The Market Viability of Eco-Fish in Hong Kong

February 28, 2008

Sponsoring Agency: Worldwide Fund for Nature

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ABSTRACT

In the Mai Po region of Hong Kong, the Worldwide Fund for Nature has developed environmentally sustainable practices for fish farming, the eco-pond. The ecological balance is threatened by unsustainable fishing. By surveying 450 consumers we determined that middle income respondents are the best market for eco-fish at a 30-40% price premium. The net profit is enough incentive for fishers to adopt the eco-pond. Ultimately, we determined the potential market for eco-fish in Hong Kong contains approximately one million households.

EXECUTIVE SUMMARY

The Mai Po region of Hong Kong is an ecologically important wetland where traditional fish farming methods are used to harvest freshwater fish in ponds and many endangered migratory birds flock. There is now competition from the aquaculture industry in mainland China because freshwater fish can be produced there at a lower cost. The influx of fish into the Hong Kong market from Mainland China has caused a price drop, thus endangering the economic viability of the Mai Po farms. The lower profits have driven some traditional farmers away from their industry, while others have resorted to environmentally unsafe fishing practices. Without sustainable fish farming methods in place the balance in the Mai Po wetlands ecosystem has been disrupted, thereby endangering the food source of migratory birds. These birds are important to the biodiversity of the region and the ecologic stability of Mai Po, a protected wetland.

If the current fish farming practices were changed to be ecologically sustainable, or green if you will, the fish harvested in the Mai Po region could be considered eco-fish. The Worldwide Fund for Nature has created an experimental fish pond in the Mai Po region which raises eco-fish, fish which are healthy, environmentally friendly, and ecologically sustainable. Eco-pond methods include using the organic standards from the United States Department of Agriculture. Eco-fish are raised without the use of chemicals, antibiotics or growth hormones. The hope is that this green product can increase profits for the fishers and maintain the ecological diversity of the area.

Market research was conducted in Hong Kong to identify potential eco-fish buyers. A questionnaire was conducted over a two week period during which approximately 450 survey responses were collected. Data from this survey showed that the respondents most willing to pay a high price premium for eco-fish were organic buyers and those that ate freshwater fish several times per week. Organic buyers were most interested in the healthy and sustainable qualities of eco-fish. Frequent freshwater fish buyers were most interested in the fact that eco-fish are healthy for consumption because of their chemical-free growing methods.

We determined that 84% of our respondents were willing to pay within a 20%-40% price premium. In an interview with Mr. Lai Loi-Chau, the Chair of the New Territories Fish Culture Association, we learned that a 15% premium would be enough of an incentive for Mai Po farmers to change their ponds to eco-ponds. This tells us that a 30% premium would more than allow pond fishing to sustain itself in the Mai Po region. We recommend marketing eco-fish at a price premium between 30%-40% above the current market price of standard freshwater fish. This premium is large enough to attract the fishers of Mai Po to switch to the eco-fish pond scheme because of its potential profits.

The target market for eco-fish should be set on the middle level income groups of Hong Kong, those households making between HK$10K and HK$50K per month. At this level we found the majority of organic and freshwater fish buyers who were interested in eco-fish at a high price premium, around 55-60%. We have found that within this market in Hong Kong the consumer base is around 1 million households. Our results tell us that since the stocking rate of the eco-fish is about 7,000 fish during its experimental phase, the potential public demand for

eco-fish products will be met. Also, the WWF should consider an expansion of eco-fish production to meet its demand.

To create more awareness for eco-fish and its values we suggest establishing a brand for eco-fish. As from our data, organic buyers find the intrinsic values of a product the most important factor when purchasing a certain product. If eco-fish establish a name synonymous with human health and environmental sustainability consumers will become more aware of its benefits and thus are more likely to purchase.

In conclusion, a price premium for eco-fish that would allow the fish farmers of Mai Po to continue their way of life is achievable. In order to establish a successful market for eco-fish distribution outlets must first be created which allow for convenient sales to middle income households throughout Hong Kong.

Chapter 1: Introduction

Developed nations have become more aware of their impact on the environment and their inability to maintain many of the world's ecological systems. As the world continues many of its unsustainable practices, such as clear cutting forests, widespread over-fishing, and destruction of wetlands, we continue to weaken our planet's biodiversity and degrade the natural balance of ecosystems. Biological diversity, which contributes to the renewal of key natural resources that society depends on, will only be ensured if governments encourage environmentally conscious practices. The Worldwide Fund for Nature (WWF) believes in the preservation of biodiversity and the adoption of ecological and sustainable practices in industry.

The Mai Po region of Hong Kong is an ecologically important wetland where traditional fish farming methods are used to harvest freshwater fish in ponds and many endangered migratory birds flock. There is now competition from the aquaculture industry in mainland China because freshwater fish can be produced there at a lower cost (Chan, 2005). The influx of fish into the Hong Kong market from Mainland China has caused a price drop, thus endangering the economic viability of the Mai Po farms. The lower profits have driven some traditional farmers away from their industry, while others have resorted to environmentally unsafe fishing practices. Without sustainable fish farming methods in place the balance in the Mai Po wetlands ecosystem has been disrupted, thereby endangering the food source of migratory birds.

If the current fish farming practices were changed to be ecologically sustainable, or green if you will, the fish harvested in the Mai Po region could be considered eco-fish. Organic and eco-products are marketed and priced higher than their conventional counterparts. This premium may offer a solution to the viability of the Mai Po farms. In a study done in the UK and

Germany, Latahz-Lohmann and Foster determined that in Germany the price premium for organic food can be placed at "20-30 percent above conventional prices" (p. 279). Yirido's (2005) findings also show that in general people are willing to pay a price premium approximately 10-20 percent above non-organic counterparts (p. 33). Consumers are aware of the environmental issues of food production and so are more willing to pay a higher price for these products. Since eco-fish are environmentally sustainable and healthy for human consumption there is a possibility for this product to be marketed at a higher price.

Although the organic and eco-food markets are relatively new to Hong Kong, over the last decade these markets have grown considerably. A systematic analysis of the pricing and distribution outlets for eco-fish in Hong Kong has not been carried out. Because the current situation is not economically practicable for many fish farmers, more research needs to be done on the economic viability of the Mai Po fish farms and the viability of marketing their output as eco-fish. Determining what new pricing could be achieved for this eco-product could decrease the uncertainty in the market viability thereby indicating the possible profits farmers could expect if they choose to change to eco-fish farming in Mai Po.

The main goal of our project is to determine the consumer's willingness to buy Mai Po fish at a higher price if labeled as eco-fish. The farmers would then be able to continue their practices in an environmentally sustainable manner to preserve the ecological balance of that area. We determined the potential niche eco-fish could fill by surveying and investigating the current Hong Kong markets. In this project we determine outlets for this green product and the price changes that may accompany marketing. We also assess the possible benefits for the farmers in the Mai Po region. We will predict a market response to price increases based on the

consumer reaction to environmentally sustainable products. This research will determine the market for eco-fish in Hong Kong and potentially allow the farmers of Mai Po to continue their traditional way of life. These eco-pond methods preserve the ecological balance between migratory birds (some that are endangered), freshwater fish, and people in the internationally important wetland of Mai Po.

Chapter 2: Background

In today's world, consumers are becoming concerned with more than simply the price of products. They feel the need to be more aware of how and where products are produced. Often, consumer concern is rooted in health and environmental issues. This chapter discusses the environmental importance of the Mai Po Ramsar site in Hong Kong, the cultural and health issues of the fish market in Hong Kong, the global market for organic products and the current state of the organic/eco-market in Hong Kong.

2.1 Mai Po Ramsar Site

The Mai Po and Inner Deep Bay area is located in the north-western quadrant of the New Territories, marking the border between Hong Kong SAR and Mainland China. Due to an abundance of rich sediment and freshwater the area is ideal for farming both plants and fish. In 1976 the Mai Po zone was designated as a Site of Special Scientific Interest (SSSI) by the Department of Agriculture, Fisheries and Conservations to ensure its preservation. In 1984 the Worldwide Fund for Nature expressed interest in the site. Over the years they have managed the wetlands and helped Mai Po to be established as a Ramsar site in 1995 (Wetlands International, 2007).

Table 1: Justification of Mai Po as a Ramsar Site (Wetlands International, 2007)

Criteria of a Ramsar Site	How Mai Po meets the criteria
It is a particularly good representation of a natural or near-natural wetland, characteristic of one, or common to more than one, biogeographical region.	The stand of mangrove forest round Deep Bay/Mai Po is the sixth largest remaining along the coast of China and the reedbed is one of the largest in Guangdong Province.
It supports an appreciable assemblage of rare, vulnerable or endangered species of plants or animals.	12 endangered waterbirds species occur in Mai Po. Besides, over 20 species of invertebrates new to science have been found.
It holds more than 20,000 waterbirds.	Mai Po regularly holds over 20,000 wintering waterbirds. In January, 1996, over 68,000 waterbirds were recorded in the Mai Po / Deep Bay wetlands.
It holds more than 1 % of the individuals in the population of a species of waterbird.	Mai Po holds 1 % of the individuals in the population of 11 species of waterbirds. In particular about 23 % of the world population of the Black-faced Spoonbill (*Platalea minor*) winters at Mai Po.

Ramsar refers to the Convention on Wetlands which is an intergovernmental treaty that provides the framework for the conservation and wise-use of wetland areas. It is known as Ramsar because of the location of its signing in Ramsar, Iran in 1971. Currently there are 1720 wetland areas around the world with the distinction of being on the Ramsar List of Wetlands of International Importance, Mai Po being one. Table 1 shows how the Mai Po region meets the criteria of being a Ramsar Site. Its establishment as a Ramsar site elevated Mai Po to becoming an internationally important wetland, instantly increasing the importance of its preservation.

Contrary to its name, Deep Bay is a vast area of shallow water with an average depth of only three meters. The water depth frequently fluctuates due to a number of factors including tidal changes and flooding brought on by heavy summer rainfall (Grant, 1971). Over the last century urbanization has lead to the destruction of hundreds of hectares of wetlands in the region. Fortunately, the shoreline of Deep Bay is slowly expanding through a natural process

known as progradation. This process occurs when sediment from the Pearl River, Shum Chun River, and Yuen Long Creek deposit along the ocean and can be seen in Figure 1. This progradation is aided by the dense surrounding mangrove forest which binds silt in the roots of plants (Irving & Morton, 1988).

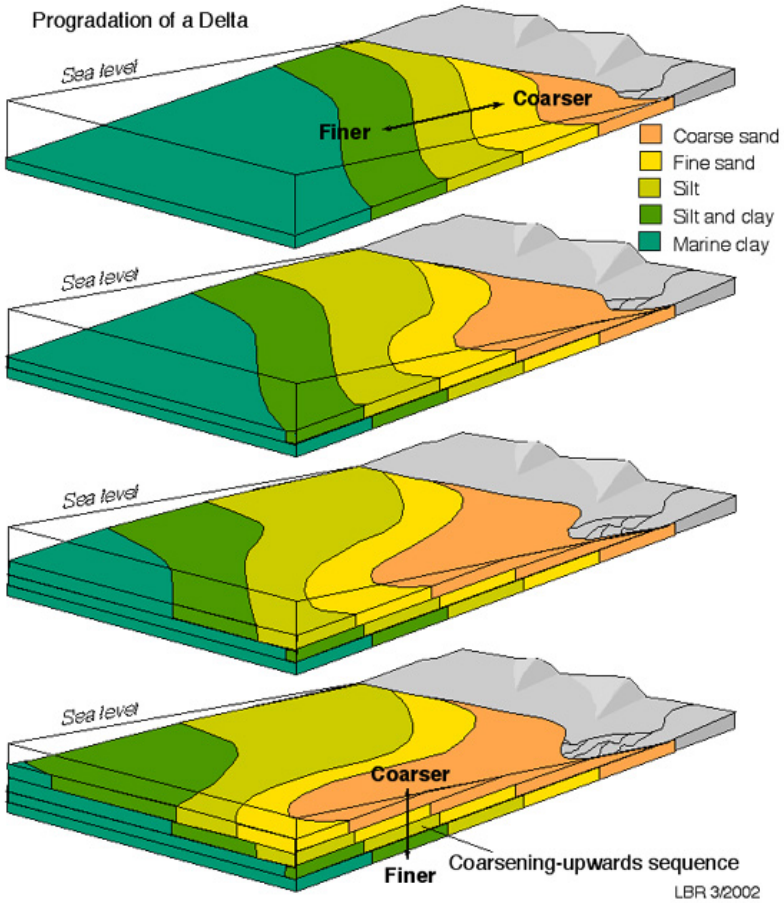

Figure 1: Progradation of a Delta (University of Georgia, 2007)

2.1.1 Basic History of the Geographic Area of Mai Po

The Mai Po wetlands have been a crucial part of Hong Kong's economic and ecological sustainability for nearly a century. While fishing has been an integral part of Hong Kong's

culture for centuries, it was not until 1970 that fish farming became a viable commercial industry. Before 1945 only 12 hectares (120,000 square meters) of Hong Kong's wetlands, such as those in the Mai Po area, were used for private fish farming while the rest was used for rice and shrimp farming or left untouched (Irving & Mortin, 1988). By 1975 fish-pond farming was the leading agricultural use of land in the New Territories. As of 1986 nearly 2130 hectares (21.3 million square meters) of farmable fish ponds were active throughout Mai Po and the rest of the north-west New Territories (Irving & Leung, 1987). Due to rapid urbanization throughout Hong Kong many of the wetlands have been cleared and built upon over the last two decades. This has resulted in the loss of more than half of the land that was once devoted to fish farming

2.1.2 Traditional Fish Farming Methods

The fish ponds of Hong Kong vary greatly depending upon their location and the species of fish they contain. The four prominent types of fish ponds in Hong Kong are freshwater ponds, brackish ponds, Gei Wai, and nursery ponds. Freshwater ponds are small, plentiful, and typically found at the foot of hills. Moats and Feng Shui ponds are common forms of freshwater ponds which are created with the layout and forces of the surrounding environment taken into consideration. Brackish fish ponds are large ponds that are filled by freshwater streams or rain water and have salinity between 0.4% and 5% due to the salt content in surrounding soil. These ponds are common in the marshes of the Deep Bay and are home to the grey mullet, a major food fish of Hong Kong. (Grant, 1971) Gei Wai or tembaks are coastal ponds that utilize a trapping system which captures fish during high tide. Fish typically enter the Gei Wai during the spring and stay in the ponds until the end of the year when the ponds are drained. Nursery ponds are unique in that they sustain fish which are not native to Hong Kong. It is now common practice

that several species of carp are brought to Hong Kong as newborns (or fry) from Mainland China because they are unable to breed in the waters of Mai Po. (Grant, 1971) Together the different types of fish ponds aid the ecosystem and provide a variety of fish for market.

Aerial view of Mai Po. Photo by WWF Hong Kong.

2.1.3 Traditional Fish Farming

The fish farmers of the Mai Po wetlands allow fish to reproduce and grow naturally in their ponds. The fish are harvested by annual draining of the ponds, which drastically lower water levels to make it easy for the farmers to collect the fish. Some ponds in Mai Po are polycultural, meaning that many species of fish are raised in the same pond. Among the most prevalent fish harvested are Carp, Tilapia, and Grey Mullet.

Migratory birds feeding on drained ponds. Photo by S.K. Lau

The Common Carp is the most widely distributed species of freshwater fish in Hong Kong. Several sub-species of the Common Carp include the Bighead Carp, the Grass Carp, the Black Carp, the Mud Carp, and the Silver Carp. The Bighead Carp is widely cultured in Hong

Kong and mainland China making it the second most important freshwater species in Chinese aquaculture production.

As the name implies, Grass Carp are herbivores that constantly feed on soft grasses. Constant grazing allows the Grass Carp to reach up to 30lbs. before being harvested and sold to market.

Silver Carp is widely considered the most important species in Chinese freshwater aquaculture due to its wide distribution and ability to adapt to new areas. (Li & Mathias, 1994) These fish dwell just under the surface of freshwater where they feed on plankton and regularly jump into the air.

The Black Carp and Mud Carp are also notable species in Chinese aquaculture. The Black Carp is a temperate bottom-dwelling fish, while the Mud Carp is a species that prefers warmer waters (Li & Mathias, 1994).

Tilapia is a tropical fish species that has become vital to aquaculture world-wide. Like Carp, Tilapia consists of many subspecies that can be found under varying conditions.

The Grey Mullet is a vital food fish that can endure the high salinity of brackish water ponds. In November the Grey Mullet spawns in the open sea and then migrates back to the Deep Bay from December to March at which point it is harvested (Irving & Morton, 1988).

2.1.4 Ecologic sustainability

As fish ponds play an important ecological role in the survival of many species of resident and migrant birds, the degradation of wetlands poses an important ecological threat that is likely to have an adverse impact on the wildlife in the ecologically sensitive Mai Po and Inner

Deep Bay Ramsar Site. Many species of fowl, some domestic and others migratory, rely on the wetlands of Hong Kong for food. Fifteen species of endangered birds rely on the Mai Po wetlands at some point in the year. Several species of Heron and Egret complete the regional food chain by feeding on non-commercial fish, shrimp, and insects year round. The Guinea Grass that fish farmers plant to feed Grass Carp has proven useful as cover for prinias, a small bird species, which now successfully breed in the area (Young, 1995). Between February and May, thousands of migratory swifts, swallows, pipits, phalaropes and wagtails feast on the chironomid flies that emerge from the ponds. When the fish ponds are drained in mid-October to mid-May, the area attracts a key endangered species known as the Black-faced Spoonbill. These birds are dependent on the shallow water of drained ponds which allows them to feed on trapped mosquito fish, tilapia, and shrimp (Walthew, 2007).

Various waterfowl species at Mia Po. Photo by S.K. Lau

2.2 Impact on the Local People

Traditionally, many people of the Mai Po region have farmed freshwater fish in tidal ponds. Recently the drop in market price of freshwater fish and the large scale importation of fish from Mainland China have forced the sale of land previously used for aquaculture to developers. The development and urbanization of the area has only made the farmers' problems

more complex, increasing the risk of chemical contamination from industrial runoff. Without a sustainable environment in which to harvest fish, the farmers will not be able to maintain their livelihood. If Mai Po were to become completely urbanized, it would result in a large decrease in bird population and could also result in the loss of certain species of endangered waterfowl.

Harvesting a Mai Po fish pond. Photo by S.K. Lau

2.2.1 History of pond fishing in the Mai Po Area

C.Y.M. Jachey (1999, p. 3-7) explains that, the Han colonists brought cultivated pond fishing to Hong Kong in about 1000A.D. These ponds were often multipurpose moats around villages, which provided food and protection. In the late 19th century Hakka immigrants from China further developed pond fishing as an important sustainable food source that also helped protect the residents, control mosquitoes, manage waste and provide fertilizer for their fields. In the 1940's, after World War II, refugees from Mainland China found that their pond fishing skills could provide a living for them in Hong Kong. The Agricultural and Fisheries Department began studying polyculture fish ponds in the 1960's and found that they provide both an ecological and economic safety net for farmers. This allowed farmers to invest in several fish species while improving the health of their ponds. This discovery along with the use of modern

construction methods resulted in a boom in the pond fishing industry in Hong Kong. Such growth was sustained until urban encroachment began to threaten ponds in the late 1980's.

2.2.2 The Fishers' Needs

According to C.Y.M. Jacthey (1999, p. 47) the highest market price of Grey Mullet was in the mid-1970's to the early 1980's, at around $25/catty (one catty equals 500 grams). Tilapia was at $60/catty in 1992. By 1999 Grey Mullet was down to $8-$10/catty and $26/catty for Tilapia. This significant decrease in market value has resulted in many fish farmers being forced to take on other jobs to support their families. Jacthey's findings (1999, p.67-72) also indicate many of the next generation of farmers are choosing to pursue other professions, leaving the ponds to be tended by the aging, traditional farmers. Furthermore, many fish farmers are tenant farmers, so they are being forced out of the trade by landowners who are selling off the land; leaving them not only without a job but also without a place to live.

2.2.3 Basic Recent Events Affecting the Fishing of Ponds in Mai Po

Recently the boom in development of the North-West area of the New Territories has resulted in many ponds being filled-in and the land sold off. Furthermore, farmers have been abandoning the ponds because of the poor economic value of the fish they harvest. According to Cheung (1999) the farmers who have opted to stay at their ponds are concerned about the low market price and the rising cost of fish food (p.54). Through the grants they've received from the government, WWF Hong Kong has being working to protect the Mai Po region while insuring the fish farmers livelihood.

Urbanization and development have not only affected the farmers' desire to remain in the industry, they have also caused an increase in pollution. "Even though all samples, including (both) sediments and biota, were regarded as only moderately contaminated or even uncontaminated by most heavy metals, it had already been found that tilapia had excess levels of lead and chromium, which might be dangerous for human consumption" (Cheung & Wong, 2006, p. 35). Lead and chromium are industrial heavy metals that have accumulated downstream of areas that have been rapidly developing. If this continues, not only will the fish farmers be unable to sustain themselves, but the ecosystem will suffer greatly.

2.2.4 Current Status of Pond Fishing in Mai Po

Agriculture is often encouraged by government subsidies if the market is weak for the farmers. In the case of Mai Po fish farming the Hong Kong government supplies subsidies to the non-governmental agencies that manage the site (i.e. WWF) and the owners of the ponds. However, approximately 90% of the fish farmers in Mai Po are tenants of the ponds and so only lease the usage of the ponds for farming (Jacthey, p. 53). This means that they are not eligible to receive government subsidies directly.

WWF Hong Kong Mai Po Reserve officer, Mr. Tobi Lau, has worked with the fishers of Mai Po since 2001. His work aims to preserve the environment while helping fish farmers to maintain their livelihoods. According to Mr. Lau, (Appendix D) the future of Hong Kong's pond fish farming industry is in danger because the younger generations have been encouraged by their elders not to pursue fish farming. While some veteran fishers have sold their fish ponds and retired to escape the industry, many others have chosen to continue their careers accepting the hard work and limited profitability. Those who opt to retire sometimes sell their ponds to large-

scale fishers who are able to earn a living because of the volume of fish they cultivate. These larger-scale fishers put in many hours of hard work but Mr. Lau suspects that the often elderly fishers simply cannot manage such large ponds efficiently.

Farmer collecting fish from drained pond. Photo by S.K. Lau

To alleviate both the ecological and economical problems surrounding current fish farming methods, the WWF Hong Kong is experimenting with eco-ponds which use the organic standards of the United States Department of Agriculture as a guideline. The WWF has established experimental ponds in Mai Po that are using environmentally sustainable and organic methods. These new ponds are meant to bring the farmers back to methods that will not degrade the biological balance of the area; they are trying to stop practices like over fishing. Once the smaller ponds have been tried and tested, the WWF is hoping to expand this system to all the fish ponds of Mai Po. The WWF is expecting the first harvest of eco-fish to be available at market by December 2008.

2.2.5 Import of Freshwater Fish from Mainland China

The use of growth hormones in aquaculture has grown significantly in the past decade as progress in genetic research has accelerated. Transgenic fish are created through the insertion of genes which increase the mass of the fish upon reaching maturity (Simco, 2000). Producers use growth hormones to create more meat without having to increase the number of fish and amount

of feed needed to sustain an aquaculture farm. The use of growth hormones in food products has recently come under scrutiny as it may cause health problems in consumers. Due to a lack of documentation, the use of growth hormones and antibiotics by fish farms in mainland China has not been reliably reported to Hong Kong consumers.

Chemical contamination is also a significant concern with regards to fish imported from the mainland. In November 2006 the trade of freshwater fish from mainland China to Hong Kong was halted due to Malachite Green contamination. The embargo lasted several weeks, until officials felt the proper paperwork had been done to document that the fish coming into Hong Kong were coming from “clean” ponds. This event made it evident that the Hong Kong’s fresh fish market is very much dependent on imports from mainland China. According to Jonathan Cheng (2006), "The move left wholesale fish markets silent all day, with vendors fearful about the future and idle food transporters demonstrating to demand a swift government response to the crisis”(para. 7). There continues to be concerns about the safety of imported freshwater fish.

2.3 Organic Food Markets

With the growing knowledge of environmental problems and health problems that are associated with agriculture production and processing, consumers concerns now lie on how products are grown, not just their brand and cost. For the consumer, problems within the organic market come with the labeling and distinction of organic and eco- products. For farms to self-label themselves is not as reliable as having a third-party or even a government organization set out guidelines for organic farming. As guidelines and consumer knowledge are set up and defined, the organic markets are becoming well established parts of many nations' food markets (Gulbrandsen, 2006).

2.3.1 Global Presence of Organic and Eco- Markets

The organic food market in North America and Europe has grown considerably over the past ten years. Consumers have begun to recognize the "organic" branding of many foods including seafood and fish. Organic foods are those that are produced without growth hormones and chemicals. This makes organic products much more healthy and safe for consumers. Consumers are more wary of what they are buying and where it comes from because of issues like bovine spongiform encephalopathy, commonly known as mad cow disease, which can impact the global meat market in a major way (Gulbrandsen, 2006).

Consumers are now more aware of the environmental issues that come from agriculture and food production. In a recent survey conducted by BBC World and Synovate it was noticed that the majority of consumers polled who were concerned about the environment bought green products (Product focus--green products, 2007). Green products are those that are harvested in environmentally friendly ways and can also be environmentally sustainable. Globally, the surveyors noted that 54% of people who were aware of environmental issues "bought one or more green products in the past year." Comparatively, China as a country had the highest percentage of concerned consumers buying green at 76%.

In the food market a consumer must be willing to pay a premium price for organic food. The branding of eco-products is still new to many markets, but since consumers are more knowledgeable about organic food there is actually a higher willingness to pay for "organic" food than "eco" food (Arquitt, 2007). Eco-products are products developed in an environmentally sustainable manner, but are not necessarily organic. In most developed cities there is a more knowledgeable consumer class who is more concerned with the environment and

sees the benefits of buying organically grown food. However, there is a limit as to how much organic food can be marked up over its non-organic counterparts before people are no longer willing to buy organic food products. In general, people are not willing to pay a price premium over 10-20% for most products (Yiridoe, 2005).

2.3.2 Organic Consumer Demographic

Understanding the people who buy organic food allows more insight into the organic market on the demand side. A younger consumer is more likely to buy organic food products because of the environmental and chemical-free attributes that are associated with them. Educated consumers can also make the distinction between the values of organic food products over their non-organic counterparts. (Yiridoe, 2006)

2.3.3 Eco-Labeling

Demand for organic and eco-products is associated with the benefits of the product rather than their price. Consumers see the health, environmental, and ecological advantages of these products and are therefore willing to pay more (Yiridoe, 2005). Branding, labeling, pre-knowledge of the product, and production methods are all important factors to investigate when introducing a new product to the market. This is because they justify the product's premium in the buyers' eyes. Labeling is especially important because people can recognize it as they shop. Some farms have taken to self-labeling which is not a controlled way to ensure an eco-product. In some cases third-party organizations have been created to fill this position and in others governments themselves have created departments that regulate the labeling of products so that they are held to certain uniform criteria.

In Europe and North America governments have not begun to define what an eco-product is, so most companies are relying on outside organizations, like the Marine Stewardship Council (MSC), to set guidelines for eco-labels. The MSC was started by the WWF and Unilever in 1996 to improve fishery practices. By creating standards for which seafood products can be called eco-products, the MSC label gives buyers confidence in what they purchase. Currently distributors like Whole Foods, Wal-Mart, Safeway and Tesco are stocking MSC products. MSC has also had success marketing its eco-seafood in Germany, Switzerland and the Nordic countries. However, there are "no MSC products in the Asian seafood markets" (Gulbrandsen, 2006, p. 484-485).

2.3.4 Organic Products in China

China has had an overwhelming push towards organic farming in the past twenty years. According to Paull (2007) between 2005 and 2006 China increased its organic farmland eleven-fold, from 298,990 hectares to 3,466,570 hectares. Figure 2 illustrates the dramatic increase of organic farmland which has made China second only to Australia in total hectares. The Chinese government has been supporting this move by creating organic divisions like Green Food which is a "government food certification program created to bring to market *San Pin* or "no-public-harm food" (p. 6). Green Food performs operations such as residue testing for pesticides as well as field testing and processing inspections. It has been said that China's organic certification is "the most stringent set of organic requirements in the world" (p. 10). China is trying to become one of the world leaders of organic products and means to do so in an environmentally friendly way.

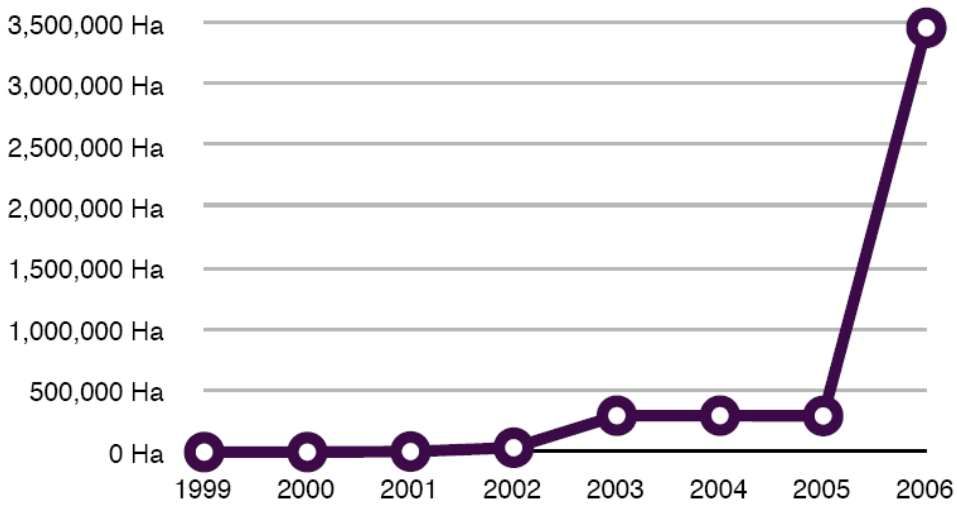

Figure 2: Organic hectares in China 1999 to 2006 (Paull, 2007, p. 2).

With this governmental support, it seems that the organic market will thrive in the long run. However the Chinese government, is not supporting prospective organic markets for the sake of being organic, but is moving that way in order to lower production costs and increase price (Paull, 2007). Although the environment is not the main reason Chinese government is supporting green methods, the improvements to their agricultural industry are more environmentally friendly. In the end the environment is gaining from China's move toward farming that is profitable and sustainable.

Labeling of these organic products has also come under the control of China's government divisions. As of April 1, 2005, there was only one supported organic label for China and all of its products, shown below as Figure 2 (Paull, 2007). With this procedure, China hopes to resolve the confusion of the multitudes of organic labels that are seen in the food market today. Also, this will help to control self-labeling that may not be up to the standards that the

government has set for growing, production, and processing. Because of China's strict new labeling methods, the problem of different label standards will be eliminated.

Figure 2: New Chinese organic logos introduced 1 April 2005 to replace the previous proliferation of labels (Paull, 2007, p.9).

2.3.5 Organization and Methods of Marketing Organic Fish in Hong Kong

In Hong Kong the locally farmed freshwater fish market has been declining in supply and in profitability. This is because the aquaculture industry in Mainland China has been growing in production numbers, making Hong Kong more dependent on them for fish (Chan, 2005). For freshwater fish farming the quantity and monetary value of fish have decreased by 70% and 68%, respectively. This could be attributed to the 68% decrease in fish farmers over the past 20 years, as stated by the Agriculture, Fisheries and Conservation Department (AFCD) of Hong Kong in 2004.

Organic-specific markets have become more prevalent in the Hong Kong food farmers markets. These organic farmers' markets are usually held and publicized by larger organic organizations like the Hong Kong Organic Farming Association (HOFA) and large organic farms

like Kadoorie Farm and Botanical Garden (*Hong Kong Organic Farming Association, 2007*). It is a good sign that these solely organic markets are now being held once a month in several of Hong Kong's districts. This frequency indicates the increased popularity of food that is organic and environmentally friendly.

2.4 Seafood and Freshwater Fish Markets in Hong Kong

Hong Kong has the largest per capita consumption of seafood in the world (Sadovy & Lee, 1998). Hong Kong has a hunger for fresh fish that its over-fished waters cannot satisfy. The fish market in Hong Kong now relies on importing a great amount of its seafood. Along with importing frozen seafood products, there is an even greater demand for live fish. It is the custom in Hong Kong to cook fish immediately after killing them. This system also increases distribution costs mainly because of the higher cost of transporting live fish. To satisfy its hunger Hong Kong has to import fish from mainland China as well as countries such as India, Australia, Singapore, the Philippines, and Myanmar.

2.4.1 Traditional Distribution Methods

The tragedy of the commons in Hong Kong refers to the monopolizing of fish trade by the Fish Marketing Organization which has used its power over this communal resource for its own gain (Lawrence & Lai, 2002). The fish industry in Hong Kong operated under free trade until around 1938. Fishermen would have a middleman for the sale of fish. These middlemen would distribute the fish to various retailers, and they were paid by a commission. Around 1940, the British colonial government began a system to ration food sources because of the possibility of war.

It was a 'fish marketing scheme' that took the middlemen out of the picture, replacing them with a controlled marketplace in which all fish were auctioned at wholesale markets run by the government which paid their salesmen a large commission. This scheme restricted any trade of fish outside the official marketplace. The 'fish marketing scheme' was later renamed the Fish Marketing Organization (FMO), and it would not allow fish to be bought or sold outside the market, with the exception of fish caught for sport, fish not intended for sale, and any fish sold retail from the ship it was caught on. In turn the FMO provided ice for the fish and a means of transportation to the retailers. In the early years, this system was very useful to the fishermen because of the higher cost of transportation and refrigeration. But around the 1970's it became less desirable because the fishermen couldn't benefit as much, so they tried to find ways around it.

Fishermen began to bypass the FMO through the few loopholes in its policies, one of which was catching fish outside Hong Kong waters and exporting them to countries such as Japan. Fishermen would also switch to marine fishing, selling fish live which allowed them to escape from the regulations of the FMO. Another way fishermen bypassed the FMO was through fish farming. Because of this avoidance of the system by the fishermen, the FMO has been weakened. (Lawrence & Lai, 2002)

Today fish, marine and freshwater, wild caught and farmed, are either imported live or on ice before being sold to wholesalers at various fish markets. There are many wet markets in Hong Kong, the two main fish markets being Sai Kung and Lei Yue Mun. At these markets thousands of restaurants as well as consumers buy their source of food fish. Fish markets have also become integrated into large supermarket chains such as Wellcome and Park N' Shop.

These two chains are the largest supermarket chains in Hong Kong, and their growing popularity with fish consumers makes them increasingly significant to the distribution of fish. Having multiple locations in each district of Hong Kong, these supermarkets are becoming the largest wholesale consumers of fish in the city.

2.5 The Market for Eco-fish in Hong Kong

The fish in the Mai Po region are of great ecological and economic value. In order to sustain that value, an incentive must be established that will allow the fish farmers to sustain their livelihoods monetarily while maintaining the ecological integrity of the area. One incentive that may prove a solution would be to market their fish as "Ecologically Sustainable" allowing the farmers to raise their prices and thus increase their profits. In doing so the farmers would continue their traditional culturing methods that provide consumers with a healthy fish supply, while providing a protected place for the endangered species of birds to continue their migration pattern.

Experimental eco-fish pond. Photo by S.K. Lau

Chapter 3: Methodology

The main goal of our project was to determine the potential of marketing eco-fish at a price higher than the current market value of standard freshwater fish. Our three objectives were,

- To determine a possible niche for eco-fish within the current freshwater fish market
- To identify the demographics of potential eco-fish consumers
- To investigate consumer willingness to pay a price premium

These objectives were achieved by collecting data on the current freshwater fish market and fish consumers in Hong Kong, which included current buying practices with regards to organic products, marine fish and freshwater fish, knowledge about eco-fish and willingness to buy eco-fish at a 100% price premium. To determine the consumer demographic of potential eco-fish buyers we collected data on income, age and place of purchase. This chapter outlines the methods used to accomplish the objectives required to fulfill the ultimate goal of assessing the eco-fish market.

3.1 Collaboration with Hong Kong University of Science & Technology

The WWF is also working with a group of students from the Hong Kong University of Science and Technology (HKUST). These four business students are conducting product research on eco-fish from January to April 2008. They worked in parallel with us until the end of our project and they will be continuing eco-fish market studies with the WWF.

The work done by the HKUST students included translating the consumer survey into Cantonese and approving the survey contents. They also helped carry out the consumer survey in several districts and input some of the data they collected from those surveys.

3.2 Consumer Survey

In order to develop a general profile of the type of consumer who would most likely buy eco-fish, a consumer survey was developed and conducted using various techniques. Questions regarding personal background information, organic buying habits, fish buying habits, and willingness to purchase eco-fish at a price premium were asked. Data about frequency of buying fish, amount spent per month, and location of purchase were also collected. This data was taken into consideration when developing a recommended price premium and a target consumer demographic.

3.2.1 Developing the Survey

A twenty-five question consumer survey was created in collaboration with our WWF liaison, Tobi Lau. Following discussion with Mr. Lau and input from the student team from Hong Kong University of Science and Technology (HKUST), the survey was comprised of four sections: consumer demographic, current organic food consumption, current fish consumption, and eco-fish. These questions would result in data applicable to our objectives. All questions were multiple-choice or used a rating scale to minimize the need for translation. However, five of the twenty-five questions offered a write-in option for unexpected answers. The survey was intended to be less than five minutes long to encourage participation.

3.2.2 Survey Contents

. The four sections of the survey, background information, organic product consumption, fish consumption, and eco-fish were arranged in a manner that ultimately focuses respondents on the most important question, their willingness to pay a price premium for eco-fish.

The background information, organic product, and fish consumption sections were used to gather information about the consumers and their current buying habits. Studying the background information allowed us to determine potential consumer demographics and a target market for the eco-fish product.

Information on current organic product consumption was included in the questionnaire to determine if current organic consumers are likely to be future eco-fish buyers. The consumer data, with regards to both the marine and freshwater fish markets, indicated the general demand for fish as well as the amount currently being spent on these products.

The final section on eco-fish was the most important. It was structured in a manner that provided information to the respondent while also asking their opinion. This section also included two questions on a potential price premium for eco-fish in hopes of encouraging the respondent to seriously consider how much they are willing to pay.

3.2.3 Testing Survey

The trial run of our survey was done on January 12, 2008, at an organic food fair in the Prince Edward district of Kowloon. This food fair was a good starting point because experimental eco-fish were on display.

With five volunteers from the WWF and two HKUST students 51 surveys were completed. After this trial we decided, along with Mr. Lau and HKUST students, that only one

question on the survey needed revision. The question of interest was changed to ask for the district of fresh food purchase rather than the district of residence. We then continued surveying in various districts throughout Hong Kong using the revised questionnaire.

3.2.4 Survey Sampling

In order to get a diverse sample we, along with HKUST, developed survey sampling methods. These methods were based on convenience and cluster sampling to try to get a diverse sample of consumers.

Convenience sampling was used when choosing who to interview. This is a method of interviewing or surveying people who are willing to stop and talk with you. All of our respondents were those who were willing to stop and spend five minutes of their time to complete our survey. Although this street-corner surveying technique lacks randomization the large sample size validates the data collected.

Cluster sampling was used to decide which districts in Hong Kong to survey. This method involves dividing a population into groups or clusters and taking a sample from each. Birchall(2007) suggests that when using this method there must be a large sample size, however it does equate to a simple random sample when done correctly. Our districts were not chosen in a random way, but were chosen based on income level. This alters the randomization of our sampling and so reliability may be questioned without an appropriate sample size.

In order for cluster sampling and convenience sampling to give reliable results there must be a high sample size. For our survey sample size we used a formula relating to a proportion since we are trying to assess the percentage of consumers who approve of eco-fish. This formula is:

$$s = (z^2 (p (1-p))) / e^2$$

Where s is our sample size, z is the normal value for 95% confidence (1.96), e is the error that we will accept in our data (0.05), and p is an estimate of the proportion of people who approve of eco-fish (50%). The formula gives us a sample size of 385. However since our sampling is not completely random this sample size is lower than is needed and may affect the reliability of our survey. (Birchall, 2007)

Our sponsor set a goal of 400 surveys, we surveyed during the two busiest shopping times of the day outside of popular food shopping areas. Conducting the survey at 10am and 6pm for two hour intervals allowed us to reach our goal in the allotted two weeks. We surveyed during each of these two times on both a weekday and weekend day in the districts mentioned below.

We divided Hong Kong's districts into low income, middle income, and high income groups based on the average monthly income of the people living in those districts. This information was obtained from the Census and Statistics Department of the Hong Kong Special Administrative Region and can be found in Appendix G. We chose to survey in seven districts that expressed a wide variety of income levels.

When choosing the districts we used the three main regions of Hong Kong, Hong Kong Island, Kowloon and the New Territories, as a base for our sample area. Within these areas smaller districts were chosen based on income level. The high income districts included Central and Hang Hau. The Middle income districts included Wan Chai and Kwai Tsing. The low income districts included Sheung Wan, Sham Shui Po, and Tsuen Wan.

3.3. Information about the Mai Po Fishers

3.3.1 Interview with Tobi Lau

Tobi Lau of the Worldwide Fund for Nature has been working with the fishers of the Mai Po region for seven years. During this time he has gained valuable knowledge pertaining to the fishers' needs and practices. Through interviewing Mr. Lau we obtained further insight into the people of the Mai Po region and the potential benefits they stand to gain through farming eco-fish. He discussed the current state of affairs in the Mai Po fishponds and the WWF's intentions with regard to current and future involvement in the area. His interview can be seen in appendix D.

3.3.2 Information from the New Territories Fish Culture Association

The New Territories Fish Culture Association is a Hong Kong trade organization of fishers in the New Territories. Although we were unable to interview them directly, our WWF liaison Tobi Lau provided us with information he obtained during a meeting with the Chair, Mr. Lai Loi-chau (Appendix E). This information served as a valuable resource, explaining the fishers' expectations of eco-fish as a product and providing the most recent freshwater fish market information.

Chapter 4: Data and Analysis

From 449 total consumer questionnaires, we are able to see trends in the demographic characteristics, organic buying habits, and fish buying habits of the consumers of Hong Kong. From these trends we can begin to understand the potential market for eco-fish. Upon completion of our survey we found that there to be no statistical difference between the trial data collected at the Prince Edward food fair and the rest of the data. Therefore, we chose to include the data from the food fair in our analysis. (Appendix G)

4.1 Organic Buying Habits

Of the 449 consumers surveyed 58% said that they currently buy organic products. When asked why they chose organic products over non-organic respondents were given five options and asked to rate them from 5 being most important to 1 being least important (Fig. 3). The most important reason among consumers for buying organic was that organic products possess good intrinsic values. Intrinsic values are the properties attributed with production of the organic food. In the survey the option pertaining to intrinsic values was stated as “Good intrinsic values in terms of natural; nutritious; healthy; environmental-friendly, ecological and safe production”, as seen in Appendix C.

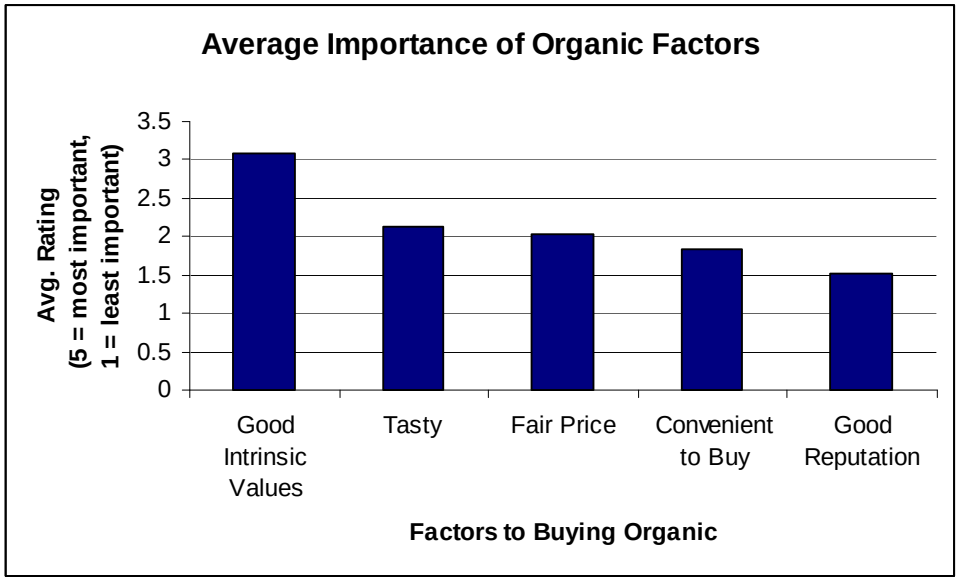

Figure 3: Factors to Buying Organic Products

Taste and fair price were also found to be important factors in the consumers' choice to buy organic products. The response to taste suggests that consumers of organic products find such products to often taste equal to, if not better, than their traditional counterparts. Considering that eco-fish are a food product, the quality of taste is a relevant concern which could potentially determine its success. Having a fair price is also a factor. However, it must be taken into consideration that this would be a fair price within the organic market where products are often marketed at a premium compared with their non-organic counterparts.

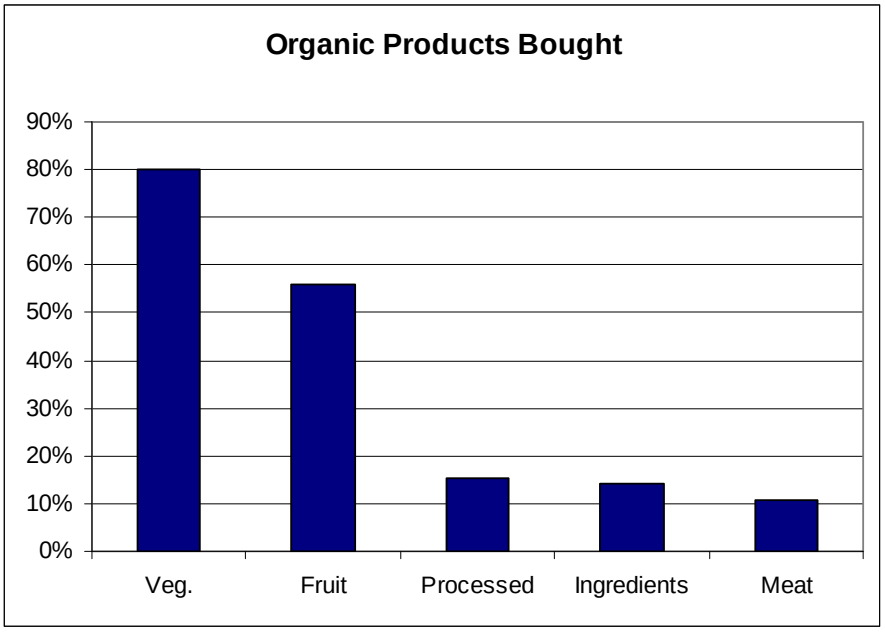

Figure 4: Organic Products Purchased

Our data shows that consumers who currently buy organic goods most frequently buy organic fruits and vegetables. Organic ingredients, processed foods (cheese, etc.), and meats appear to be far less popular among Hong Kong consumers (Fig. 4). While a strong organic market appears to be in place already, existing organic meat products do not appear popular among those consumers surveyed. The organic fish market in particular appears to be virtually non-existent, as eco-fish are an experimental product never before seen on the Hong Kong market.

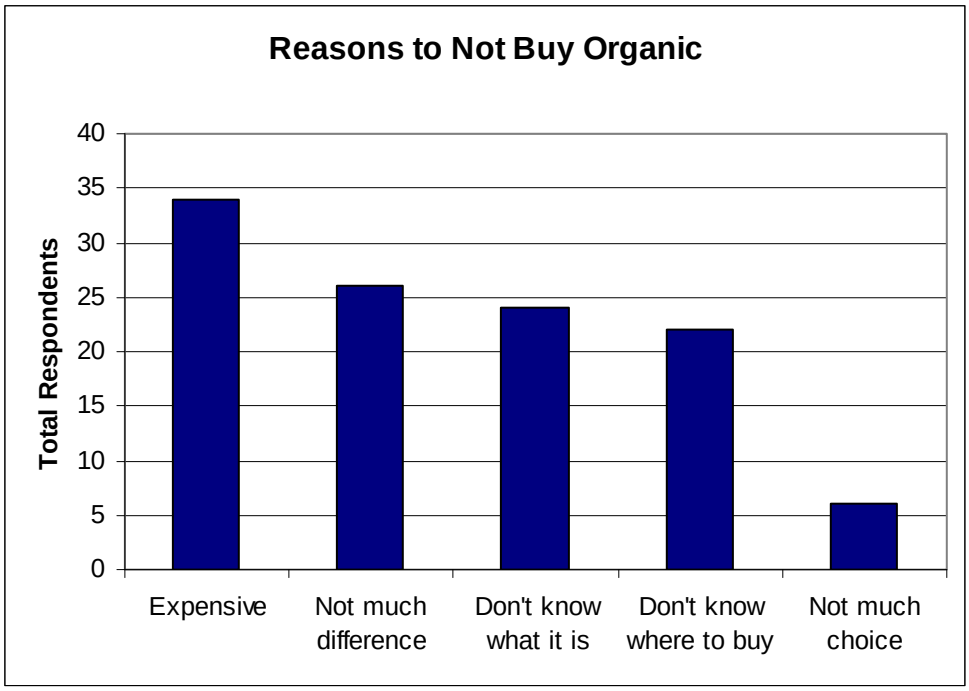

Figure 5: Reasons to Not Buy Organic Products

Of the consumers surveyed 42% said that they do not currently buy organic products. Approximately one third of those respondents who do not buy organic products listed price as their reason for abstaining (Fig. 5). It is apparent that many consumers believe the organic products currently on the market are too expensive. Other reasons cited are based on a lack of knowledge about the current organic market. Approximately twenty-five consumers admitted that they were unaware of which products are organic, while another twenty five consumers were unsure where they could purchase organic food. Most significant perhaps is how few respondents believed there was a lack of choice among organic products. This suggests that the organic market of Hong Kong is well established and offers a variety of products.

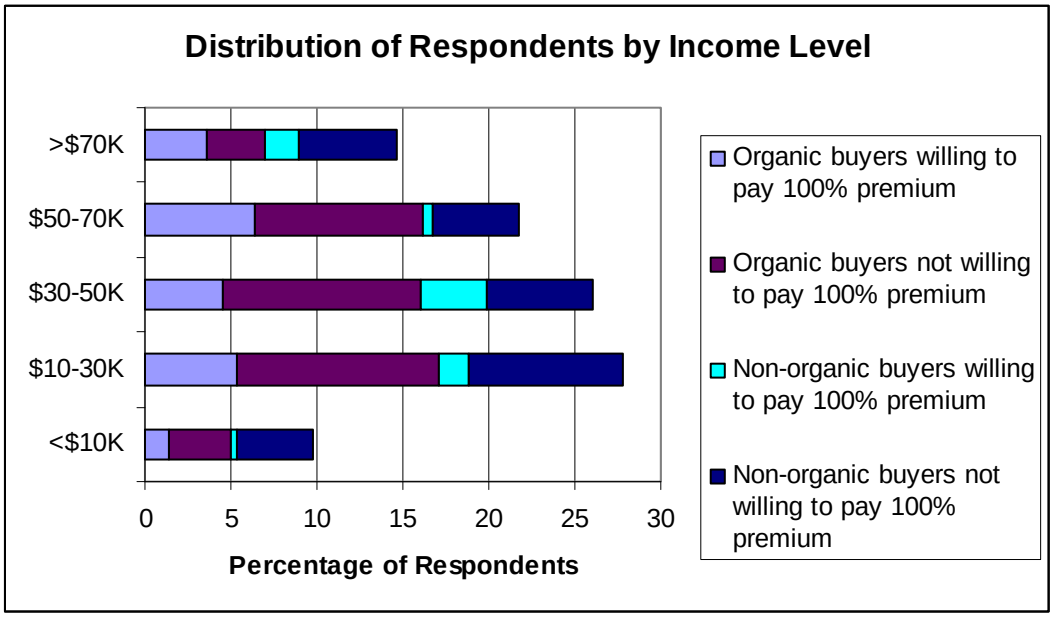

Figure 6: Distribution of Respondents by Income Level

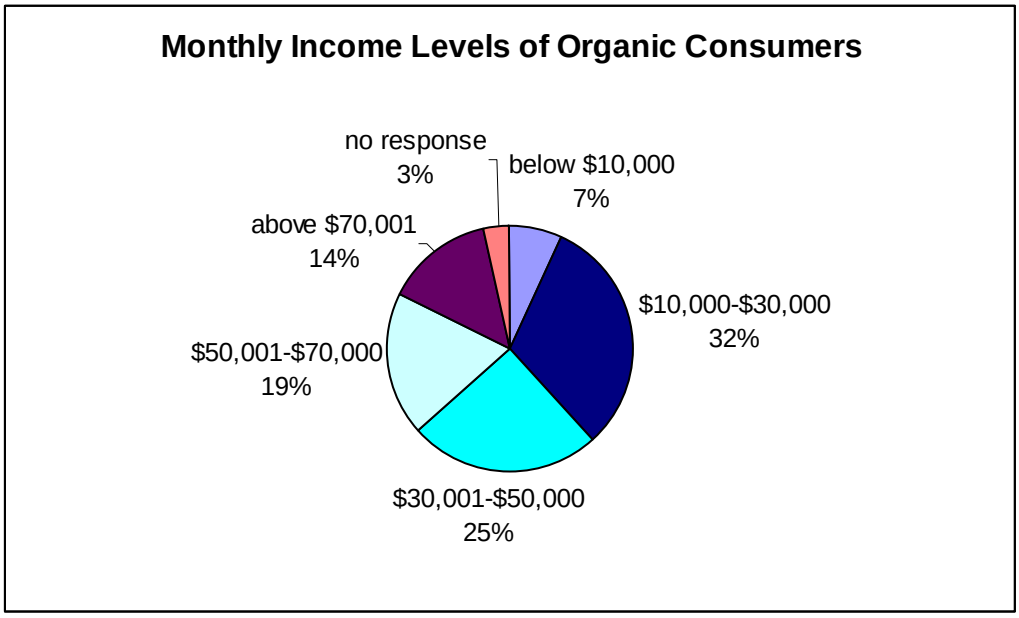

Figure 7: Monthly Income Levels of Respondents Who Purchase Organic Products

When analyzed side by side figures 6 and 7 offer great insight into the potential target market of eco-fish. Those households which earn less than HK$10,000 per month show very

little interest in eco-fish (Fig. 6). Not only does the lowest income group purchase the fewest organic products, they are the least willing to pay a 100% price premium. This is potentially the result of a lack of disposable income amongst those in the low income group.

Of the respondents who currently buy organic products 57% have a monthly income between HK$10,000 and HK$50,000. In Hong Kong, these respondents fall within the middle income level. Those middle income households which purchase organic products show a greater interest in eco-fish than households which do not purchase organic products. Approximately one third of those who purchase organic products were willing to pay the premium, while approximately one fifth of those who do not buy organic were willing to pay the premium. Interestingly, those respondents with an income level of HK$30,001-HK$50,000 who do not buy organic were found to be more likely to purchase eco-fish than those at the same level who have previously purchased organic products.

Among the upper income level respondents, earning in excess of HK$70,000, there was a high willingness to pay a 100% price premium. Wealthy patrons who reported a history of organic purchases were the only group analyzed who showed a majority, 85%, in favor of paying the 100% price premium.

The similarities in the income levels of respondents willing to buy eco-fish at a 100% price premium (Fig. 6) and the income levels of respondents currently buying organic products (Fig. 7) suggests that there are parallels between the two markets.

4.2 Fish Buying Habits

In order to pinpoint potential markets where eco-fish can be sold, we asked consumers in which districts they shop and the types of stores they prefer to purchase fish from. When asked

where they would most likely buy eco-fish consumers were given five choices: supermarkets, wet markets, organic markets, specialized shops, or online. While there was a positive response to all options, supermarkets and wet markets were the most popular locations among respondents for the retail of eco-fish (Fig. 8).

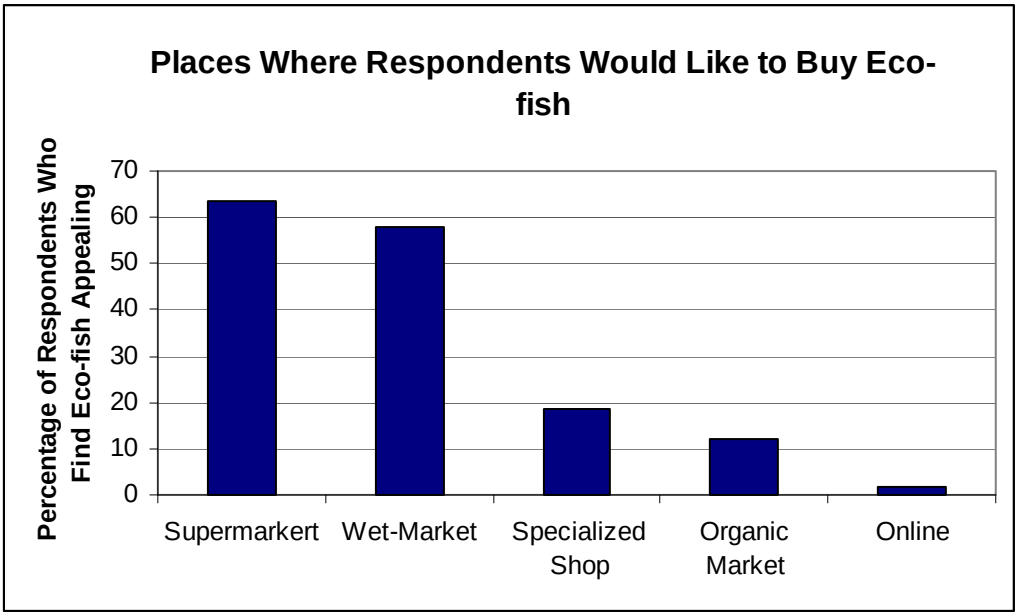

Figure 8: Places Where Respondents Who Find Eco-fish Appealing Would Likely Buy Eco-fish

Consumers were also asked which species of freshwater fish they most often purchase. This allowed us to observe which species were most popular and therefore in the greatest demand. Grass carp and grey mullet were found to be in the highest demand, while big head carp also proved popular (Fig. 9). These are the same species that are currently being raised in the ponds of Mai Po as eco-fish (Appendix D).

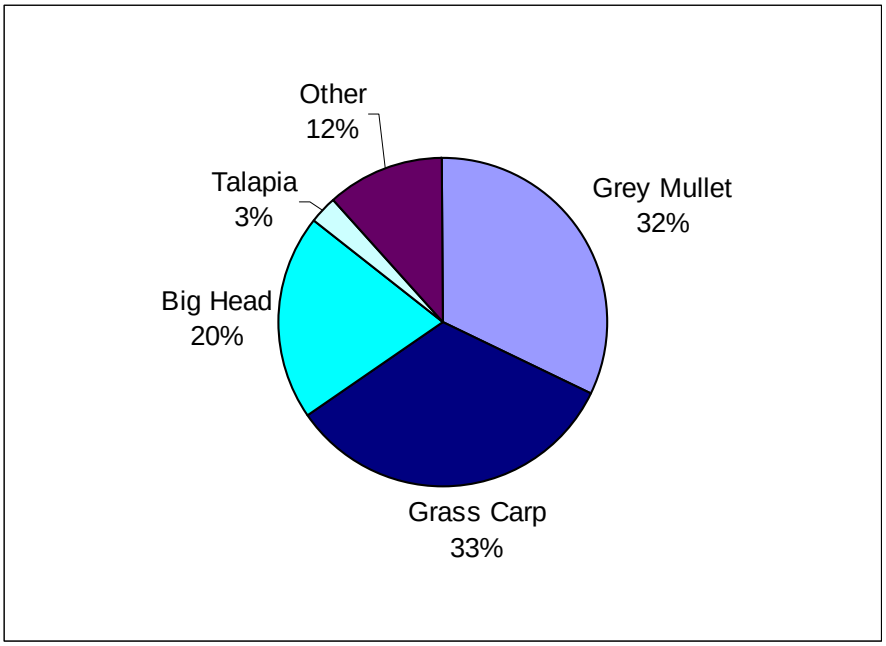

Figure 9: Species of Freshwater Fish Typically Bought

Our respondents overwhelmingly prefer consuming freshwater fish at home rather than in restaurants. 78% in all reported eating freshwater fish at home. This finding seems to exclude restaurants as a possible distribution outlet for eco-fish.

4.3 Price Premium for Eco-fish

As seen in figure 10, 84% of people surveyed would buy eco-fish at a 20-40% mark-up price. This includes both respondents who would and those who would not buy eco-fish at double the current market prices.

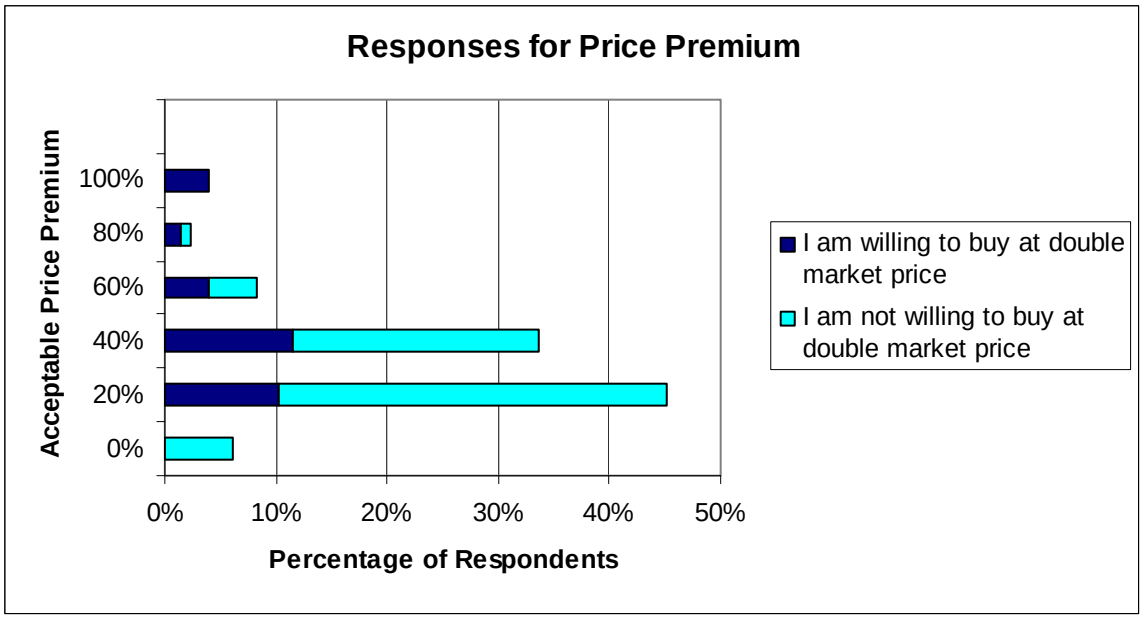

Figure 10: Acceptable Price Premium

4.3.1 Data from Interview with New Territories Fish Culture Association

The chair of the New Territories Fish Culture Association believes the fishers of Mai Po would consider changing to an eco-fish scheme if a higher profit can be achieved. He states that the winter 2007 average price for grey mullet was HK$13 per catty and suggests a raise to HK$15 per catty would be sufficient. However, the chairman believes that grey mullet is the only species that could initially be adopted because of its high market value. Furthermore, he stated that the fishers would be interested in changing to eco-fish at this price level even without financial support from the WWF. (Appendix E)

4.4 Respondent Demographic

In order to determine a target market for eco-fish within Hong Kong several personal questions were asked of consumers. Responses to these questions were kept anonymous. The survey results have been used to create a demographic profile of potential eco-fish consumers.

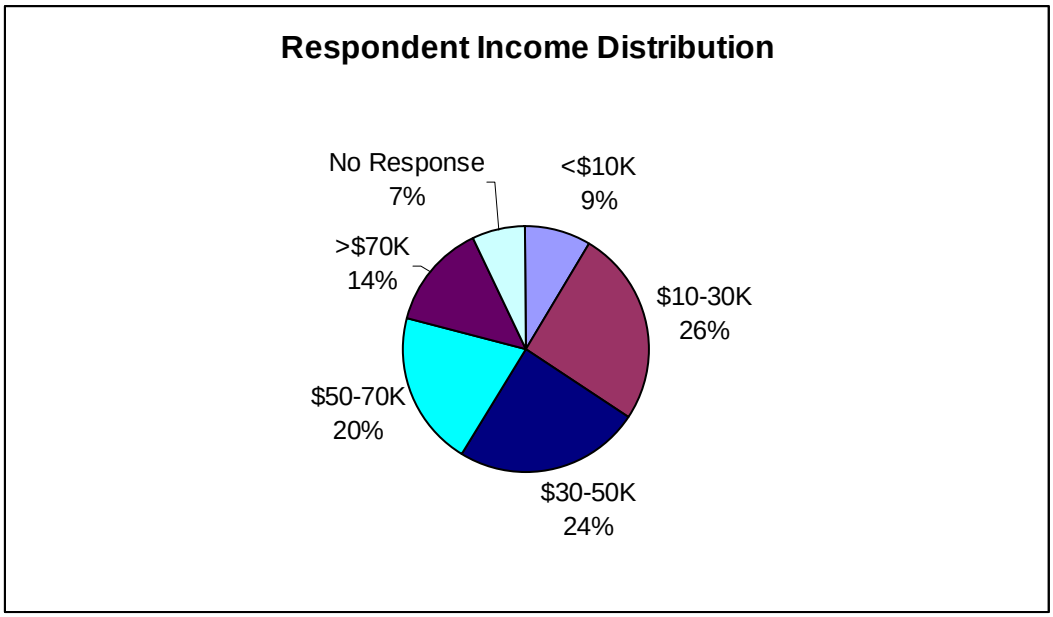

Figure 11: Monthly Income Distribution

As eco-fish will most likely cost more than the freshwater fish currently on the market, it is essential to determine which groups of consumers are willing to pay more. The distribution of monthly incomes among consumers shows that nearly half of those surveyed fell within the middle income groups (Fig. 11). Less than 10% of those surveyed earned less than HK$10,000 per month, making the lower income group the least represented demographic. Approximately one third of those surveyed fell within the upper income group, earning in excess of HK$50,000 per month.

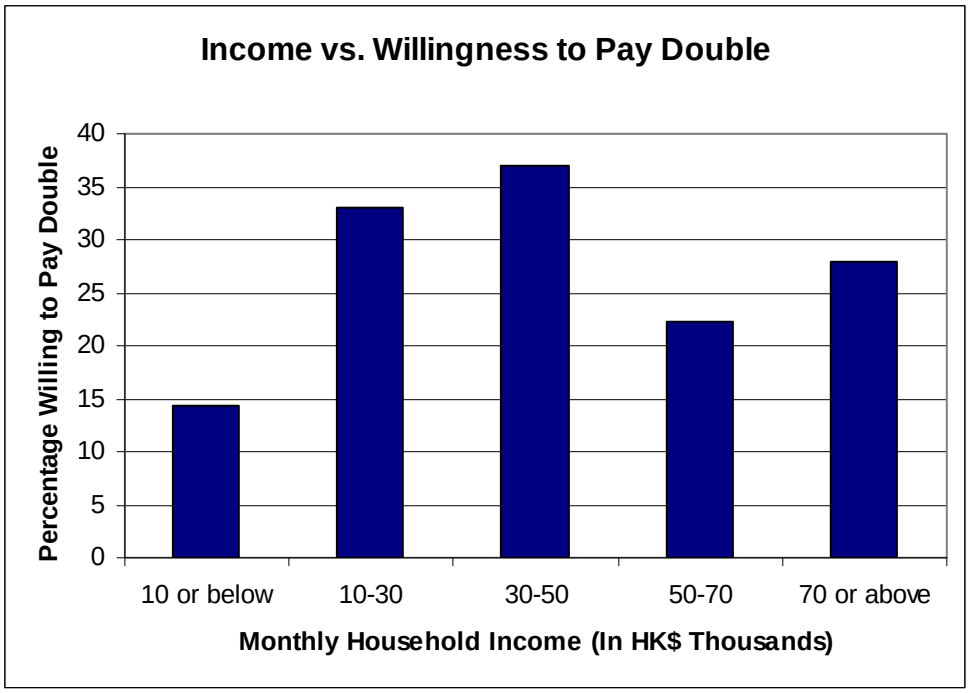

Figure 12: Monthly Income of Respondents Willing to Pay 100% Price Premium

The financial status of consumers appears to dictate their shopping habits and willingness to pay more for select products. Consumers were asked whether they would pay a 100% price premium for eco-fish. We found that over a quarter of our total respondents were willing to pay double. It is evident that the middle income level groups are most willing to pay double for eco-fish (Fig. 12). Those families who earn HK$10,000-50,000 per month recorded the greatest willingness to pay a high premium for eco-fish. Those earning in excess of HK$50,000 per month were slightly less willing to pay double, while those earning less than HK$10,000 per month simply were not as willing to purchase such a product.

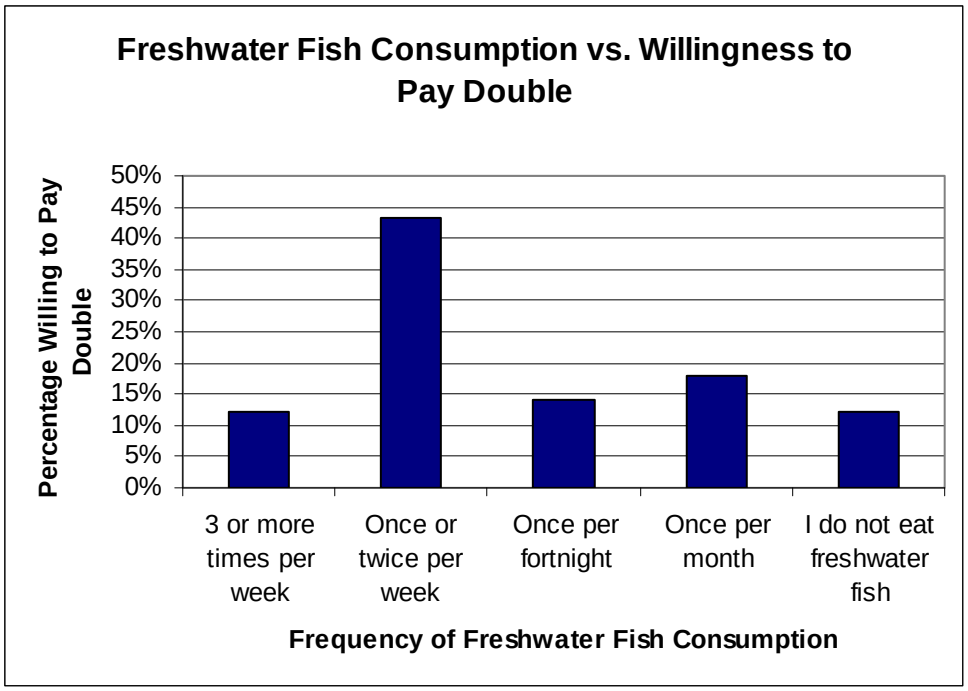

Figure 13: Freshwater Fish Consumption and Willingness to Buy Eco-Fish at 100% Price Premium

As seen above (Fig. 13), people who eat freshwater fish once or twice per week are the most willing to buy eco-fish at 100% price premium. Since freshwater fish are a relatively inexpensive product, it is not too much of an expense for those who only eat it several times per week to pay a 100% price premium. Perhaps those who purchase freshwater fish once or twice per week are most willing to pay a premium for eco-fish because the added cost is a relatively small share of their weekly food expenditures. The added cost may be too great a burden for those who purchase freshwater fish three or more times each week. Those who buy infrequently may not care enough to pay the premium.

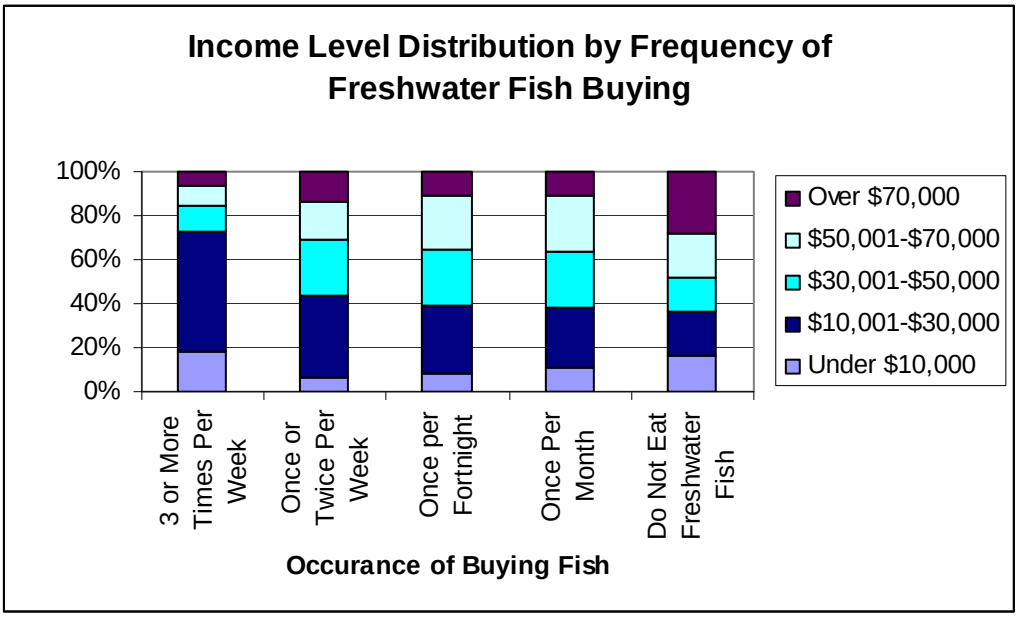

Figure 14: Income Levels and the Frequency of Buying Freshwater Fish

It can be seen in figure 14 that 40% of respondents who regularly buy freshwater fish (at least once per fortnight) are in the middle income levels, with a monthly income between HK$10,000 and HK$50,000..

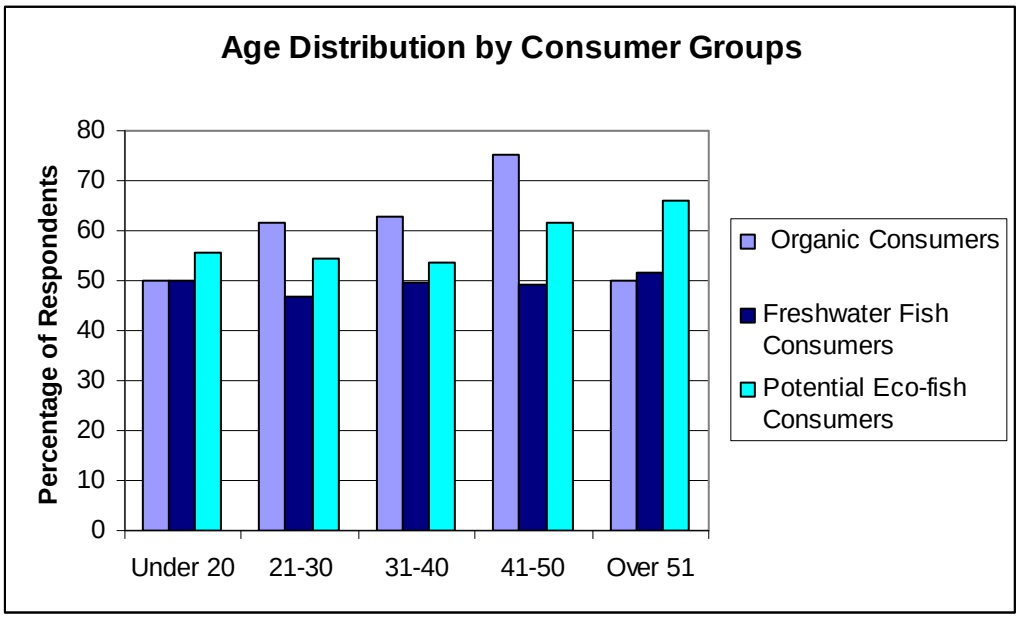

Figure 15: Age Distributions for Consumers of Organic Products, Freshwater Fish and Potentially Eco-fish

The age distributions of organic consumers, freshwater fish consumers, and potential eco-fish consumers (Fig. 15), along with their income distributions (Fig. 14, Fig. 12 & Fig. 7), suggests that there are similarities between the demographics of respondents who are both organic consumers and potential eco-fish consumers, as well as respondents who are both freshwater fish consumers and potential eco-fish consumers. The data indicates that middle income level consumers not only hold the ideals of eco-fish as important and appealing, but they also enjoy eating freshwater fish, making them a viable potential market for eco-fish.

4.5 Census Data

Data on income levels was collected in a 2001 census by the Hong Kong Census and Statistics Department. According to this latest information there are a total of 2,053,412 households in Hong Kong. Around 62% of the total households fall into our middle level income group of HK$10K to HK$50K per month. The complete breakdown of the income groups by household is shown in Table 2.

Table 2: Household Income (Hong Kong Census and Statistics Department)

Monthly Domestic Household Income (HK$)	2001	
	Number	% of total
< 2,000	65 855	3.2
2,000 - 3,999	97 568	4.8
4,000 - 5,999	93 018	4.5
6,000 - 7,999	116 340	5.7
8,000 - 9,999	120 721	5.9
10,000 – 14,999	318 623	15.5
15,000 – 19,999	262 086	12.8
20,000 – 24,999	223 708	10.9
25,000 – 29,999	159 470	7.8
30,000 – 39,999	219 229	10.7
40,000 – 59,999	197 311	9.6
≥60,000	179 483	8.7
Total	2 053 412	100.0

Chapter 5: Results and Conclusions

Based on the information presented in our analysis we have come to three main conclusions:

1) Consumers view eco-fish as similar to organic products and thus organic consumers are attracted to their qualities

2) Most frequent freshwater fish consumers are willing to pay double for eco-fish

3) Consumers, in general, are willing to pay a 30-40% premium for eco-fish.

From these conclusions we determined a possible niche for eco-fish within the Hong Kong food market. We identified the demographics of potential eco-fish consumers and have made recommendations on the consumers' willingness to pay a price premium.

5.1 Marketing the Organic Traits of Eco-fish

Organic products are appealing to consumers because of their production methods and their impact on the environment and peoples' health. As an organic product establishes itself in the market it creates brand recognition. This recognition informs the consumer that the food is produced in an organic way. Because of the intrinsic values they possess consumers are willing to pay more for organic products.

Organic consumers relate to eco-fish because of the product's intrinsic qualities which are similar to those of organic products. The qualities of eco-fish are:

1) They are free of contaminants, making them healthy for human consumption.

2) The methods used to produce eco-fish do not pollute or degrade the environment.
3) Maintenance of eco-fish ponds will increase environmental sustainability in the internationally important wetlands of the Mai Po region.

An accurate representation of a product's qualities, such as those of eco-fish listed above, is crucial to gaining a positive reputation among consumers. If eco-fish can create a strong reputation for itself based on those qualities more organic consumers are likely to be interested in eco-fish.

In Hong Kong, both organic farmers' markets and supermarkets are well established. Farmers markets are operated by organizations that promote organic foods, such as the Hong Kong Organic Farmers Association and Kadoorie Farms. Supermarkets specializing in organic products, such as Three Sixty and Taste, have many stores in Hong Kong. The similarities between eco-fish and organic products may give these stores an incentive to carry the eco-fish product.

5.2 Freshwater Fish Consumers

Over 85% of our survey respondents purchased freshwater fish at least once per month. The respondents most attracted to eco-fish were those that ate freshwater fish several times per week. We found that these respondents were typically in the middle income group.

Taste and price are the top factors that appeal to consumers of freshwater fish. Freshwater fish are less expensive than marine fish and are purchased frequently for consumption at home. While there is a multitude of species of freshwater fish available in Hong Kong markets, 85% of our respondents primarily buy grey mullet, grass carp, and big head carp.

These are the same species currently being grown as eco-fish in the experimental ponds in Mai Po.

5.3 Consumer Demographics

In our analysis we determined a few key demographic characteristics of potential eco-fish consumers. People who are frequent freshwater fish consumers, organic consumers, and also fall within the middle income level are the most attracted to eco-fish. This group has indicated a willingness to pay a premium for eco-fish. These people often shop in popular supermarkets, such as Park N' Shop, Wellcome, Three Sixty, and Taste, as well as wet markets. In order to target such consumers a distribution outlet involving these places must be pursued.

5.4 Recommendations

We have two major recommendations for the WWF. These recommendations are with regard to the future marketing of eco-fish and the need to continue data collection in order to expand the research we began.

5.4.1 Eco-fish Product

We recommend pursuing middle income families as a potential target market for eco-fish. Those families that earn HK$10,000 – HK$50,000 per month show the greatest willingness to buy eco-fish. Within this income range a large number of both organic and freshwater fish consumers find eco-fish to be an appealing product.

The proposed target market for eco-fish, consisting of those households earning $10,000-$50,000 per month, makes up nearly70% of Hong Kong's total households. Hong Kong's population of approximately seven million people is distributed among over two million

households. We estimate that the number of households which contain potential eco-fish consumers is around 1.5 million.

Establishing a brand name for eco-fish will strengthen the product's appeal to consumers. We know that organic consumers tend to buy products which are reputable and widely trusted. If eco-fish can establish a brand name that conveys its values it should quickly establish a favorable reputation among consumers.

Placement of eco-fish should be concentrated at supermarkets, organic and general, and wet markets. Not only would these locations introduce the product to a variety of consumers, they proved to be the most popular locations among consumers surveyed. Restaurants are not seen as viable distribution outlets since most people prefer to eat freshwater fish at home.

The price premium we recommend for eco-fish at market is 30-40%. At a 30% premium grey mullet would be sold at HK$16.9 per catty (about HK$27.90/ kg), exceeding the advised price of HK$15 per catty (about HK$ 24.80/kg) that Mr. Lai Loi-Chau of the New Territories Fish Culture Association suggested.

5.4.2 Further Research

We recommend continuing the consumer survey to determine if the trends we have identified are supported with a larger sample size. We believe that adding a question pertaining to place of residence, in addition to place of purchase, would provide information on which areas have a large amount of non-resident shoppers. This information will be useful when developing a comprehensive marketing and advertizing scheme. In order to aid in the development of a distribution system for eco-fish, we suggest adding a question asking if consumers prefer to buy live or prepackaged fish.

Further research should also go into better determining the fishers' economic needs. This requires establishing a price premium for eco-fish that will allow eco-fish farmers to be economically sustained without requiring subsidies from organizations like the WWF.

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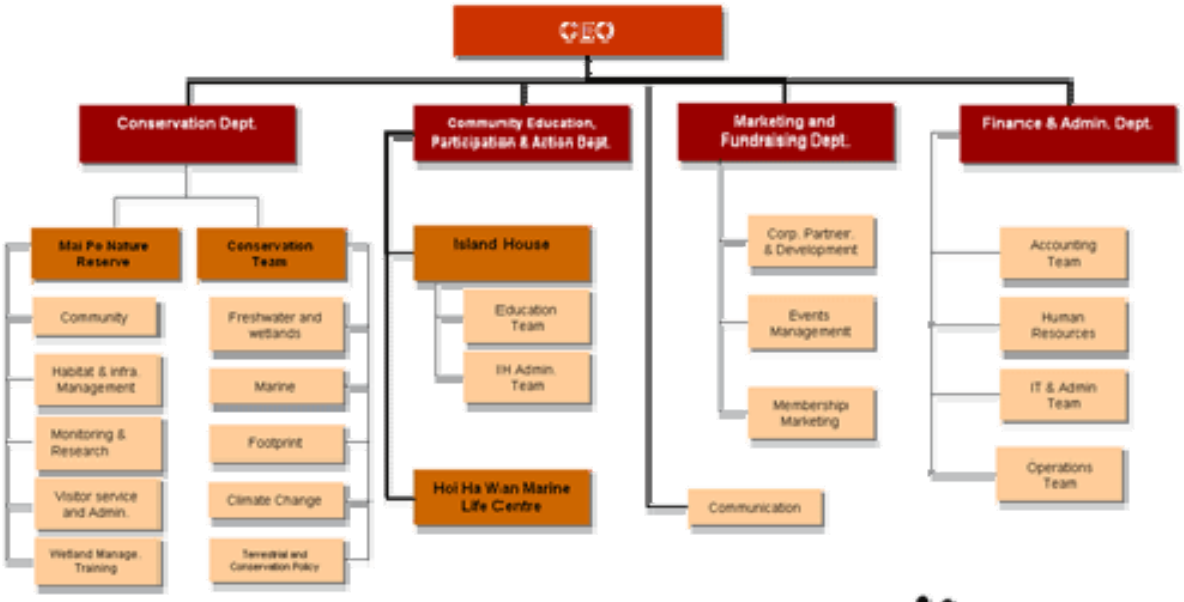
APPENDIX A: Sponsor Description

The Worldwide Fund for Nature, also referred to as the World Wildlife Fund, is a global conservation organization that is committed to preserving the environment. Their official mission statement is "To stop the degradation of the planet's natural environment, and to help build a future in which humans live in harmony with nature by; conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption."(Wetlands International, 2007) To achieve its goals the fund educates people on renewable and sustainable resources, pollution and waste reduction methods, and the importance of ecosystem conservation. The WWF is a non-profit, non-governmental organization which is funded primarily through public donations.

The WWF works in 100 countries; we will be working specifically with by their offices in Hong Kong. The Hong Kong branch consists of five offices in Central, Wan Chai, Mai Po, Tai Po and Hoi Ha Wan that employ over eighty fulltime staffers. The aid of hundreds of volunteer workers also plays a key role in the productivity and success of the organization. Our project will be working closely with the Mai Po section of WWF Hong Kong, as their conservation department is responsible for overseeing the Mai Po Inner Deep Bay Ramsar site. Below is a chart which shows their current structure.



Current Structure © WWF Hong Kong

The Mai Po Inner Deep Bay site is an ecologically diverse region, which supports around 80,000 wetland birds. Many species are attracted to the site when local ponds are drained during the fish harvesting process. When the ponds' water levels are lowered it creates a dense feeding area for the birds. Many of the bird species have become dependent on the drainage process for food. If the ponds are not drained the food chain will be disrupted, and the ecological balance of this site could be endangered. The WWF is involved in trying to conserve endangered species and also the diverse ecosystems where they live. Funding for this site is split between the WWF and the Agriculture Fisheries and Conservation Department (AFCD) of Hong Kong. Sixty percent of the revenue from the Mai Po program comes from visitor income and special fundraising events held by the WWF, while the remaining forty percent is provided by the AFCD under jurisdiction of the government.

The WWF is a partner organization of the Ramsar Convention. The Ramsar Convention is an international organization whose “mission is the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world.” Mai Po wetlands area was established as a Ramsar site September 4th 1995. This site was designated as international important under specific criterion by the Ramsar convention. Currently the Mai Po Inner Deep Bay region is considered internationally significant as it is defined under four criteria for an important wetlands area: it supports vulnerable, endangered, or critically endangered species or threatened ecological communities; it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region; it regularly supports 20,000 or more water birds; it regularly supports one percent of the individuals in a population of one species or subspecies of water bird.

Another organization that works on the Mai Po site is the Agriculture fisheries and Conservation Department (AFCD) of the Hong Kong Government which manages the Mai Po wetlands site. Their goals for the site include, "to increase biodiversity values of the site, realize the full potential of the site for education and raising public awareness with respect to wetland values, and advance the regional and international obligations undertaken by and opportunities afforded to Hong Kong as a consequence of its participation in the Ramsar Convention"(Wildfowl & Wetlands Trust, 2007). The AFCD also controls access to Mai Po in order to minimize disturbance to its natural environment.

APPENDIX B: What is an IQP?

An Interactive Qualifying Project (IQP) is a project required of Worcester Polytechnic Institute (WPI) students. Students research the application of scientific and technological ideas to solve societal problems and meet human needs. "The objective of the IQP is to enable WPI graduates to understand, as citizens and as professionals, how their careers will affect the larger society of which they are part" (Worcester Polytechnic Institute, 2007, p.42).

The Mai Po region has been designated a Ramsar site for over ten years, which means it is an internationally important wetland, since it winters migratory birds some that are endangered. Ramsar is an international organization which helps to determine which wetlands are important to the biodiversity of the world by setting certain criteria, like species of birds and animals in the area. The Mai Po wetlands meets 3 of their criteria as well as being a major feeding ground for an endangered bird which is only found in Asia, the black faced spoonbill.

The agricultural industry of the world has evolved because of a need for a greater amount of food products. In Asia one of their main sources of protein is fish and so they have been keeping current in the new methods of production in fish. One of these methods is in aquaculture, which is raising fish in man-made ponds and helping their growth with hormones and special feed. Aquaculture is a cheap method for harvesting fish, but is not as environmentally friendly or as healthy as the traditional Chinese methods of pond raising fish. This has caused a problem in the Mai Po area because China is importing their lower cost fish into the fish market in Hong Kong, which has lowered the price for freshwater fish. This means

that the Mai Po fish farmers are now having a harder time keeping the economic viability of their farms with their current methods of harvesting.

Our team will work to determine if there is a viable market for eco-fish in Hong Kong. This will be done in order to ensure that the fish farmers of the Mia Po region would be able to sustain their livelihood and continue their traditional fish farming methods, which have become of great ecological importance. Our project qualifies as an IQP because it addresses the larger societal problem of the need for all people to be more aware that the production methods of everyday products can greatly impact the environment.

APPENDIX C: Consumer Survey (English)

WWF for a living planet

Eco-fish questionnaire

Aim of the questionnaire: In 2007 WWF Hong Kong started experimenting with a pond-cultivating system of raising "Eco" pond-fish. This system encourages the farmers to manage their ponds in a sustainable manner that benefits the wildlife, is good for the environment and provides safe and high-quality locally-produced freshwater fish to the public. Since this is the first time ecologically sustainable fish will be made available in Hong Kong or Southeast Asia, WWF is now attempting to collect some information from the public about their opinion and response to the "Eco-fish" product.

A. Background Information

1. Gender ☐ Male ☐ Female

2. Age ☐ 20 or below ☐ 21 – 30 ☐ 31 – 40 ☐ 41 – 50 ☐ 51 or above

3. Occupation

☐ Employer /Manager /administrator ☐ Professional ☐ Clerk

☐ Service worker and Shop sales worker ☐ Physical worker ☐ Housewife

☐ Student ☐ Unemployed ☐ Retired ☐ Other

4. Status within the family

☐ The household (single household) ☐ Husband / Wife ☐ Son / Daughter

☐ Household's father / mother (in-law) ☐ Domestic helper

5. Number of people in your household

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more

6. Total monthly household income

☐ $10,000 or below ☐ $10,001 – $30,000 ☐ $30,001 – $50,000

☐ $50,001 – $70,000 ☐ $70,001 or above

B. Organic products

7. Have you ever bought organic food products?

☐ Yes. (Please answer #9 to #11) ☐ No. (Please answer # 12)

8. How much do you spend per month on organic product(s)?

☐ $100 or below ☐ $101 – $300 ☐ $301 – $500

☐ $501 – $1000 ☐ $1001 or above

9. Please select the organic food product you purchase most often:

☐ Organic vegetables ☐ Organic fruits ☐ Processed organic products, e.g. cheese

☐ Organic food ingredients, e.g. flour ☐ Organic meat, e.g. lamb, fish

10. Please rank the following factors based on what you take into consideration when purchasing organic products?

(1 extremely important, 2 very important, 3 important, 4 less important, 5 not important).

____ Fair price

____ Good intrinsic values in terms of natural; nutritious; healthy; environmental-friendly, ecological and safe production

____ Good reputation

____ Tasty

____ Convenient in buying

11. If you don't currently purchase organic products, what factor(s) contribute to this choice?

☐ Expensive, out of budget / not worthwhile ☐ Don't know where to buy

☐ Not much difference between organic and inorganic ☐ Don't know what is organic

☐ Not much choice

C. Fish Consumption

12. Where do you always buy fresh food?

☐ Wan Chai	☐ Eastern	☐ Central / Western	☐ Southern
☐ Kwun Tong	☐ Kowloon City	☐ Wong Tai Sin	☐ Sham Shui Po
☐ Yau Tsim Mong	☐ Sai Kung	☐ Shatin	☐ Islands
☐Tsuen Wan	☐ Kwai Tsing	☐ Tuen Mun	☐ Yuen Long
☐ North	☐ Tai Po		

13. How often do you buy/eat marine fish?

☐ 3 or more times per week ☐ Once or twice per week

☐ Once per fortnights ☐ Once per month ☐ I do not eat marine fish

14. How much do you typically spend on marine fish each month?

☐ $100 or below ☐ $101– $200 ☐ $201– $300 ☐ $301– $400 ☐ $401 or above

15. How often do you buy/eat freshwater fish?

☐ 3 or more times per week ☐ Once or twice per week

☐ Once per fortnights ☐ Once per month ☐ I do not eat freshwater fish

16. How much do you typically spend on freshwater fish each month?

☐ $100 or below ☐ $101– $200 ☐ $201– $300 ☐ $301– $400 ☐ $401 or above

17. Where do you typically consume freshwater fish? ☐ At home ☐ At restaurants

18. Which species do you often buy/eat?

☐ Grey mullet ☐ Grass carp ☐ Big head ☐ Tilapia ☐ Other

19. Why do you buy/eat freshwater fish?

☐ Taste ☐ Good price ☐ Convenience to buy ☐ Lots of choice ☐ Told to buy

D. Eco-fish

20. Have you ever heard about "Eco-fish"? ☐ Yes. ☐ No.

21. What do you associate the brand name of "Eco-fish" with? (more than one choice can be selected)

☐ Fish fed non-genetically modified or organic feed, which is good for human health.

☐ Safely produced fish that avoid the use of chemicals, hormones and antibiotics.

☐ Environmentally friendly production methods that avoid environmental destruction.

☐ Ecologically sensitive management methods that are beneficial to wildlife.

☐ None of the above. Please specify: _____

22. Eco-fish have the following attributes

i. good for people's health,

ii. protect the environment,

iii. conserve the wildlife,

Do these values make Eco-fish more appealing to you? ☐ Yes ☐ No

23. If the price of the "Eco-fish" is 100% higher than the current market price subject to the "Eco-values", will you buy the fish? ☐ Yes. ☐ No.

24. How much more would you be willing to pay for "Eco-fish" than the other freshwater fish?

☐ 20% ☐ 40% ☐ 60% ☐ 80% ☐ Other___ ☐ I am not willing to pay extra for "Eco-fish"

25. Where would you by most likely to purchase "Eco-fish?

☐ Supermarkets ☐ Wet markets ☐ Organic farmer markets

☐ Specialized shops ☐ Online order (extra cost will be added for delivery service)

☐ Other, Please specify: _____

Thank you for taking the time to complete this survey.

Date_____ Time_____ Location_____

APPENDIX D: Email Interview with Tobi Lau, WWF Mai Po Reserve Officer

1. How long have you been working with the fishermen of Mai Po?

I have been working with the fishers around the Mai Po since 2001.

2. What are the basic needs of the fishers, are they being met?

In general, the fishers just want making money as much as possible. Indeed, they are not wrong at all as farmers keep on farming because they benefit economically from farming realistically.

3. Currently what is the average annual income of a typical Mai Po fisherman?

The currrent annual gross profit is about 40,000 to 50,000 per ha fishpond every year. Those fishers with larger pond area can obtain greater profit because of economies of scale.

4. Do the fishers find the pond fishing industry profitable in its current state?

According to the figure from Q3, they are quite happy with the profit level. However, most of the fishers hold the attitude of “living for today”. This is because many many of them are aged over 60s, while their young generation are not dare OR are not being encouraged, to join the industry because of hard-work with low economic return.

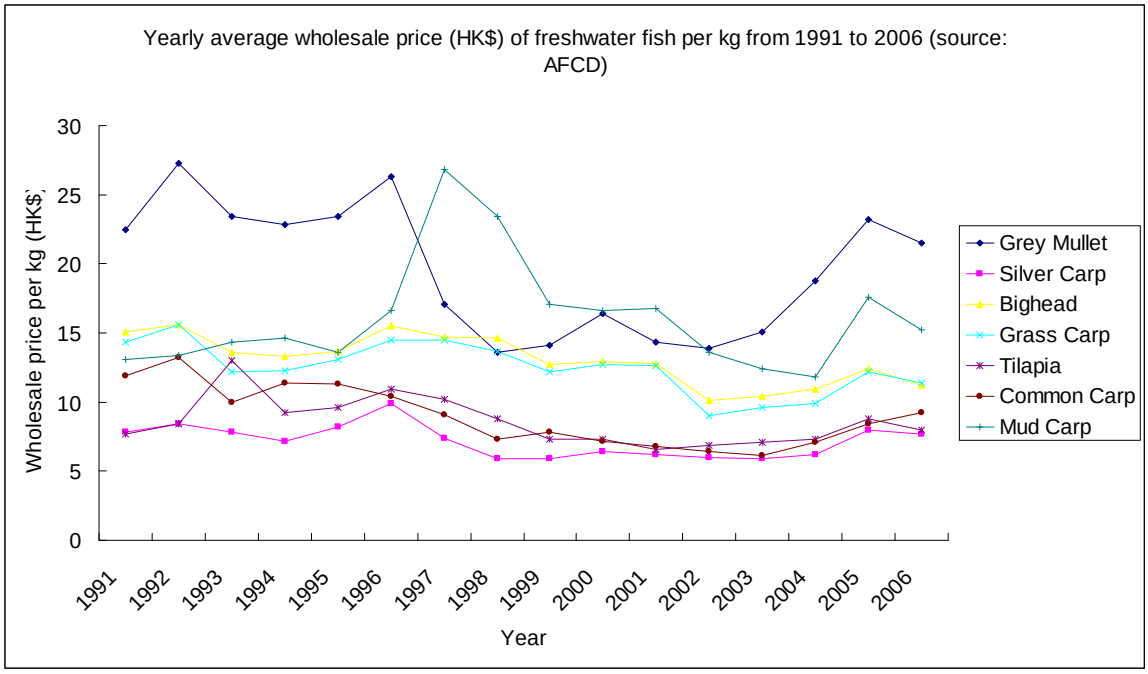
5. If not, what if any actions have the fishers taken to maintain a sustainable income?

The very straight response is to leave the industry. One phenomenon occurs in the last 2 ot 3 years at the Deep Bay pond-fish community is many small-scale fishers who operates 2 to 3 ponds has had left the industry becauese they lost competitive power from China import and their neighours. They transfer the management right of the fishponds to other “big” fishers; get some money and then retired. For the big fishers, as they get more ponds (from the small fishers) to raise fish, these additional ponds will consume much more of their time to manage. I am quite suspected that if these big fishers, usually aged over 60s, can take care all their ponds in a efficient manner.

6. What are the current species being raised in the eco-fish pond?

They are Grey mullet Mugil cephalus, Grass carp Ctenopharyngodon idellus and Bighead carp Aristichthys nobilis.

7. Has the profitability of the pond fishing industry changed in the time you've been working with the fishers of Mia Po?



According to above Figure, since 2002 or 2004 for the species of mud carp, the price level (at 2006) has been uprising to the level of the mid-1990s.

8. If so, are there any definite causes for this change?

Simply speaking, the market force. The local demand for freshwater fish within the mainland China is also increasing. This is because the supply of marine fish for local demand in China are far enough due to over-catching in recent years. As a result, the mainland people make use freshwater fish to substitute marine fish. Many freshwater fish produced in South China has been transported to North China. These days, price differentiation between Hong Kong produced freshwater fish and the mainland is 15% in general; that is the latter is 15% cheaper than the former.

9. Whatif anything is the WWF currently doing to help the fishers better themselves?

Please see following content which is cut from the project brief that being sent to you the other day.

In order to path a sustainable development for these fishponds of ecological importance, a mechanism is therefore needed to secure the sustainable livelihoods of the pond fish farmers who are essential in providing a sustainable food resource for water birds around the Deep Bay area. In 2007, WWF Hong Kong started trialing a pond-cultivating system in which fish stock are raised using "Eco" pond fish farming method. The trial Eco-fish farming aims to generate higher profit for eco-friendly and organically produced fish. This will be a show case to encourage fish farmers to manage the ponds in a sustainable manner that:

1. *benefit to wildlife and its associated biodiversity,*
2. *provide direct and extra economic return to the pond fish farmer community, and*
3. *provide safe and quality locally-produced freshwater fish excludes the use of chemicals antibiotics and growth hormones that are good for the health...*

Simply speaking, the Eco-pond fish farming focuses on the management practices that are being carried out by the pond fish farmers. WWF Hong Kong has established guidelines of "Eco Aquaculture Practices" for the participating farmer to follow. This set of practice focuses on encouraging pond fish farmers to continue those traditional management practices that are well-recognized good for wildlife, particularly the water birds. Additionally, WWF Hong Kong uses

the organic standards from United States Department of Agriculture as a reference for setting the health value of the Eco-fish. The project believes the timing is right as the popularity of organic and other healthy food rises in Hong Kong, and as some freshwater fish imported from the mainland have been implicated in health scares. It is hoped that by adding the above three values on top of the existing market value of the locally produced freshwater fish, pond fish farmers will be able to make a higher profit. This could motivate the pond fish farmers or even some youngsters to continue the industry, and thus help to conserve the ecological function of the fish ponds around the Mai Po Inner Deep Bay Ramsar Site.

10. What advantages does the WWF hope farming eco-fish will offer the fishers of the Mai Po region?

If the experiment were successful, the pond fish farmers could sell their the fish stock at higher market price at the minimal costs following the “Good Aquaculture Practices”, while it is not necessary of doing much extra, intensive management works nor input additional capital investment on the other hand. It is hoped that fish pond farmers of whatever background or age would be receptive this eco-farming system. WWF is also trying to establish a distribution network for selling these eco-fish to make sure the much of the profit would be saved to the farmers’ pocket.

APPENDIX E: Correspondence with Mr. Lai Loi-chau, Chair of the New Territories Fish Culture Association

Following information is provided by Mr. Lai Loi-chau, Chair of the New Territories Fish Culture Association, in a meeting with Mr. Tobi Lau on February 12, 2008.

A. Daily sale status at Au Tau* freshwater fish whole-sale market in Yuen Long

1. Grey mullet: 40 piculs (2,400kg) to 50 piculs (3,000kg)

2. Other freshwater fish species: 150 (9,000kg) to 200 piculs (12,000kg)

B. According to Lai, if there would be a network which could absorb 10 piculs (600kg) to 15 piculs (900kg) of grey mullet directly from the fishermen everyday at the annual flat price of HK$15 dollars per catty (1 catty = 0.6kg), they would consider to join into eco-fish scheme even with no more direct financial support would be received from WWF. The chairman suggested that only the grey-mullet would be available in this case because of its comparatively higher market value. Since the current marketable size of each grey mullet is 1 catty per fish, the15 piculs of grey mullets would be about 1,500 pieces of grey mullet fish.

C. Fish pond area to involve to achieve the daily supply through the whole year

- Daily supply: 15 piculs
- Annual supply: 15 piculs each day x 365 days = 5,500 piculs (330,000kg)

Since 1 mu fishpond can produce 8 to 10 piculs of fish in every management cycle**, it is estimated that the project would involve 500 mu (30 ha) fishponds to supply eco-fish to the public in an all-year-round basis to achieve the suggested fish supply.

D. The whole-sale price in average in winter 2007.

1. Grey mullet is HK$13 per catty

2. Grass carp and the bighead carp are HK$1.10 per tael (1 catty = 16 tael)

E. In Yuen Long, the daily sale rate of freshwater fish at one wet-market is 500 catties (30 kg). This figure includes various and both locally produced and China imported.

F. Mr. Lai is also concerned with the selling the fish at PARKnSHOP. He mentioned that the supermarket is likely to re-frozen the left-over to next days. This information may not need to put into the report but for your information.

Table 1. A “transfer” table of measurement unit

Chinese system	Metric system
1 catty (1 picul = 100 catties)	0.6kg (1 picul = 60 kg)
16.8 mu	1ha

Points to note:

* Most of the fishers around the Deep Bay would sell their fish at this market.

** Management cycle begins at Spring with fish fry stocking to winter of harvesting. Usually, it takes about 10 to 12 months to finish a cycle.

APPENDIX F: Income Distribution of Hong Kong (Census and Statistics Department, HKSAR)

Distribution of Household Income Groups

* More affluent income groups were found in Central & Western and Eastern District, with 18-20% of the population earning income over HK$40,000 per month (HK$480,000 per year, ~US$61,500 per year).

* Moderate income groups earning HK$20,000 to HK$40,000 (per month, in HKD) were found in Kwai Tsing and Kowloon City.

* The lowest income groups were found in Sham Shui Po and Kwun Tong earning from HK$2,000 - HK$8,000 per month (approx. US$3,000/year to US$12,300/year).

Distribution of Income Groups broken down by 9 Districts (# of people)

Kwai Tsing (61,208 total)

$2k - $8k: 11,765 (19%)

$8k - $20k: 23,648 (39%)

$20k - $40k: 18,018 (29%)

Above $40k: 7,777 (13%)

Kowloon City (61,378 total)

$2k - $8k: 11,508 (19%)

$8k - $20k: 19,247 (31%)

$20k - $40k: 16,553 (27%)

Above $40k: 14,070 (23%)

Sham Shui Po (35,225 total)

$2k - $8k: 9,377 (27%)

$8k - $20k: 13,258 (38%)

$20k - $40k: 7,960 (22%)

Above $40k: 4,630 (13%)

Kwun Tong (49,494 total)

$2k - $8k: 11,449 (23%)

$8k - $20k: 18,000 (36%)

$20k - $40k: 13,787 (28%)

Above $40k: 6,258 (13%)

Yau Tsim Mong (60,048 total)

$2k - $8k: 14,865 (25%)

$8k - $20k: 22,664 (38%)

$20k - $40k: 14,802 (24%)

Above $40k: 7,717 (13%)

Eastern (55,205 total)

$2k - $8k: 7,829 (14%)

$8k - $20k: 15,014 (27%)

$20k - $40k: 17,343 (32%)

Above $40k: 15,019 (27%)

Central & Western (37,858 total)

$2k - $8k: 5,455 (14%)

$8k - $20k: 9,523 (25%)

$20k - $40k: 10,118 (27%)

Above $40k: 12,762 (34%)

Wan Chai (8,407 total)

$2k - $8k: 1,303 (16%)

$8k - $20k: 2,035 (24%)

$20k - $40k: 2,038 (24%)

Above $40k: 3,031 (36%)

Tsuen Wan (3,077 total)

$2k - $8k: 473 (15%)

$8k - $20k: 933 (31%)

$20k - $40k: 987 (32%)

Above $40k: 684 (22%)

Percentages of people earning over $40,000 broken down by 9 Districts

Kwai Tsing: 11%

Kowloon City: 20%

Sham Shui Po: 6%

Kwun Tong: 9%

Yau Tsim Mong: 11%

Eastern: 20%

Central & Western: 18%

Wan Chai: 4%

Tsuen Wan: 1%

APPENDIX G: Statistical Justification of Including Data from the January 12th Food Fair

T o prove that the surveys we conducted at the organic food fair in Prince Edward on January 12, 2008 did not significantly bias our results we conducted several tests to determine if the mean and variances of all the surveys were different than those of the data exclusive of the food fair surveys. We conducted an analysis of variance (ANOVA) on the amount of organic consumers and frequency of buying freshwater fish and the income levels. We chose these pieces of data because of their high importance to the results of this project.

The procedure known as the ANOVA is a general technique that can be used to test the null hypothesis that the means of two or more groups are equal, assuming the sampled populations are normally distributed. (NIST, 2006) The ANOVA accounts for natural chance of variation within the data. The results are interpreted evaluating the F ratio (F). The F ration is the relationship between the means square between the groups and the means square within the group. If the F ratio is larger than the F critical value (F crit) the null hypothesis is rejected because there is a statistically significant difference. (Sloan, 2003) If it is smaller than the F crit value, you fail to reject the null hypothesis and therefore the differences are best explained by chance. So they are statistically equal.

ANOVA: Single Factor for Organic Consumers

SUMMARY

Groups	Count	Sum	Average	Variance
All	445	274	0.61573	0.237139
Without Food Fair	395	241	0.610127	0.238476
Food Fair	50	33	0.66	0.22898

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.110394	2	0.055197	0.232622	0.792502	3.005873
Within Groups	210.4694	887	0.237282			
Total	210.5798	889				

ANOVA: Single Factor for Freshwater Fish Consumption

SUMMARY

Groups	Count	Sum	Average	Variance
All	440	904	2.054545	1.623442
Without Food Fair	390	794	2.035897	1.638811
Food Fair	50	110	2.2	1.510204

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.193473	2	0.596737	0.367464	0.692595	3.005989
Within Groups	1424.188	877	1.623932			
Total	1425.382	879				

ANOVA: Single Factor for Income

SUMMARY

Groups	Count	Sum	Average	Variance
All	435	1265	2.908046	1.489221
Without Food Fair	385	1139	2.958442	1.477435
Food Fair	50	126	2.52	1.438367

ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	8.506774	2	4.253387	2.871724	0.05714	3.006107
Within Groups	1284.137	867	1.481127			
Total	1292.644	869				

As shown above the ANOVA s for all three data types, at a 95% confidence interval result in F values less than the F-critical. For this reason we can accept that the data collected at the food fair is statistically equal to the other data collected and therefore including this data in our analysis does not skew our results

APPENDIX H: Live Reef Fish Trade in Hong Kong

Freshness of fish before one eats it is a very important factor affecting both the taste and the texture when being consumed. The Cantonese people in particular prefer to eat fish that have been alive until they have been cooked. This way the fish is at maximum freshness when eaten. Thousands of restaurants in Hong Kong serve their fish fresh from a tank in this way. About 80% of the live seafood consumed in Hong Kong is imported from other countries (Sadovy & Lee, 1998).When the fish arrive in Hong Kong they are distributed by sea to surrounding coastal towns where they are bought by seafood restaurants and fish traders.

The most popular of the reef fish eaten moments after death are several grouper species and hump head. The consumer driven demand for these reef fish give them the highest value in the fish market. Restaurants prefer to cook these fish especially the ones with reddish tint because of their high demand among the local population. Another problem that comes with these consumer driven costs is the methods by which the fishermen obtain the fish. Many fishermen are using cyanide to collect their fish because it is cheap and easy, giving them the highest yield of fish. This in turn leads to outbreaks of ciguatera. Ciguatera is a food poisoning that can result in gastrointestinal illnesses. The biodiversity of the areas in which the reef fish are farmed will continue to lessen because of the constant over fishing (Sadovy & Lee, 1998).

APPENDIX I: Data CD

Attached is a CD containing the excel data sheet of the compilation of our surveys.