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AZERBAIJAN COMPETITIVENESS AND TRADE (ACT) PROJECT

USAID ACT Updating of DRC, Analysis of Potential New Areas, and Related Institutional Capacity-Building Strategy

Final Report on Aquaculture

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Azerbaijan Competitiveness and Trade (ACT) Project

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Final Report on Aquaculture

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Executive Summary

Introduction

Given its partly saline soils and cool mountain streams, aquaculture in Azerbaijan has a large potential and could be one of the major income-generating activities for the rural population. In addition, per capita consumption of fish is less than one fifth of the world average so there is room for long-term growth. But expansion of this subsector is seriously threatened by a number of constraints, which are both technical and related to government policy. If these constraints are not removed, or at least seriously diminished, an important opportunity will be lost and income and employment will be reduced.

The subsector is divided into the raising of carp and other warm water species in ponds in the central and southern parts of the country and the raising of trout and other cold water species in the raceways to the north. Both forms of aquaculture face problems of poor genetics, limited access to eggs and fingerlings, lack of information on good management practices, poor feeding, bad health conditions, inadequate equipment and physical structures, absence of cold chains, and undercapitalization. In addition, both types of aquaculture, suffer from potentially severe market constraints as well as obstacles to the importation of quality fish feed, insecurity regarding the use of land for fish ponds, discretionary and inefficient allocation of water, monopolistic fish markets, high cost and lack of financing for investment in plant and equipment, and illegal payments required for the production and transport of fish.

Place of Aquaculture in Azerbaijan

Official figures show that the total fish captured from all sources in 2010 was 45,315 MT, of which 43,749 MT are unaccounted for. Some of these may come from aquaculture, which was assessed by a recent survey at 5,665 MT of carp and 118 MT of trout, which is well above official government figures, but, beyond this, there are still major questions regarding the quantity of fish that flow into the open, green markets, which comprises most of the demand for local fish. This is very important because if the total supply of fish, including imports of about MT, is substantially less than that shown in the official figures, the market for local aquaculture products may be a very serious barrier to future expansion.

Constraints on the Aquaculture Subsector

The most important constraints on the aquaculture subsector are the following:

<u>Carp</u>

- Primitive feeding leading to low yields
- High loss of small fry
- Limited market
- High seasonality of production and sales
- Minimal processing
- High barriers to imported inputs
- Processing and marketing monopoly
- Uncertainties and cost of access to land

- Water shortages
- Lack of access to financing
- Weak management

Trout

- Highly specialized and limited market
- Transportation and marketing
- Minimal processing
- Poor trout feeds due to high barriers to imported feeds and other inputs
- Inappropriate physical structures left over from Soviet era

Each of these constraints is analyzed in detail in the text.

DRC Methodology and Approach

At each stage of the value chain, the costs and benefits of that stage are assessed. Profitability at each stage is calculated by subtracting costs at that stage from the price margin that is available. The difference is profit. One calculation is made in terms of financial prices. These are the prices that prevail in the market. But profitability is also made in terms of economic prices. These prices, or opportunity costs, reflect the real value of goods and service to the economy as a whole. The major differences between these two sets of prices are the taxes and subsidies assessed by government on various goods and services, and the effects that trade policy has on domestic prices in relation to those on the world market. DRC is a cost/benefit ratio, with costs in terms of domestic resources (land, labor, and capital) in the numerator and net benefits (value added in world market prices) in the denominator.

- If DRC<1, domestic resources used cost less than the value added created and you have comparative advantage
- If DRC>1, domestic resources used cost more than the value added created and you have comparative disadvantage

Twelve aquaculture value chains were selected for DRC analysis in order to choose those chains offering the highest benefits in terms of financial and economic profitability, employment, and other objectives. Data were gathered using a questionnaire in the Salyan/Neftchala and Sheik/Zagatala regions. The results were compiled using the IMPACT Excel computer template designed for this purpose. The analysis also entailed understanding the macroeconomic and sector policy implications of the results as well as building institutional awareness of DRC methodology and policy extensions on the part of relevant public policy-making and private sector research/advocacy institutions.

Results and Implications of the Analysis

Carp

The analysis shows that carp production is highly profitable financially, but its economic profitability is low and in some instances negative, with the DRCs sometimes being greater than one. The difference between financial and economic profitability is due primarily to relatively

high rates of protection against imported fish, which raise the domestic price for fish well above the CIF price. Part of this protection is due to customs duties and the VAT, which is assessed on imports but not on domestic production, but much of it is unexplained and appears to be linked with the Caspian Fish Company's monopoly on fish imports. Without this protection, it is questionable whether carp production in the north could survive.

All the value chains from the Salyan/Neftchala region have DRC levels less than 1 whereas the DRCs for Sheki/Zagatala are greater than 1, which shows that it is less costly for the country to base this type of aquaculture in the central and southern regions of Azerbaijan. The higher level of DRC for the northern part of the country mainly derives from two sources: high capital and transportation costs. The capital costs are greater primarily because of higher costs for digging ponds than in the Salyan/Neftchala region. But even neglecting these capital costs and subtracting out transportation costs, the operating costs for the Sheki/Zagatala region are higher, which suggests that carp production is less suitable in the northern part of the country. This may be because the Salyan/Neftchala region is generally more adapted for aquaculture because it is somewhat saline.

Results for larger farmers were somewhat better than for smaller farmers. This may be because of economics of scale – for example in the digging out of ponds. But it may also be because larger farmers are closer to the technological frontier and provide better management. Transport costs could also play an important role in reducing the DRC through the use of larger trucks at lower costs for bigger shipments.

There are several simulations that were performed to see the effects of better management and investment in new technology. One set of management problems is relates to early sales of products. Most farmers sell their fish during the September – November period, when competition is strong. One reason for this is that many farmers borrow money during the year (usually to buy feed) to be paid back during the harvest season. They try to sell the product quickly to repay their debts and loans. Traders take advantage of this and offer relatively low prices to farmers who owe them money. In addition, the market is relatively saturated at this time so that prices are lower. Farmers without financial and other obligations may store the product till the end of December or later and sell for a better price. Simulations using recorded data on fish weights and prices over time show that there is a distinct benefit from holding fish off the market until at least the holiday season. Furthermore, at least in the Salyan/Neftchala regions, the fish do not lose weight during the colder winter months, as sometimes assumed.

The impact of improved feeding on the DRC results was also assessed. Improved feed makes it possible to increase the density of fish in the pond several times by making more efficient use of the available feed. This leads to a slight improvement in profitability and in the DRCs because of the benefits associated with fuller use of capital invested in ponds and other fixed assets, but these costs are not very important relative to operating costs, which tend to be proportional to the number of fish. This does not mean that the owner is not better off, however, because his or her total profit is also in proportion to the number of fish. The analysis also shows the production of feed to be quite profitable both financially and economically. In part this is true because most of the feed inputs are produced locally and do not have to pay customs duty or value added tax.

Arguments for improved hatcheries are not completely justified by the current analysis. The problem is that very high loss rates from small fry are not solely the result of poor hatcheries, but are also of poor farm management. If farmers took better care of their small fry, they would reduce their losses and have more fish. Even at full capacity utilization, the new hatchery at Zagatala has higher costs per kg of produced carp compared with the costs of the traditional hatcheries, and the loss rates are the same as reported by the new hatchery owner. For the advantages of modern over traditional hatcheries to become apparent, the modern hatcheries, with their improved capacity and resources, should keep their fry for extended periods of time (up to 30 days) under a better feeding regime, in which case survival rates would be much higher.

Improved feed and holding by hatcheries of fry for longer periods of time will reduce losses and increase the density of fish in existing ponds and of those still to be constructed. Since existing feeding practices are not very sophisticated, the potential for expansion is quite large. In addition, as long as financial profits are relatively high, farmers can be expected to increase their investment in fish ponds. All of this will increase substantially the quantity of warm water fish on the market. The question is how well will the market absorb this increase without a substantial decline in price.

The market for fish in Azerbaijan is highly fragmented, with open-air bazaar sales of live warm water fish during the colder months, and fish shop and supermarket sales of frozen, previously frozen, and processed imported fish year round. There are significant barriers to local fish penetrating the market outside of the bazaars because of the Caspian Fish Company's monopoly on that market. Without a breakdown of those barriers, the market for warm-water carp will be limited to the bazaars.

If aquaculture production of carp were to double over the next five years, the projected expansion of demand would not keep up and the price of fish would have to fall by about 20-25% in order to absorb the surplus. Financial profits would be cut in half for even the best farmers; others might find themselves out of business. This would hurt smaller carp farmers, especially in the north. It would also hurt those who fish by other means and try to sell their fish, since they would have no increases in efficiency to cushion the blow, as would the more progressive fish farmers. This is a minimum estimate of the decline in price; the price decrease could be much greater. The only way to avert this would be to open up the market so that local fish could substitute for imports.

Trout

The DRC results for trout vary substantially by size of fish farm. The larger farm, which is relatively state-of-the-art, is profitable both financially and economically, suggesting a strong comparative advantage. For the smaller fish farm, both financial and economic profitability are negative, and the DRC indicator is quite high, suggesting a strong comparative disadvantage. Although the scale of operations may have something to do with the difference in profitability between these two sizes of farms, it is likely that larger farm is also much more efficient. When the efficiency of feeding is increased, through use of better feed and improved management, the results for the small farm also improve considerably. Even though economic profitability

remains negative, financial profitability is positive and the DRC is closer to one. One reason why small farmers may operate even with negative profits is that they may be able to cover their operating costs and consider their capital cost as sunk. The analysis suggests that this is the case. Furthermore, lowering transport costs improves both financial and economic profits, as well as the DRC, especially for the smaller farmers.

Conclusions and Recommendations for Next Steps

There are a number of important conclusions and recommendations that can be drawn from this analysis. One positive conclusion is that Azerbaijan appears to have a comparative advantage in carp and trout aquaculture for the local market, given its suitable soils and supplies of water. In addition, per capita consumption of fish is only about one-sixth of the world average so there is room for long-term expansion. Despite this generally favorable prognosis, there are number of things that need to be done to assure that this potential is realized.

- There is an urgent need to conduct a careful assessment of the size and growth of the market for carp and for trout.
- The monopoly situation in Azerbaijan's fish industry needs to be understood and options for making the industry more competitive need to be explored by the Government. The ACT project should approach the Caspian Fish Company regarding the possibility of their buying local fish on condition that quality standards be maintained and supply regularity be assured, both activities in which the ACT project can provide assistance.
- The economics of holding fish deeper into the winter need to be studied. It the results reported here are confirmed, they need to be disseminated.
- The Government should take steps to facilitate the importation of quality fish feeds and their ingredients, as well as other inputs into the aquaculture industry.
- The ACT project should support the improvement of a carp hatchery in Neftchala, especially to allow it to hold small fry for up to 30 days.
- The results for trout production suggest that there are substantial profits to be made through investment to increase feed efficiency and better manage existing fixed resources.
- There is a need to explore possibilities for small-scale fish processing, assuming that problems of competition with the Caspian Fish Company can be resolved.
- It is urgent that the instruction issued by the Cabinet in May 2011 regarding the use of land for aquaculture be reconsidered. If the Law of 1998 is to be implemented, then the process of registering land for aquaculture should be streamlined and the cost should be minimized.

- Efforts currently being pursued to identify specific unnecessary transactions costs associated with the importation of fish and aquaculture inputs should be pursued and appropriate action should be undertaken to eliminate these.

- The fees charged to fish farmers for water should be harmonized and the subsidies on water offered to wheat and other crop farmers should be eliminated in order to conserve water for aquaculture as a more profitable use. Water user associations may have an important role to play in eliminating these distortions

- The prevalence of unofficial payments for the establishment and operation of fish farms needs to be addressed as part of the overall drive to decrease corruption in Azerbaijan.

- Options for reducing the cost of transport and for prolonging the period over which fish can be marketed through refrigeration and processing should be explored.

1 Introduction

Given its partly saline soils and cool mountain streams, aquaculture in Azerbaijan has a large potential and could be one of the major income-generating activities for the rural population. The subsector is divided into the raising of carp and other warm water species in ponds in the central and southern parts of the country and the raising of trout and other cold water species in raceways in the north. Both of these activities collapsed following land privatization in 1995-96, and have only recently been revived, with help from the Azerbaijan Competitiveness and Trade (ACT) project and its predecessor, the Private Sector Competitiveness Enhancement Project (PSCEP) Both forms of aquaculture face problems of poor genetics, limited access to eggs and fingerlings, lack of information on good management practices, poor feeding, bad health conditions, inadequate equipment and physical structures, absence of cold chains, and undercapitalization. Identifying which of these constraints is most binding and offers the greatest opportunities for investment is one of the goals of the domestic resource cost (DRC) analysis that was performed on the subsector.

DRC analysis involves estimating the financial and economic profitability of the principal value chains in aquaculture, as well as identifying major constraints to expansion within those value chains and assessing the financial and economic viability of overcoming those constraints. For example, the introduction of new fish feed rations in aquaculture may raise the cost of the inputs used but also increase productivity. Profitability needs to be assessed, therefore, not only at the level of the farm but also at that of the feed mill. In addition, higher productivity normally will lead to increased production. This growth in production will have to be absorbed by the market, but will the price at which this takes place be sufficient to maintain positive financial and economic profits? Another example relates to the effects of policy. Aquaculture appears to be financially quite profitable, given the strong interest shown by famers who have been investing in the subsector. But to what extent is this profitability due primarily to strong protection against competing fish imports, and if this protection were removed would this profitability be reduced. These are questions that can be answered with DRC analysis.

In addition to undertaking a DRC analysis of aquaculture, another goal of the study was to develop institutional capacity within Azerbaijan to conduct the data gathering and analysis and subsequent institutional outreach and policy dialogue activities related to the DRC research agenda. Two research centers were chosen for this capacity-building exercise through a competitive bidding process: the Economic Research Center (ERC) and the Azerbaijan Agribusiness Center (AAC). The training began with a two-day workshop in April 2011, followed by collection of background information, preparation of questionnaires, and field trips for the purpose of conducting informal interviews and pre-testing the questionnaires in July 2011. Khalid Karinli (ERC), Vahid Maharramov (ERC), and Hajiyev Anar (AAC) participated in the field trips and subsequently administered the questionnaires during the formal survey. Kamil Alasgonov (ERC) assisted in the subsequent analysis and was responsible for most of the report drafting, along with Vahid Maharramov. Gubad Ibadoglu, Chairman of the Management Board of the ERC, and Miri Mirzoyev and Mirnail Mirsalahov, of AAC, provided valuable

advice and oversight. Dirck Stryker, DRC Consultant to the ACT project, provided most of the training, organized the study, and completed the final report.

The next section provides background regarding the place of aquaculture in Azerbaijan, including an assessment of the size of the subsector in relation to total fish capture. Following this there is a discussion of the major constraints on aquaculture, including both technical and policy-related constraints. Section 4 then describes the domestic resource cost methodology, followed by a discussion of the research approach adopted for its implementation. The results and implications of this analysis are then presented. The final section offers conclusions and recommendations.

2 Place of Aquaculture in Azerbaijan

Fish production in Azerbaijan consists of sea and freshwater capture as well as aquaculture in a variety of environments. It involves a considerable range of species from commonly consumed fish types such as Cyprinidae-s (carp family) to usually niche products like Salmonidae-s (trout family) and Acipenseridae-s (sturgeon family). Following worldwide trends, freshwater aquaculture is becoming increasingly important in Azerbaijan as the natural fish stock is decreasing.

Azerbaijan appears to have a comparative advantage in aquaculture for the local market, given its suitable soils and supplies of water. In addition, per capita consumption of fish is less than one fifth of the world average so there is room for long-term growth. But expansion of this subsector is seriously threatened by a number of constraints, which are both technical and related to government policy. If these constraints are not removed, or at least seriously diminished, an important opportunity will be lost and income and employment will be reduced.

2.1 Warm-Water versus Cold-Water Aquaculture

The aquaculture subsector is divided into the raising of carp and other warm water species in ponds throughout much of the country and the farming of trout and other cold water species in the north. While carp farming is considered extensive or at best semi-intensive, with relatively low investment and use of resources, trout farming is intensive, demanding more investment, sophisticated management, and more organization and planning. Both forms of aquaculture appear to have a comparative advantage, though the distribution and sustainability of that advantage depend on a number of factors that pose significant challenges. In the south, and especially in Salyan and Neftchala, carp aquaculture benefits from the saline soils that are good for fish production but not very good for the cultivation of crops. In the north, trout aquaculture takes advantage of cold, well oxygenated water from the Greater Caucasus Mountains. Both types of aquaculture, however, suffer from potentially severe market constraints as well as obstacles to the importation of quality fish feed, insecurity regarding the use of land for fish ponds, discretionary and inefficient allocation of water, monopolistic fish markets, high cost and lack of financing for investment in plant and equipment, and illegal payments required for the production and transport of fish.

2.2 Size of Fisheries Sector

Although official figures are very unreliable, it would appear that aquaculture twenty years ago produced over 1,600 metric tons of fish per annum. This may be compared with total annual domestic supply of food from aquatic species in Azerbaijan in 1988 of 56,000 metric tons. The difference was due in large measure to fish caught in the Caspian Sea and to a lesser extent in inland lakes and other waterways.

Following the breakup of the Soviet Union, domestic production of fish from all sources plummeted. Harvest from the Caspian Sea collapsed because of industrial pollution, overfishing, and a Mnemiopsis jellyfish invasion.[1] Aquaculture production declined as fish farms were abandoned with land privatization, restrictions on land usage, and uncertainty regarding land tenure. By 2010, official figures show only 1,082 MT of fish captured under quota, 361MT of fish captured from lakes and pools, and 123 MT of fish farm production. However, revised figures from household surveys suggest that the total fish captured from all sources in 2010 was 45,315 MT, leaving 43,749 MT that are unaccounted for.[2] In addition, on the basis of a recent survey, aquaculture production is estimated in 2010 at 5,783 MT rather than the 123 MT found in the official data.[3] Of the two types of aquaculture, carp farming is far more important, accounting for 5,665 MT while trout production was only 118 MT. Taken together, these higher estimates imply that total fish captured from natural sources plus aquaculture production could be as high as 51,000 metric tons.[4] This would imply that the price of fish in Azerbaijan is largely determined by the natural capture plus imports, so that increased aquaculture production would not have much influence on prices. However, as seen below, there are reasons to suspect that the natural capture is in fact much smaller. If this is the case, then the problem of market access becomes more acute.

2.2.1 Comparative Data from ACT survey, BIC, and Official Sources

As noted earlier, official data on fish captures outside of aquaculture are surprisingly large, as can be seen in Table 1. As stated earlier, during the first years of independence, fish production went down abruptly. The amount of fish captured under international quotas also diminished for the reasons mentioned earlier. But the category of "Fish captured by individuals which is not subject to international regulations" increased substantially starting in 2005. The reasons for this abrupt change and where these fish came from are not clear. In 2009, this figure increased abruptly once again, supposedly to help explain the level of fish consumption being measured by household consumption surveys, according to the statistical authorities. This increased availability could include unofficial fishing from the Caspian Sea and fish captured from natural lakes and waterways as well as unaccounted aquaculture. However, such an increase in

[1] USAID.ACT Project, "Trip Report from December 2010: Assessment Report and Strategic Game Plan on the Aquaculture Value Chain", prepared by Thomas Ort, January 17, 2011, p. 9.
[2] State Statistical Committee Web site.
[3] USAID/ACT Project, *Aquaculture Market Research in Azerbaijan*, prepared by the Business and Innovation Center (BIC), April-June 2011, and accompanying *Aquaculture Market Study Analytical Data*.
[4] There is also a possibility that 43,749 MT of production, which is described by SSG as "Fish captured by individuals which is not subject to international regulation", also includes aquaculture production that is unaccounted for, which would mean that the total figure of 51,000 MT would be somewhat less.

Table 1: Official Data on the Quantity of Fish Captured in Azerbaijan

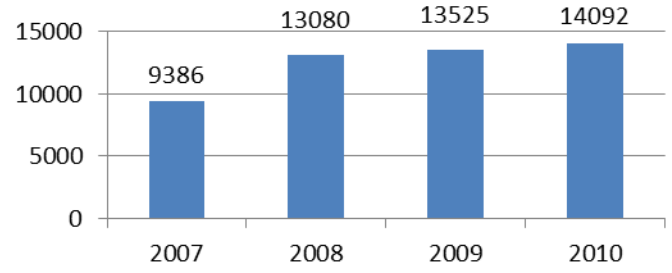
	2000	2005	2006	2007	2008	2009	2010
Total quantity of captured fish in Azerbaijan, tons	**19122**	**26400**	**21430**	**20599**	**20908**	**45088**	**45315**
of which:							
Fish captured according to international quotas	18797	9003	3976	2943	1517	1202	1082
Fish captured by individuals which is not subject to international regulations	185	17283	17344	17534	19208	43566	43749
Fish farm production (aquaculture)	140	114	110	122	144	137	123
Fish captured by individuals from lakes and ponds					39	183	361

Source: State Statistical Committee

availablity would have to be explained by both a rapid expansion of demand and a similar growth in supply.

The figure on captured fish for the year 2000 is probably fairly accurate since it is based on fishing under international quotas. This amount declined steeply in subsequent years, at least partly because of the problems noted earlier. However, imports of fish increased to offset some of this decline. As shown in Figure 1, fish and fish product imports rose to 13,080 MT in 2008.

Figure 1: Fish and fish product imports, tons



Source: State Statistics Committee

When added to the figures for fish captured according to quota and fish captured by individuals from ponds and lakes, availability from all these sources equals 14,636 MT. Fish consumed per capita was estimated in the household surveys conducted by the SSC in 2008 to be 3,5 kg. Multiplying times the population of 8,780,000 we arrive at total fish consumption of about 31,000 MT. This would require approximately 16,000 MT of fish to come from aquaculture and

other sources that were not officially recorded. This does not appear to be impossible, though it is probably an upper limit.

The Ministry of Ecology and Natural Resources (MENR) reports releasing 439.5 million fingerlings in 2010 into all natural water systems in the country according to the following structure: [5]

- sturgeon fingerlings – 1,522 million units
- trout family fingerlings – 0,17 million units
- carp family fingerlings – 432,08 million units
- white amur and other herbivores – 5,75 million Units

However, these figures have been challenged by BIC and ACT project personnel, who claim that they are grossly overstated. The MENR itself estimates the total capture harvest to be only a little over 950 MT. The ACT project has also obtained information from fishing companies, processors, and local ichthyologists, who support much lower figures for total capture than those reported officially.

Consequently it seems that total consumption in 2008 was unlikely to have been any greater than 31,000 MT, of which almost half was imported. Given the sharp slowdown in the rate of real economic growth that prevailed for most people during the ensuing two years, it is unlikely that this figure increased very much, if at all, by 2010. Yet the data from the SSC suggest that total fish consumption in 2010 was 45,315 MT of local fish capture plus 14,092 MT of imports. Assuming that most aquaculture production was included in the unrecorded category, total consumption would have been close to 60,000 MT, or 6.6 kg per capita. It is apparent that this per capita figure caused the statistical authorities to increase their estimate of unrecorded fish capture even though there is no obvious source from where these fish came. It is also possible, of course, that the 2010 consumption surveys are wrong and that average consumption remains closer to the 3.5 kg per capita shown in the 2008 surveys, which is more in line with past trends and even heroic estimates of unrecorded capture.[6]

2.2.2 Area and Yields under Aquaculture

According to the Ministry of Agriculture ("Sound food provision state program for 2008-2015"), in the Salyan region there are 163 individuals and entities which produce carp-like fish from the ponds and lakes. The overall area of those ponds and lakes constitutes 2,247 hectares, the main part of which (2,243 ha) is leased to the individuals by government. The Neftchala region has a similar area for ponds and lakes, with 1880 hectares used for aquaculture.

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[5] http://eco.gov.az/su-fealiyyet.php

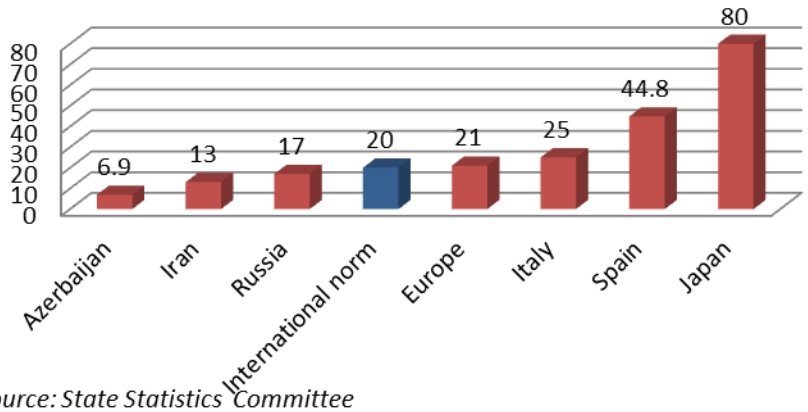
[6] The reliability of the 2010 consumption estimates is also called into question by the fact that the full results of this survey have yet to be released.

The average yield of the industry is reported by the Ministry to be about 300-350kg/ha, which is less than the average number of 510 kg/ha for the farms interviewed in these regions for the current study. BIC found the average yield to be 560 kg/ha for the whole country. Farmers in the industry claim to obtain 1 ton/ha from the ponds that are fully used for production. This seems quite possible, despite the various survey results, since some farmers do not use the whole capacity of the ponds because of limited finances. As this study focuses on best practices employed in the country, we have taken yields to be 1 ton/ha on average in the DRC calculations.

2.2.3 Potential for Expanded Per Capita Consumption

If the official figures on per capita fish consumption in 2008 are correct, and consumption per capita has not increased very much in the past three years because of the slowdown in the rate of economic growth, then per capita consumption is about 17 to 18% of the world average (see Figure 2 for comparators against the SSC's estimate of Azerbaijan's per capita consumption of 6.9 kg per person). Although fish consumption appears to have increased at a relatively fast rate up until 2008, because of rapidly growing incomes, this rate of growth would not have been sustained. Nor is it likely to resume anytime soon.[7] This does not mean that consumption will not eventually increase to catch up with the rest of the world, but just that growth will be slower than in the past.

Figure 2: Per capita annual fish consumption in the countries in 2010, kg



Source: State Statistics Committee

[7] The National Budget Group estimates that the rate of real GDP growth per capita declined to 3.7% in 2010 and is due to fall even further in 2011. This may be compared with an average rate of almost 30 % during 2005-07. National Budget Group, *Evaluation of Macroeconomic Condition in Azerbaijan in 2010: Analytical Review,* May 2011, p. 9.

3 Analyzing Aquaculture Value Chains and Their Constraints

This study has as one of its major goals assisting the Government of Azerbaijan in the formulation of policies that will encourage the most economically efficient allocation of capital and budgetary resources in order to maximize the growth of income and employment. A second goal is to assist the ACT project in identifying key constraints within the aquaculture subsector and assessing the economic and financial viability of overcoming those constraints.

3.1 Constraints in the Aquaculture Subsector

3.1.1 Brief description of principal constraints

Most the constraints on the aquaculture sector are related to policy, marketing, and technical conditions. Policy constraints are those closely related to government policies and unsolved legal issues, such as land use restrictions, water supply priorities, quality control systems, and barriers to imports. Marketing constraints are related to the size of the market, its degree of fragmentation, the extent of monopolization, availability of transport and cold storage, seasonality in the supply of the product, and quality of market management. Technical constraints include quality of the genetic stock, technical expertise of the farmers, access to water, feed quality issues, availability of processing facilities, and appropriateness of physical structures such as raceways for trout. If the cost of overcoming these constraints is less than the benefits achieved, profits will increase, providing greater incentives for investment and enhanced efficiency in the allocation of resources.

3.1.2 Carp Production and Marketing

3.1.2.1 Primitive feeding leading to low yields

Many carp farmers use very inefficient feeds or none at all. Where no supplementary feeding occurs, natural bio-resources may be sufficient for the first year to keep the fish alive and even growing, though at a very low rate. By the second year, however, most of these resources will be exhausted and the fish will stop growing. Farmers will be obliged to hold the fish another year, feeding them something, until they have attained commercial size of at least one kilogram. This is extremely inefficient.[8]

More often, whole-grain wheat and barley are thrown into the ponds along with some alfalfa grown on the farm. According to farmers surveyed, it takes 4-6 kilograms of this type of feed in order to get one kilogram of fish meat. This type of feeding also results in very long growing periods, substantial costs of tied up capital, and low levels of production.

There is an enormous potential for upgrading feed. Use of improved feed could increase yields from the current level of 560 kg/ha to 2-3 MT/ha, depending on management intensity.[9] Ponds

[8] USAID/ACT Project, *Aquaculture Market Research…*, p. 31.
[9] USAID/ACT Project, "An Action Plan for Fish Feed Productivity Enhancement Providing Carp Feeds to Southern Azerbaijan."

could be stocked at much higher densities and fish would be more resistant to disease.[10] Farmers are well aware of this and strongly support strengthening the capacity to produce quality feeds locally.

There are several feed mills in Azerbaijan that produce fish feed along with feed for other purposes. Most of these mix various ingredients loosely and sell them in 25-kg bags. These need to be upgraded and equipped with extruders, which simplify the feeding process, greatly reduce feed losses, and make the feed more digestible and available for fish. The feed should also be more balanced with the addition of meal, fish oil, and other sources of protein. This would result in a feed/meat ratio closer to one.

3.1.2.2 High losses of carp small fry

Most carp are purchased from hatcheries as small three-day old fry. Although there are no very accurate statistics, the fact that 25,000-50,000 fry are purchased per hectare, but yields average only 560 kg per hectare of carp, suggests that losses are very high. If each mature fish were to weigh at least one kilogram, this implies that the survival rate is a maximum of about 2.2 %. This is much lower than in other countries, where the usual practice is to stock young fry in smaller fingerling ponds, where they can be intensely fed and managed. After 30 days, the carp can be stocked in production ponds with survival rates of 90% or greater.[11]

Another choice facing carp farmers is whether to buy small fry in May and June and carry them for 18-24 months until they are sufficiently mature to sell commercially, or to buy juveniles weighing 50 – 150 grams each in March and carry them for only about six months before they are large enough to sell in the fall. In the former case there are higher capital costs and the mortality rate is much higher than for juveniles, but the margins are greater because the fish are held for a longer period of time. One could envision a situation in which the hatcheries -- with their generally greater technical expertise, more appropriate feeds, and reduced mortality rates -- raise fingerlings until they attain a weight of up to 100-150 grams, at which point they would be sold to fish farmers, who raise them to commercial size.

3.1.2.3 Limited market

Most carp transported to Baku first go to the Keshla Bazaar, an open green market, where they are sold to retailers or wholesalers for sale live or fresh there or in other open markets. Relatively few of these fish go to fish stores, which carry mostly previously frozen, canned, smoked, or deep-frozen imported fish, most of it processed by the Caspian Fish Company.

The big question is what will be the impact of increased carp production sold in live markets on market prices. This will depend in part on the growth in demand for these fish due to increases in income and the ability to substitute local carp for other sources of fish. One other source is the fish that are captured from the Caspian Sea as well as local lakes and streams. If that capture is as big as indicated by the official figures, then aquaculture production could simply displace this capture without pressing too much on demand. But for reasons cited in Section 2, the official data appear to be substantially overstated. It would be very surprising if a large quantity of fish

[10] USAID/ACT Project, *Aquaculture Market Research*..., p. 34.
[11] USAID/ACT Project, "Action Plan for Carp Hatchery in Salyan Region".

came from the Caspian Sea given problems of overfishing and pollution. But it is equally difficult to see how the lakes and rivers of Azerbaijan could supply such a quantity of fish.

This implies that most substitution will have to take place with imports. But there appears to be considerable market segmentation between locally produced warm-water fish and that which is imported. The capacity to substitute local for imported live fish at a relatively constant price is extremely limited given that the latter amounted to only about 2 MT in 2010 while the former exceeded 5,600 MT. Imports of frozen carp and other similar fish are much more important, equaling 3,600 MT in 2010, but most of this fish is handled and processed by the Caspian Fish Company and is sold in shops and supermarkets comprising a separate market. Only if local fish were sold in these same shops and stores, would they begin to compete with imports.

As long as this is not the case, carp from fish farms will be competing within a market totaling a maximum of about 16,000 MT of fish per year. There are no estimates of the price elasticities of demand for fish in Azerbaijan. However, there are estimates from other countries, which can be used as an approximation. For example, Asche and Bjorndal (1999) of the International Food Policy Research Institute (IFPRI) find that price elasticities of fish products tend to vary from -0.7 to -1.5 across most countries. We can make use of this parameter if we assume that farm-raised carp and fish captured from other sources are perfect substitutes so we can deal with a single market for live fish, leaving aside imports of processed fish. This analysis is performed below in Section 5.

3.1.2.4 High seasonality of carp production and sales

A major problem with carp production is its high seasonality. Most of the carp is harvested in November and December, when growing has all but ceased because of cooler temperatures. But this is also a time when prices are relatively low because of the large supply coming onto the market. Without processing, these fish must be consumed within a very short period or they will spoil. Freezing is an alternative, but it substantially prolongs the conservation period only if it brings the temperature down to -20^{o} C. The equipment to do this is expensive; only the Caspian Sea Company has such equipment, and it does not buy from small local suppliers.

Another alternative is to carry the carp in ponds beyond November/December until prices rise. Although they may lose some weight as they go into a period of dormancy and diminish their feeding, there is evidence, supported by the DRC analysis, that this weight loss, if any, is more than compensated by the rise in prices that occurs up until at least March or April. However, this may only be true in the south, where the amount of weight loss is less because the water remains somewhat warmer than further north. Carrying carp of commercial size beyond April is very difficult because of the lack of cold storage and refrigerated transportation equipment.

3.1.2.5 Minimal processing

All of the carp produced is consumed fresh without undergoing any processing. Some people attribute this to the difficulty of applying major processing techniques, such as smoking, to locally produced carp, but there are other reasons as well. One is the high cost and lack of financing for other processing options such as freezing.

3.1.2.6 High barriers to imported inputs

Major costs, delays, uncertainties, and other impediments are experienced in the importation of fish feed, fish feed ingredients, fish eggs, and fingerlings. For example, Azaquaproduction is a private company that would like to import fish inputs such as eggs, feed, and aquaculture equipment. Its first shipment of consolidated trout feed imports in 2010 encountered severe problems.[12] The feed was kept at customs for several days and the customs office charged Azaquaproduction an extra 15%. There was also uncertainty regarding whether the purchased feed would be released at all. As a result, Azaquaproduction decided not to continue importing trout feed, which was left to the Caspian Fish Company. Trout producers claim that the quality of this imported feed is relatively low.

An order of rainbow trout eyed eggs from Troutlodge in late 2010, under the PSECP project, also encountered severe problems clearing customs. At one point the project team assisting in the importation was told that insurance had to be purchased to cover transport from the airport to the cargo's final destination even though the group leaders insisted that insurance was not necessary and no mention of it could be found in the Customs Code. Eventually, after eight hours, the eggs were released without the insurance. At a minimum, the entire import clearance process consumed the time of 13 people for nearly one and one-half days.[13]

All traders and fish millers interviewed for the DRC study indicated that customs clearance is a major problem. Estimates also suggest that there are very high "unexplained transactions costs" in the importation of fish, which together with taxes on imports result in domestic prices that are approximately double the prices of these fish at the border. The consequence is substantial trade protection against fish imports, which hurts consumers and encourages inefficient production.

3.1.2.7 Processing and marketing monopoly

There is substantial evidence of monopoly power in processing and marketing of fish in Azerbaijan. There is only one large processing plant, Caspian Fish Company, which imports and distributes most seafood in the country. It is a vertically integrated producer/distributor/retailer, and the only legal producer of sturgeon caviar in Azerbaijan, which is largely exported. It imports bulk frozen fish and processes it locally for sale in Azerbaijan, mostly in 10-12 specialized fish stores in Baku and several other stores in larger regional towns.[14]

There are a total of 10 fish stores that are owned by the Caspian Fish Company, but there are more stores that have the "Caspian Fish Co." sign because they sell Caspian products and use the Caspian logo as protection from tax collectors and unwanted visitors from government agencies. Other small grocery stores and supermarkets have fish departments rented by people related to the Caspian Fish Company. This keeps competition out of this segment of the consumer market.[15]

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[12] Many but not all of these are documented in Azaquaproduction, Private Sector Competitiveness Enhancement Program (PSCEP) Standard Grant Agreement No. STA-400-005, "Report: Fish Feed Distribution Channel," November 10, 2010.
[13] "Facilitation of the Rainbow Trout Eyed Eggs Import Deal Summary Report".
[14] USAID/ACT Project, *Aquaculture Market Research*, pp. 54-56.
[15] USAID/ACT Project, *Aquaculture Market Research*, p.48.

Even in the open green markets there are elements of monopoly among the wholesalers and retailers of live carp. Although the retail market is relatively closed, the distribution of live fish has become more competitive as the number of distributors specialized in live fish hauling has increased in the last few years from 5 to 70.[16] While most distributors haul straight to the open markets, others have holding ponds in suburbs around Baku from which fish are distributed as demanded.

3.1.2.8 Uncertainties and cost of access to land

The aquaculture industry in Azerbaijan is mainly regulated by the "Law of Azerbaijan Republic on Fish Industry" signed by the President on March 27, 1998, along with the laws and codes on water, land, property and other relevant areas. The Article 12 of this fish law states that commercial aquaculture production of fish should take place in natural lakes and rivers or lakes and ponds created within special projects following relevant technical guidelines. Article 13 of the law is very important as it defines the process of organisation of the sales of fish products. It explicitly states that for such projects to be traded their production should have certificates of quality and origin. The problem is that most of the aquaculture producers in the regions (both Salyan/Neftchala and Sheki/Zagatala) have not complied with these laws from the beginning and this has led to illegal solutions, including bribing of local authorities. The farmers argue that the procedures for complying with the law are extremely time-consuming, costly, and cumbersome. The result is that less than one-quarter of the estimated land under aquaculture is registered for this purpose.[17]

In most instances this has not seemed to matter because the government has not until recently enforced these land laws – in part because much of the land, especially in Salyan and Neftchala, is suitable for little other than aquaculture. However, in May 2011, the Cabinet of Ministers issued an instruction to use land for the purposes shown in formal documentation. This instruction was applied to three regions in the vicinity of Zagatala, where aquaculture had been underway for six years, despite the fact that most aquaculture ponds had been constructed on lowlands that were not suitable for agriculture. The effect of this instruction, however, was to halt unauthorized carp production in this area and cause investors to incur severe losses.

Apart from creating operational problems, this legislation and its sporadic enforcement lead to poor access of fish farmers to credit, as they are not entitled to borrow from the banks without registered property. They also cannot insure their farms, which is also an obstacle to credit.

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[16] USAID/ACT Project, *Aquaculture Market Research*, pp. 50-51.

[17] The existence of a large number of unregistered fish farmers can also be seen from the official statistics. Information about the actions taken and results in 2010 within the "Sound Food Provision State Program for 2008-2015" notes the existence of 192 individuals or entities who produce fish in the lakes and ponds with an overall area of 4158 hectares, whereas the State Statistics Committee shows the number of individuals to be 80 with the total area of the ponds being equal to 1048 hectares -- a four-fold difference. This may be one of the reasons why there is such a large difference between the State Statistical Committee's figures on aquaculture production and those emanating from the survey by the BIC.

3.1.2.9 Water shortages

Water charges are assessed by regional and local Water Committees. These assessments vary substantially across fish farmers – from as low as 0 AZN/ha to as high as 200 AZN/ha. This results in substantial distortions in incentives regarding the use of water. This has severe consequences for fish farmers in Salyan and Neftchala, who almost all report major problems from shortages of water during the summer, the major growing period.

There are also major distortions in the use of water as between plant-growing farmers and fish farmers. For example, irrigation is provided to field crops according to norms that have been in effect since the Soviet era: 1 hectare of cotton: 1st application – 2500 m3, 2nd application – 1800 m3, 3rd application – 1500 m3; 1 hectare of wheat - 1500-1600 m^3. Plant-growing farmers pay 1.2 AZN per 1000 m^3 of water, while the majority of fish farmers have to pay 12-20 AZN per 1000 m^3. In fact, however, since the use of water is not metered for agriculture but has built-in controls for aquaculture, there is major wastage in its use for field crops compared with that for aquaculture. Plant-growing farmers taking advantage of the lack of metering by irrigating their fields though flooding, rather than using more efficient and effective methods of irrigation, which results in large water losses. Furthermore, when farmers face seasonal problems in water supply, local executive authorities step in and give preference to plant-growing farmers in the provision of water. This is especially a problem in July and August, when water shortages are most acute

3.1.2.10 Lack of access to financing

Lack of access to finance leads to inefficient marketing. Dependence on borrowed working capital results in selling fish earlier than necessary at prices that are relatively low. Finance is also a problem for production. For example, farmers often expand their ponds beyond their capacity to fill them with fish and provide feed for those fish. Surveys and interviews revealed that farmers try to keep 1000 units of fish per hectare of pond, which translates into yields of 1 ton/ha. This density is low in relation to world averages of 5-8 tons of fish per hectare. But the farmers explain that they are unable to feed more fish in the pond because of the higher operating costs and lack of working capital. This results in their having relatively high fixed costs associated with their investment in ponds without being able to offset this cost over greater production. One of the problems is that it is difficult to obtain loans from the banks or National Fund for Entrepreneurship Support because many of the fish farms are not registered or insured.

3.1.2.11 Weak management

Most of the carp farmers in Azerbaijan do not have the education and training to operate efficiently. This is reflected at all stages of production, from initial fry planting to sales. For example, in international practice, small, several-day-old fry are usually stored in a nursery pond or tank with special conditions created for them until they reach a certain degree of maturity. This involves waiting for relevant water temperature and feeding the fry with nutrient-rich feed to have higher survival and growth rates.[18] But most of the carp farmers in Azerbaijan simply release the fry into ordinary ponds and do not feed them properly, leaving them to depend on the phytoplankton in the pond. The result is carp fry, which are sensitive to small temperature

[18] It is known that starting feed could be extremely important in further feed intake by the fish and make a difference in the final weight of the fish.

changes, die out if the natural conditions are slightly less favorable, while those remaining become feed for other inhabitants of the pond or die because of improper feed. This results in loss rates as high as 95-98%.

3.1.2.12 Priorities of Fish Farmers

The priorities of carp fish farmers are revealed in Table 2, which shows the percentage of farmers' responses to questions regarding their priorities. By far the largest percentage would like to have government assistance in the form of subsidies or other forms of support. Close

Table 2: Suggestions of the Fish Farmers

N	Suggestions	Share
1	Subsidies, government support	22,2%
2	Organizing fish feed production	18,5%
3	Establishing centralized purchasing centers	11,1%
4	Improving water supply system	11,1%
5	Inexpensive and accessible credit	11,1%
6	Establishment of farmers association	5,6%
7	Making technical services cheaper	3,7%
8	Establishment of deep-freezing system	1,9%
9	Abolition of local intervention	1,9%
10	Improving hatcheries	1,9%
11	Insurance of fish farmers	1,9%
12	Restoration of roads	1,9%
13	Regulation of prices	1,9%
14	Establishment of fish processing plants	1,9%
15	Provision of better quality broodfish	1,9%
16	Increasing government support to tourism	1,9%

behind this is organization of fish feed production. This reflects the fact that farmers recognize that the feed they are using is very inadequate and that better feeds would increase their productivity and raise their profits. The next tier is shared by establishing centralized purchasing centers, improving water supply systems, and providing inexpensive and accessible credit.

3.1.3 Trout Production and Marketing

3.1.3.1 Highly specialized and limited market

The most important issue facing trout farmers is the market for their fish. To date, most of these fish have been sold directly to hotels and restaurants by the farmers themselves, who pay the transportation cost to Baku. In other cases, the fish are sold to traders, who pay the cost of transport. Hotels and restaurants have little interest in live fish, so the fish must be cleaned and

packed in ice before being shipped. This poses particular problems in the warmer months because of the absence of refrigeration. These fish compete with imports of fresh trout, comprising 2 MT in 2010 compared with domestic production of 118 MT. About 45 MT of frozen trout were also imported in 2010. The market for trout is not quite as segmented as for carp, in that small quantities of local fresh trout are sold in shops and supermarkets, but there appear to be substantial barriers to entry into this larger market. This is discussed further below.

As with carp, the big question is how much the existing market can absorb of increased production without a sharp decline in prices. Some price decrease already appears to be taking place. Whereas the market for carp is relatively large, that for trout is quite narrow so that a modest increase in production could have a devastating effect on prices and therefore on farmer profits. If the trout producers were to increase their level of production, the constraints on the market would need to be addressed immediately to prevent this increase from resulting in a financial crisis for trout farmers. Furthermore, as we shall see in the next sub-section, the margin for improvement in productivity in trout farming is less than for carp, so more of the impact of declining prices must fall on profits.

3.1.3.2 Transportation and marketing

Trout is usually marketed fresh but not live. Though larger farmers have their own marketing chains, usually the cleaned fish are transported to the capital by means of passenger buses in boxes stuffed with ice. Although cost-effective, this type of transportation would have to be abandoned if proper quality norms were introduced. Whether refrigerated trucks are required is unclear, but some changes in conservation during transport and marketing would have to be made. Locally raised trout are sold to hotels and restaurants and usually do not find their way to the shelves of markets due to limited supply and the monopoly of the Caspian Fish Company.

3.1.3.3 Minimal processing

Trout production involves basic processing such as cleaning and filleting at the farm level. This is not enough if production levels are to increase. There needs to be proper freezing and packaging so that the seasonal nature of trout marketing can be reduced and the overall market expanded.

3.1.3.4 Poor trout feeds due to high barriers to imported feeds and other inputs

Most trout farmers use imported trout feed. There is no production of this feed currently in Azerbaijan. Virtually all of the feed is imported from Georgia by the Caspian Fish Company and is of relatively low quality. Farmers are well aware of this. One trout farmer/miller in Sheki is planning to produce higher quality feed, though access to the ingredients could prove to be a problem. Some ingredients are simply not available locally and must be imported, with all the barriers to imports this entails (see Section 3.1.2.6). Other ingredients are available for part of the year but not year-round because of the seasonality of agricultural production.

3.1.3.5 Inappropriate physical structures left over from Soviet era

Most raceways for trout farms were designed during the Soviet era and do not allow for the recycling of water. Cascading would allow the water to be reused, practically free of charge. This could result in a doubling of capacity.[19]

4 Research Methodology and Approach

4.1 DRC Methodology

4.1.1 Domestic resource cost

The focal point of the study is DRC analysis for determining the comparative advantage of aquaculture sector in Azerbaijan. The methodology is quite comprehensive and it is an excellent tool for determining financial and economic profitability of each link of the value chain along with overall profitability of the entire chain.[20]

The methodology is as follows. At each stage of the value chain, the costs and benefits of that stage are assessed. This could pertain, for example, to production, collection, processing, and distribution to the final market. Profitability at each stage is calculated by subtracting costs at that stage from the price margin that is available. The difference is profit. For example, a distributor buys the fish at one price and sells them at another. The difference between these prices is the price margin. The distributor also has transport and handling costs, and possibly storage costs as well. These costs are subtracted from the price margin to obtain the distributor's profit.

One calculation is made in terms of financial prices. These are the prices that prevail in the market. But profitability is also made in terms of economic prices. These prices, or opportunity costs, reflect the real value of goods and service to the economy as a whole. The major differences between these two sets of prices are the taxes and subsidies assessed by government on various goods and services, and the effects that trade policy has on domestic prices in relation to those on the world market. For example, production could be profitable because of high protection from imports and subsidies on output, but from an economic point of view, the country could lose precious resources producing a good in which it does not have a comparative advantage.

Costs are divided into their tradable and non-tradable components. Labor, land, and capital are considered to be nontradable because their supply is limited to the country concerned, in this case Azerbaijan. Other goods and services are considered to be tradable to extent that they can be bought and sold on the world market at constant prices. Some inputs, such as transportation and construction, are not directly tradable but may be broken down into their tradable and non-tradable components. For example, transportation consists of tradable fuels and nontradable driver services. In this analysis, the breakdown into tradables and nontradables is done using

[19] USAID/ACT Project, *Aquaculture Market Research*, p. 26.
[20] A detailed technical description of the DRC methodology is contained in Annex A.

Azerbaijan's input-output table. This also enables us to separate out taxes and subsidies according to whether they apply to tradables or non-tradables.

The domestic resource cost (DRC) is an indicator of the efficiency with which a country's domestic resources (labor, capital, land) are converted into output measured as value added at world market prices:

$$DRC = \frac{\text{Labor + Capital + Land}}{\text{Value Added in World Prices}}$$

where value added is the value of output minus the value of tradable inputs, all expressed in world market prices.

DRC is a cost/benefit ratio, with costs in the numerator and net benefits in the denominator

- If DRC<1, domestic resources used cost less than the value added created and you have comparative advantage
- If DRC>1, domestic resources used cost more than the value added created and you have comparative disadvantage

Division of costs into tax/subsidy and economic cost components seems relatively simple, as the subsidies usually are straightforward and taxes can be defined from rates applied throughout the country. But we need to take into account the fact that agriculture in Azerbaijan is free from most taxes; therefore using standard tax rates would be inappropriate. We also need to divide the costs of various inputs going into production into their tradable and non-tradable components. All direct nontradable costs – labor, rent, and capital costs -- are directly attributed to non-tradable costs. Remaining inputs costs are divided into tradable and non-tradable components using Azerbaijan's input-output table.

Getting relevant world prices can be difficult. One approach would be to calculate implicit CIF prices from trade statistics by dividing values by quantities imported and adjusting for the cost of import tariffs, transportation, and handling until we reach the local wholesale market. Several problems emerge: (a) getting world prices from trade statistics requires actual trade in the analyzed commodity and, especially for carp, this is difficult as there has been little trade in live carp in recent years, (b) the trade statistics do not show actual CIF prices because of frequent undervaluation;[21] (c) even if we have valid CIF prices and adjust them for trade taxes and local costs, the resulting cost of imports is often considerably less than the domestic wholesale price, implying that there are informal charges and restrictions, which we describe as "unexplained transaction costs".

[21] Research using "mirror statistics" on foreign trade (exports of trading partners compared with Azerbaijan imports from the same countries) suggests the problem of undervaluation in Azerbaijan is very extensive. Economic Research Center, "'Mirror Statistics' and Defining Foreign Trade Indicators in the Republic of Azerbaijan." May 2010.

One other difficulty arises when we try to get costs at different stages in the value chain in the same units of measurement. Units of output differ from one stage to another because of product conversion; therefore, we need conversion factors to be able to adjust them to a common unit of final output. Taking into account the information provided by the farmers and some expert knowledge, we have used the following conversion factors for different stages of carp and trout value chains:

1. Conversion factor from a pack of carp fry (which is said to contain 10,000 fry) to kilograms of commercial fish = 400. This same conversion factor for Sheki/Zagatala region is 1000 as a pack of fry from hatcheries there contains 25,000 fry;
2. Conversion factor from a pack of carp fry to kilograms of juvenile fish = 33-40;
3. Conversion factor from a kilogram of juvenile carp to kilograms of commercially tradable carp = 10;
4. Conversion factor from a kilogram of trout fingerlings (usually 20-30 grams each) to kilograms of marketable trout (200-300 gram each) = 10.

The DRC methodology takes into account capital costs in addition to operational costs. We know that most of the capital cost is incurred at the beginning of production; therefore we need to convert these capital costs to an annual cost of depreciation and tied up capital over the service life of the structures or equipment. The usual way is to apply an annuity formula, which defines the start-up value of the capital investment as the present discounted value of these annual flows over the service life of the capital investment at a constant interest rate. For the sake of consistency, we have used 10% annual interest rate throughout the study. This is a reasonable approximation to the real cost of capital. Service lives are defined with respect to both legal depreciation requirements and common sense. In all cases we have taken service lives of buildings, ponds, and lakes to be equal to 20 years, whereas the major equipment is assumed to depreciate over 10 years. Other service lives are defined on the basis of logic and interview information.

For the methodology to be complete we also need to define the shadow exchange rate of the Azeri manat, which is its real opportunity cost; here we assume initially the ratio of the shadow to the official rate to be equal to 1. This is reasonable because, although the manat may have become overvalued in the past with the influx of oil revenues, these have declined somewhat and currently neither depreciation nor appreciation pressure is observed on the official exchange rate.

4.1.2 Financial and economic profitability

Within this methodology, financial profitability, being a main driver of activity for the entrepreneur, is defined as revenue minus all costs, including opportunity costs and taxes. This differs slightly from accounting profit for the business by including opportunity costs as a part of the costs. For example, family labor on a farm is treated in the same way as hired labor even though it is not cash cost. This is because family workers always have the opportunity of working off the farm. Financial profitability does not mean the country is actually maximizing total profit, rather is shows the profitability of separate activities or value chains where all costs and prices are measured in financial or market terms.

In contrast, economic profit subtracts taxes from costs and adds subsidies to these costs in order to measure costs to society as a whole.

Economic cost = Financial cost – taxes + subsidies

Economic profit also takes into account barriers to trade. These take the form principally of import duties and the value added tax that is assessed on imports but not on local production. Barriers to trade may also arise because of quantitative restrictions, monopoly profits, and other distortions. Where these exist, as in Azerbaijan, a tariff equivalent may be calculated by taking the ratio of the domestic price of a product to its CIF import price and subtracting one, with adjustment for any real costs associated with transportation and handling after the goods have arrived at the port of entry. The economic price of a product equals its CIF price plus transportation and handling. The financial price of an imported good equals its wholesale price. The difference between the two is the tariff or tariff equivalent.

Financial price = Economic price (CIF + transport and handling) + tariff or tariff equivalent

In the countries with high protection on imports, economic profit is usually less than financial profit. Because of this and any subsidies that may apply, a producer can make a financial profit even if production is unprofitable from an economic point of view.

4.1.3 Nominal and effective protection

The nominal protection coefficient (NPC) is defined as the tariff rate or tariff rate equivalent on an imported good plus one. Leaving aside the cost of transport and handling,

NPC = Domestic price/ World price.

NPC is a good indicator of trade protection for the good, which shows whether the consumers are being taxed or subsidized. For example, if the NPC is greater than one, they are being taxed; if it is less than one, they are receiving a trade subsidy.

The effective protection coefficient (EPC), on the other hand, measures incentives that affect the prices of both outputs and inputs, and is therefore a better indicator of protection offered to producers. The EPC shows value added in domestic prices relative to value added in world prices.

$$EPC = \frac{\text{Value added in domestic prices}}{\text{Value added in world prices}}$$

The NPC and EPC together provide a very good picture of the protectionist policy of the country. If tradable inputs of the industry receive less protection than does output, the EPC will be greater than NPC, and vice versa.

4.2 Research approach

4.2.1 Definition of value chains

This analysis involves the selection of agricultural and agribusiness value chains for DRC analysis,[22] the design of DRC studies to collect information and conduct this analysis, and the elucidation of implications of the analysis for the choices to be made regarding support of the value chains that offer the highest benefits in terms of financial and economic profitability, employment, and other objectives. It also entails understanding the macroeconomic and sector policy implications of the DRC analysis as well as building institutional awareness of DRC methodology and policy extensions on the part of relevant public policy-making and private sector research/advocacy institutions.

The DRC analysis of aquaculture covers the following 12 value chains:

- Small carp farmers in Salyan/Neftchala, buying small fry and holding for 18 months, traditional feed
- Large carp farmers in Salyan/Neftchala, buying small fry and holding for 18 months, traditional feed
- Small carp farmers in Salyan/Neftchala, buying juveniles and holding for 6 months, traditional feed
- Large carp farmers in Salyan/Neftchala, buying juveniles and holding for 6 months, traditional feed
- Small carp farmers in Salyan/Neftchala, buying juveniles and holding for 6 months, improved feed
- Large carp farmers in Salyan/Neftchala, buying juveniles and holding for 6 months, improved feed
- Small carp farmers in Sheki/Zagatala, buying small fry from modern hatchery operating at full capacity and holding for 18 months
- Small carp farmers in Sheki/Zagatala, buying small fry from traditional hatchery and holding for 18 months
- Large carp farmers in Sheki/Zagatala, buying small fry from traditional hatchery and holding for 18 months
- Carp feed mill in Sheki, with extruder
- Small trout farmer in Sheki/Zagatala
- Large trout farmer in Sheki/Zagatala

4.2.1.1 Carp value chains

Developing a consumable carp requires 2 years which usually involves 3 or 4 stages along the value chain from starting point to wholesale. The usual value chains look like the following:

[22] In keeping with the specificity of DRC analysis, we make a distinction between subsectors and value chains. While a sector according to this definition refers to such a category as fisheries and, within this, a subsector refers to aquaculture, value chains within this subsector specify where production takes place, what mode of production is used (fishponds, raceways), where processing takes place, what mode of processing is used (cleaning, freezing), where the product is sold, and what products it competes with (imports, local capture).

a) Hatchery – Farm (keeping the fry from hatchery for18-24 months) – Trader
b) Hatchery – Juvenile farm (keeping the fry for one year until juveniles) – Farm (buying juvenile and keeping up to 6-12 months) – Trader

In this study the importance of the scale effect is also taken into account, with production including both small (less than 10 hectares) and large (greater than 15 hectares) farms. Apart from that, the availability of the information allowed us to do the analysis of some carp value chains in the Sheki/Zagatala region in addition to the Salyan/Neftchala region. This permits comparison of the two regions, which vary considerably in terms of climate and soil. They also vary because of higher transportation costs to Baku. Sensitivity analysis was employed by allowing these costs to vary with the size of trucks used.

The ID designations and details regarding the carp value chains are presented in Table 3.

4.2.1.2 Trout value chains

Unlike carp, trout are not usually traded live in the markets since the main buyers of local production are the hotels and restaurants. Also, trout needs to be cleaned within an hour after being fished or it can become poisonous. Therefore it is not usually safe to keep this specie live and sell it in this form. But this means that it is difficult to ship trout during the summer months without refrigeration.

The limited number of trout farmers meant that there were only two trout value chains that were considered in the analysis.

4.2.1.3 Collection of existing data and documentation

Data requirements for DRC analysis are extensive. They include costs of production, processing, and marketing, often based on technical input requirements, input prices, yields or other indicators of outturn, and capital valuations at each stage of the value chain. Sales quantities, prices, and values at each stage are also required. In addition, data on CIF prices, import taxes, transport costs, port charges, and other costs are needed to estimate the import parity prices with which we compare the costs and prices of local products. Finally data are required to break costs down into their tradable and nontradable components.

Where extensive studies and project analyses have already been undertaken, these will frequently present producer and wholesale prices, production and processing costs, technical input-output coefficients, and other variables that are required. This is not the case in Azerbaijan, where these studies are relatively rare or seriously out of date. On the other hand, there are quite good and relatively available data on import quantities and values, consumer prices, macroeconomic variables, financial statistics, and other indicators of importance for the analysis. There is also an input output table for 2006.

Table 4: Value Chain ID Designations and Descriptions for Carp

Value chain ID	Value chain description
SN_B18	Hatchery → **Large carp farms in Salyan/Neftchala of at least 15 hectares, producing from small fry, holding for 18 (to 24) months →** Trader selling in Baku from November to March
SN_S18	Hatchery → **Small carp farms in Salyan/Neftchala of less than 10 hectares, producing from small fry, holding for 18 (to 24) months →** Trader selling in Baku from November to March
SZ_B18	Hatchery → **Large carp farms in Sheki/Zagatala of at least 15 hectares, producing from small fry, holding for 18 (to 24) months →** Trader selling in Baku from November to March
SZ_S18	Hatchery → **Small carp farms in Sheki/Zagatala of less than 10 hectares, producing from small fry, holding for 18 (to 24) months →** Trader selling in Baku from November to March
SN_B06	Hatchery → **Farms in Salyan/Neftchala buying carp fry, holding for a year and selling juvenile fish to other farmers →** Large carp farms in Salyan/Neftchala of at least 15 hectares buying and holding juvenile fish of 100g to 150g for 6 (to 12) months → **Trader selling in Baku from November to March**
SN_S06	Hatchery → **Farms in Salyan/Neftchala buying carp fry, holding for a year and selling juvenile fish to other farmers →** Small carp farms in Salyan/Neftchala of less than 10 hectares buying and holding juvenile fish of 100g to 150g for 6 (to 12) months → **Trader selling in Baku from November to March**
SN_FB18, SN_FS18, SZ_FB18, SZ_FS18, SN_FB06, SN_FS06	All the above with improved fish feed
SN_TB18, SN_TS18, SZ_TB18, SZ_TS18, SN_TB06, SN_TS06	All of the above with transport cost reduction based on survey data from one trader with bigger transport facility.

Desk research was utilized at the first stage in order to gather secondary data regarding the value chains to be studied, the import chains with which they compete, and other relevant information. Customs data were collected on import quantities and values from 2008 until 2010 for fresh and frozen carp and trout. Price data were also collected at the producer, wholesale, and retail levels.

4.2.1.4 Preliminary data analysis

Preliminary data analysis involved comparison between domestic prices, generally at the wholesale level, and import parity prices, where the products are produced domestically as substitutes for imports. Import parity prices are those that apply at the point where both domestically produced products and imported products are consumed. Sometimes this is in Baku and sometimes it is upcountry. In either case, we started with the CIF price and added the costs of transportation and handling to arrive at the import parity price at the point of common marketing. There we compare the import parity price with the domestic wholesale price to determine the level of protection.

An important element in this equation is differences in the quality of local and imported products. Differences in quality can be measured by the differences in prices that consumers are willing to pay at the retail level. These differences must be introduced into the analysis to avoid attributing the price differences to trade barriers, taxes and subsidies, and other distortions when in fact they are due to differences in quality. For example, measuring unexplained transactions costs by comparing wholesale prices of local products with CIF prices of imports adjusted for trade taxes and handling costs requires correcting for any differences in quality.

Accurate price comparisons required detailed consumer and producer price data. One source of these data is the State Statistical Committee. These data are useful for examining the relationship between domestically produced goods and those that are imported from the world market. For this purpose, retail prices obtained for the consumer price index may be adjusted to the wholesale level since both imports and domestically produced goods pay pretty much the same margin between the two, especially in the open markets and smaller shops where most Azeri products are sold. However, wholesale prices were also available from the surveys so this adjustment was not often necessary.

CIF prices are often initially estimated from trade data by calculating unit values, i.e., trade value divided by quantity. Here three problems are often encountered. One is that recent trade data are not always accurate and available. As noted earlier, in Azerbaijan there is substantial undervaluation of imports. Another is that the classification of the available data is not always at the level of product specification required to make careful comparisons with domestic price data. Finally, the quality of imports often is quite different from the quality of domestically produced products, making direct comparisons difficult. For these reasons, wherever possible, direct CIF price quotations for products of similar quality are obtained rather than using unit values from the trade data.

For the current study, unit values obtained from the trade data were very low in relation to international FOB prices adjusted for transport to Baku. The unit value for frozen carp entering Azerbaijan in 2010 is 0.447 USD/kg, yet frozen carp are exported from the United States at an FOB price of $1.27/kg, and this agrees fairly well with information on carp in Iran, which has in the past exported carp live to Azerbaijan. However, 50% has to be added to the price of frozen

carp to adjust it for the difference in frozen and live retail prices in Azerbaijan. Then the cost of transport from Iran to Baku is added to this adjusted price to arrive at a CIF price in Baku of 3.4 USD/kg. This may be compared with the unit value for live carp obtained from customs data, which is only 1.117 USD/kg. The former price was used in the DRC calculations. Details are presented in Annex B.

4.2.1.5 Survey Preparation and Implementation

Survey Strategy

In order to acquire the specific data needed to undertake the DRC analysis, surveys were conducted of farmers, processors, distributors, and wholesalers. These surveys took several forms. Rapid reconnaissance appraisals tended to focus on interviews with a few knowledgeable informants or focus groups. Broader surveys were conducted over a range of farmers and traders. These were non-random surveys based on interviewers with farmers, processors, traders, and others, who were known because of previous contacts associated with providing extension or business development services. This led to inclusion in the samples of a disproportionate number of more innovative entrepreneurs who were likely to use improved practices, in addition to those engaging in average practices. This was judged to be desirable since an important objective of the DRC analysis was to evaluate the viability of improved technology in relation to current practices. In addition, attention was paid to potential innovations in technology, development of new markets, and ways of reorganizing value chains in order focus on issues that are on the frontier of value chain development and not just what is practiced today.

The survey comprised the administration of 36 questionnaires, of which only 3 questionnaires on trout were possible. The questionnaires were filled out for all stages of the value chains from hatchery to traders.

The initial preparation for the survey involved:

1. Questionnaire development
2. Pretesting with a pilot survey
3. On-the-job training for implementation of the survey

Questionnaires

The questionnaires are composed of close-ended questions to be able to obtain valuable statistical data as well as semi-closed and open questions to provide detailed information on respondents' opinions. They were developed in English and then translated into Azeri after they were approved by the DRC Consultant and other ACT project staff.

Pretesting and Informal Interviews

Pretesting of the questionnaires with a pilot survey was undertaken in the field by the interviewers who were to participate in the implementation of the survey. Based on the experience of the pilot survey, the questionnaires were revised before final approval.

Survey Implementation

After the questionnaires were prepared, translated, pretested, and approved, the target farmers, processors, and traders were chosen. Conducting interviews involved arranging phone calls with

the key people who could access companies' management. Interviewers went to meetings and interviews after the key people arranged the meetings. Implementation involved administering the questionnaires that had been designed, pretested, and approved for this purpose.

After implementation, the completed questionnaires were checked for accuracy and consistency in order to allow errors and omissions to be corrected while in the field. Fieldwork was carried out by the people who had attended the workshop and on-the-job training by the DRC Consultant. To ensure accuracy of the data collected during the fieldwork, similarities among questionnaires and consistency of related questions within the questionnaire were checked, direct phone contacts were initiated multiple times with the respondents from ERC and AAC offices, and all the completed questionnaires were passed through an eye-check control by each company's control staff.

Data Processing and Analysis

Data processing and analysis were undertaken using the Integrated Model for Policy Analysis Computer Template (IMPACT), an Excel based automated analysis tool which was developed as a standard tool for conducting DRC analysis. Distinct models were constructed from the common template for each value chain, defined with respect to product, technique and scale of production and processing, and location of production, processing, and final sale. Examples of this template are included in the Annex.

5 Results and Implications of the Analysis

5.1 Carp

5.1.1 Results for existing production

DRC analysis was initially conducted on 6 existing value chains -- 4 in the Salyan/Neftchala regions and 2 in Sheki/Zagatala. The results are summarized in Table 4 for all 6 value chains. Several points here are noteworthy. First, the analysis shows that carp production is highly profitable financially, but its economic profitability is low and in some instances negative, with the DRCs being greater than one. The difference is due primarily to relatively high rates of protection against imported fish, which raises the domestic price for fish well above the CIF price. Part of this protection is due to customs duties and the VAT, which is assessed on imports but not on domestic production, but much of it is unexplained and appears to be linked with the Caspian Fish Company's monopoly on fish imports. Without this protection, it is questionable whether carp production in the north could survive.

Second, all the value chains from the Salyan/Neftchala region have DRC levels less than 1 whereas the DRCs for Sheki/Zagatala are greater than 1, which shows that it is less costly for the country to base this type of aquaculture in the central and southern regions of Azerbaijan. The higher level of DRC for the northern part of the country mainly derives from two sources: high capital and transportation costs. The capital costs are greater primarily because of higher costs for digging out ponds than in the Salyan/Neftchala region. But even neglecting these capital costs and subtracting transportation costs, the operating costs for the region are higher, which

Table 4: Results of Baseline Carp DRC Analysis

Region	Salyan/Neftchala				Sheki/Zagatala	
Value chain	**SN_B18**	**SN_S18**	**SN_B06**	**SN_S06**	**SZ_B18**	**SZ_S18**
Total Cost per kg	**3,19**	**3,23**	**3,32**	**3,28**	**3,77**	**4,72**
Hatchery	0,06	0,06	0,06	0,06	0,06	0,06
First farm (juvenile seller)			0,44	0,44		
Farm	2,66	2,70	2,35	2,31	2,97	3,93
Trader (transportation)	0,47	0,47	0,47	0,47	0,74	0,74
Alternative transport	0,15	0,15	0,15	0,15	0,23	0,23
Operating Cost	**2,58**	**2,72**	**3,01**	**2,94**	**3,05**	**3,83**
Operating Cost - transport	**2,10**	**2,24**	**2,54**	**2,46**	**2,31**	**3,09**
Import Parity Price						
CIF ($/kg)	3,40					
Exchange rate (AZN/$)	0,80					
CIF (AZN/kg)	2,73					
Customs duty (USD/unit live)	0,50					
Import tariff and VAT	0,97					
Handling and transport to Baku	0,55					
Unexplained transactions costs	1,26					
Wholesale (AZN/kg)	5,50					
Consumer (AZN/kg)	5,85					
Financial Profit	**2,31**	**2,27**	**2,18**	**2,22**	**1,73**	**0,78**
Financial Operating Profit	**2,92**	**2,78**	**2,49**	**2,56**	**2,45**	**1,67**
Economic Profit	**0,13**	**0,08**	**0,02**	**0,04**	**-0,47**	**-1,42**
NPC, output	1,68	1,68	1,68	1,68	1,68	1,68
NPC, tradable inputs	1,01	1,01	1,02	1,01	1,01	1,01
Value Added Domestic Prices	4,40	4,58	4,18	4,65	4,86	4,85
Value Added in World Prices	2,19	2,36	1,98	2,43	2,64	2,63
EPC	2,01	1,94	2,11	1,91	1,84	1,84
Cost of Non-tradables	2,06	2,28	1,96	2,40	3,11	4,05
DRC	**0,94**	**0,97**	**0,99**	**0,99**	**1,18**	**1,54**
DRC w alternative transport	**0,80**	**0,84**	**0,84**	**0,86**	**0,99**	**1,33**

suggests that carp production is less reasonable economically for the Sheki/Zagatala region. This may be because the Salyan/Neftchala region is generally more suitable for aquaculture because it is somewhat saline.

Third, the DRCs are consistently lower for large farms rather than for smaller ones although the difference is not great. This difference is to be expected because of economies of scale, for instance in the cost of digging out ponds.

Fourth, there does not seem to be an advantage in some farmers or hatcheries raising small fry to the juvenile stage and then selling them to large fish farms, which raise them to adults. Profits are slightly lower and the DRCs are higher with these value chains in comparison with those that are integrated.

In the course of the work it was found out that transport costs could play a very important role in reducing the DRC. Usually the traders carry the fish to market with two types of trucks: (1) a medium-sized truck which has the capacity of carrying up to 600 kg of live fish, and (2) trucks of larger size which can carry 2 tons of live fish. The average per kg costs with medium-sized trucks amount to 47 qapiks, whereas the costs with the larger sized trucks reduce to 15-16 qapiks per kg. When the cheaper transportation is introduced into the analysis, there is considerable improvement in the DRC. However, there is almost no competition between medium and large-sized transport facilities for three reasons First, both types of the traders profit from the activity and they do not bother about leaving the business since the profit is quite high. Second, there are not many traders who own large-sized trucks to carry the fish and these trucks are not readily available to buy. Therefore, even if the traders want to upgrade to larger and cheaper means of transportation, it is not easy. Finally, the larger lot of fish carries a higher degree of risk for the traders. If not sold in time, the fish could spoil, and it takes longer to assemble a full load of fish with the larger trucks. If production expands, however, this could result in a reduction in transport costs and greater economic as well as financial profitability.

There is one issue of particular interest in the results, which is that the EPC is higher than the NPC in all cases. This shows that output has more protection than the tradable inputs of carp aquaculture. This means that value added is more highly protected than final output. However, the inputs of carp aquaculture do not yet include specialized fish feed, which is more highly protected than most other inputs and could result in a decline in effective protection relative to nominal protection.

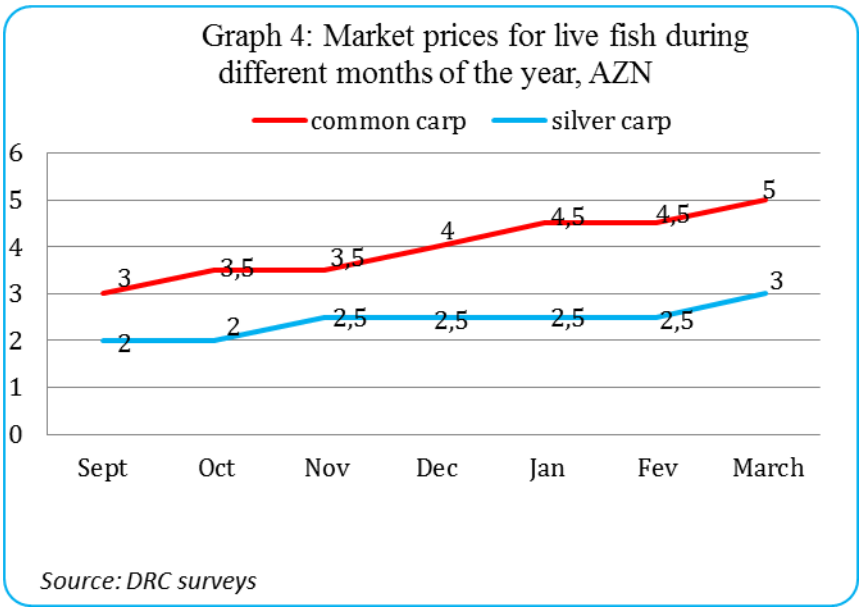
5.1.2 Results for Better Management and Investment in New Technology

There are several simulations that were performed to see the effects of better management and investment in new technology.

5.1.2.1 Timing of sales

One set of management problems is related to early sales of products. Most farmers sell their products during the September – November period, when competition is strong. One reason for this is that most farmers borrow a certain amount of money during the year (usually to buy feed) to be paid back during the harvest season. Therefore they try to sell the product quickly to repay their debts and loans. Traders take advantage of this and offer relatively low prices to farmers who owe them money. In addition, the market is relatively saturated at this time so that prices or lower. Farmers without financial and other obligations may store the product till the end of December or later and sell for a better price.

Surveys also demonstrate that in order to diversify their holiday menus, people tend to buy more fish around the New Year and Novruz holidays. There is increased demand at this time and prices rise by 30-40%. This is a lost opportunity for farmers who sell their product ahead of time. Graph 4 shows the progression of prices over time. Encouraging fish to be held off the market would help to lessen this seasonal variation.



Another reason for early sales lies in the belief that keeping fish in the ponds as their temperature declines could cause a loss in weight. This might be compensated, however, by the rise in prices The analysis of some of the records of one of the farmers interviewed reveals quite interesting results (see Table 5). According to this information, carp and silver carp fish stored until March have higher profitability compared to the sales of the same fish earlier in the season.

Although this is just one observation, it clearly shows that, in addition to the gain from the price increase, this farmer did not suffer from a weight decrease, and actually there was a slight increase in the weight of the fish he sold during March compared to his previous sales. This may be due to the climate of the region, where winter weather is relatively mild, so fish kept in ponds preserve their weight. As seen from the table, the farmer initially marketed heavy fish (1.4 kg) between December 17 and 20, while keeping relatively small ones for the later period. His revenues out of stock sold in March were high due to the price increase. If he had kept more stock until March, his overall revenue would have been even higher.

Table 5: Analysis of Periodic Sales of a Farm in Salyan Region

Day, mo, year	Carp sold (kg)	Carp sold, units	Average weight of 1 unit	Average price per kg (AZN)	Weight gain (loss) compared to previous obs., kg	Price change compared to previous obs., AZN
17.12.2010	1495	1054	1.418	4.34		
18.12.2010	900	633	1.421	4.39	+0.03	+0.05
19.12.2010	797	580	1.374	4.21	-0.047	-0.18
25.12.2010	1471	1240	1.186	4.38	-0.236	+0.10
26.12.2010	2029	1827	1.110	4.22	-0.076	-0.16
27.12.2010	236	207	1.140	4.32	+0.03	+0.10
28.12.2010	778	732	1.062	4.31	-0.078	-0.01
17.03.2011	944	871	1.08	5.50	+0.018	+1.19
18.03.2011		959		5.20		

5.1.2.2 Improved feeding and milling of improved feed

Using the technical input-output relations in a report by a local ichthyologist[23], the impact of improved feeding on aquaculture growth was analyzed within the DRC framework. There are several things we need to account for in this analysis. First, the improved feed makes it possible to increase the density of fish in the pond several times by making more efficient use of the available feed. This is actually where the benefits of the improved fish feed come from, since decreasing capital and other fixed costs per kg of production should make it possible to achieve a decrease in the DRC. However, increasing density also results in new problems and costs. For example, increasing density requires more cleaning of the pond and definitely more oxygenation. We can therefore expect increasing density associated with more efficient feeding to be subject to diminishing returns after a point of maximum profit. The simulation analysis shown below suggests that there is little gain in the DRC beyond a density factor of 4. During the interviews, some farmers claimed that more density makes the outer body (scales) of the fish degrade easily. Ichthyologists do not recommend exceeding a density of 3 under these conditions, so we have used a density of 3 in the analysis of improved feeding in Salyan and Neftchala, which is shown in Table 6.

[23] Azerbaijan Competitiveness and Trade (ACT) Project, "Production and Marketing of Compound Fish Feed for Cyprinid Family Fish Farming," prepared by Sabir Ganizade, 2010.

Table 6: DRC Analysis of Improved Carp Feeding and Feed Production

Region	Improved Feeding Salyan/Neftchala		Feed Production Sheki
Value chain	**SN_FB06**	**SN_FS06**	**Feed**
Total Cost per kg	**3,09**	**3,49**	**0.772**
Hatchery	0,06	0,06	
First farm (juvenile seller)	0,44	0,44	
Farm	2,12	2,52	0.622
Trader (transportation)	0,47	0,47	0.150
Alternative trader	0,15	0,15	
Operating Cost	**2,92**	**3,30**	**0.763**
Operating Cost - transport	**2,44**	**2,83**	**0.613**
Import Parity Price			
CIF ($/kg)	3,40		0.980
Exchange rate (AZN/$)	0,80		0.800
CIF (AZN/kg)	2,73		0.784
Customs duty (USD/unit live)	0,50		0.357
Import tariff and VAT	0,97		0.280
Handling and transport to Baku	0,55		0.078
Unexplained transactions costs	1,26		0.000
Wholesale (AZN/kg)	5,50		1.142
Consumer (AZN/kg)	5,85		0.800
Financial Profit	**2,41**	**2,01**	**0.028**
Financial Operating Profit	**2,58**	**2,20**	**0.037**
Economic Profit	**0,16**	**-0,12**	**0.101**
NPC, output	1,68	1,68	1.341
NPC, tradable inputs	1,02	1,02	1.051
Value Added in Domestic Prices	4,09	3,83	472
Value Added in World Prices	1,89	1,65	222
EPC	2,16	2,33	2.124
Cost of Non-tradables	1,74	1,76	155
DRC	**0,92**	**1,07**	**0.698**
DRC w alternative transport	**0,75**	**0,88**	

This analysis indicates a slight improvement in profitability and in the DRCs. The reason why this increase is not greater is that most of the benefits are in the fuller use of capital invested in

ponds and other fixed assets, but these costs are not very important relative to operating costs, which tend to be proportional to the number of fish. This does not mean that the owner is not better off, however, because his or her total profit is also in proportion to the number of fish.

Table 6 also shows the production of feed to be quite profitable. To a large extent this is true because most of the feed inputs are produced locally and do not have to pay customs duty or value added tax. Financial profits are relatively low because the feed is assumed to be sold to fish farmers at 800 AZN per ton, which is in line with its costs. However, if the feed were sold at the prevailing wholesale price of imported feed, profits would be significantly higher – about 370 AZN per ton. The economic profit already reflects this higher price, which is the CIF price adjusted for transport and handling – equal to 859 AZN per ton.

5.1.2.3 Improved hatcheries

Arguments for improved hatcheries are not completely justified by the current analysis. The problem, as stated earlier, is that very high loss rates from small fry are not solely the result of poor hatchery management, but are also due to poor farm management. If farmers took better care of their small fry, they would reduce their losses and have more fish.

The new hatchery in Zagatala suffered from a sudden decrease in demand following the issuance of a Cabinet instruction in May 2011 prohibiting fish farming on land reserved for other purposes. This resulted in significant losses because many of the fry that were produced could not be sold. However, this hatchery has higher costs per kg of produced carp even when its full capacity is being utilized (8-9 qapiks), compared with the costs of the traditional hatcheries (6 -7 qapiks), and the loss rates are the same from the small fry as reported by the new hatchery owner. For the advantages of modern over traditional hatcheries to become apparent, the modern hatcheries, with their improved capacity and resources, would have to keep their fry for extended periods of time (up to 30 days) under a better feeding regime, in which case survival rates would be much higher.

5.1.2.4 Market limitations

Improved feed and holding by hatcheries of fry for longer periods of time will reduce losses and increase the density of fish in existing ponds and of those still to be constructed. Since existing feeding practices are not very sophisticated, the potential for expansion is quite large. In addition, as long as financial profits are relatively high, farmers can be expected to increase their investment in fish ponds. All of this will increase substantially the quantity of warm water fish on the market. The question is how well the market will absorb this increase without a substantial decline in price.

Carp is for the moment essentially an import substitution product. Most countries try to have their own carp production so it is difficult to export unless one has a substantial price advantage, which Azerbaijan does not have at this point. There is not much international trade in carp so competition is mostly with other species that are imported. As described elsewhere in this report, the market for fish in Azerbaijan is highly fragmented, with open-air bazaar sales of live warm water fish during the colder months, and fish shop and supermarket sales of frozen, previously frozen, and processed imported fish year round. There are significant barriers to local fish penetrating the market outside of the bazaars because of the Caspian Fish Company's monopoly

on that market. Without a breakdown in those barriers, the market for warm-water carp is limited to the bazaars.

What is the projected rate of expansion of this market? This will depend primarily on growth of the population and growth of per capita income. Population is growing about 1.3% a year. Per capita income is growing at about 3.7% annually. Taken together, this implies a 5% annual rate of growth of total income at the present time. Although this growth may accelerate, it is highly unlikely that it will revert to the very high rates of growth that characterized the period from 2005 to 2007.

The growth in demand for fish depends not only on the growth of income but also on the income elasticity of demand. Although we have no precise estimates for Azerbaijan, it is possible to borrow from the experience of other countries. Asche and Bjorndal (1999), of the International Food Policy Research Institute, in their research across countries find that the income elasticity of demand for fish to be usually between 1.0 and 1.2.

Using these estimates of the income elasticity of demand and the projections of income growth shown above, we can estimate the growth in the demand for fish in the next few years to be about 5-6% per year. Assuming that the total supply of fish in the green market is about 16,000 MT from Section 2.2.1 above, which is an upper limit, this implies that the market will be able to absorb about 2,000 MT of additional fish by the end of the next 5 years without any change in prices. If aquaculture production does not grow any faster than this in absolute terms, there should be no problem. However, if production should double over the next five years because of improved feeding and expansion of pond surface area, then some downward pressure on prices would be felt. A doubling of production at a constant rate over the next five years would imply that the market would have to absorb over 6,000 MT of additional fish. Since growing population and income would absorb less that 2,000 MT, supply would exceed demand, and the price of fish would be expected to fall. By how much depends on the price elasticity of demand.

Asche and Bjorndal (1999) report that that the demand for aquaculture products is sensitive to their own prices. They estimate the price elasticity of demand for fish products to be from -.7 to -1.5. Economic profits and the DRC will not be influenced by an expansion in supply because they depend only on world market prices, which are not affected by what goes on in Azerbaijan -- at least as long as fish continue to be imported. But domestic prices are affected because import protection acts as a quantitative restriction, which does not let world prices pass through without change. Assuming the price elasticity of demand equals unity, the price of fish would have to fall by about 20-25% in order to absorb the surplus. Financial profits would be cut in half for even the best farmers; others might find themselves out of business. This would hurt smaller carp farmers, especially in the north. It would also hurt those who fish by other means and try to sell their fish, since they would have no increases in efficiency to cushion the blow, as would the more progressive fish farmers. However, many of these people are probably fishing for their own family consumption and to that extent are not affected by price movements.

The caveat, here, is the assumption that there are about 8,000 MT of fish capture that are unaccounted for. If this is wrong and the total market size for aquaculture is only about 8,000 MT, then the situation is much more serious. Demand in this case will only be growing at a rate

of over 400-500 MT per annum, which will allow for only about a 7-8 % per annum rate of expansion of aquaculture production before prices start to fall. If growth of supply is at 20% per annum instead, an additional 700 to 800 MT of fish will have to be absorbed in the first year and more thereafter. This will require a 12-13% annual decline in price. The effects of such a price drop on the subsector would be catastrophic. The only way to avert this would be to open up the market to a much greater extent so that local fish could substitute for imports. This possibility is discussed below.

5.2 Trout

Table 7 gives the results for trout production in the north. Each of the farms for which data are available is presented in three scenarios. The first uses a feed conversion ratio (FCR) of 2.0, which is considerably higher than what appears to be the average ratio of 1.32 but nevertheless is experienced by some farmers.[24] The second scenario applies the average FCR of 1.32. The third scenario uses the FCR of 1.32 but includes the annualized cost of capital expenditures made more than 20 years ago, which are assumed to be written off in the first two scenarios.

The results vary substantially by size of fish farm. The larger farm, which is relatively state-of-the-art, is profitable both financially and economically. Its DRC is 0.51 even with a FCR of 2, which is well below one and suggests a strong comparative advantage. The results for the smaller fish farm are not very good. Both financial and economic profitability are negative, and the DRC indicator is 2.44, which suggests a strong comparative disadvantage. When the FCR is raised to the average ratio of 1.32, however, the results for the small farm improve considerably. Even though economic profitability remains negative, financial profitability is positive and the DRC is closer to one. This suggests the importance of farmers having access to quality trout feed and employing the management practices that will make best use of it. Although the scale of operations may have something to do with the difference in profitability between these two sizes of farms, it is likely that larger scale is also associated with better management.

The third scenario looks at the effect of including all capital costs regardless of whether or not the service life of a structure has expired. This is done to examine the argument that trout production is profitable primarily because the farms have taken over the old structures that existed in the Soviet era and have consequently not had to invest as much today. Table 3 suggests this is not the case. The results are pretty much the same under this scenario as when these capital costs are written off.

One reason why small farmers may operate even with negative profits is if they are able to cover their operating costs. Table 7 suggests that this is usually the case. Furthermore, lowering transport costs improves both financial and economic profits, as well as the DRC, especially for the smaller farmers.

[24] Ratio of kilograms of feed to kilograms of fish. The average FCR of 1.32 was calculated from the BIC survey. USAID/ACT Project, *Aquaculture Market Research,* p. 35.

Table 7: DRC Analysis of Trout Production

Region	Sheki/Zagatala					
Farm Size	Small	Large	Small	Large	Small	Large
Number of hectares	1.9	6.0	1.9	6.0	1.9	6.0
Feed Conversion Ratio	**2:1**	**2:1**	**1.32:1**	**1.32:1**	**1.32:1**	**1.32:1**
Total Cost per kg	**13.17**	**6.24**	**9.00**	**4.42**	**9.90**	**4.84**
Hatchery	0.39	0.39	0.39	0.39	0.56	0.56
Farm	12.28	5.35	8.10	3.53	8.84	3.78
Trader (transportation)	0.50	0.50	0.50	0.50	0.50	0.50
Alternative trader	0.15	0.15	0.15	0.15	0.15	0.15
Operating Cost	**11.16**	**6.02**	**7.66**	**4.27**	**8.56**	**4.69**
Operating Cost - transport	**10.66**	**5.52**	**7.16**	**3.77**	**8.51**	**4.19**
Import Parity Price						
CIF ($/kg)	7.267					
Exchange rate (AZN/$)	0.803					
CIF (AZN/kg)	5.835					
Customs duty (USD/unit live)	0.500					
Import tariff and VAT	1.524					
Handling and transport to Baku	1.167					
Unexplained transactions costs	3.473					
Wholesale (AZN/kg)	12.000					
Consumer (AZN/kg)	12.000					
Financial Profit	**-1.17**	**5.76**	**3.00**	**7.58**	**2.10**	**7.16**
Financial Operating Profit	**0.84**	**5.98**	**4.34**	**7.74**	**3.44**	**7.31**
Economic Profit	**-5.22**	**2.07**	**-1.38**	**3.45**	**-2.24**	**3.00**
NPC, output	1.72	1.72	1.72	1.72	1.72	1.72
NPC, tradable inputs	1.27	1.47	1.26	1.45	1.21	1.40
Value Added in Domestic Prices	7.74	7.96	9.06	9.21	8.53	8.98
Value Added in World Prices	3.63	4.23	4.65	5.06	4.13	4.82
EPC	2.13	1.88	1.95	1.82	2.07	1.86
Cost of Non-tradables	8.86	2.16	6.02	1.61	6.37	1.77
DRC	**2.44**	**0.51**	**1.30**	**0.32**	**1.54**	**0.37**
DRC w alternative transport	**2.29**	**0.45**	**1.22**	**0.28**	**1.44**	**0.32**

6 Conclusions and Recommendations for Next Steps

There are a number of important conclusions and recommendations that can be drawn from this analysis. One positive conclusion is that Azerbaijan appears to have a comparative advantage in carp and trout aquaculture for the local market, given its suitable soils and supplies of water. In addition, per capita consumption of fish is only about one-sixth of the world average so there is room for long-term expansion. No assessment has been made of export potential, but exporting fish from Azerbaijan, except for the niche caviar market, does not seem likely in the near future. Despite this generally favorable prognosis, there are number of things that need to be done to assure that this potential is realized

6.1 Market limitations

There is an urgent need to conduct a careful assessment of the size and growth of the existing market for carp and for trout.

The greatest uncertainty is the size of fish capture outside of aquaculture. In particular there are important disparities between the results of household surveys and what is known about actual fish capture. The surveys suggest that actual fish consumption is much larger that the consumption derived from estimates of fish availability. If the consumption surveys are correct, there is some breathing room; if the estimates of availability derived from expert knowledge of the sources of supply are correct, a marketing crisis may be immanent.

The short-term domestic market prospects for these fish are much less apparent than the long-term potential. Carp are primarily sold live in the bazaars; most trout are sold directly to hotels and restaurants. How many more fish can be absorbed by these markets without a significant fall in price is unknown. There is very little room to substitute domestic production for imports of live or fresh fish given the small magnitude of the latter. If carp and trout could be processed for sale in fish stores and supermarkets, where they would compete with imports, the possibilities for expansion could be increased, but there are important barriers to entry into these markets, as discussed in the next section. A decline in price is therefore highly likely unless there is a large unknown fish capture for which aquaculture production can be substituted.

The monopoly situation in Azerbaijan's fish industry needs to be understood and options for making the industry more competitive need to be explored by the Government. The ACT project should approach the Caspian Fish Company regarding the possibility of their buying local fish on condition that quality standards be maintained and supply regularity be assured, both activities in which the ACT project can provide assistance.

The possibility exists of extending the market for carp and trout through processing, which would enable sales to reach into the higher-tiered shops and supermarkets, but this depends on the willingness of the Caspian Fish Company either to allow more competition or to buy local fish for its own processing facilities, something it has so far been unwilling to do. Ultimately this is a policy distortion arising from lack of an effective competition policy and from the barriers that exist to fish imports, which permit fish to be sold domestically at relatively high prices, thus inhibiting expansion of demand and strengthening monopoly profits. If the market for fish is to expand, either this policy distortion must be removed or the Caspian Fish Company must agree to start buying local fish for its processing facilities.

6.2 Improved management

The economics of holding fish deeper into the winter need to be studied.

Data were presented earlier suggesting that carp could be profitably held for some time during the winter and that their weight loss would be more than compensated by the gain in prices at which they could be sold. This needs to be verified and farmers need to be advised of the results. In addition, efforts should be made on the financial side to help farmers bridge this period.

6.3 Improved feed

The Government should take steps to facilitate the importation of quality fish feeds and their ingredients, as well as other inputs into the aquaculture industry.

The ACT project and USAID should move forward to provide grants for the upgrading of the selected feed mill in Salyan and the carp hatchery in Neftchala. They should also provide assistance as necessary to the feed mill in Sheki and the carp hatchery in Zagatala to assure that they are able to operate efficiently and produce the products that are most profitable for the farmers.

After a segmented market, the second most important problem in Azerbaijan's aquaculture subsector is lack of good sources of quality feed. Most farmers are well aware of this and would be willing to buy good fish feed if it were available. USAID's ACT project is currently helping to design an improved mill for producing carp feed in Salyan. The financial and economic profitability of mill fish feed, as well as that of using the products of this milling, have been analyzed as part of the DRC analysis. They will be profitable both financially and economically. The owner of another mill in Sheki is planning on using his mill to produce trout as well as carp feed. Most of the equipment has already been installed, including an extruder. This mill and its products should also be the subject of DRC analysis.

6.4 Hatcheries

The other key investment that should be promoted at this time by the ACT project is the improvement of a carp hatchery in Neftchala.

Upgrading this facility will enable young fry to be retained for longer periods of time until they are sold. This will greatly increase their survivability. In addition, expansion of the hatchery will allow it to retain young fry until they become fingerlings weighing 50 to 150 grams each. This will shorten the time required by fish farmers for them to reach maturity, which will decrease the need for working capital and increase annual profits, though it may not increase profits per kilogram of fish, according to the DRC analysis. The viability of this improved hatchery as well as of that of the carp hatchery in Zagatala, which was built under the PSECP project, will depend on their being able to reach full capacity utilization. This will require the Government reducing uncertainty associated with land use rights.

6.5 Increasing the Efficiency of Trout Production

The results for trout production suggest that there are substantial profits to be made through investment to increase feed efficiency and better manage existing fixed resources.

Improving feed conversion ratios will require better quality feed, either imported from other countries or produced domestically, as well as better fish management. This is especially important for smaller trout farmers, who appear to be quite unprofitable with fish conversion ratios of 2 or above. Some of the infrastructure used for trout production was inherited from the Soviet era and is not the most suitable. However, any investment in new, improved facilities should be undertaken only after a thorough cost-benefit analysis, including a market analysis. Other, less expensive, means of increasing production need to be investigated, especially those that would enhance productivity with existing physical structures and equipment.

6.6 Processing

There is a need to explore possibilities for small-scale fish processing, assuming that problems of competition with the Caspian Fish Company can be resolved.

Possibilities include cleaning, filleting, drying, smoking, canning, freezing, and placement in vacuum packing. Much of this processing can be fairly simple without requiring a lot of expensive machinery.

6.7 Land Access

It is urgent that the instruction issued by the Cabinet in May 2011 regarding the use of land for aquaculture be reconsidered. If the Law of 1998 is to be implemented, then the process of registering land for aquaculture should be streamlined and the cost should be minimized.

The most damaging policy constraint for the aquaculture subsector is the instruction issued by the Cabinet in May 2011that prohibits the use of land in the regions around Zagatala for aquaculture without full documentation. Not only has this resulted in losses of more than 800,000 AZN, but it also has led to considerable apprehension on the part of fish farmers as to their ability to continue engaging in aquaculture without going through the currently onerous process of obtaining the right to use their land for fish farming. The DRC analysis presented in this report suggests that investment in aquaculture in the north may not be as profitable as in the south, but restricting those who have already made such investments is wasteful and does not necessarily lead to better decision making. Instead, the options that exist for the use of this land should be studied carefully and farmers advised accordingly. This is especially true for low-lying areas in the north that may not be suitable for other forms of agriculture.

6.8 Unnecessary Transactions Costs

Efforts currently being pursued to identify specific unnecessary transactions costs associated with the importation of fish and aquaculture inputs should be pursued and appropriate action should be undertaken to eliminate these.

The effect of excessive charges, delays, and uncertainties related to imports of fish-farming inputs is to raise their cost to fish farmers, millers, hatcheries, and others involved in the aquaculture subsector and , as we have seen, to lower the quality of these inputs. Although Azerbaijan should be able to supply most of these inputs internally, there are still a few critical inputs such as fish eggs, feed ingredients, medicines, etc., that must be purchased from abroad.

Barriers and high transactions costs in the importation of fish raise prices to consumers tend to encourage wasteful allocation of resources in production. Although this may make aquaculture more profitable in financial terms, it is wasteful and potentially unsustainable over the longer run.

6.9 Water Charges

The fees charged to fish farmers for water should be harmonized and the subsidies on water offered to wheat and other crop farmers should be eliminated in order to conserve water for aquaculture as a more profitable use. Water user associations may have an important role to play in eliminating these distortions

The heavy subsidy on the use of irrigated water for crop cultivation relative to the cost of water for aquaculture is a policy distortion that is severely constraining the expansion of the more financially and economically profitable aquaculture subsector, especially in the south. DRC analysis undertaken under USAID's PSCEP project showed that Azerbaijan does not generally have a comparative advantage in growing wheat and barley, whereas aquaculture does have such an advantage, so encouraging the former relative to the latter clearly is inefficient.

6.10 Unofficial Payments

The prevalence of unofficial payments for the establishment and operation of fish farms needs to be addressed as part of the overall drive to decrease corruption in Azerbaijan.

Farmers and traders pay substantial sums to the police and other public officials in order to establish and operate their farms. This creates an important disincentive, which distorts the allocation of resources and results in underinvestment in aquaculture.

6.11 Reducing Cost of Transportation and Marketing of Fish

Options for reducing the cost of transport and for prolonging the period over which fish can be marketed through refrigeration and processing should be explored.

The DRC analysis has shown that it is possible to greatly reduce costs of transporting fish to market by using larger trucks. The possibility of doing this should be explored. There is a need for investment in refrigerators, cold storage, refrigerated trucks, and processing facilities. The profitability of all these investments should be evaluated using DRC analysis once their costs are known.

Annex A: Technical Description of DRC Methodology

This annex briefly sets out the basic theory underlying the DRC/NPC/EPC models, followed by a discussion of how that theory has been applied in a number of countries using the IMPACT model or a variation thereof.[25] Appendix I to the annex provides an example of the use of the IMPACT model for aquaculture production of carp and transportation from Salyan/Neftchala to Baku.

DRC/NPC/EPC Model

The concepts of domestic resource cost and nominal/effective protection, as well as the relationships between these concepts, are well established in the literature (Bruno, Krueger, Corden, Pearson, Page and Stryker, Pearson and Monke, Tsakok). What follows is a brief review of these concepts coupled with a discussion of some important aspects that have received little attention until recently.

Domestic Resource Cost

Domestic resource cost (DRC) is an indicator of the efficiency with which a country's factors of production (land, labor, and capital) are converted into useful output. More precisely, we define the DRC for a given economic activity as the ratio of the economic opportunity cost of the domestic, non-tradable[26] resources used in the production of output j to the value added that is created measured in world market prices.

$$DRC_j = \frac{\Sigma f_{sj} P_s^*}{P_j^* - \Sigma a_{ij} P_i^*} \quad \ldots (1)$$

where

[25]These countries include Algeria, Bangladesh, Burundi, Côte d'Ivoire, Ghana, Guinea, Iraq, Jordan, Liberia, Madagascar, Mali, Morocco, Nigeria, Rwanda, Senegal, and Tunisia.

[26] Non-tradable resources are those whose prices vary domestically depending on supply and demand. Tradable resources, on the other hand, are those whose border prices (FOB and CIF) are determined by the world market. Although the domestic prices of tradables can vary from their border prices because of tariff and nontariff barriers to trade, changes in domestic supply and demand do not normally result in movements in the prices of tradables unless these changes lead to the cessation of trade.

f_{sj} is a technical coefficient relating non-tradable primary factors (land, labor, capital) to output j,
P_s^* is the economic opportunity cost of non-tradable factor s,
P_j^* is the world market price of tradable output j,
P_i is the world market price of tradable intermediate input i,
a_{ij} is an technical coefficient relating input i to output j

An alternative to the DRC measure is net social, or economic, profitability (NSP), obtained by subtracting the numerator from the denominator of equation (1).

$$NSP_j = P_j^* - \Sigma a_{ij}P_i^* - \Sigma f_{sj}P_s^* \quad \text{... (2)}$$

This indicator is expressed in units of output, however, which prevents comparisons being made of the relative profitability of activities involving different products. The DRC is a ratio, on the other hand, which expresses the amount of gain that can be achieved per unit of scarce domestic resources. The lower the DRC, the more efficient is the activity that it represents.

A corresponding measure of financial profitability is obtained by expressing all prices in financial or domestic market terms. In the absence of monopoly, externalities, or other market imperfections, the economic opportunity cost of a resource differs from its financial cost in that the former is exclusive of indirect taxes or subsidies, such as the value added tax and import duties, whereas the latter includes these taxes and subsidies. Economic cost and profit, or comparative advantage, exclude the influence of indirect taxes and subsidies; financial cost and profit are inclusive of these. World market prices exclude taxes and subsidies and thus are used to calculate economic profitability; domestic prices include taxes and subsidies and are used to calculate financial profitability.

If there are intermediate inputs that are non-tradable, these are broken down into their tradable intermediate input and non-tradable primary factor components. This assumes that the non-tradable intermediate inputs are produced at constant costs so that it is appropriate to break them down using the existing input-output structure of the supplying industries. The numerator of the DRC given in equation (1) thus represents the opportunity cost of all non-tradable primary factors employed both directly in the production of output j and indirectly in the production of inputs used in the production of j. Similarly, the denominator equals the value of output less the value of direct and indirect tradable inputs. [27]

The distinction between tradables and non-tradables is critical to the analysis. The basic distinction is that tradables are obtainable from the international market at constant prices whereas non-

[27] This is according to the Corden method of dealing with non-tradable intermediate inputs. It requires a reasonably up-to-date and accurate input-output table, where industry branches are defined at a fairly high level of detail. Such does not exist in Mali. Consequently, the Balassa method was used as an alternative. This method assumes intermediate inputs to be completely tradable if most of the inputs used in their creation are tradable; otherwise the intermediate inputs are assumed to be non-tradable. As an example, transport is assumed to be tradable because trucks, fuel, oil, and spare parts, which constitute the most important inputs, are all tradable. Other tradable inputs include fertilizer and phyto-sanitary products. Labor, locally produced equipment, irrigation infrastructure, and most other inputs except for the above are assumed to be non-tradable. In practice, the choice of methods for treating non-tradable intermediate inputs does not make much difference for the results of the analysis.

tradables are available only at prices that rise as the aggregate quantity used increases. Non-tradables thus act ultimately as the constraints on economic production. In the absence of monopoly, externalities, or other market imperfections, economic efficiency implies the maximization of value added measured in world prices subject to these constraints.[28]

The difference between tradables and non-tradables is also critical insofar as the exchange rate is concerned. Both numerator and denominator of the DRC are given in the same currency by multiplying the latter by the economic opportunity cost of foreign exchange, or the shadow exchange rate, which expresses the marginally efficient rate at which non-tradable primary factors of production may be transformed into tradable value added. Multiplying the denominator of the DRC by this rate converts the shadow prices of tradable outputs and inputs, expressed in foreign currency, into their opportunity cost at the margin in terms of domestic factors of production. Once this is done, the numerator and denominator of the DRC may be compared to see whether activity j is more or less efficient than the activity that, at the margin, is just efficient. If the DRC is less than one, the domestic resource cost per unit of value added is less for activity j than for the marginally efficient activity, so the country has a comparative advantage in activity j. If the DRC is greater than one, the opposite is true and the country does not have a comparative advantage. Alternatively,

If DRC < 1, there is a comparative advantage because the value of the domestic resources used to create a given value added in world market prices is less than that value added. The activity is therefore economically profitable and efficient.

If DRC > 1, there is a comparative disadvantage because the value of the domestic resources used to create a given value added in world market prices is greater than that value added. The activity is therefore economically unprofitable and inefficient.

Nominal and Effective Protection

While the DRC indicator is related to the theory of comparative advantage, nominal and effective protection refers to the structure of incentives involving international trade (import duties, export taxes, quantitative restrictions on imports, etc.). Nominal protection may be measured either as the nominal protection coefficient ($NPC = P_j/P_j^*$) or as the nominal rate of protection ($NRP = NPC - 1$), where P_j is the domestic price of output j. These indicators measure the degree to which consumers are either taxed or subsidized by trade policy. If the NPC is greater than one (NRP>0), they are being taxed because they are paying prices which are higher than those paid on the world market; if the NPC is less than one (NRP<0), they are being subsidized vis-à-vis the world market.

Effective protection measures incentives that affect the prices of both outputs and inputs, and is therefore a better indicator of protection offered to producers. The effective protection coefficient (EPC), which measures value added in domestic prices relative to value added in world prices, is given by

[28]This is analogous to the standard linear programming problem. Whereas inputs purchased on the market at constant prices (tradables) form columns of the LP matrix, inputs that are either fixed in supply or are available only at rising prices (non-tradable factors of production) are included as rows. The LP problem is to maximize the weighted sum of the columns subject to the row constraints.

$$EPC_j = \frac{P_j - \Sigma a_{ij} P_i}{P_j^* - \Sigma a_{ij} P_i^*} \quad ...(3)$$

The effective rate of protection is obtained from this by subtracting one (ERP = EPC - 1). If the EPC is greater than one (ERP>0), producers receive positive incentives vis-à-vis the world market; if EPC<1 (ERP<0), then producers receive negative protection. The denominator of the EPC is the same as that of the DRC if each is measured at the shadow rate of exchange.

Implementation Using the IMPACT Template

The Integrated Model for Policy Analysis Computer Template (IMPACT) was developed as a standard tool for conducting DRC/NPC/EPC analysis. A separate model is constructed from the common template for each production/marketing/processing/ manufacturing activity which is defined with respect to product, technique, and location of production and consumption.

Organization of the Template

The template is used with an Excel electronic spreadsheet and is divided into four basic parts. The first presents a series of key parameters, such as the interest rate on capital and the world market price on output. The parameters can be easily changed for sensitivity analysis.

The second part of the template provides data on quantities of inputs and outputs, their unit prices, the financial cost of the inputs delivered to the producer, and the breakdown of these costs into the economic cost of the inputs, and taxes and subsidies on tradables and non-tradables. The economic cost is, in turn, divided into its tradable and non-tradable components, the latter including labor and capital, and, where relevant, land. Each of these variables is added across inputs to derive total costs and its components at the production, processing, and trading stages.

A third area of the template is used to calculate the parity price of tradable outputs. Starting with the world price, adjustment is made for quality differences and for freight costs to obtain the relevant border price, either FOB or CIF. Conversion to local currency is made at the official exchange rate. The border price is then adjusted for trade taxes and subsidies, handling, and delivery charges, and transport costs to the point at which the calculations are made. For imports, this may be a major wholesale market or a rural market or assembly point. In calculating the indicators for an import substitution activity, adjustment is made for the savings not only in the CIF value of imports but also in the cost of delivering those imports to the point of consumption. For exports, on the other hand, the frontier is the point at which domestic production competes with the world market. Ideally this is the FOB price, but in some cases it is the wholesale price at the destination point.

The fourth area of the template shows the calculations of nominal and effective rates of protection and of the domestic resource cost ratio.

Uses of Impact

IMPACT has proven to be a highly versatile tool of analysis. One of its main advantages is that it combines a variety of different types of data in one spreadsheet. For example, data on yields, labor times, and input prices and quantities are often available from surveys and information gathered by extension agents. Costs of processing, transportation, and marketing can frequently be obtained from feasibility studies and other project documents, as well as specific surveys. Even where data on downstream activities are limited, informal interviews with a few traders and processers will usually quickly fill in the gaps.

One of its most intriguing features of IMPACT is the ease with which it permits the analyst to investigate the effect of different market locations on the profitability of production. DRCs in many countries vary enormously depending upon whether output is consumed upcountry, is consumed in the capital city, or is exported.

Another use to which IMPACT has been put is in the construction of supply functions based on either financial or economic costs as well as on additional information regarding the actual or potential relative importance of each activity in production. These are then linked to demand functions in order to determine which regions and techniques of production would be profitable in both the presence and the absence of policy distortions.

Because of IMPACT's prepackaged design and the fact that most data are either already generally available or can be obtained in a fairly short period of time through informal interviews and rapid appraisal surveys, value chain analyses using the DRC/NPC/EPC methodology can be accomplished relatively quickly

Benefits of DRC/NPC/EPC Analysis

What do we derive from DRC analysis? First and foremost, the analysis tells where the comparative advantage of a given country lies in relation to its international trade. This indicator of comparative advantage is specific with respect to product, location of production, technique of production, and destination. It can be made dynamic by focusing on current best-practice technology or on new techniques that have been identified and can be transferred to the country.

Second, the analysis tells us the extent to which the policy environment is encouraging or discouraging the exploitation of this advantage. For example, a trade regime that provides high protection to domestic industry acts to encourage production in areas of comparative disadvantage. As long as profits are to be made in heavily protected sub-sectors of the economy, high-cost investments there are likely to increase. On the other hand, if the DRCs for activities in the export sector are well below their effective protection coefficients, as is often the case, this suggests that investment there will be economically profitable. Thus DRC analysis serves as a guide to where there are policy distortions and what their effects on investment are likely to be.

Third, by eliminating the effects of taxes, subsidies, and other distortions in the economy as part of our DRC estimation, we gain a picture of what would be financially, as well as economically, profitable should these distortions be eliminated. This is always a danger. Policy environments

change – sometimes as a result of broad-based reform. Investments made in value chains that depend on subsidies and trade protection are always vulnerable to these changes.

Appendix 1: Example of the Use of the IMPACT Template

Fish (common carp) Production in Neftchala (from fry to fish - 18-24 months) and Sale in Baku

(the other fish types are included just to be able to divide the costs)

Key Parameters:	
Ratio of Shadow to Official Exchange Rate	1.00
Tax on imports, %	0.68
Cycle factor for the farm	1.00
Conversion factor from a pack of fry to kg of carp	400.00
World Price (CIF) USD/kg	3.40
Interest Rate	0.10

DRC	0.83

All these numbers represent costs for common carp solely

			Svc Life	Unit Price		Financial cost/sales/profit	Financial cost/sales/profit for carp	Taxes & Subsidies			Economic Cost		
Input	Units	Nr Units	(years)	(AZN)	Total			Total	Tradables	Nontradables	Total	Tradables	Nontradables
HATCHERY (Qasim Badalov)													
Carp fry sales out of total sales		0.92											
TOTAL COSTS						10091.5	9279.5	120.8	27.3	93.5	9158.8	2990.7	6168.0
ESTABLISHMENT (CAPITAL) COSTS						1806.5	1661.13	27.9	3.0	24.9	1633.2	1073.6	559.6
incubator		1.0	10.0	2500.0	2500.0	406.9	374.13	0.0			374.1	374.1	
flasks		30.0	10.0	40.0	1200.0	195.3	179.58	7.6	0.8	6.8	172.0	92.8	79.2
special equipment		8.0	10.0	400.0	3200.0	520.8	478.88	20.3	2.2	18.1	458.6	247.5	211.1
bath		8.0	10.0	300.0	2400.0	390.6	359.16	0.0			359.2	359.2	
other		1.0	10.0	1800.0	1800.0	292.9	269.37	0.0			269.4		269.4
OPERATING COSTS						8285.0	7618.39	92.8	24.3	68.6	7525.6	1917.2	5608.4
salaries	worker	4.0		1200.0	4800.0	4800.0	4413.79	0.0			4413.8		4413.8
medicines					2600.0	2600.0	2390.80	82.8	22.4	60.4	2308.0	1769.3	538.7
eggs	unit	450.0		0.1	45.0	45.0	41.38	0.8	0.3	0.5	40.6	15.7	24.9
maintenance					500.0	500.0	459.77	0.0			459.8		459.8
water	ha				180.0	180.0	165.52	9.3	1.6	7.7	156.2	132.1	24.1
rent					160.0	160.0	147.13	0.0			147.1		147.1
COST PER PACK (CARP)		400.0					23.20	0.3	0.1	0.2	22.9	7.5	15.4
COST PER KG OF CARP							0.06	0.0	0.0	0.0	0.0572	0.0187	0.0386
SALES						17400.0	16000.00						
fry - carp	pack	400.0		40.0	16000.0	16000.0	16000.00						
fry - silver carp	pack	10.0		60.0	600.0	600.0	0.00						
fry - white amur	pack	10.0		80.0	800.0	800.0	0.00						
PROFIT						7308.5	6720.48						
PROFIT PER PACK (CARP)	pack	400.0					16.80						
profit per pack (silver carp)	pack	10.0				25.2							
profit per pack (white amur)	pack	10.0				33.6							
FARM (Jamal Samadov + some additions from other farmers)					0.0								
Carp sales out of total sales		1.00											
TOTAL COSTS						40400.8	40400.8	752.4	197.1	555.3	39648.4	15685.1	23963.3
ESTABLISHMENT (CAPITAL) COSTS						8150.8	8150.81	84.9	9.3	75.6	8065.90	1369.22	6696.68
fish pond	ha	14.0	20.0	2000.0	28000.0	3288.9	3288.87	0.0			3288.9		3288.9
holding tank			20.0		1500.0	176.2	176.19	0.0			176.2		176.2
shed cabin			20.0		20000.0	2349.2	2349.19	0.0			2349.2		2349.2
tractor		1.0	10.0	5000.0	5000.0	813.7	813.73	34.5	3.8	30.8	779.2	420.5	358.7
mixer		2.0	10.0	3500.0	7000.0	1139.2	1139.22	48.3	5.3	43.1	1090.9	588.7	502.2
boat		2.0	10.0	300.0	600.0	97.6	97.65	0.0			97.6	97.6	
net		1.0	5.0	200.0	200.0	52.8	52.76	0.0			52.8	52.8	
electricity generators		1.0	10.0	300.0	300.0	48.8	48.82	2.1	0.2	1.8	46.8	25.2	21.5
uniform		4.0	2.0	80.0	320.0	184.4	184.38	0.0			184.4	184.4	
OPERATING COSTS						32250.0	32250.00	667.5	187.9	479.7	31582.5	14315.9	17266.6
salaries					4800.0	4800.0	4800.00	0.0			4800.0		4800.0
wheat	ton	40.0		250.0	10000.0	10000.0	10000.00	181.7	72.5	109.2	9818.3	3799.4	6018.9
barley	ton	40.0		200.0	8000.0	8000.0	8000.00	145.4	58.0	87.4	7854.6	3039.5	4815.1
electricity					200.0	200.0	200.00	11.2	1.9	9.4	188.8	159.6	29.1
lime					250.0	250.0	250.00	0.0			250.0	250.0	
medicines					250.0	250.0	250.00	8.7	2.3	6.3	241.3	185.0	56.3
water					5000.0	5000.0	5000.00	281.2	47.3	233.9	4718.8	3990.9	727.9
rent					400.0	400.0	400.00	0.0			400.0		400.0
fry - carp	unit	60.0		40.0	2400.0	2400.0	2400.00	0.0			2400.0	2400.0	
loading-unloading, transport					750.0	750.0	750.00	31.6	4.2	27.3	718.4	355.5	363.0
fuel					200.0	200.0	200.00	7.8	1.6	6.1	192.2	135.9	56.3
COST EX FRY							38000.81	752.4	197.1	555.3	37248.4	13285.1	23963.3
COST EX FRY PER KG CARP							2.71	0.05	0.01	0.04	2.7	0.9	1.7
SALES						60200.0	60200.00						
carp	ton	14.0		4300.0	60200.0	60200.0	60200.00						
PROFIT						19799.2	19799.19						
PROFIT PER KG (CARP)		14000.0					1.41						

TRADER (Afqan Karimov + some additions from other traders)													
Loss rate		0.01											
TOTAL COSTS						88944.9	88944.91	23.1	2.5	20.6	2921.79	281.59	2640.21
CAPITAL COSTS			here the service life is going to be			544.9	544.91	23.1	2.5	20.6	521.79	281.59	240.21
truck		10.0	350.0	15000.0	150000.0	544.9	544.91	23.1	2.5	20.6	521.8	281.6	240.2
OPERATING COSTS						88400.0	88400.00	0.0	0.0	0.0	2400.00	0.00	2400.00
carp purchases	ton	20.0		4300.0	86000.0	86000.0	86000.00	0.0			0.0		
shipment cost		10.0		140.0	1400.0	1400.0	1400.00	0.0			1400.0		1400.0
other (including oxigen tanks)	per visit	10.0		100.0	1000.0	1000.0	1000.00	0.0			1000.0		1000.0
COST EX CARP PURCHASES							2944.91	23.1	2.5	20.6	2921.8	281.6	2640.2
COST EX CARP PURCHASES PER KG SALES							0.15	0.00	0.00	0.00	0.15	0.01	0.13
SALES						108900.0	108900.00						
carp sales	ton	19.8		5500.0	108900.0	108900.0	108900.00						
PROFIT						19955.1	19955.09						
PROFIT PER KG (CARP)		19800.0				1.0	1.01						
Total Cost (the whole value chain)	kg						2.92	0.06	0.01	0.04	2.87	0.98	1.88
Hatchery	kg						0.06	0.00	0.00	0.00	0.06	0.02	0.04
Farm	kg						2.71	0.05	0.01	0.04	2.66	0.95	1.71
Trader	kg						0.15	0.00	0.00	0.00	0.15	0.01	0.13
Operating Cost	kg						2.30	0.05	0.01	0.03	2.25	0.86	1.39
Import Parity Price													
CIF ($/kg)	kg						3.40	0.00	0.00	0.00	3.40	3.40	0.00
Exchange rate (AZN/$)							0.80						
CIF (AZN/kg)	kg						2.73	0.00	0.00	0.00	2.73	2.73	0.00
Customs duty (USD/unit for live and % CIF for frozen)							0.50						
Import tariff and VAT	kg						0.97	0.97	0.97	0.00	0.00	0.00	0.00
Handling and transport to Baku		20.00%					0.55	0.02	0.00	0.02	0.52	0.26	0.26
Unexplained transactions costs							1.26	1.26	1.26	0.00	0.00	0.00	0.00
Wholesale (AZN/kg)	kg						5.50	2.25	2.23	0.02	3.25	2.99	0.26
Consumer (AZN/kg)	kg	10.00%					5.85	0.00					
Profit	kg						2.58				0.39		
NPC, output							**1.68**						
NPC, tradable inputs							**1.01**						
Value Added in Domestic Prices							**4.48**						
Value Added in World Prices							**2.27**						
EPC							**1.97**						
Cost of Non-tradables							**1.88**						
DRC							**0.83**						

Annex B: Structure of Imported Fish Costs

Annex B
Structure of Imported Fish Costs

		Live Carp 2010		Frozen Carp	
		Unit Value	FOB adjusted	Unit Value	FOB adjusted
CIF ($/kg)		1.117	3.400	0.447	1.620
Exchange rate (AZN/$)		0.803	0.803	0.803	0.803
CIF (AZN/kg)		0.897	2.729	0.359	1.300
Customs duty (USD/unit for live and % for frozen)		0.500	0.500	15.00%	15.00%
Import tariff and VAT		0.635	0.965	0.128	0.464
Handling and transport to Bacu	20.00%	0.179	0.546	0.072	0.260
Unexplained transactions costs		3.607	1.078	3.078	1.612
Wholesale (AZN/kg)		5.318	5.318	3.636	3.636
Consumer (AZN/kg)	10.00%	5.850	5.850	4.000	4.000
Consumer price/CIF		6.525	2.144	11.145	3.076