Trout are mostly farmed in the Swat Valley, while the major market for the fish is in the Islamabad/Rawalpindi area. In 2012-2014 most of the farmers have made arrangements to deliver fish fresh on ice directly to retail seafood stores. So the value chain is shorted with farmers being paid by the stores. This minimizes the role of middlemen, but takes time, effort and resources from the farm. The store then sells to the consumer for $8.00 to $12:00 per kg.

Trout Value Chain as of April 2014

Farmers (delivery by farm) -US$5.00 - $6.60 /kg - Small retailer / Grocery - $8.00-12.00/kg – Consumer

Picture. Trout caught at M. Rasheed farm in Madyan, Swat (Photo Courtesy: R.S.N. Janjua, SoyPak (ASA/WISHH) dated 09-11-2013

Tilapia are widely farmed across Punjab and Sindh with markets for the fish in most of the urban areas. In 2012-2014 most of the farmers have made arrangements to deliver fish fresh on ice directly to retail seafood and grocery stores. And in one case the farmer developed his own retail outlet in Karachi. These direct connections may not continue as additional farms add tilapia production to carp ponds. We anticipate that custom harvesters and/or haulers will begin to develop competitive advantages and

Tilapia Value Chain as of April 2014

Farmers (delivery by farm) - US$1.80 - $3.00 /kg - Small retailer/Grocery -$3.00-$5.00 kg - Consumer

Byproducts – Skins have become the most valuable byproduct from processed tilapia (Fitzsimmons, 2006). There are four primary markets. First, skins have been used to make a variety of leather goods. In Brazil, Colombia and Thailand, several companies have extensive product lines including clothing and accessories. The second market is as a snack food. De-scaled skins can be cut into thin strips and deep fried. These are especially popular in Thailand and the Philippines. A third market for skins is as a pharmaceutical product. European companies are substituting material from tilapia skins for mammalian products for gelatin used to make time released medicines. The fourth market for skins is for collagen. In China especially, the skins are processed to recover collagen which is utilized in a large number of beauty care products.

Fish scales are used to make ornamental flowers. Individual scales are collected, and dyed different colors, then carefully glued onto a stick to mimic various flowers.

Tilapia skins dyed for use as leather.

Tilapia scales dyed to make flowers

Another byproduct is the trimmings and heads. Heads are used for soups in some countries. Post-ocular and throat muscles can be recovered and used for ceviche and other preparations using small amounts of meat. Recovery of flesh through deboning of pin bone cuts and skeletons can provide a base for fish sticks or other highly processed forms. Carcasses, heads and trimmings can be used for animal feeds, especially hogs.

D. Quality Control and Traceability

For both domestic and international markets quality control and traceability have become critical factors.

Quality control beyond off-flavor will incorporate visual inspection for parasitic worms, checking for metal contamination during processing, bacterial contamination and chemical pollutants. Visual inspection should be conducted at all stages of the value chain. Metal contamination is both visual and in a processing plant with a metal detection device which will find even small amounts of

metal chips or shavings that might come from malfunctioning processing equipment. Bacterial and chemical pollutants will need to be checked with a more sophisticated quality assurance lab with appropriate testing equipment.

Traceability refers to the ability of stakeholders to follow the provenance or chain of custody of the fish from farm to hauler to processor to shipper/exporter to importer to wholesale to retail to the customer. With today's computer technology and organized logistics, bar codes, Quick Response Codes (QR mark), Radio-frequency identification (RFID) tags, real time websites and cloud computing, anyone on the chain can check lot numbers and follow fish products in transit, or on arrival, or retroactively find the origin and history of a shipment or even individual package. There are several companies whose primary focus is to provide these services across a complete value chain and numerous owners of an individual lot. Wisefish http://www.wisefish.com/ is one example. Seafood Traceability: A Practical Guide for the U.S. Industry by Arni Petersen and David Green, is an 30 page document available free on line

http://seafood.oregonstate.edu/.pdf%20Links/Seafood%20Traceability%20-%20A%20Practical%20Guide.pdf that provides and very complete description of tools and software.

E. Markets and Market Development

Pangasius processing for Pakistani markets – Vietnamese catfish, or *Pangasius*, are one of the most popular fillet products in Pakistani grocery stores. Farmers and processors in VietNam have developed a one million metric ton industry in little more than 15years with exports to scores of countries. Virtually all of these fish are grown in intensive ponds with high densities of these air breathing fish. The fish are harvested and delivered live to state of the art processing plants built in recent years. The fillets for international

trade are filleted by hand and then individually quick frozen. These are the typical product forms sold in Pakistan.

Tilapia processing for international markets - Taiwan was the first growing area to produce and export significant quantities of tilapia in the 1980's. Most of the exports were whole or gutted frozen fish sent to the U.S. Jamaica was the second major exporter on the world market, sending fresh and frozen fillets to the U.S. and Europe. Just a year or two later, Indonesia began processing cage reared tilapia from reservoirs and exporting frozen fillets. At about the same time, Colombia and Costa Rica began processing fish grown in raceways and semi-intensive ponds and exporting fresh fillets to the U.S. After a series of major disease outbreaks, several shrimp farmers in Ecuador switched to tilapia production. Using existing production, processing and marketing channels, Ecuadorian farms have taken a significant share of the fresh fillet market in the U.S. Using technology and investment from Taiwan, provinces on the mainland of China have become major producers and exporters. Large quantities of frozen fillets are now exported to the US and Europe. Production in Zimbabwe is based on cage operations in Lake Kariba. Fillets from the processing plant are marketed in Europe. Brazil and Thailand, major producers who have sophisticated processing plants but are minimal exporters, have had little impact on the international markets for processed tilapia. Mexico and the Philippines each have major producers who expect to develop international quality processing plants and products in the near future.

The market for fresh fillets has grown to be the most valuable sector. While sales of whole frozen fish have stagnated and frozen fillets have grown steadily, sales of fresh fillets have exploded globally. In virtually every region of the U.S., fresh fillets are available in stores and restaurants. Since 2010, tilapia has been the fourth most commonly consumed seafood in the U.S.

Potential markets for Pakistan – The Pakistani domestic market should be the most profitable for Pakistani trout, tilapia, carp or catfish. There seems to be pent up demand for high quality fresh and locally produced frozen fillets. Outside Pakistan, potential customers include the Gulf Emirates and Saudi Arabia. The third country nationals there are familiar with these fishes and are likely customers. Pakistan has a well-developed food export industry to the Gulf region. The primary competition for frozen fillets of tilapia and carp products would be from the current Egyptian and Chinese suppliers. With the proximity and frequent air connections to the Gulf Cooperation Council countries, the market for fresh fillets would seem to be a more preferable and profitable market niche.

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