system is not based on any understanding of the actual market size and value of the products being grown. Analysis of fish price by species and weight, perhaps based on surveys at Half Assini and Takoradi would help determine the target sizes, species and production costs for both small and larger scale investors.
- *Develop contacts with regional expertise.* Ghana is the regional leader in tilapia cage aquaculture, but has little indigenous expertise in other species and systems. Nigeria has a very profitable, productive and professional catfish farming sector. A study tour by potential investors would lay a firm technological foundation for expansion of the local industry. In addition, the provision of a technology consultant from a neighbouring country could help jump-start local technological adaptation. A list of knowledgeable people to contact for advice would include:

Gamal Othman El-Naggar

Alex Futson Anpe

Central Lab for Aquaculture and WorldFish Center

Highland Fisheries & Aquaculture Services

Abbassa, Egypt

JOS, Plateau State, Nigeria.

Tel: +20 (55) 20 55 3404227

Tel: +234 803 7208607

E-mail: g.naggar@cgiar.org

E-mail: Alexanpe12@yahoo.com

Felix Olusegun Gbolade

Dr. Steve Yong Sulem

Felimar Aquaculture Centre

Inst for Ag Rsch for Development

Ogun State, Nigeria.

Yaoundé, Cameroon.

Tel: +234 803 3443508

Tel: +237 -79 81 73 03

E-mail: felimaraqua1@yahoo.com

E-mail: yongsulem@yahoo.com

- *Development of production guidelines.* At present, only a few of the key stakeholders in aquaculture have any substantive understanding of the biological, ecological, physiochemical and economic functioning of an aquaculture system. Clear, straightforward and reliable aquaculture technology for ponds, cages and atidzas is available and needs to be packaged for use by local investors, preferably in local or highly simplified language.
- *Rural Banking Seminar.* For the sector to expand and produce positive economic and food security outcomes for local communities, the scope and scale of aquaculture investment needs to be considerably enhanced. Without any project intervention, large-scale farms will eventually

take advantage of lucrative markets and productive bio-assets and infrastructure to the disadvantage of potential local and smaller-scale investors. Laying out clearly the economic realities of doing aquaculture in Western Ghana will help small-scale farmers, medium-scale investors and bankers to understand the potential and dangers associated with the development of a productive aquaculture sector that can help assure local livelihoods and contribute importantly to development in the project area.

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Appendix I: Programme of Work

- 11 May 2010 - Travel to Accra
- 12 May 2010 - Travel to Takoradi
 - Briefing with CRC Programme Management Team
 - Briefing with A.A. Addo, Western Regional Director, Fisheries Commission
- 13 May 2010 - Travel to Half-Assini with Patricia Aba Mensah
 - Meetings with Edward Essiljoe and Rhoda Obeng, District Fisheries Office
 - Meetings and pond visits with members of the Kabenlasuazo-Half-Assini Fish Farmers Association (List of Farmers in Annex I)
 - Visit to Tano River Fish Landing
- 14 May 2010 - Interviews with fish marketing women, Joyum Quai on the Tana lagoon
 - Meetings and pond visits with fish farmers at Bonyere
 - Meetings and pond visits with fish farmers in Ellembelle
- 15 May 2010 - Meeting with James Aidoo, fish hatchery manager, and Raymond Beyejou, secretary of the N'kroful fish farming association.
 - Debriefing with A.A. Addo, Western Regional Director, Fisheries Commission
- 16 May 2010 - Site visit to fish hatchery, Tikobo II.
- 17 May 2010 - Debriefing with CRC Programme Management Team and partners
 - Meeting with Dr. E.A. Obodai and Mr. D. Aheto, University of Cape Coast
 - Meeting with Mr. Ghartey, commercial farmer
- 18 May 2010 - Travel to Accra
 - Meeting with Prof. Ofori-Danson, University of Ghana/University of Cape-Coast
 - Meeting with Dr. J.K. Ofori, Water Research Institute
- 19 May 2010 - Meetings at University of Ghana-Legon
 - Meeting with Mr. Lionel Awitty, Head of Inland Fisheries, Fisheries Commission
- 20 May 2010 - Return to Cameroon

Appendix II: List of Persons Interviewed

Mr Edward Essiljoe	District Fisheries Commission	Half-Assini	0242368917
Mr Alex Addo	Regional Fisheries Commission	Takoradi	0207735391
Mr. Lionell Awitty	Head, Inland Fisheries	Accra	0244591458
Mr James Aidoo*	Fish Hatchery Manager	Tikobu II	0544502474
Mr Abraham Miezah*	Fish Farmer	Half-Assini	0206500672
Mr Mane Miezah Gyibah*	Fish Farmer	Half-Assini	0274224318
Mr Mallam Gaston Kaku*	Fish Farmer	Half-Assini	0275127202
Mr Alfred E. Ackah	Fish Farmer	Half-Assini	0241117111
Mr Ewuaneha Waweghah	Fish Farmer	Half-Assini	0209176563
Mrs Williy Kangah	Fish Farmer	Half-Assini	0208619093
Rev Andrews Kanpah*	Fish Farmer	Half-Assini	0208302682
Mr Isaac M.K. Akpanye	Fish Farmer	Half-Assini	
Mr. Kwame Knrumah	Fish Farmer	Half-Assini	0276221041
Mr Godfrey Andrews Kangoh	Fish Farmer	Half-Assini	0276963546
Rev Anthony Afo*	Fish Farmer	Bonyere	0273360002
Mr John Bonyah Annor Milzah*	Fish Farmer	Bonyere	0249088222
Mr Derick Beuleh	Fish Farmer	Bonyere	0207478508
Mr. Raymond Beyejou	Would-be Fish Farmer	N'kroful	0275595107
Mr Albert Ekobo Mensah	Fish Farmer	Essiama	0201989954
Mr Hamidu Moro Eshun*	Fish Farmer	Kamgbunli	0209050017
Mr Ghartey	Commercial Farmer	Takoradi	0244518298
Mr James Nkansah Denteh	Nyame Ye Cold Stores	Takoradi	0244690526
Hon Joseph Nyamikeh	Assembly-Man	Bonyere	0249765100
Hon Edo Adjei	Assembly-Man	N'kroful	0208090492

Prof P.K. Ofori-Danson	Univ. Ghana, Legon	Accra	0208351477
Dr J.K. Ofori	Water Research Institute	Accra	0273975689
Mr Seth Agyakwa	Water Research Institute	Akosombo	0275516465
Dr E.A. Obodai	Univ. Cape Coast	Cape Coast	0244085253
Mr Chris Nugent	FAO	Accra	0247529804

* Indicates farmers who, in the author's opinion, demonstrate interest and capacity, to achieve financial sustainability.

Appendix III: Excerpts from the Aquaculture Strategic Framework Ghana

E.K. Abban¹, J. Moehl², L. K. Awity³, M. Kalende², J. K. Ofori¹ & A. Tetebo³

1 - CSIR- Water Research Institute, Ghana.

2 - FAO Regional Aquaculture Office, Accra, Ghana

3 - MOFI, Directorate of Fisheries, Accra, Ghana.

June, 2006

Forward

The Ministry of Fisheries (MOFI) Ghana, and myself are pleased to have completed the process of building a strategic framework for the development of aquaculture in Ghana with the help of the FAO and GTZ. This product provides a missing link in development efforts in the aquaculture sub-sector as a viable industry. It is the anticipation of the ministry and the development partners involved that implementation of the framework will, through aquaculture, contribute to both poverty reduction and wealth creation in the country.

We are pleased with the outcome of the steps taken to generate the framework as the output already shows benefits of public and private sector collaboration in development.

It is anticipated that further steps intended towards implementation of the framework will be as fruitful as the steps involved in its preparation. We wish all those to be involved in this noble assignment success and satisfaction in their endeavors.

Hon. Gladys Asmah

Minister for Fisheries.

Introduction

Governments throughout Africa, have been concerned about the poverty status of their populations for more than a decade now. The governments, especially those south of the Sahara, have in recent years, established food security policies and programs as compliments to their poverty reduction strategies. Fish as a major source of animal protein in the diets of majority of African communities, has thus become a food commodity of great importance. More than 60% of animal protein in diets of Ghanaians, has traditionally been derived from fin and shellfish. However, there are indications everywhere that wild fish stocks, which have provided virtually all locally produced fish, are either over fished or nearly so.

In Ghana, capture fisheries production that accounts for over 95% of local fish supply, also continues to decrease while demand increases. This has necessitated fish imports to meet the short fall.

Under the circumstances, aquaculture development, with fin and shellfish fish as the major culture organisms, has become a concern for Africa South of the Sahara (ASS). Fish production through aquaculture is a source of income, and also, is regarded as one of the ways of alleviating poverty.

Aquaculture production has not reached 1% of total local fish production in Ghana. However, the government intends and is making efforts to develop the aquaculture sub-sector rapidly and raise its production to about 20% of local fish production, similar to the global mean as soon as possible. Toward this end, efforts have been made for the sub-sector to benefit from various sources including extra budgetary support.

Aquaculture development, as a more assured option of increasing local fin and shellfish production, compared to management of wild stocks for capture, has been of concern to governments of Ghana since the 1950s.

Government has sought FAO's assistance to strengthen capacity of farmer groups under a Technical Cooperation Programme (TCP/GH/2904). The Programme initiated private farmer seed production and distribution as well as provided business approach to fish farming to farmer associations. Under the programme efforts were geared towards rapid development of aquaculture to contribute to national socio-economic development.

However, inputs made by governments and the development partners over the years have not had much impact on status and contribution of aquaculture to fish availability in Ghana, just as in other countries in Africa, South of the Sahara (ASS).

In response to aspects of analysis of previous failures, the government of Ghana and its development partners, through FAO, engaged in establishing an Aquaculture Development Strategic Framework to guide the development of the sector in Ghana as other African countries also engaged in.

The Strategic Framework was developed around a series of workshops that identified principal issues, associated constraints and suggested approaches to resolving the constraints. The principal issues, constraints associated and suggested solutions were identified as follows.

- Inputs issues
- Institutional issues
 1. Public and private sector roles in aquaculture development
 2. Education and training
 3. Extension
 4. Research
 5. Partnerships
- Production systems issues

A summary of the constraints and suggested solutions (resolving constraints) for the principal issues is provided as follows.

INPUTS ISSUES (mainly fish seed, feed and financial resources)

- i *Constraints:* Absence of fish hatcheries, fish feed industry and financial resources to enable profitability of aquaculture operations.
- ii *Resolving constraints:* Public sector such as MOFI with involvement of appropriate private sector bodies including farmers associations should encourage inputs providers basically as private sector concerns.

INSTITUTIONAL ISSUES - Public and private sector roles in aquaculture development

- i *Constraints:* Low involvement of private sector and insufficient public sector institutional arrangements to provide organized and effective support to aquaculture development.
- ii *Resolving Constraints:* Private sector institutions to be identified by government (MOFI) and encouraged to play their roles while public sector institutions reform, organize and structure their support to aquaculture enterprise.

A private – public sector committee on aquaculture development be established under DoF to make involvement of the sectors permanent.

EDUCATION AND TRAINING

- i. *Constraints:* Lack of structured training and educational programmes with appropriate facilities to produce needed human resource for aquaculture development.
- ii. *Resolving Constraints:* Government and other aquaculture stakeholders should make concerted efforts to establish relevant and structured educational programmes.

EXTENSION

- i. *Constraints:* Lack of effective extension system (including: - personnel, tools and mechanism of technology transfer).
- ii. *Resolving Constraints:* Review of current aquaculture extension system for comprehensive improvement.

RESEARCH

- i. *Constraints:* Absence of in-country funded research agenda and duplication of efforts with little resources available.
- ii. *Resolving Constraints:* Resources must be identified from public and private sectors to support nationally determined research agenda for sustainable aquaculture towards aquaculture resources wise-use and for improved productivity of farmers.

PARTNERSHIPS

- i. *Constraint(s):* Weak public sector institutional linkages and non-existence of national networks of fish farmers.
- ii. *Resolving Constraint:* Aquaculture related public institutions to formalize links in support of aquaculture development. Establish and strengthen fish farmer associations and their networking.

PRODUCTION SYSTEMS ISSUES

- i. *Constraints:* Zoning of country has not been done with comprehensive aquaculture related characteristics to rank potentials of production systems for each zone.
- ii. *Resolving constraints:* Basic agro-ecological zones of the country need to be ranked in relation to various aquaculture production systems.

Conclusions and Recommendations

The consultation workshop was an appropriate initiative to identify issues limiting aquaculture enhancement in Ghana and how the limitations should be resolved.

However the suggestions made towards resolution of identified constraints were without the means by which the strategic aquaculture development framework could be carried forward.

The issues that came up in the workshops such as, institutional reforms and arrangements to formalize, strengthen and create new partnerships, as well as Public/Private sector involvements are relevant.

The recommendations therefore refer mainly to the basic activities that need to be carried out to trigger the speedy development of the aquaculture industry.

For the development of Strategic Framework to guide aquaculture advancement in Ghana, the workshops recommended the following:

1. The eventual strategic steps such as 'projects' should be formulated soon for Government and its development partners to establish the approaches suggested in the Framework and to guide its implementation.
2. In all government efforts, it must seek technical and other support from the international community and development partners through FAO to implement the Framework.
3. A national steering committee, composed of public and private sector persons, must be inaugurated by government to ensure the implementation of the Strategic Framework.

Appendix IV: Pond-based Aquaculture

Pond-based systems are able to take advantage of natural pond water fertility to generate fish food, most particularly vitamins and proteins often lacking in supplementary feeds. Food conversion ratio (FCR) is the amount of dry food required to produce 1 kg of fresh fish; the lower the FCR, the better. Typical FCR in fish ponds is normally about 2.0.

Without aeration, stocking rates can go as high as 2-3 fish per square meter. Productivity varies with the quantity and quality of external inputs:

300 kg/ha – highest natural water productivity (e.g., highly eutrophic lakes)

2500 kg/ha – average production of ponds fertilized with a mixture of organic and inorganic inputs

3500 kg/ha – average production of ponds with supplemental feeds (relying on natural pond food organisms for essential vitamins and amino acids.

5000 kg/ha – average production of ponds receiving completely balanced pelleted feeds.

Figure 7 is an annotated schematic of a well-constructed small pond. Despite their apparent simplicity, care in their orientation and design can make a big difference in how well the pond serves its purpose. To facilitate management, ponds should be generally rectangular and not too large. The sides (dikes) of the pond should be sloped at a ratio of at least 2:1. This means that the total area occupied by the pond will be somewhat greater than the water surface, so a 1.0 acre pond will require almost 1.4 acres of land). Rip-rapping, the placing of stones into the pond bottom or sides, might be necessary to prevent erosion, especially from in-flowing water when the pond is being filled.

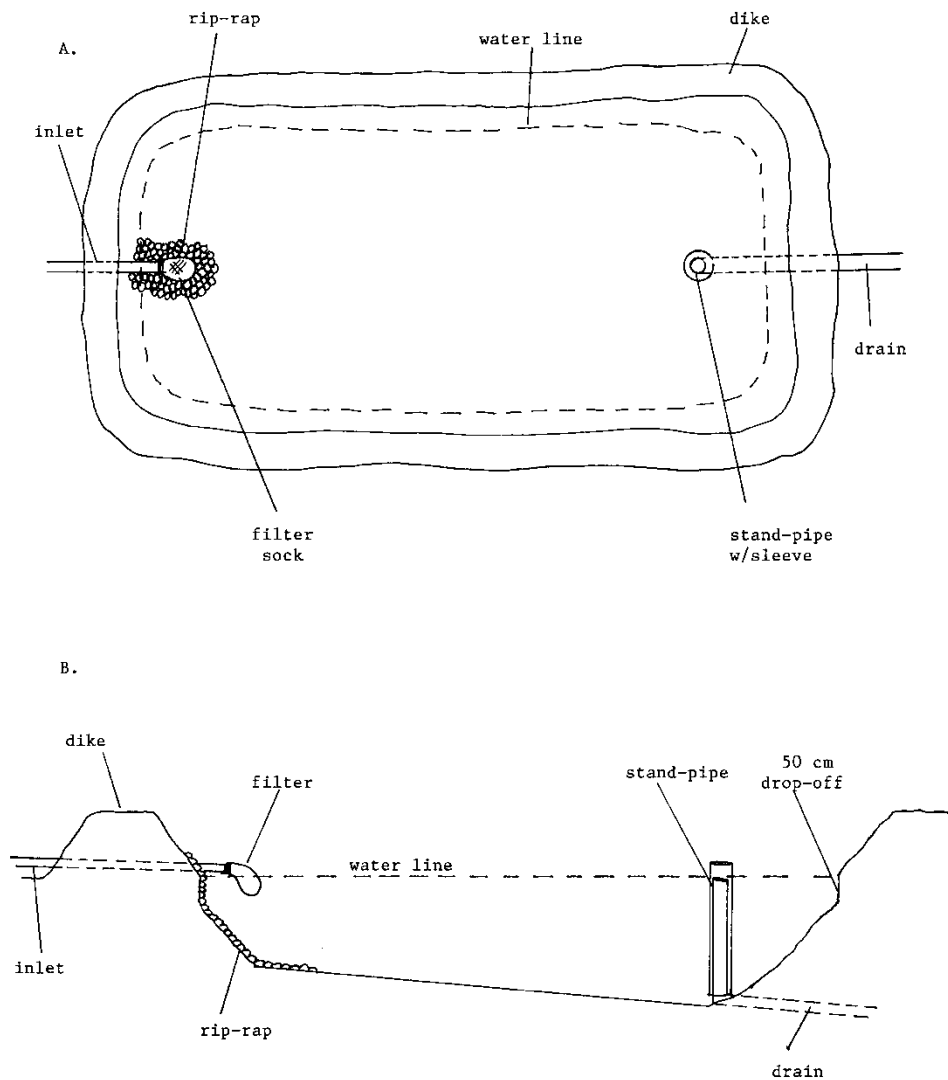


Figure 12: A typical earthen pond design

In a fertile pond, light will not penetrate below 0.5-1.0 m into the water. Water below that depth will tend to have less oxygen and be less productive. Small ponds should therefore average about 1.0 m in depth. A minimum depth of 50-60 cm will help prevent the incursion of weeds. A free-board of 50 cm above the water level will help prevent the loss of the fish and possibly the dikes themselves in case of flooding.

Ponds built into sub-optimal soil may leak excessively. Plastic sheets, cement or imported clay may be used to line such ponds. If leakage is not too bad, organic matter in the pond water will help to create a good seal within a couple of years. Ponds can be dug down into the ground, built above ground or half of each. For any part of the dike built above ground, the soil must be carefully compacted.

The pond should be completely drainable within 24 hours. To do this, the pond bottom and drain pipe must be sloped by at least 1.0%. A stand pipe will permit the draining of the pond in stages as well as prevent over-flowing. A minimum of 4" drain pipe should be used. As with the drain, the fill pipe must also have a 1% slope to keep the water moving and prevent clogging by suspended soil particles. To help remove debris that might come in with the in-flowing water, a fine-mesh sock or other filter mechanism should be placed over the inlet. An over-flow sleeve will help keep fish out of the drain and allow low-quality bottom water to be removed from the pond if flushing should become necessary. There should be separate fill and drain lines for each pond so that each can be managed separately in case of disease or other emergency.

Appendix V: Cage Aquaculture

To calculate the potential for cage aquaculture to create economic opportunities for small-scale investors the Water Research Institute (WRI) ran two trials (one of four and one of six units) with communities on the Volta Lake. Cages were built locally from available materials at a cost of approximately GHC 900 per 48m³ cage (Table 3)¹.

Item	Description	Quantity	Unit cost	Amount (Ghana ¢)
Galvanized pipe	1.5" - 2"	12	18	216
Floats	Plastic barrel (250 l)	8	30	240
Nets	15 mm stretched mesh	40 m	4.375	175
Shackles		16	3	48
Hapa nets	40m	0.5	100	50
Rope	10mm	2 coils	20	40
	6mm	1 coil	5	5
Anchors	0.3m ³	6	5	30
Welding			50	50
Cage cover net	6m x 5m	1	12	12
Labour		1	30	30
Total				896

Economic analysis of the WRI trials is shown in Tables 4 & 5. Total costs averaged GHC 2038 per six-month production cycle. Feed was the major component of cost, averaging over 50% of the total. Fingerling purchase was another major cost, accounting for an average of 27% of the total.

¹ A newer design of 2.5 x 2.8 x 2.0 = 14 m³ for GHC 600 is now being piloted by WRI at Akosombo.

Gross yield ranged from 232 to 1176 kg/cage averaging 460 kg/cage (9.6 kg/m³). To break even, harvested biomass of fish needs to exceed 15 kg/m³. At 25 kg/m³, small-scale cage aquaculture generated a net income of GHC 717 per cage per six months (ROI =30.2%) on revenues of GHC 3,500.

Food conversion ratio (FCR, the weight of dry food needed to produce one kilogramme of fresh fish) was between 2.5 and 8.1 with an average of 3.54. Failure to replace stocking mortality resulted in a miscalculation of the feeding rate by nearly 50% (fish that were actually dead were still being fed). Saving the feed and money wasted would have added an additional GHC 700 to the bottom line, substantially improving the economics of the system.

Only the cage from which more than one tonne of fish (>96 fish weighing 24.5 kg per m³) was harvested made a significant profit (Table 4). According to the WRI trials data, a minimally profitable 48 m³ small-scale cage aquaculture system in Ghana would have to produce at least 1 tonne of fish at an FCR of less than 2.5.

	Cage 1	Cage 2	Cage 3	Cage 4	Cage 5	Cage 6	Cage 10
Fixed cost*	109.5	109.5	109.5	109.5	109.5	109.5	109.5
Variable costs	1,760.76	2,700.00	2,458.70	1,468.06	1,598.0	1,867.0	1,687.0
Total cost	1,870.26	2,809.50	2,568.20	1,577.56	1,707.5	1,976.5	1,796.5
Revenue	812.82	3,527.04	741.3	1,207.50	1,136.4	812.00	1,760.1
Net Income	-1,057.44	717.54	-1,826.90	-370.06	-571.1	-1164.5	36.40

* For the cage, amortized over 4 years.

	Quantity	Unit Value (GHC)	Amount (GHC)
Cost Elements			
Cage (amortized over 4 yrs)	½	219.00	109.5
Fingerlings	6000	0.12	720.00

Feed	3000	0.49	1470.00
Labour (pers mos)	6	60.00	360.00
Marketing			50.00
Transportation			100.00
Total cost			2809.50
Revenues			
Total harvest (kg)	1176	3.00	3528
Net Income			718.54
ROI			25.6%

Fingerlings of 10-30 g can be stocked at rates ranging from 3000 up to 9000 fish per 48m³ cage (63 to 188 fish/m³). Fish in cages should be fed pelleted fish feed containing approximately 28-32% crude protein² at a declining rate of 10 down to 2% of estimated average bodyweight (BW):

Average Weight	% BW/Day
5 to 20g	10 - 7
20 to 50g	7 - 4
50 to 100g	4 - 3.5
100 to 250g	3.5 - 1.5
250 to 450g	1.5 - 1.0

Production and growth data from WRI trials in 2006 and 2007 are shown in Table 6. Seven out of 10 cages made it through the six month trials. Two cages were sabotaged and another was damaged when it became fouled with a submerged tree when the water level was low and then ripped open, releasing the fish, when the water level rose again.

Overall, survival was low in all cages, averaging about 30% among those that were not damaged or robbed. This was mostly the result of poor fish conditioning, handling and transport during stocking. Typical survival rate in small-scale tilapia cage culture is in the range of 70-80% although survival as low

² Optimal feeding requires that smaller fish receive somewhat higher protein levels, but these feeds are not generally available in the region at this time.

as 60% has been associated with stocking densities in excess of 70 fish per m². WRI and other hatcheries have since these trials developed improved conditioning and transport methods that have reduced stocking mortality to less than 20%. Check with WRI for advice on best practices.

Table 6a. Fish stocking, growth and harvest data for mixed sex tilapia grown in 48m³ cages fed with sinking feed for six months in Volta Lake, Ghana.

	Cage 1	Cage 2	Cage 3	Cage 4
Date Stocked 2006	27/10	08/12	31/10	31/10
No. Stocked	4000	6000	7000	2780
Avg. wt at stocking (g)	13.4 ± 10.33	25.0 ± 4.14	12.9 ± 7.97	31.7 ± 15.02
Avg. wt at harvest (g)	207.5 ± 59.98	277.5 ± 42.36	219.7 ± 88.27	307.5 ± 134.19
Grow-out (days)	153	147	133	152
No. Fish at harvest	1946	4639	1079	1647
Survival (%)	48.70	77.3	15.4	59.2
FCR	2.64	2.50	3.51	2.97
Gross yield (kg/cage)	324.7	1175.7	247.1	402.5

Table 6b. Fish stocking, growth and harvest data for mixed sex tilapia grown in 48m³ cages fed with sinking feed for six months in Volta Lake, Ghana.

	Cage 1	Cage 2	Cage 3	Cage 4	Cage 5	Cage 6
Date Stocked 2007	31/1	6/7	7/3	31/08	18/07	7/7
No. Stocked	7500	8200	7500	9000	6000	6000
Avg. wt at stocking (g)	22.92 ± 9.75	22.88 ± 8.75	12.45 ± 4.92	12.45 ± 4.90	20.08 ± 9.32	20.13 ± 9.34
Avg. wt at harvest (g)	369.70 ±155.50	452.2 ±230.32	Net caught on bottom	Net slashed by fishers.	Poisoned by fishers.	308.1 ±141.23

Grow-out (days)	169	147	and torn open.			130
No fish at harvest	1480	523				1542
Survival (%)	20	6.4				25.7
FCR	2.64	2.5				8.05
Gross yield (kg/cage)	324.7	232				503.4

The environmental protection agency (EPA) requires an environmental impact assessment (EIA) as one element of the permitting process for cage aquaculture. The relevant contact on cage aquaculture at the EPA is Mr. Carl Kojo Fiati at EPA-Accra (efiati@epaghana.org).