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IRAQ PRIVATE SECTOR GROWTH AND EMPLOYMENT GENERATION

May 15, 2006

Business Models for Aquaculture in Iraq

IZDIHAR
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EXCUTIVE SUMMARY

In a country like Iraq with a limited supply of animal feed, the development of aquaculture makes considerable sense because the most common varieties of farmed fish have a much more favorable feed conversion rate than either cattle or poultry.

The demand side of the equation appears to be highly favorable for aquaculture:

- There is a clear, unmet demand for fish; fish is often unavailable in the markets and supply is clearly unable to keep up with consumer demand.[1]

- The current low per capita consumption of fish - only 0.8/kg per person per year -is likely to increase considerably with the development of better and more sophisticated supply. Per capita consumption in 1990 – before the economic embargo – was 2.5/kg, and fish consumption in neighboring countries is growing fast. In Syria and Jordan the level is already 5kg, and in Egypt and Iran levels are well above 10kg per capita.

- Realistically, there might well be an immediate additional demand of 25,000 tons, of farmed fish but a more likely figure would be close to 50,000 tons.

- Based on a preliminary cost analysis, it seems possible to produce quality farmed fish in Iraq at a competitive price - perhaps at a retail price 15% lower than poultry and 70% below red meat - a factor that should have a positive impact on short-term demand. Actual fish demand seems currently inhibited by excessive retail price for fish - 3.500 IQD/kg ($2.33/kg) – often the same level as poultry.

In principle, many business models and systems are technically feasible in Iraq. Nevertheless, only one has the short-term potential to develop into an efficient aquaculture industry: The semi-intensive cultivation of grass carp in earthen ponds. The recommended business model has many advantages and involves little risk.

Semi-intensive grass carp cultivation in earthen ponds (1 ha):

- Requires a relatively small investment - $26,000 capital investment, $5,000 for working capital. Where a suitable pond is available or in the marshes, where ponds are easily obtainable with the adoption of simple nylon plastic nets, the capital investment drops to $11,000;[2]
- Requires relatively little know-how;
- Grass carp fingerlings are already available in the market – although costly compared to other countries;
- Carp have proved to be adaptable to Iraq's ecosystem;
- Grass carp enjoys a high level of consumer acceptance in the market;
- The model is flexible and creates jobs: A realistic estimate is that, in the short-term, the industry could create 5,000 direct jobs;

[1] Conclusion based on visits to the main wholesaler and retailer fish markets in Baghdad and on interviews and questionnaires conducted with consumers in Baghdad.
[2] The Marshes (Al-Ahwar in Arabic) is a unique region to Iraq covering a large area surrounding Shatt El-Arab waterway and the union of the Tigris and Euphrates rivers just below Qurna, stretching from Kut in the north to Basra in the south. This vast expanse of marshland dotted with shallow lagoons currently occupies an estimated area of 2.000 km^2 down from an estimated surface of 15.000m^2 in 1970. See map on page 31.

- An economic analysis has shown that the business model is profitable, with an attractive level of profitability.

Semi-intensive Grass carp in Ponds (1 ha/year)	Digging Ponds		Marshes or Natural Ponds available	
PROFIT & LOSS	Price $1.67/kg		Price $1.67/kg	
Total Gross Revenue	**34,667**	**100%**	**34,667**	**100%**
Net Margin	**4,667**	**13.5%**	**7,125**	**20.5%**
EBITDA	**12,230**	**35.2%**	**11,802**	**34.0%**
Capital investment	**$26,000**		**$11,500**	
Working capital	**$5,000**		**$5,000**	
R.o.I	**17.7%**		**61.7%**	

Another business model appears viable in the short term as well, but with less impact on fish supply and job creation: Semi-extensive cultivation of grass carp in rice paddy canals.

As is done in China, carp farming can easily be integrated with existing agricultural activities, resulting in clear synergies, especially when coupled with paddy rice. In this case, the investment is limited to working capital requirements, but productivity is low and catches are unable to support a stand-alone commercial operation.

There is also potential for tilapia farming. However, unlike the situation in South America or Southeast Asia where tilapia is farmed year round, the high temperatures in Iraq would allow only one eight month cycle per year.

In order to be profitable, tilapia would have to be sold in the market with a 20% premium over grass carp and farmed medium-intensively (that involves greater risk, and requires higher investments – *scenario 5*) or semi-intensively in existing or natural ponds (*i.e., in* the marshes – *scenario 2*) where the investment required is considerably lower. [3]

	Marshes or with Natural Ponds (no digging)				**With Cost of the digging a Pond**					
Scenario	**1**		**2**		**3**		**4**		**5**	
Tilapia (1 ha/year)	Tilapia price parity with carp. Density 5/m^3		Tilapia price +20% vs. carp. Density 5/m^3		Tilapia price parity with carp. Density 5/m^3		Tilapia price +20% vs. carp. Density 5/m^3		Tilapia price +20% vs. carp. Density 10/m^3	
PROFIT & LOSS	Price $ 1.67/kg		Price $ 2.00/kg		Price $1.67/kg		Price $2.00/kg		Price $ 2.00/kg	
Total Gross Revenue	**40,625**	**100%**	**48,750**	**100%**	**40,625**	**100%**	**48,750**	**100%**	**97,500**	**100%**
Net Margin	**2,843**	**7.0%**	**10,359**	**21.2%**	**-3,613**	**-8.9%**	**3,030**	**6.2%**	**19,375**	**19,9%**
EBITDA	**9,680**	**23.8%**	**17,196**	**35.2%**			**16,832**	**34.5%**	**36,487**	**37.4%**
Capital investment	**$11,500**		**$11,500**		**$39,000**		**$39,000**		**$39,000**	
Working capital	**$20,000**		**$20,000**		**$20,000**		**$20,000**		**$38,500**	
R.o.I	**24.3%**		**89.5%**				**7.7%**		**78.8%**	

Other models have emerged as theoretically possible, but only in the medium to long term, and would require extensive market research and a separate feasibility analysis. They include: The intensive farming of rainbow trout in the north of Iraq and the semi-intensive cultivation of Bunni fish (Barbo Sharpeyi) in the marshes.

[3] In the marshes unique topography and ecosystem, suitable fish farming ponds can easily be obtained with the adoption of simple nylon or plastic nets with limited capital investment.

Shrimp farming has been discarded as a possibility, primarily for the absence of domestic demand. Shrimp are not highly prized by Iraqis and it would be difficult to establish an export-oriented industry: There is, in fact, an oversupply in the world and efficient competition from Asia, South America and Saudi Arabia.

1. AQUACULTURE OUTLOOK

1.1 Aquaculture Systems

Fish farming is the principal form of aquaculture; it involves raising fish commercially in ponds, tanks, enclosures or cages. Basically, there two kinds of aquaculture: Extensive aquaculture, in which fish consume naturally occurring plants and other organic material produced by photosynthesis, and intensive aquaculture, in which the fish are kept in high density enclosures and fed with an external food supply, not relying on any significant contribution of naturally occurring food. Managing of these two kinds of aquaculture systems requires completely different methods and techniques, and requires different levels of investment.

1.2 Extensive Aquaculture

Two factors limit fish growth in extensive aquaculture: The available food supply from natural sources - commonly zooplankton feeding on pelagic algae - and the minimum level of oxygen required by the fish themselves. Excessive density almost inevitably leads to a food shortage – the consequence of which is slow weight gain – or to oxygen depletion and massive die offs. As a practical matter, without additional feeding and supplemental oxygen fish harvests in extensive ponds will probably not exceed a modest 200-300 Kg/ha per year.

1.3 Intensive Aquaculture

Intensive fish farms can be operated using earthen ponds, but more often tanks or cages of concrete or fiberglass are employed. In intensive systems, fish production per unit of surface area can be increased at will, assuming sufficient supplies of oxygen, fresh water and food are provided. Normal population density in intensive fish farming is between 5 and 10 fingerlings per m^3. At any higher level, a large water purification system must be employed and relatively sophisticated know-how is required.

Fish production costs in intensive farming are higher than in extensive farming, mainly because of the high cost of feed - 100 percent of required diet - ideally comprised of at least 30% of pure protein. The higher feed cost is offset by higher productivity per hectare, with catches as large as 15,000-20,000 Kg/ha/cycle.

Intensive Farming: Ponds

Intensive Farming: Tanks

In intensive aquaculture (with densities > 5-6 fingerlings per m^3) artificial aeration is indispensable, usually relying on bubblers, cascades, or liquid oxygen dissolution, and high densities entail a very high risk of infections by parasites, fungi, and bacteria, which means that intensive aquaculture requires close monitoring and a high level of expertise on the part of the farmer.

Another significant problem with intensive aquaculture is that it may use millions of liters of water per/ha (about $1m^3$ of fresh water per m^2 of surface) unless sophisticated and expensive water recirculation systems are employed. In most Middle Eastern countries, limited water supplies mean that intensive aquaculture is only possible with recirculation systems costing upwards of $200,000.

1.4 Semi-Intensive Aquaculture

Semi-intensive aquaculture employing earthen ponds is by far the most common system in developing countries by virtue of its simplicity and the low required investment. In semi-intensive systems, fingerlings are stocked at medium density (2-5 per m^3) and fish are fed mostly with commercial feed. Good water quality and sufficient dO (dissolved oxygen) are maintained by frequent or continuous water exchange and occasionally with aerators.

Pumped water in-flows must be sufficient to compensate for evaporation - perhaps as much as 25 mm/day in Iraq[4] - and to guarantee that a minimum of 15% of the total volume is recycled per month. Harvests in a well managed semi-intensive system may reach as much as 10,000 -12,000 kg/ha per cycle.

1.5 Cages: Systems

Cage systems use existing water resources, usually rivers or lakes. Although popular in much of Asia, they are increasingly opposed in most countries where they tend to be considered as a commercial alternative only when an open pond culture is not practical. A cage system has in reality many disadvantages: Is vulnerable to external water quality problems, requires highly intensive farming, is vulnerable to disease and poaching, is often highly polluting and poses a risk to the ecosystem. It comes as no surprise that the use of cages is usually discouraged in most of the Middle East countries and not recommended in Iraq where ponds suitable for aquaculture are abundant or easily obtainable in the marshes with the adoption of simple nylon or plastic nets.

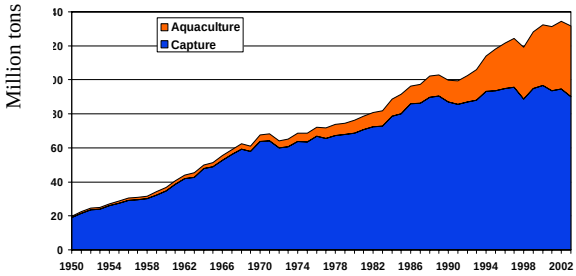
[4] Based on values in South America corrected taking into account +5 ^{0}C – on average temperature – in Iraq.

2. AQUACULTURE IN THE WORLD AND IN THE MIDDLE EAST

2.1 The Aquaculture Industry in the World

Worldwide fishery production continues to grow, but at lower rates than in the 1990s.[5] With wild fish stocks increasingly being fully fished or over-fished, this growth is mainly due to aquaculture production, which has grown at an average rate of 9 percent since 1970. The capture of wild fish since the 1990's has remained relatively stable at around 90 million tons.

World Fish Production: Aquaculture and Captures (million tons)



In 2004, aquaculture – with a production of approximately 35 million - accounted for about one third of total fish production world wide. Asia dominates this activity, producing almost 90 percent of all farmed fish. China alone contributes nearly 70% of the worldwide aquaculture output; India – with only 5% – is the second largest producer.

Aquaculture: Production Share by Country in Volumes

COUNTRY	SHARE OF GLOBAL PRODUCTION
China	70.2%
India	4.8%
Japan	3.1%
Philippines	2.2%
Korea	1.8%
Indonesia	1.6%
Bangladesh	1.4%
Viet Nam	1.4%
Thailand	1.4%
Other countries	12.0%

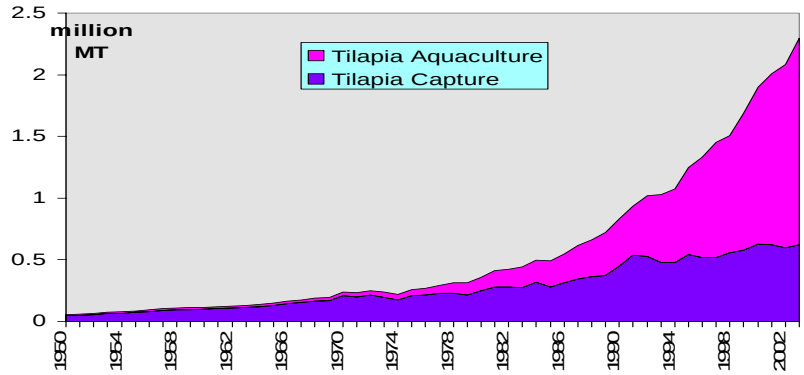
Aquaculture products fall into two basic groups: High-value species such as shrimp and salmon, frequently grown for export, and lower value species such as carp and tilapia, primarily consumed locally.

Chinese aquaculture production is dominated by carp. Four major species – silver carp, grass carp, common carp, and bighead carp – account for nearly all the production in China, where they are raised as a supplementary activity, mainly in rice paddies. Carp are herbivores, and can survive on low-cost, readily available feed material.

[5] FAO – Rome – January 2006

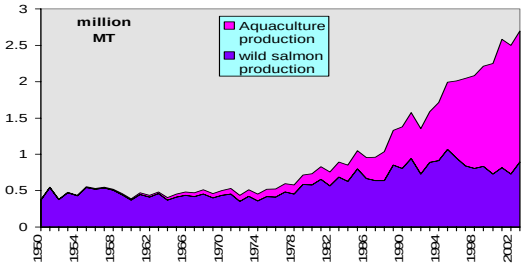
Carp farming is more or less limited to China. Catfish farming is concentrated in Viet Nam and the United States. In the last twenty years the production has grown quickly and worldwide production reached almost 20 million tons in 2005.[6]

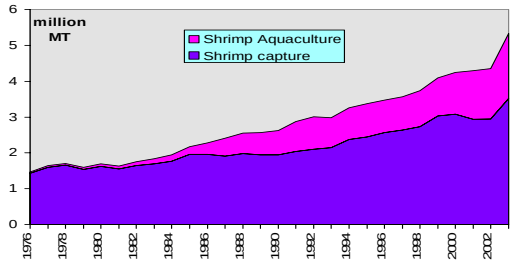
Tilapia: Capture and Aquaculture Volumes in the World



The largest volumes of farmed tilapia in the world are still produced in Asia – Thailand, Taiwan, Indonesia, China and Philippines. Latin America – Brazil, Mexico, Costa Rica, Colombia and Honduras – is the second biggest producer, but accounts for no more than 150,000 tons/year. Salmon and shrimp are the dominant high value products.

Salmon and Shrimp: Worldwide Capture and Aquaculture Volumes





Farmed salmon, mainly from Chile, Norway and Scotland, amounted almost to a million tons in 2005, but the spectacular growth rates of supply have suppressed prices to the point that many farms are currently operating below the break-even point.

Farmed shrimp production is estimated at 1.3 – 1.5 million tons, representing 25 percent of world supply. In this market as well, prices are falling and profitability is decreasing. This is due primarily to a significant oversupply in India, Bangladesh, Thailand, Brazil and Honduras, aggravated by the return of Ecuador and China to international trade.

It should be kept in mind that the spectacular growth of aquaculture in the world has not occurred free of criticism and concern. For one thing, intensive fish farming requires a large quantity of good quality water – a resource often in short supply. Secondly, intensive farming can produce pollution and contribute to harmful algae blooms that can cause serious environmental impact.

[6] Earth Trends Estimate, 2006.

2.2 Aquaculture in the Middle East

Aquaculture has a short history in the Middle East. In 2004, overall aquaculture production in the region was less than 220,000 tons - less than 0.5% of estimated global production. Three of the 17 regional countries account for nearly 90 percent of the production – Egypt with 48 percent, Turkey with 30 percent, and Israel with 12 percent.

The overriding constraint for aquaculture development is scarcity of water and competition with other users of fresh water. Because of the competition for water, extensive aquaculture is generally uncommon in the Middle East. Therefore, semi-intensive aquaculture has generally the greatest potential in the region, and is the recommended approach in Iraq. While there are other constraints such as the high price of feed, scarcity of fingerlings, and certain bureaucratic requirements for obtaining licenses and permits, their impact is minor when compared to that of water.

2.3 Aquaculture in Egypt

Egypt has been the traditional Middle East leader in aquaculture. The industry is supported by generous government incentives, both to increase food supply and to create jobs. A national plan was approved in 2004, aimed at increasing per capita fish consumption from the present level of 10 kg to 13 kg by 2017.

Semi-intensive aquaculture provides some 82 percent of Egyptian aquaculture production. Farms are privately owned, and most are located in the northern or eastern parts of the Nile delta. Tilapia comprises 45 percent of the total, followed by mullet at 25 percent and carp at 25 percent. Sea bass and sea bream constitute 2.5 percent each.

Carp production is concentrated in rice paddies, where farming has been supported by the government with free supplies of fingerlings and where carp have been introduced to control weeds in the canals. Mullet – and especially grey mullet, *Mugil caphalus* – is in high demand in Egypt, despite a retail price three times higher than either carp or tilapia.

Vital supporting services and related industries such as hatcheries and feed production have flourished in Egypt since the privatization process began in 2001. According to private sector sources, there are now 22 state-of-the-art hatcheries and 17 modern feed companies in Egypt that meet international quality standards. The shrimp sector, by contrast, is underdeveloped in Egypt, and shrimp consumption is negligible.[7]

2.4 Aquaculture in Israel

Over the last decade, Israel has shown slower growth than several other nations in the region, and has been displaced by Turkey as the second most important producer In the region. Aquaculture in Israel has refocused on high-value species such as sea bream and mullet. In addition, Israel has recently diversified into high-tech aquaculture and related services, and has become the regional leader in areas such as genetic modification, water control and recirculation systems, feed improvement, aquaculture project conception, and design consulting.

[7] Shrimps consumption is lower than 100 g per capita in Egypt according to the Ministry of Agriculture.

2.5 Aquaculture in the GCC Countries [8]

Taking into account the critical issue of water availability, it comes as no surprise that aquaculture is not a strategic industry in the GCC countries. Nevertheless, some useful lessons may be drawn from an analysis of aquaculture developments there.

In Bahrain, the industry never developed to any significant size because shrimp farming was regarded as potential competition to the strong local trawling industries and therefore discouraged. In Kuwait and the UAE, the Marine Resources Research Center (MRRC) was established and performed a wide range of feasibility studies, but there is as yet no significant production, in part because after extensive research Kuwait's coastline appears unsuitable for fish farming, being too open and unprotected from severe weather.[9]

Better conditions than those in Kuwait are found along the 1600 km Saudi Red Sea coast -- especially for shrimp. Although fish farming in the kingdom commenced only in 1978, the industry has witnessed spectacular development, with large integrated operations along the Red Sea coast. In shrimp farming, Saudi Arabia has emerged as a notable producer. Production was 8,200 tons in 2004.[10]

At present, Saudi operations are all-in-house integrated production and marketing operations. This is a costly, capital intensive business model dictated in part by the absence of supporting and related industries. Saudi Fishery Company in Jazan, with a yearly production of 1,500 tons, National Prawns Company in Mecca, and Jazan Agricultural Development Company (JAZADCO) are reportedly among the biggest shrimp farms in the world. Unlike the marine fisheries sector, which is reserved for local entrepreneurs, foreigners may invest in aquaculture.

Low-value fish farming such as tilapia and carp has been all but closed down because it is unable to compete with the influx of substandard frozen tilapia from Thailand, Taiwan, and the Philippines, which sells at an average retail price of SR 5/kg - $1.33.

A year ago - confirming the high-value and high investment strategic positioning of the Saudi Arabia aquaculture industry - the launch of an ambitious sturgeon and caviar production program was announced.[11]

2.6 Aquaculture in Turkey

Aquaculture in Turkey has shown almost exponential growth since 1988, quickly overtaking Israel as the second largest producer in the region. The main species produced – unlike any other country in the region but Lebanon – is rainbow trout, while consumer acceptance of carp has significantly decreased in the last two decades, leading to the almost complete disappearance of the carp farms.

[8] Gulf – Cooperation – Council: Bahrain, Kuwait, Oman, Qatar, UAE and Saudi Arabia.
[9] Relevant to Iraq since Iraq's coastline is shared with Kuwait.
[10] Saudi Arabia Ministry of Agriculture
[11] Caviar is perhaps the only foodstuff in the world the supply of which falls short of demand.

3. AQUACULTURE IN IRAQ

3.1 Aquaculture in Iraq: Status

In the 1980s there were reportedly some 2,000 fish farms in Iraq. Now, apparently, there are only some 500 or so, all of them using earthen ponds, and averaging around 8,000 m^2 of water surface.

The technology is rudimentary, and the system is similar to that of extensive aquaculture with limited supplemental feedstuff. There are virtually no aeration systems, no water filters, and no facilities for preserving the catch and transporting it efficiently to the market. Related and supporting industries are poorly developed:

- Currently only four hatcheries are operating in Iraq, three of them privately owned. The only fingerlings available are grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), and common carp (*Cyprimus carpio*).

- Feedstuff producers do not meet even minimal international standards: Feed composition is standardized rather than modified for the needs of individual species. Often the feed employed was originally developed for poultry and then adapted to fish farming. The exact formulations are often unknown, and may vary depending on the availability of imported raw materials in Iraq at any given moment.

- At present there is no regular assistance or support by specialized biologists, technical personnel or consultancies for project conception and design.

Despite the various problems, conditions in Iraq favor the development of an aquaculture industry, especially from the standpoint of consumer demand. The constraints are far from insurmountable.

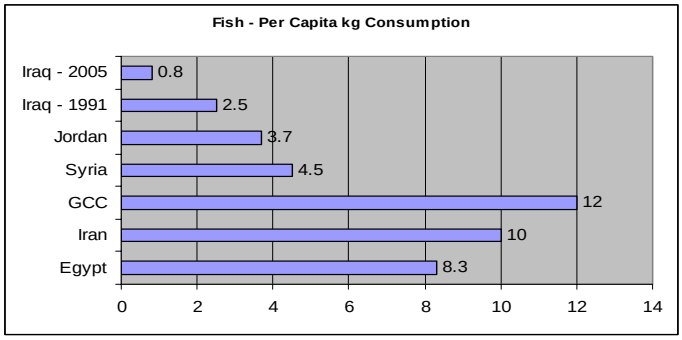
3.2 Aquaculture in Iraq: Favorable Conditions for Development

1. There is a clear gap between the current supply and market demand for fish. In the main Baghdad fish markets the daily supply fully sold well before closing time. Fish production falls short of demand because of low productivity, too few farmers in the business, and poor transportation facilities to make product available at the right place at the right time.

2. The current average consumption of fish in Iraq stands at only 0.8/kg per capita, compared to 2.5/kg in 1990, before the international embargo. It is fair to assume that consumption has been hampered not only by a decrease in purchasing power – as occurred with poultry and red meat – but also by poor supply in terms of both quantity and quality. Were the supply chain to be reorganized, consumption could quickly regain pre-embargo levels.

   Iraqi fish consumption per capita is currently the lowest in the region. In the neighboring GCC countries it stands at almost 12/kg per capita, nearly 10/kg in Egypt and Iran, while in Jordan and Syria it is about 5/kg.

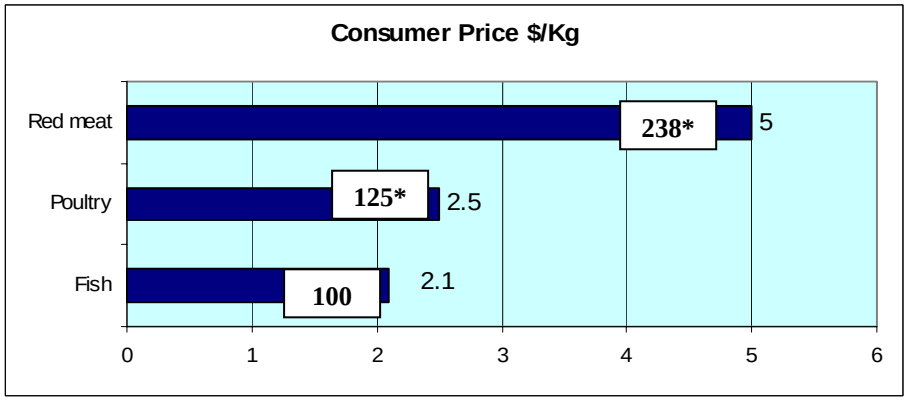
Fish: Per Capita Consumption – Kg – in the Middle East



In the short term, and notwithstanding dwindling purchasing power of Iraqi consumers, there could well be an unmet demand for fish of 25,000[12] to 50,000[13] tons. Over the medium term, consumption is likely to stabilize at around 4-5/kg[14] per capita, creating further potential for the aquaculture industry to develop.

3. Historically and under normal conditions, there is a clear gap between the consumer price of fish and the price of poultry and red meat in Iraq:

Meat Retail Price/kg: Fish, Poultry, Red Meat Comparison



- Fish $/kg price = index =100

A more efficient model for aquaculture in Iraq should enable the marketing of fish at a retail price of $2.1/kg, considerably lower than poultry, sold in normal condition at 2.5/kg.[15] In a country like Iraq, where the desired diet includes meat or poultry with every meal, a price advantage for fish is probably important. Based on consumer interviews, it appears that a 15% price advantage over poultry would help assure a strong market. However, there is certainly a significant baseline market in Iraq, partly because – especially among Shiite Muslims – fish is associated with prosperity and there exists a tradition of eating it once a week, particularly on Wednesdays. Hence, in central and southern Iraq it is not unrealistic to assume that many households probably consume fish more than once a week.[16]

[12] Assuming a quick return to 75% of the fish per capita level in 1990 (pre – embargo).
[13] Assuming per capita fish consumption +15-20% vs. 1990, more in line with the regional pattern.
[14] Still lower than Jordan and Syria, the countries with the lowest fish consumption in the Middle East.
[15] The price of poultry in the market has momentarily dropped - from $ 2.5/kg to $ 2.0/kg - in the aftermath of the bird flu crisis.
[16] Based on consumer interviews.

3.3 Aquaculture in Iraq: Constraints

Some existing constraints might hamper the development of an aquaculture industry in Iraq, but they seem neither insurmountable nor difficult to address in the short term.

1. Financial Assistance for Aquaculture Development

Even employing a semi-intensive system with earthen ponds - the most widely used method fish farming worldwide - aquaculture is relatively capital intensive compared to an activity such as the cultivation of fruits and vegetables. The capital investment required to start an efficient medium sized, market oriented carp farming operation is about $26,000 in Iraq, and needs working capital of about $5,000.[17] The capital investment drops to only $11,000 if a suitable earthen pond is available – or in the marshes.

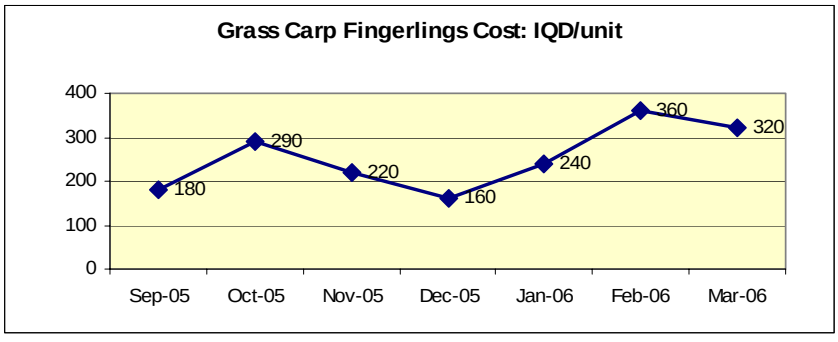
Establishing an effective micro-finance scheme is a precondition for developing a successful, financially feasible, semi-intensive aquaculture industry in Iraq in a short period of time. At present, the lack of available loan capital is a systemic problem throughout Iraqi business and industry. In particular, cash-flow based lending has yet to become well established, and therefore collateral requirements are burdensome and usually based on real estate equity. In addition to capital requirements that are often beyond the means of a small farmer, the situation is exacerbated by the fact banks perceive aquaculture as risky – and riskier than other agricultural activities.

2. Hatcheries and Fingerlings

This appears to be an important constraint due to short supplies of fingerlings in much of the Middle East, even including Egypt and Turkey, where aquaculture is reasonably developed. Presently in Iraq there only a few hatcheries. There are only four in the Baghdad region, none in the north apparently, where fish consumption is the lowest in the Iraq, and one is reported to be operating in Basrah.[18]

The only fingerlings available in Iraq are grass carp, silver carp and common carp, and they sell for 200-350 IQD ($0.13 - 0.23) per 12-15g unit, more than twice the price of their equivalent in Brazil or the United States. However, violent fluctuations in the market price of fingerlings probably represent a more severe constraint on developing the industry than the high price in and of itself.

Baghdad: Fingerlings Cost IQD/unit (12-15g)



[17] Assuming an earthen pond of 1 ha.
[18] It was reported operational in 2005.

The excessive cost of fingerlings is probably a consequence of a *de facto* oligopoly and of low volumes. In Iran the cost per unit of comparable fingerlings is about 130 IQD/ unit ($0.09). In South America, where carp is uncommon, the cost is approximately 80 IQD/unit ($0.05). With the development of the industry and considerably larger volumes, we would expect the cost of fingerlings to stabilize at around 180 IQD/unit ($0.12).

3. Insufficient Supply and Quality of Specialized Fish Feed

Fish feed represents by far the most important cost in fish farming. In successful operations it usually accounts for no more than 50% of total variable costs. In countries with a significant fish farming industry, feed production is usually an integrated in-house operation run on a full cost basis with no profit. At the moment, fish feed manufacturing in Iraq is at best underdeveloped Iraq. The real problem does not appear to be the manufacturing itself – fish feed can be extruded easily and efficiently using production lines that cost no more than $50,000. Rather, the problem is in the formulation and the erratic availability of the necessary raw materials – grains, soya cake and animal proteins – in the market.

Few farmers in Iraq actually adapt the feed formulation to the characteristics of individual fish species, and local feed manufacturers usually only produce a “one size fits all” product. In many cases a lack of know-how among farmers often leads to overfeeding, which in turn can result in a deterioration of water quality.

The price of fish feed in the Iraqi market is a seemingly reasonable $0.20/kg on average, but because the formulations are unknown and appear to have low nutritional value, it is hard to be more precise. In established markets, high quality fish feed has a minimum pure protein content of approximately 30%, much higher than in Iraq, where values of 20% - 22% are apparently the standard. As a result, the feed conversion rate for carp must be about 2.3 in Iraq, less efficient than in countries where high quality feed is available and a typical conversion rate would be around 1.5- 1.7.[19] Improving the quality of feed available in Iraq would certainly translate into increased efficiency, shorter cycles for the fish to reach optimal weight, and greater weight gains.

4. Inadequate Water Controls

Water analysis and control is a critical factor in aquaculture, and developing a more efficient and modern aquaculture industry depends on obtaining the kind of technical expertise that is usually provided by a biologist or fish farming expert. Today in Iraq, aquaculture operates on a seat-of-the-pants basis, guided more by individual experience than technology. In modern aquaculture, continuous control of water quality, dO levels, pH, salinity, un-ionized ammonia concentration, and nitrites can lead to remarkable gains in productivity and drastic reductions in mortality rates. The equipment for modern, scientific water testing and control can be bought for approximately $2,000; the real constraint, therefore, is the lack of skilled managerial and technical personnel.

5. Inadequacy of Project Conception and Design

There is clear need for an improved design capacity to facilitate the establishment of aquaculture projects in Iraq, and specialized engineers should be utilized. Good site selection is one of the most important factors in fish farm planning along with questions concerning the appropriateness of soil amendments, pond lining, and irrigation. Good

[19] Ratio of the gain in body weight to the amount of feed fed.

project conception and design may reduce significantly the risk and necessary investment, while maximizing productivity.

6. Limited Facilities of Scientific Research and Technology Development

A modern aquaculture industry requires well trained biologists and help from general and specialized research and technical institutes. They can address matters such as water and ecosystem control, and support the development of an efficient, modern hatchery industry. In addition, they can advise on optimizing feed and treating fish diseases.

7. Marketing and Logistics

Market linkages in Iraq are insufficient, and this leads to disruptions in supply and occasional periods of general or localized oversupply. Refrigerated storage and transportation are almost unknown, leading to heavy post-harvest losses. Unpredictability of supply has a deleterious effect on potential demand for the product.

4. A NEW MODEL FOR AQUACULTURE IN IRAQ

4.1 Domestic Demand Driven or Export Driven

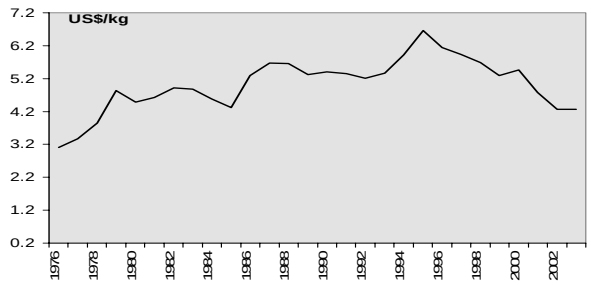
The potential demand for the products of an aquaculture industry in Iraq is likely to be overwhelmingly domestic, partly because demand for tilapia and carp, the most commonly farmed species, is low in all the nearby countries but Egypt. In the Gulf countries tilapia is well received by South Asian expatriates, but the local population is less welcoming. Carp consumption is almost non-existent. The only major tilapia importer in the world is the USA, while in Europe tilapia consumption is negligible. As far as carp is concerned, import-export is almost non-existent. China is the only major consumer market but is entirely self sufficient.

In light of the above, the only possible export opportunities seem limited to trout for the Turkish market, shrimp for the EU, USA, or GCC countries, and tilapia for the US market. The potential for trout exports to Turkey requires a more comprehensive study of demand in Turkey and a feasibility study of the north of Iraq as a potential supplier. Upon closer analysis, however, it is clear that shrimp and tilapia for export should not be pursued.

Shrimp:

1. There is currently a huge oversupply in the two biggest markets for shrimp, the EU25 and the USA. As a result, export prices for shrimp have been declining steadily since 1996 with no sign of recovering.

Frozen Shrimp: Export Prices $/kg



The European and American markets are monopolized by Southeast Asian and South American suppliers – both with huge, modern integrated enterprises, and both characterized by high productivity. With ideal climatic conditions, they successfully harvest four batches per year, yielding 6 – 7 tons/hectare per quarterly cycle.

Frozen Shrimp: EU25 Imports

IMPORT FROZEN SHRIMP EU25	Import Euro 000	Import tons	Price/Kg	Price Index	Share
	2004	**2004**	**2004**	**2004**	**2004**
Argentina	136,219	17,701	7.7	**143**	**12.0%**
Bangladesh	63,615	9,901	6.43	**120**	**5.6%**
Brazil	108,051	33,263	3.25	**61**	**9.5%**
China	10,561	1,311	8.06	**150**	**0.9%**
Colombia	30,400	8,180	3.72	**69**	**2.7%**
Ecuador	113,408	27,804	4.08	**76**	**10.0%**
Honduras	28,851	6,358	4.54	**85**	**2.5%**

India	94,370	18,912	4.99	**93**	**8.3%**
Indonesia	70,006	12,698	5.51	**103**	**6.2%**
Madagascar	106,351	11,127	9.56	**178**	**9.4%**
Malaysia	38,701	7,645	5.06	**94**	**3.4%**
Mozambique	32,956	3,862	8.53	**159**	**2.9%**
Nicaragua	9,978	2,433	4.1	**76**	**0.9%**
Nigeria	38,651	5,376	7.19	**134**	**3.4%**
Tunisia	24,354	2,262	10.76	**201**	**2.1%**
Venezuela	33,558	6,770	4.96	**92**	**3.0%**
Vietnam	26,689	4,125	6.47	**121**	**2.3%**
Total Import EU25	1,136,096	211,628	5.37	**100**	**100%**

Frozen Shrimps: USA Imports

IMPORT FROZEN SHRIMP USA	Import Value $ 000	Import Value $ 000	Share %	Share %
	2004	**2005**	**2005**	**2005**
Bangladesh	56,378	24,635	**5.2%**	**2.4%**
China	115,550	23,801	**10.6%**	**2.3%**
Ecuador	74,055	79,765	**6.8%**	**7.6%**
Guatemala	20,615	4,119	**1.9%**	**0.4%**
Honduras	12,867	14,679	**1.2%**	**1.4%**
India	126,427	121,605	**11.6%**	**11.7%**
Indonesia	160,301	176,945	**14.7%**	**17.0%**
Mexico	13,592	15,851	**1.2%**	**1.5%**
Malaysia	62,208	45,722	**5.7%**	**4.4%**
Thailand	219,485	257,627	**20.2%**	**24.7%**
Vietnam	156,261	202,922	**14.4%**	**19.5%**
Total Import USA	1,087,917	1,042,806	**100.0%**	**100.0%**

2. Regional shrimp consumption is low throughout the GCC, and Saudi Arabia has already established clear leadership in the region, enhanced by massive investments in state-of-the-art shrimp farms in the Red Sea.

3. On the supply side, Iraq's harsh climate is a highly restrictive factor, hampering productivity and the number of cycles per year. Daily and seasonal temperature fluctuations that result in cool temperatures overnight are too low for shrimp, even in the very warm Basrah region,

Tilapia:

Tilapia: USA Imports (tons)

USA Tilapia Imports	2000	%	2001	%	2002	%	2003	%	2004	%	2005	%
Whole frozen	27,781	65%	38,730	66%	40,748	59%	49,045	53%	57,299	50%	63,602	50%
Frozen fillets	5,186	12%	7,372	13%	12,253	18%	23,249	25%	36,160	31%	41,116	32%
Fresh fillets	7,502	18%	10,236	18%	14,187	21%	17,951	19%	19,480	17%	20,890	16%
Total	42,469	100%	58,339	100%	69,190	100%	92,248	100%	114,943	100%	127,613	100%

US imports of tilapia are growing rapidly, having almost doubled in the last three years. It is a very competitive market, dominated by China and Taiwan in the frozen segment and by Latin American countries in the fresh segment of the market.

Frozen Fillets Tilapia: USA Imports (tons)

USA Frozen Tilapia Imports	2000	%	2001	%	2002	%	2003	%	2004	%	2005	%
China	11,622	42%	10,870	28%	19,616	48%	28,763	59%	31,782	55%	29,892	47%
Taiwan	15,916	57%	27,599	71%	20,660	51%	19,664	40%	24,935	44%	32,564	51%
Total	27,781	100%	38,730	100%	40,748	100%	49,045	100%	57,299	100%	63,602	100%

Frozen Fillets Tilapia: USA Imports (tons)

USA Frozen Fillets Tilapia Imports	2000	%	2001	%	2002	%	2003	%	2004	%	2005	%
China	1,810	35%	2,529	34%	6,026	49%	15,857	68%	28,086	78%	30,837	75%
Indonesia	1,218	23%	2,179	30%	2,572	21%	3,582	15%	4,250	12%	5,386	13%
Taiwan	1,730	33%	2,133	29%	2,761	23%	2,470	11%	2,666	7%	2,672	6%
Total	5,186	100%	7,372	100%	12,253	100%	23,249	100%	36,160	100%	41,116	100%

Fresh Fillets Tilapia: USA Imports (tons)

USA Fresh Fillets Tilapia Imports	2000	%	2001	%	2002	%	2003	%	2004	%	2005	%
Ecuador	3,253	43%	4,924	48%	6,616	47%	9,397	52%	10,164	52%	9,860	47%
Costa Rica	2,684	36%	3,109	30%	3,206	23%	3,996	22%	4,090	21%	3,990	19%
Honduras	1,038	14%	1,438	14%	2,874	20%	2,857	16%	4,042	21%	5,514	26%
Total	7,502	100%	10,236	100%	14,187	100%	17,952	100%	19,480	100%	20,890	100%

There is currently an oversupply in the market and prices for tilapia are weakening in the face of a flood of imports. This is especially true for frozen tilapia, the price of which dropped below $1.65/kg in August, 2005, the lowest level ever.

Latin America is the main supplier of fresh tilapia fillets to the US market, no surprise given the relative geographical advantage over Asian exporters. The key suppliers are Ecuador, Costa Rica, and Honduras.

4.2 The Choice of an Appropriate Aquaculture System for Iraq

Semi-Intensive Aquaculture in Earthen Ponds

Semi-intensive aquaculture in earthen ponds seems by far the most appropriate system to develop in Iraq for a number of reasons:

1. It is the system that maximizes rural employment: large intensive farms, although they achieve some economies of scale, as in the case of Saudi Arabia, would crowd out small farmers. Furthermore, most of the economies of scale can be achieved by small farmers forming associations or cooperatives. The adoption of semi-intensive aquaculture, coupled with additional demand for fish, estimated at 25,000 tons, could lead to the

creation of at least 3,000 direct jobs in Iraq in the short term without significant market growth and acceptance.[20] With an estimated potential of 50,000 tons, the fish farming industry in Iraq could probably create at least 5,000 direct jobs, plus a considerable amount of related jobs.

The capital requirement for semi-intensive aquaculture is relatively low - $26,000 including the digging of a pond, and as low as $11,000 for farmers with a suitable pond available or in the marshes area where natural ponds can be easily obtained with the adoption of simple nylon or plastic nets.

2. The low level of investment should both maximize farmers' adherence to the scheme and is suitable for support by micro-finance institutions.

3. Aquaculture is an industry where intensive, integrated, high volume farms often lead to oversupply and low prices unless the production is directed to exports, a hard lesson learned in many other countries.

4. A minimal capital investment in a semi-intensive system seems more appropriate in today's Iraq, flexible enough to match local supply efficiently with demand, while also taking also into consideration the constraints of logistics and transportation.

The recommended minimum size for a commercial fish farm operation would be a pond of 1 ha (10,000 m^2), normally of 1.5 meters depth. Due to the extreme temperatures reached during the Iraqi summer, a depth of 1.8 meters or more may be required. The cost estimate for such a pond is around 1,500 IQD/m^2.

Additional capital requirements – apart from pond excavation – would be limited to a water pump (± $6-7,000) and working capital for fingerlings and fish feed (± $5-6,000).

Semi-Extensive Aquaculture Integrated in Rice Paddy Canals

Integrated systems that combine fish production with other types of agriculture such as rice cultivation could also be applied with little investment rather than the required working capital. In such as schemes, productivity is low and fish production more suitable for self-consumption or as a source of modest cash income, without little real sizeable commercial activity.

Intensive Aquaculture Systems

Intensive systems with either concrete or fiberglass tanks would suffer from serious constraints in Iraq:

1. The flow through system of discarding water after use requires a huge amount of water - on average 1 m^3 for each m^2 of surface. The cost of constructing the tanks would be a significant entry barrier for small farmers, since the accepted minimum is 20 tanks per farm, at an average cost of $5,500 each.[21]

[20] At an average carp farm in Egypt, catches equal 10,000 kg per cycle.
[21] Circular concrete tank, 1.8 meters deep with a 4.0 meter radius. Usually, intensive tank systems support a density 10 times higher than that of semi-intensive systems. Therefore 20 such tanks would be the equivalent of a 10,000 m^3 earthen pond in a semi-intensive operation.

2. The minimum investment for a recirculating aquaculture system (RAS) designed to treat water and remove toxic wastes and recycle it is around $220,000.[22] RAS systems are normally adopted only in added value fish farming, such as for shrimp, with a selling price > $5.00/kg, or in areas with high land costs.

4.3 The Choice of Appropriate Aquaculture Fish Species for Iraq

Realistically speaking, initial efforts should be concentrated on only carp and possibly tilapia, the objective being to develop an industry in the short term. Nevertheless, a preliminary assessment suggests that there might also be a potential for rainbow trout farming in the north, and other added value species (premium products and delicacies) such as Bunni fish (Barbo Sharpeyi) in Baghdad, central, and southern Iraq. The possibilities should be explored further.

Fish Species: Carp

Carp is the most obvious and safest choice for the rapid development of aquaculture in Iraq:

- Various varieties of carp are either native to or already adapted in Iraq; carp is already farmed extensively in Iraq; carp has been semi-intensively farmed in the past.
- Carp fingerlings are currently available in the market (although costly);
- Carp enjoys proven consumer acceptance in the market;
- Carp is the high volume - low cost species that does best in Iraq's harsh climate, particularly in the sharp daily and seasonal temperature fluctuations.

Grass carp (*Ctenopharyngodon idella*) is the species with the highest acceptance among consumers in a market where common carp (*Cyprimus carpio*) and silver carp (*Hypophthalmichthys molitrix*) are also available. Therefore, grass carp is the ideal fit - and recommendation - for the quick development of an expanded aquaculture industry in Iraq. (*Attachment 1*)

Fish Species: Tilapia

Tilapia is second only to carp as the most widely farmed freshwater fish in the world.

Advantages

The positive characteristics of tilapia for aquaculture are their tolerance of poor water quality, high tolerance of salinity, and their food efficiency (feed conversion rate as low as 1: 1.3). Tilapia survive easily at dO < 0, 5 mg/l (ppm), with an ideal dO of at least 3.0 mg/L (ppm). Massive die offs occur only when the water has an unionized ammonia concentration > 2 mg/l. Tilapia are also more tolerant of nitrite than any other cultured fish; even more importantly, tilapia are more resistant to viral, bacterial, and parasitic diseases than other commonly cultured fish.

In South America and Southeast Asia, tilapia is considered by consumers to be better quality meat than other farmed fish, and commands a 30 – 40% premium over premium over the price carp at the retail level. Tilapia have far fewer bones than carp, a characteristic highly prized by consumers. In addition, tilapia usually adapt well to high density farming, even in non-ideal conditions.

[22] Price includes bio-filter converting ammonia to nitrite and then to nitrate, and purification.

Constraints

One major constraint affecting the development of commercial farming in Iraq is the inability of tilapia to withstand sustained water temperatures below 10 – 11^{0}C. The optimal water temperature for their growth is about 28 -31^{0}C, and they generally stop feeding when temperatures fall below 17^{0}C. Their limited adaptability to low temperatures is indeed a serious constraint, as temperatures in Iraq are likely to follow below 10 - 11^{0}C for three to four months per year in most of the country, and overnight temperatures may be low even in the spring and autumn.[23]

Average Temperatures in Iraq

Average Temperatures ***Baghdad*** *Latitude: 33 14N* *Longitude: 044 14E*

^{0}C	YEAR	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	22	8	12	16	22	27	32	34	33	30	24	16	11

Average Temperatures ***Al Amarah*** *Latitude: 32 10N* *Longitude: 046 03E*

^{0}C	YEAR	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	25	11	13	18	24	30	34	36	35	33	27	18	13

Average Temperatures ***An Najaf*** *Latitude: 31 59N* *Longitude: 044 19E*

^{0}C	YEAR	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	24	10	13	18	24	30	34	36	35	32	27	18	12

Average Temperatures ***An Nasiriyah*** *Latitude: 31 05N* *Longitude: 046 14E*

^{0}C	YEAR	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	25	11	15	19	25	31	34	36	35	33	27	19	13

Average Temperatures ***Al Basrah*** *Latitude: 30 34N* *Longitude: 047 47E*

^{0}C	YEAR	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	25	12	15	20	25	30	33	35	34	32	27	20	14

Average Temperatures ***Sulaymaniyah*** *Latitude: 35 33N* *Longitude: 045 27E*

^{0}C	YEAR	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	19	4	7	11	17	23	29	33	32	28	22	13	8

Source: Weatherbase International

Because of the temperature, two cycles per year for tilapia would be impractical in Iraq. The only viable option is a maximum of one eight month cycle per year, but this may have serious implications for profitability, retail pricing, and stocking density.

[23] Daily fluctuations are usually extreme in Iraq. Average night temperatures are 7-8^{0}C lower than daytime averages.

Tilapia grow relatively fast with,15g fingerlings reaching 500g in five-six-months, but there is then a diminishing return on further cultivation, as they rarely exceed 700 - 800g, even after ten months. This is especially true in farms outside the tropics, and this growth pattern may ultimately present a significant constraint in Iraq, where there is a marked consumer preference for large fish. Tilapia fingerlings are not available Iraq at the moment, but are available in Egypt and Jordan.

The dress-out percentage of tilapia is relatively low compared to species such as trout or catfish, generally 51 to 53% of live weight for whole-dressed fish (head off), and 32 to 35% for fillets, with pin bones along the lateral line removed. (Compare catfish at 60% and 45% respectively).

Tilapia males grow as much as 40% faster than females, so all-male culture is desirable from an economic standpoint. The most common method of obtaining an all-male population, known as “sex reversal,” is carried out by feeding hatched fry with male-hormone treated feed. This requires a degree of know-how and technology not currently available in Iraq.

The Nile tilapia *(Oreochromis niloticus)* is the obvious recommendation for fish farming in Iraq, as it is ubiquitous (including Egypt), and is highly adaptive to different ecosystems.
Red tilapia - widely farmed in South America and in Egypt – is not recommendable for Iraq, despite a delicious flavor and attractive appearance. Farming red tilapia requires considerably more know-how than the Nile species, with much higher reported rates of failure and lower survival rates in semi-intensive pond culture.

5. ECONOMIC ANALYSIS

Fish Species and Aquaculture Systems: Priorities

System / Species	SEMI EXTENSIVE	SEMI INTENSIVE	MEDIUM INTENSIVE	INTENSIVE
Grass carp	Possible but with low yields.	Viable.		
Tilapia		Viable in models - as in the marshes – where ponds are available or obtainable with low investment.	Viable farming at high density (high investment).	
Shrimp				Discarded.
Trout	Market research in the north.			
Bunni fish	Medium term only; no immediate action.			

Two aquaculture business models emerge as probable priorities:

- Grass carp farming in semi-intensive system utilizing earthen ponds.
- Nile tilapia in medium-intensive systems (if conditions permit) or semi-intensively primarily in the marshes or where suitable ponds – requiring little digging and outfitting investment – are available.

Shrimp fails the test of practicality and competitiveness at many levels:

- Domestic demand is almost non existent;
- Global competition from Asia, South America, and Saudi Arabia is fierce and highly competitive;
- A supply chain must be created from scratch; in particular hatching shrimp larvae requires sophisticated technology;
- Regional export oriented demand is also limited, and Saudi Arabia has a significant competitive edge, having invested heavily in large, integrated shrimps farms.

5.1 Carp in a Semi-Intensive System – Profit & Loss and Investments

Grass carp Semi-Intensive Earth Pond 1 ha: Some Assumptions and P & L

	Cycles Frequency	1 Cycle/Year	2 Cycle/Year
1	Species	Grass Carp	
2	Area Pond m^2	10,000	10,000
3	Fingerlings Stocked m^3	2	2
4	Fingerlings Initial Weight g	10	10
5	Cost: Fingerlings (1000) $ Cost	133	133
6	Survival Rate %	80	80
7	Cycle Days	180	180
8	Avg. Weight Fish Harvested g	650	650
9	Total Weight Fish Harvested Kg	10,400	20,800
10	Feed/Kg Cost	0.2	0.2
11	Feed Conversion	2.3	2.3
12	Total Feed Kg	23,920	47,840
13	Total Fertilizers Kg	600	1200

14	Fertilizers/Kg Cost	0.263	0.263		
15	Fish/kg IQD Wholesaler Price	2,500	2,500		
16	Fish/Kg $ Wholesaler Price	1.67	1.67		
	PROFIT & LOSS			% 1 Cycle/year	% 2 Cycle/Year
17	**Total Gross Revenue**	**17,333**	**34,667**	**100%**	**100%**
18	Fingerlings Cost	2,660	5,320	**15.3%**	**15.3%**
19	Feeding Cost	4,784	9,568	**27.6%**	**27.6%**
20	Fertilizers Cost	158	316	**0.9%**	**0.9%**
21	Other Variable Costs: @3.5% Gross Revenue[24]	607	1,213	**3.5%**	**3.5%**
22	Distribution Costs: @$40/ton/50km	832	1,664	**4.8%**	**4.8%**
23	Commercial Cost: @5% Gross Revenue	867	1,733	**5.0%**	**5.0%**
24	**Total Variable Costs**	**9,907**	**19,814**	**57.2%**	**57.2%**
25	**Gross Margin**	**7,426**	**14,852**	**42.8%**	**42.8%**
26	Land Leasing	140	140	**0.8%**	**0.4%**
27	Pond and Tank Depreciation	440	440	**2.5%**	**1.3%**
28	Pond Maintenance	83	83	**0.5%**	**0.2%**
29	Pump Depreciation	670	670	**3.9%**	**1.9%**
30	Purging Tank and Live Haul Depreciation	250	250	**1.4%**	**0.7%**
31	Nets, Buckets, Depreciation	240	240	**1.4%**	**0.7%**
32	Instruments Depreciation	167	167	**1.0%**	**0.5%**
33	Labor Cost (1 Employee) or Pro-Labore	2,400	2,400	**13.8%**	**6.9%**
34	**Total Fixed Costs**	**4,390**	**4,390**	**25.3%**	**12.7%**
35	**Operational Net Margin**	**3,036**	**10,463**	**17.5%**	**30.2%**
36	Financial costs	2,898	5,796	**16.7%**	**16.7%**
37	**Net Margin**	**138**	**4,667**	**0.8%**	**13.5%**
38	**EBITDA**	**4,803**	**12,230**	**27.7%**	**35.2%**

5.2 Carp Semi-Intensive System: Economic Analysis Assumptions

Carp Semi-Intensive System: Revenue

The wholesale for carp (farmers' revenue) is designated as 2,500 IQD/kg ($1.67/kg), consistent with a target retail price of 3,000 IQD/kg ($2.00/kg).[25] The target grass carp retail price is positioned at 15% below the price of poultry – normally selling at 3,800 IQD/kg ($2.50/kg).

Semi-Intensive Carp Farming: Costs

Feed is the primary cost in any semi-intensive fish farming enterprise, but of course there is also a cost for fingerlings. The calculations for fingerlings and feed are based on current market prices in Iraq, but fluctuations are significant. In any case, the cost of feeding and the cost of fingerlings are relatively high compared to other countries.

Leaving aside potential benefits from any improvement whatsoever in the security situation, market development, improved technology, and competition should have a positive short term impact on the cost of these inputs. The cost of fingerlings and feed might also be reduced significantly through cooperative purchasing and marketing arrangements at the local level.

[24] Estimate based on Brazilian fish farming costs.
[25] The current retail price for comparable fish is 4,000 IQD/kg due to booming demand after the poultry crisis.

The cost of distribution for farmed fish is presently about $40 per ton for distances up to 50 km. For purposes of business planning, an average delivery distance of 100 km. has been assumed. Distribution costs could be reduced by as much as 50 percent if there were associations or cooperatives providing transportation services to the member-owners, with one 25 ton truck per 30 - 35 fish farmers.

The cost of marketing is assumed to be 5%, based on the current commission rates at wholesale auctions in Baghdad.

Semi-Intensive Carp Farming: Investment

The investment required to start a modern and efficient grass carp farming operation with a small budget assumes an earthen pond of 1 ha and approximately ±1½ - 2 ½ meters depth. The required capital expenditure is $26,000 and the required average monthly working capital is $5,200. The capital investment is only about $11,000 for farmers with a suitable earthen pond available or in the marshes. Additionally, models can be derived from this plan for farmers with access to existing canals where fish can be farmed. The capital investment plan contemplates the purchase of a diesel water pump, a diesel generator, nets, and some basic instruments.

Working capital is calculated on the basis of the cash flow of the operation, assuming two six-month cycles per year for grass carp, with fingerlings of 15g and an expected final weight of 650g. Interested rate is calculated at 18% per year according to the conditions of the main micro-finance institutions operating in Iraq. The feed conversion rate is assumed to be 1.0: to 2.3, lower than the state of the art but not unreasonable for present conditions in Iraq, considering the generally low quality the feed available in the market.

Grass carp 1 ha Semi-Intensive Fish Farm: Capital Investment

SEMI-INTENSIVE FISH FARM, GRASS CARP 1 HA.	$	COMMENTS	Year/Amort.
Total Instruments	1,674		10
Aerator 2HP	1,455		10
Water Pump 8HP	6,700		10
Land	140	Leasing 50,000 Dinars/Donum/Year	
Pond Construction, digging	11,000	4 Million/Dinars/Donum	25
Nets, Buckets etc.	1,200		5
Purging Tank, live haul box 1.000	3,500		20
Total Capital Investment	**25,669**		
Working Capital Avg. $5,200			

Semi-Intensive Carp Farming: Conclusion - Evaluation

Farming grass carp in Iraq appears to be viable, sustainable and potentially profitable running two six month cycles per year. Risk appears to be limited, as historically carp have proven adaptable to conditions in Iraq and the product is both accepted and in demand among consumers. Potential barriers to entry such as the necessary level of investment and know-how should be manageable, especially if micro-finance loans can be made available and basic technical support can be provided by public officials or private consultants.

The model seems highly promising in the marshes where suitable ponds could cheaply

be obtained with simple nylon or plastic nets.

5.3 Carp in a Semi-Extensive System Integrated with Agriculture (Rice Paddy)

Semi-extensive fish farming integrated with agriculture is common, especially in areas where paddy rice is cultivated. In those areas existing canals can be used rather than digging ponds, thereby lowering the investment considerably. Rice irrigation canals are rich in algae and vegetation that can supply most of the necessary nourishment for grass carp, an herbivorous species. However, fish farming in paddy canals has low productivity and the limited catches hardly allow sizeable commercial operations.

Micro-finance loans of $300 would enable small farmers to start a small fish farming operation with catches of 600-800 kg/year and limited operational risks.[26]

5.4 Tilapia in a Medium-Intensive System – Profit & Loss and Investments

Tilapia, despite being present in most of the neighboring countries, is totally unknown in Iraq, but some tilapia characteristics suggest there could be a potential for it in Iraq:

- Tilapia is highly adaptable, resistant to disease, and can be farmed at relatively high densities (5 fingerlings/m^3);
- In most of countries where both two species are both present - including the Middle East, tilapia meat is considered more palatable than carp;
- Tilapia usually has better feed conversion rate than carp.[27]

Nevertheless a more detailed economic analysis suggests some potential constraints:

Because of the impossibility of running two cycles/year, tilapia can only be economically viable in Iraq if farmed at higher density than carp utilizing a medium-intensive system.[28]

A medium-intensive operation is more risky, and requires greater know-how and a higher investment in water pumps, aerators, drainage systems, and holding tanks than a low-intensity operation.

The capital requirement in the tilapia business model (± $39,000) is higher than that for grass carp ($26,000) and so is the working capital (± $38,000 for tilapia vs. only $5,000 for grass carps).

Furthermore Profit & Loss simulations show that satisfactory level of profitability (using R.o.I as indicator) can only be achieved if tilapia is sold in the market at a premium of at least 20% over the price of grass carp – something that clearly must be tested with consumers.[29]

Tilapia Medium-Intensive Earth Pond 1 ha: Some Assumptions and P & L

	Cycles Frequency	1/year 8 months		1/year 8 months		1/year 8 months	
1	Species	Tilapia		Tilapia		Tilapia	

[26] Assuming a minimum purchasing of 1,000 grass carp juveniles.
[27] Under ideal conditions the rate is as low as 1.0: to 1.2 although 1.0 to 1.5 is the average in South America.
[28] A density of 10 fingerlings m^3 compared with only 2/m^3 for that recommended for the carp.
[29] Using grass carp farming as a benchmark.

2	Area Pond m^2	10,000		10,000		10,000	
3	Fingerlings Stocked m^3	5		5		10	
4	Fingerlings Initial Weight g	50		50		50	
5	Cost: Fingerlings (1000) $ Cost	250		250		250	
6	Survival Rate %	75		75		75	
7	Cycle Days	240		240		240	
8	Avg. Weight Fish Harvested g	650		650		650	
9	Total Weight Fish Harvested Kg	24,375		24,375		48,750	
10	Feed/Kg Cost	0.2		0.2		0.2	
11	Feed Conversion	2		2		2	
12	Total Feed Kg	48,750		48,750		97,500	
13	Total Fertilizers Kg	600		600		600	
14	Fertilizers/Kg Cost	0.263		0.263		0.263	
15	Fish/kg IQD Wholesaler Price	2,500		3,000		3,000	
16	Fish/Kg $ Wholesaler Price	1.67		2.00		2.00	
	PROFIT & LOSS	Density 5/m^3 Price $1.67/kg		Density 5/m^3 Price $2.00/kg		Density 10/m^3 Price $2.00/kg	
17	**Total Gross Revenue**	**40,625**	**100%**	**48,750**	**100%**	**97,500**	**100%**
18	Fingerlings Cost	12,500	**30.8%**	12,500	**25.6%**	25,000	**25.6%**
19	Feeding Cost	9,750	**24.0%**	9,750	**20.0%**	19,500	**20.0%**
20	Fertilizers Cost	158	**0.4%**	158	**0.3%**	158	**0.2%**
21	Other Variable Costs: @ 5.0% Gross Revenue	2,031	**5.0%**	2,438	**5.0%**	4,875	**5.0%**
22	Distribution Costs: @$40/ton/50km	1,950	**4.8%**	1,950	**4.0%**	3,900	**4.0%**
23	Commercial Cost: @ 5% Gross	2,031	**5.0%**	2,438	**5.0%**	4,875	**5.0%**
24	**Total Variable Costs**	**28,420**	**70.0%**	**29,233**	**60.0%**	**58,308**	**59.8%**
25	**Gross Margin**	**12,205**	**30.0%**	**19,517**	**40.0%**	**39,192**	**40.2%**
26	Land Leasing	140	**0.3%**	140	**0.3%**	140	**0.1%**
27	Pond and Tank Depreciation	440	**1.1%**	440	**0.9%**	440	**0.5%**
28	Pond Maintenance	165	**0.4%**	165	**0.3%**	165	**0.2%**
29	Pump Depreciation	670	**1.6%**	1,340	**2.7%**	1,340	**1.4%**
30	Drain pipes "other outfitting"	225	**0.6%**	225	**0.5%**	225	**0.2%**
31	Aerator Depreciation	291	**0.7%**	291	**0.6%**	291	**0.3%**
32	Purging tank-Live haul box	175	**0.4%**	175	**0.4%**	175	**0.2%**
33	Building Depreciation	50	**0.1%**	50	**0.1%**	50	**0.1%**
34	Nets, Buckets Depreciation	240	**0.6%**	240	**0.5%**	240	**0.2%**
35	Instruments Depreciation	167	**0.4%**	167	**0.3%**	167	**0.2%**
36	Labor Cost (1 Employee)	2,400	**5.9%**	2,400	**4.9%**	2,400	**2.5%**
37	**Total Fixed Costs**	**4,963**	**12.2%**	**5,633**	**11.6%**	**5,633**	**5.8%**
38	**Operational Net Margin**	**7,241**	**17.8%**	**13,884**	**28.5%**	**33,559**	**34.4%**
39	Financial costs	10,854	**26.7%**	10,854	**22.3%**	14,184	**14.5%**
40	**Net Margin**	**-3,613**	**-8.9%**	**3,030**	**6.2%**	**19,375**	**19.9%**
41	**EBITDA**	**-9,499**	**-23.3%**	**16,832**	**34.5%**	**36,487**	**37.4%**

5.5 Tilapia Medium-Intensive System: Economic Analysis Assumptions

Medium-intensive fish farming with medium-high stocking density (10 fingerlings m^3).
Earthen pond of 1 ha fitted with efficient drainage system.
Strong water flow guaranteed by two 8HP pumps; 100 percent commercial feed; accurate and continuous water and ecosystem control.

One cycle/year of 7-8 months starting in April.

Tilapia Medium-Intensive System: Profitability - Revenue

A premium retail price of 20% over the grass carp.

Tilapia Medium-Intensive System: Costs

The main differences with the costs already noted in the grass carp Profit & Loss are:

- The higher cost of tilapia fingerlings is assumed 375 IQD/unit ($0.25/unit) since fingerlings must be imported. In a "normalized" situation - with growing demand - the cost should decrease steadily to $0.12/unit (*cf*. Brazil @ $0.08/unit).
- Proportionately lower cost of feed, since tilapia should have a better feed conversion rate (1:2 compared to grass carp @ 1:2.3).
- Lower survival rate due to higher density (75% for tilapia – 80% for grass carp).
- Higher "other variable costs" (tilapia @5% vs. grass carp @3.5%) mainly due to higher electricity consumption for pumps.

Tilapia Medium-Intensive System: Investment

Capital investment and working capital are both higher than in the case of grass carp farming, due to the necessary adoption of a more intensive system and longer cycles. More intensive systems require additional investments in pumps, drainage pipes, and aerators. As a result, total capital investment for tilapia is almost $39,000 compared to $26,000 for grass carp, and working capital is $38,000 in contrast to $5,000 for grass carp).

Tilapia 1 ha Medium-Intensive System: Capital Investment

TILAPIA MEDIUM INTENSIVE FARMING IN 1 HA	Medium- Intensive: Density 10m^3	Semi- Intensive: Density 10m^3	Year/Amort.
Total Instruments	1,674	1,674	10
Drainage Pipes	1,560	1,560	10
Aerator 2HP (2)	2,910	-	10
Water Pump 8HP (2)	13,400	-	10
Land	140	140	
Pond Construction, digging	11,000	-	25
Purging tanks - live haul	3,500	3,500	20
Nets, Buckets etc.	1,200	1,200	5
Building	1,000	1,000	20
Drain Pipes "other outfitting"	2,250	2,250	10
Total Capital Investment	**38,634**	**11,324**	
Avg. Working Capital: $38,000 with Fingerlings Density of 10/m^3 and $20,000 with Density of 5/m^3			

Tilapia Medium-Intensive System: Conclusions and Evaluation

Profitability for tilapia farming depends ultimately on consumer acceptance and perceived superiority over grass carp. Because tilapia is unknown here, this must be tested urgently but carefully. If our calculations are correct, tilapia farming would be viable only if consumers are prepared to pay 20% premium over the price of grass carp.

If accepted by consumers as more palatable, could also contribute to in improving fish consumption per capita, thereby contributing to the development of the industry as a whole in Iraq.

5.6 Carp and Tilapia Farming in the Marshes Area: Economic Analysis

The marshes with their distinctive ecosystem and topography provide a unique opportunity for aquaculture development at a minimum investment.

Iraq: Marshes Location

In fact the development of fish farming in the marshes does not necessarily require capital investment in ponds excavation and water pumps. Natural ponds could easily be obtainable with the adoption of simple nylon or plastic net ($5.50m^2) where either carp or tilapia could be farmed semi-intensively.

Iraq: Marshes View

An aquaculture "cluster" could be realistically developed in the marshes where limited agricultural alternatives are currently viable. The marshes' unique topography and ecosystem look naturally suitable for aquaculture and probably could guarantee a fast investment pay-back (15 months).[30]
The only clear drawback would, in principle, be the distance of the marshes from Baghdad, the biggest consumer center in the country.

Carp and Tilapia (1 ha) farming in the marshes: Some Assumptions and P & L

	Cycles Frequency	1/year 8 months		1/year 8 months		2/year 6 months	
1	Species	Tilapia		Tilapia		Grass carp	
2	Area Pond m^2	10,000		10,000		10,000	
3	Fingerlings Stocked m^3	5		5		2	
4	Fingerlings Initial Weight g	50		50		10	
5	Cost: Fingerlings (1000) $ Cost	250		250		133	
6	Survival Rate %	75		75		80	
7	Cycle Days	240		240		180	
8	Avg. Weight Fish Harvested g	650		650		650	
9	Total Weight Fish Harvested Kg	24,375		24,375		20,800	
10	Feed/Kg Cost	0.2		0.2		0.2	
11	Feed Conversion	2		2		2.3	
12	Total Feed Kg	48,750		48,750		47,840	
13	Total Fertilizers Kg	600		600		1200	
14	Fertilizers/Kg Cost	0.263		0.263		0.263	
15	Fish/kg IQD Wholesaler Price	2,500		3,000		2,500	
16	Fish/Kg $ Wholesaler Price	1.67		2.00		1.67	
	PROFIT & LOSS	Density 5/m^3 Price $ 1.67/kg		Density 5/m^3 Price $ 2.00/kg		Density 2/m^3 Price $ 1.67/kg	
17	**Total Gross Revenue**	**40,625**	**100%**	**48,750**	**100%**	**34,667**	**100%**
18	Fingerlings Cost	12,500	**30.8%**	12,500	**25.6%**	5,320	**15.3%**
19	Feeding Cost	9,750	**24.0%**	9,750	**20.0%**	9,568	**27.6%**

[30] Faster than in other locations since in the marshes ponds can be adapted with little investment.

20	Fertilizers Cost	158	**0.4%**	158	**0.3%**	316	**0.9%**
21	Other Variable Costs:@ 2.5.% Gross	1,016	**2.5%**	1,219	**2.5%**	867	**2.5%**
22	Distribution Costs @$40/ton/50km-(Avg. 150km)	2,925	**7.2%**	2,925	**6.0%**	2,496	**7.2%**
23	Commercial Cost: @ 5% Gross	2,031	**5.0%**	2,438	**5.0%**	1,733	**5.0%**
24	**Total Variable Costs**	**28,380**	**69.9%**	**28,989**	**59.5%**	**20,300**	**58.6%**
25	**Gross Margin**	**12,245**	**30.1%**	**19,761**	**40.5%**	**14,367**	**41.4%**
26	Pond Maintenance	165	**0.4%**	165	**0.3%**	165	**0.5%**
27	Purge holding Tank+live haul box 1.000 gallons	350	**0.9%**	350	**0.7%**	350	**1.0%**
28	Nets "perimeter" Depreciation	500	**1.2%**	500	**1.0%**	500	**1.4%**
29	Nets, Buckets Depreciation	240	**0.6%**	240	**0.5%**	240	**0.7%**
30	Instruments Depreciation	167	**0.4%**	167	**0.3%**	167	**0.5%**
31	Pro labore	2,400	**5.9%**	2,400	**5.9%**	2,400	**6.9%**
32	**Total Fixed Costs**	**3,822**	**9.4%**	**3,822**	**7.8%**	**3,822**	**11.0%**
33	**Operational Net Margin**	**8,423**	**20.7%**	**15,939**	**32.7%**	**10,545**	**30.4%**
34	Financial costs	5,580	**13.7%**	5,580	**11.4%**	3,420	**9.9%**
35	**Net Margin**	**2,843**	**7.0%**	**10,359**	**21.2%**	**7,125**	**20.6%**
36	**EBITDA**	**9,680**	**23.8%**	**17,196**	**35.2%**	**11,802**	**34.0%**

Both carp and tilapia farming in the marshes show encouraging results in profitability since depreciation costs are limited (pond excavation and water pump are not required) and the model is built assuming the adoption of "family business" with no employees other than family members and not additional building other than the dwellers' existing facilities.

On the other hand a higher cost of transportation has been estimated due to the marshes distance from Baghdad (always the biggest consumer market).[31]

Grass Carp (1 ha) Farming in the Marshes: Capital Investment

SEMI-INTENSIVE FISH FARM, GRASS CARP 1 HA.	**$**	**COMMENTS**	**Year/Amort.**
Total Instruments	1,674		10
Net "perimeter" Depreciation	5,000		10
Purging Holding Tanks+live Haul box 1.000 gallons	3,500		20
Nets, Buckets etc.	1,200		5
Total Capital Investment	**11,374**		
Working Capital Avg.	**5,000**		

[31] On average a distance of 150-200 km.

Tilapia (1 ha) Farming in the Marshes: Capital Investment

SEMI-INTENSIVE FISH FARM, TILAPIA 1 HA.	$	COMMENTS	Year/Amort.
Total Instruments	1,674		10
Nets "perimeter"	5,000	4 Million/Dinars/Donum	10
Purging Holding tanks	2,250		20
Nets, Buckets etc.	1,200		5
Live haul box 1,000 gallon	1,250		20
Total Capital Investment	**11,370**		
Working Capital Avg.	**20,000**		

Marshes Business Model: Tilapia and Grass Carp Comparison

Tilapia	Tilapia price parity with carp. Density 5/m^2		Tilapia price +20% vs. carp. Density 5/m^2		Marshes or Natural Ponds available	
PROFIT & LOSS	Price $ 1.67/kg		Price $ 2.00/kg		Price $ 1.67/kg	
Total Gross Revenue	**40,625**	**100%**	**48,750**	**100%**	**34,667**	**100%**
Net Margin	**2,843**	**7.0%**	**10,359**	**21.2%**	**7,125**	**20.6%**
EBITDA	**9,680**	**23.8%**	**17,196**	**35.2%**	**11,802**	**34.0%**
Capital investment	**$11,500**		**$11,500**		**$11,500**	
Working capital	**$20,000**		**$20,000**		**$5,000**	
R.o.I	**24.3%**		**89.5%**		**61.7%**	

6. FISH PROCESSING IN IRAQ

Two forms of fish processing can be envisaged in Iraq over the short to medium term: Whole frozen fish and frozen fillets.

6.1 Frozen Fillets

Carp are not suitable for fillets for their excessive quantity of bones.

Tilapia fillets on the contrary are popular among consumers in USA and represent a successful export oriented sector in South America. Nevertheless there two major constraints for tilapias fillets development in Iraq, the former on the supply side, the latter on the demand side. In fact fillet processing, in fact, only uses tilapia of a minimum of 1.0kg and preferably 1.2kg, a size probably difficult to obtain in Iraq where climatic conditions don't allow cycles longer than eight months

Assuming tilapia fillets can be produced in Iraq, the price to the consumer would probably represent a significant limiting factor. Tilapia generally have dress-out of only 35 percent for fillets meaning they would have to be sold at a retail price around $5.5/kg.
At the retail price of $5.5/kg, tilapia fillets are dangerously close to sheep and goat meat, for which, ceteris paribus, consumers seem to have a preference.

6.2 Frozen Whole Fish

Frozen whole fish only makes sense if the processing adds value to the basic proposition (live fish); in markets with a developed cold chain, frozen fish offers convenience, a guarantee of quality and conservation and provides a way to make fish available to the consumer at a cheaper price. That is highly questionable in today's Iraq.

On the production side, frozen fish is feasible and economically viable. It requires an investment of approximately $120,000 for a stocking capacity of ±25 tons. With a stock rotation of 10 -12 times/month, a perfectly realistic target, the investment could be easily amortized and the frozen processing would only add some 2% to the cost of the fish.

The constraints in the distribution chain are in many cases significant. Refrigerated trucks can easily be adopted by wholesalers or cooperatives responsible fore distribution but retail markets and consumer households have very poor or non-existent freezing facilities. Under these circumstances a freezing operation falls short of providing a clear advantage, since neither enhances the perceived value nor improves its convenience.

Consumer perception should also be taken into account. Imported, expensive frozen fish has high acceptance in Iraq, but there is evidence that for "cheap" unsophisticated species such as tilapia or carp, the frozen processing detracts value rather than affording a premium over live fish.

7. CONCLUSIONS AND RECOMMENDATIONS

In a country like Iraq with limited supplies of animal feed, the development of aquaculture makes considerable because the most common varieties of farmed fish have a much more efficient feed conversion rate than cattle or poultry.

The demand side looks highly favorable for aquaculture:

- There is a clear unmet demand for fish and there are frequent shortages in the marketplace. Supply is simply unable to keep pace with consumer demand.

- Current per capita consumption of fish is as low as 0.8/kg per person per year, and is likely to increase considerably with the development of better and more sophisticated supply. Per capita consumption in 1990 – before the economic embargo – was 2.5/kg, and fish consumption in neighboring countries is also growing fast. In Syria and Jordan has reached 5kg and is well above 10kg per capita in Egypt and Iran.

- Realistically, there could be an immediate additional demand of 25,000 tons, and it is likely that as much as 50,000 tons of farmed fish could be absorbed by the market.

- Based on a preliminary cost analysis, it should be possible to produce quality farmed fish in Iraq at a retail cost 15% lower than poultry and 70% lower than red meat, a factor that should create considerable demand for fish in the short-term.

In principle, many business models and systems are technically feasible in Iraq. Nevertheless, only one has the potential to result in the development of an efficient aquaculture industry in Iraq in the short-term: The semi-intensive farming of grass carp in earthen ponds or in the marshes area with ponds obtained with the adoption of nylon or plastic nets.

The recommended business model has many advantages and entails little risk:

Semi-intensive grass carp farming in earthen ponds:

- Requires a relatively low level of investment: $26,000 capital and $5,000 for working capital. With a suitable pond available or in the marshes, the capital investment drops to $11,000 (pay-back in15 months);

- Demands relatively little know-how;

- Can use grass carp fingerlings that are already available in the market, although costly compared to other countries;

- Carp have been proven adaptable to Iraq ecosystem;

- Grass carp enjoy high consumer acceptance in the market;

- The model is flexible and offers a realistic chance to create 5,000 direct jobs in the short term.

- Economic analysis shows the business model is profitable, with an attractive level of profitability.

Semi-intensive Grass carp in Ponds (1 ha/year)	Digging Ponds		Marshes or Natural Ponds available	
PROFIT & LOSS	Price $1.67/kg		Price $1.67/kg	
Total Gross Revenue	**34,667**	**100%**	**34,667**	**100%**
Net Margin	**4,667**	**13.5%**	**7,125**	**14.6%**
EBITDA	**12,230**	**35.2%**	**11,802**	**34.0%**
Capital investment	**$26,000**		**$11,500**	
Working capital	**$5,000**		**$5,000**	
R.o.I	**17.7%**		**61.7%**	

Another business model looks viable in the short term, but with less impact on fish supply and job creation: Semi-extensive grass carp farming in rice paddy canals**.** Similar to what is done in China, carp farming can easily be integrated with existing agricultural activities and there are clear synergies with paddy rice. In semi-extensive grass carp farming using paddy rice canals, investment would be limited to working capital requirements, but productivity is low and the catches are unable to support a significant commercial operation.

There is also potential for tilapia farming. However some assumptions should be verified, taking into account that climate only allows for a single 8-month cycle per year, in contrast to the practice in South America and Southeast Asia, where tilapia is farmed all year round.
In order to be profitable, tilapia would have to be sold in the market at a 20% premium over grass carp and farmed medium-intensively (that involves greater risk, and requires higher investments – *scenario 5*) or semi-intensively in existing or natural ponds (*i.e., in* the marshes – *scenario 2*) where the investment required is considerably lower.

	Marshes or with Natural Ponds (no digging)				**With Cost of the digging a Pond**					
Scenarios	**1**		**2**		**3**		**4**		**5**	
Tilapia (1 ha/year)	Tilapia price parity with carp. Density 5/m^3		Tilapia price +20% vs. carp. Density 5/m^3		Tilapia price parity with carp. Density 5/m^3		Tilapia price +20% vs. carp. Density 5/m^3		Tilapia price +20% vs. carp. Density 10/m^3	
PROFIT & LOSS	Price $1.67/kg		Price $2.00/kg		Price $1.67/kg		Price $2.00/kg		Price $2.00/kg	
Total Gross Revenue	**40,625**	**100%**	**48,750**	**100%**	**40,625**	**100%**	**48,750**	**100%**	**97,500**	**100%**
Net Margin	**2,843**	**7.0%**	**10,359**	**21.2%**	**-3,613**	**-8.9%**	**3,030**	**6.2%**	**19,375**	**19,9%**
EBITDA	**9,680**	**23.8%**	**17,196**	**35.2%**			**16,832**	**34.5%**	**36,487**	**37.4%**
Capital investment	**$11,500**		**$11,500**		**$39,000**		**$39,000**		**$39,000**	
Working capital	**$20,000**		**$20,000**		**$20,000**		**$20,000**		**$38,500**	
R.o.I	**24.3%**		**89.5%**				**7.7%**		**78.8%**	

Two other models have emerged as theoretically possible, but only in the medium to long term, and would require extensive market research and feasibility analyses: Intensive rainbow trout farming in the north and semi-intensive Barbo Sharpeyi (bunni fish) farms in the marshes.

Shrimp farming has been discarded for all intents and purposes, primarily for the absence of domestic demand and the difficulty of establishing an export-oriented industry. There is a current oversupply due to efficient competition from Asia, South America and Saudi Arabia.

Analysis reveals that intensive farm fishing systems should not be recommended in Iraq, due to the high investment barrier - $250,000 minimum - and the huge requirements for fresh water.

At the operational level, in order to accelerate the development of an aquaculture industry in Iraq, the coordinated action of three different players is required:

Microfinance Institutions

1. The main entry barrier is capital. Micro-finance institutions should quickly provide the necessary financial resources for capital investment and working capital. Capital requirements are generally within micro-finance policy, although the short term of micro finance loans may be a problem for farmers who must pay to have a pond excavated. Accelerating the links between micro-finance institutions and farmers is therefore a key to success in many instances.

Aquaculture Biologists and Experts

2. The necessary know-how for developing the aquaculture systems proposed here must be made available to farmers. The Ministry of Agriculture and other appropriate public and private institutions should be in a position to provide assistance. Outside experts, trainers, or technical assistance programs should be involved as required. Probably a few regional fish biologist or aquaculture experts would suffice in the early stages.

Farmers Associations and Cooperatives

3. Farmers' associations or cooperatives should be fostered in order to provide efficient services to members in the area of transportation, hatcheries, and fish feed manufacturing. At an early stage, such services may have to be obtained in the open market.

Three additional actions would also be urgently required for the possible development of the tilapia farming in Iraq:

- A product test to assess tilapia's consumer acceptance and perception (price elasticity compared to grass carp).
- A feasibility test for farming tilapia in Iraq at the density required.
- A procurement analysis to assess the availability of tilapia fingerlings in neighboring countries.

By taking immediate action, coordinated with micro-finance institutions, there is a realistic chance of developing in the short term an aquaculture industry in Iraq able to provide a cheap source of animal protein. This could also create some 5,000 direct jobs in rural areas, mainly in central and southern Iraq, where agricultural alternatives are limited by poor land quality.

The economic analyses show that the marshes region should be given top priority since its unique topography and ecosystem permit the development of carp and tilapia farming with low capital investment and fast investment pay-back. The development of an aquaculture industry in the marshes would also have significant economic impact in the region where few agricultural income-generating alternatives look viable.

Attachment 1: Grass carp characteristics.

Grass carp (*Ctenopharyngodon idella*)	
Temperatures	Grass carp easily survives extremes of temperatures within a range of – 15^0C to + 45^0C.
Feeding behavior	Grass carp eat steadily at a temperatures between +$10^{0.}$C and +30^0C. They feed satisfactorily at temperatures as low as +3^0C. They stop feeding at temperatures lower than +3^0C and higher than +30^0C. Grass carp is herbivorous but also accepts commercial feed well.
Salinity	Grass carp can tolerate medium salinity, from 2 to 5 ppt. They stop eating at salinity > 12 ppt. Prolonged exposure to 9 -10 ppt is lethal, but they can survive short periods at even higher salinity.
Oxygen	Grass carp can thrive at oxygen concentration as low as 2 mg/l (ppm). Ideal dO is around 4-5 mg/L (ppm).
Feed conversion – Weight growth	The average food conversion rate for grass carp is as low as 1: 1, 5. They commonly grow to 750 - 800 g in 6 months and 1000 g in 8-9 months.
Fry - Fingerlings	Available 200 – 400 IQD / unit (10g)
Growth - Weight	Under ideal circumstances, grass carp grow faster than other carp species, frequently reaching 1.0 -1.2kg in 8-9 months cycles.