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Farming Fish in a Transitional Economy: A Case for East Timor

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Abstract

This case study evaluates the economic potential for a grow-out mariculture enterprise in East Timor while highlighting how such a business venture could help engage a transitional nation in foreign trade, increase employment opportunities and encourage community based projects that promote sustainable resource use.

Keywords: aquaculture, mariculture, grouper, East Timor, transitional economy

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Introduction

East Timor's transitional status has been defined by its horrific and costly struggle for independence. In general, countries or territories are defined as having a transitional economy while shifting from a controlled (planned, closed) economy to a market (free, open) economy. Gaining transitional status often stems from the collapse of a centralized government, an overthrown dictatorship, post-colonial development, decolonization, or simply from being in a severely underdeveloped or poor state and seeking economic improvement.

The United Nation's recognition of East Timor as an independent nation in May of 2002 set the stage for social and economic reforms that often accompany the advent of decentralized ideologies. As East Timor continues to define its national identity to the rest of the world it becomes imperative that investment monies and development aid be used to build the nation's socioeconomic infrastructure from the bottom-up. One way to do this is by developing the confidence and potential of individuals at the community level through the utilization of available resources in a productive and sustainable way, and for this case, to do so while taking advantage of domestic investment laws and enhancing foreign trade relations.

The following case study considers the transitional and impoverished status of East Timor as an order to explore the potential of introducing an offshore mariculture enterprise as an income generating and capacity building development opportunity. To accomplish this task, university researchers funded through USAID conducted a scoping study to collect information pertaining to the development of an offshore mariculture enterprise in East Timor. Interviews were conducted and data was collected to assess site-specific variables pertaining to national and international business climates, community and market infrastructures, demand and supply chains, geographic and oceanographic conditions, along with the availability of scientific and technical support related to the emerging mariculture industry (Ako & Chan-Halbrendt 2005).

As one could imagine, several unique limitations have emerged as a result of investigating the economic potential of a transitional economy. Apart from mainstream risks associated with growing fish in open ocean cages (pollution, disease, security, natural disasters, transshipment etc), a few of the more prevalent conditions that can limit the development of a sustainable mariculture industry is the looming threat of political instability and the dependence on foreign aid needed to kick-start the industry. As a result, a risk averse investor or development bank interested in issuing aid money might be inclined to take out political risk insurance as a buffer to such instability. However, as the confidence of the social structure can be restored in time through strong leadership and well informed decision-makers, there are many positive attributes that can be assessed as well, particularly for relatively small and developing island nations rich in marine

resources. To better understand East Timor's economic potential this research highlights various strategic costs and benefits of economic development afforded by the nation's investment climate, the availability of feasible markets and the regions overall production capacity with regard to the prevailing environmental, social, economic and political atmosphere. Objectives of the following case study include exploring the economic potential of farming fish in East Timor, defining a feasible and sustainable investment opportunity and providing a blueprint for conducting a market analysis intended for developing a mariculture enterprise in a transitional nation. The overall goal of this case study is to provide a basic framework that can be used to address important variables and considerations while conducting a formal economic feasibility study in a developing nation. Readers are encouraged to consider alternative parameters for development of a mariculture enterprise and formulate alternative strategies that might play an important role in enhancing a transitional nation's economy.

Economic Potential in East Timor

Ranked as one of the poorest countries in the world, East Timor's access to a productive marine ecosystem makes the prospect of mariculture worth considering as a poverty reducing economic development strategy. East Timor, otherwise known as the Democratic Republic of Timor-Leste (or simply Timor-Leste), occupies a land area of approximately 15,000 square kilometers that includes over 700 kilometers of coastline. The country is situated at the eastern end of the Indonesian archipelago and is estimated to have a population of just over one million². East Timor's climate is tropical with distinct wet and dry seasons that can lead to inconsistent agriculture production throughout the year (UNDP 2006). East Timor's rise to independence in 2002 secured it as the newest nation of the second millennia although it has continued to struggle politically and economically. To lessen the struggle for East Timor, the road ahead must be bridged with a solution that encompasses pro-poor strategies that act to empower the economic potential of local communities in order to restore confidence back to society as a whole. One way to underwrite such an endeavor is to develop economic opportunities that the communities themselves can grow, learn and work with each other. To do this, development projects need to be economically viable and at the same time be oriented towards improving the social sector while encouraging the sustainable use of resources afforded by the natural environment. Looking at the feasibility of a mariculture enterprise provides such an opportunity.

Around 75% of East Timor's residents live in rural areas, thus agriculture is heavily relied upon for subsistence and potential income (e.g. coffee, vanilla, maize, cassava, sweet potato, etc.). Unfortunately, the chaos that followed East Timor's

² U.S. Department of State online resource: <http://www.state.gov/r/pa/ei/bgn/35878.htm> (accessed 10.31.06)

transition to independence not only eliminated entire townships, but farms and farmlands were incapacitated as well; many have yet to recover. Likewise, 90% of East Timor's seafood industry was reportedly destroyed during the same time, leaving fishermen gearless and the few hatcheries³ that did exist, annihilated beyond repair (Da Fonseca 2001). International aid was sent to East Timor following the 1999 crisis to help in the post-independence reconstruction of the region. In 2002 foreign workers began to leave East Timor following the fulfillment of two and three year contracts. As a result of losing foreign business, the bottom fell out from under East Timor's economy and the gross domestic product (GDP) per capita fell from \$466 with an estimated annual GDP growth of 16.5% in 2001 to \$366 in 2004, which is indicative of a *negative* growth of 6.7% in the GDP during 2003⁴. The annual growth of the GDP in 2004 was 1.8% based on national output statistics for East Timor⁵.

Investment Climate

Two specific and prominent goals were set forth in East Timor's 2001 National Development Plan (NDP):

1. To reduce poverty in all sectors and regions of the nation, and
2. To promote economic growth that is equitable and sustainable, improving the health, education, and well being of everyone in East Timor.

Despite obvious risks and uncertainties associated with investment opportunities in East Timor, the prospectus for a mariculture enterprise is ideal for consideration. Development projects that encourage capacity building potential by promising to increase the skill level of local workers are of high priority in East Timor. The UNDP (2006) recognizes that encouraging private sectors to invest in East Timor is a primary goal to address poverty. One positive step forward can be found within the NDP that has been administered in response to reducing poverty and soliciting economic prosperity in East Timor.

The business climate in East Timor favors the foreign investor under a new investment law that was approved in July 2005, which ultimately stemmed from the NDP. Policies have been incorporated within the infrastructure of the East Timor government that considers fiscal incentives with a minimum investment of \$100,000. These include tax breaks of up to \$300 for each hired Timorese worker, rent incentives for rural projects and custom tax exemptions when minimum

³ De Fonsecas (2001) reported that 6 inland fish hatcheries were in operation in East Timor prior to 1999, all of which supplied fingerling carp to the domestic market. Once these hatcheries were destroyed the supply of fingerlings stopped as well.

⁴ Sources: ADB. 2006. *Basic Statistics 2006*. Manila. & UNDP. 2006. *Timor-Leste HDR 2006: Path Out of Poverty*

⁵Source: ADB Statistical Database System. <http://www.adb.org/statistics/> (accessed 11/07/2006).

standards are met. This investment law also complements the UN's Millennium Development Goals (MDG) that has been set forth as a strategy to address national priorities for East Timor and for developing countries in general (UNDP 2006).

Furthermore, in January 2006, the governments of Australia and East Timor signed the Treaty on Certain Maritime Arrangements in the Timor Sea (CMATS). This highly disputed agreement evolved from an earlier treaty signed in 2003 (Timor Sea Treaty) and promises East Timor a multi-billion dollar economic boost through real and potential profits made from oilfields positioned in the Joint Petroleum Development Area (JPDA) which is conveniently located halfway between Darwin, Australia and the south shores of East Timor. Consequently, JPDA straddles both Australia and East Timor's exclusive economic zones (EEZ) giving way to intense maritime disagreements between the two countries from which the CMATS developed. Anticipated profits resulting from the CMATS could very well be East Timor's ticket out of poverty if funds generated from the JPDA are managed responsibly and allocated efficiently to rebuild and develop East Timor once and for all⁶. This case study provides one way in which revenues from national and international endeavors could be reinvested into East Timor's communities for development purposes – ideally in a sustainable fashion.

Defining a Feasible Investment Opportunity

Environmental, Cultural and Economic Considerations

In addition to valuable natural resources found beneath the seabed, East Timor is geographically situated within a region recognized by scientists as the center of marine biodiversity (Roberts *et al* 2002). Referred to as the Coral Triangle, this distinct ecoregion is characterized by more than 500 species of coral and possesses high biodiversity of fishes and other invertebrates (IUCN 2004). As a result, individuals and nations profiting from the lucrative aquarium and live fish trade often target the seas surrounding East Timor in search for these and other valuable resources. Grouper is just one of many reef species targeted in the live fish trade and its value is poised on the freshness of keeping the fish alive until the moment of consumption, much like the reverence of live lobster in the United States. For example, a humpback grouper (*Cromilepte altivelis*) captured in the wild and kept alive in a tank until sold at a Hong Kong market during the Chinese New Year can earn a wholesale market price of \$93 per kilogram (2006 est.)⁸. The

⁶ The CMATS Treaty includes setting aside Timor Sea maritime boundary claims for 50 years; increasing East Timor's share of Greater Sunrise oil revenues from 18 per cent to 50 per cent. Once ratified by both countries, the CMATS Treaty and IUA will together offer a framework that will provide investors with the certainty needed for large-scale resource projects to proceed. (<http://www.industry.gov.au/content/itrinternet/cmscontent.cfm?objectID=C0FB82FC-9AA9-4A97-8F3ECEB317A6119D>)

Food and Agriculture Organization (FAO) of the United Nations attributes the increase in the trade of live fish to technological advances within the competing seafood industries while consumer demand is fueled by a growing appetite for live seafood afforded by Chinese and Asian communities with high disposable incomes (FAO 2004; Sadovy *et al* 2003; Johannes & Riepen 1995). A live reef fish review in 2005 reported that ‘as incomes in Asia rise over the next decade and aquaculture products become more readily available, there is an expectation that consumer demand for live reef fish will likewise increase (Muldoon *et al* 2005)’. It has been estimated that live fish represent almost 30% of total grouper production in Southeast Asia whereas most of the yield comes from a relatively small portion of the region, or more specifically, from within the Coral Triangle (Sadovy *et al*. 2003). Due to the high-value and consistent demand for live reef fish in Hong Kong, the live reef fish trade is currently expanding into the South Pacific where conditions are also favorable for the capture (and mariculture) of target species despite a greater travel distances to demand centers (Sadovy *et al* 2003). Since wild caught grouper currently supply the majority of live grouper demand centers in Southeast Asia there has been considerable attention given to the culture of grouper and the future sustainability of this trade. For example, in a technical report by Pomeroy *et al*. (2003) aquaculture is cited as being a priority solution for reducing the pressures on coral reefs arising from over-and destructive fishing associated with the trade of wild caught live reef organisms.

Scientific and Technical Support

The Gondol Research Institute for Mariculture (GRIM) located in nearby Bali, Indonesia, is the leading research and extension program in the region and promotes innovative mariculture practices while providing logistical support and on-site training for managers and fish farmers alike. Following consultations with experts from GRIM, it was decided to analyze two specific species of grouper: a lower valued *Epinephelus coioides* (commonly known as the green or orange-spotted grouper) and the higher valued *Cromilepte altivelis* (humpback or high-finned grouper). This decision was based on the availability of hatchery-reared stock of these species and successful track records using similar grow-out culture methods adopted in Malaysia, Indonesia, Vietnam, Philippines, Taiwan, Thailand, and Hong Kong (GRIM 2005: *personal communication* and Pomeroy *et al* 2002). Hence, the resulting analysis is dependent upon the regional availability of information such as the supply of hatchery-reared fingerlings, type of feed used, variation of grow-out cycles, transportation costs, demand of farmed live grouper as well as the business climate with respect to East Timor’s geo-strategic location and transitional economy.

Conducting a Market Analysis

Assessing the feasibility of growing out grouper in the Indo-Pacific region was crucial for determining what species to target for production in East Timor. In order to provide a detailed financial analysis that can be assessed objectively it is first important to understand the local demand for grouper with respect to current consumption preferences while recognizing potential effects of an increase in grouper supply to the domestic sector (e.g. fish markets and restaurants). Secondly, the international demand for grouper, specifically live grouper, needs to be assessed to understand the opportunities, risks and profitability in relation to the overall success of a grouper mariculture enterprise based in East Timor. Once a demand for grouper is apparent, marketing scenarios can be established and incorporated into the financial model. Such demands are explored below as exemplified by research conducted for East Timor.

Both domestic and international demands for grouper were explored in East Timor. To better assess the domestic demand for grouper a survey was carried out in East Timor addressing the local fish trading infrastructures. Communities were surveyed as to their willingness to participate in a grouper industry and relevant opinions were solicited. The data was gathered using a face-to-face technique. Open marketplaces and restaurants were surveyed as potential buyers for cultured grouper in East Timor. Export markets for grouper were assessed using current and historical wholesale market prices for grouper at Hong Kong markets. Weekly and monthly wholesale market prices were obtained from online databases that provide updated price information from select Hong Kong markets. Hong Kong was selected as the exporting target based on the availability of information and its role as a hub in the international trade for live reef fish. Prospective transporters were also identified who are willing to transport the fish to Hong Kong markets. Other major importers of live reef fish (i.e. grouper) would be Japan and Singapore if a significant infrastructure for transportation to these destinations could be established in the future. An excellent review highlighting the dynamics of the live reef trade, particularly the value of grouper to the industry, can be found in Maclean & Sadovy's (eds.) *While Stocks Last: the live reef food fish trade*⁷.

Domestic Demand for Grouper

East Timor's domestic demand for grouper was identified through a survey of various restaurants and markets that would be impacted as a result of an increased supply of grouper. Market and menu prices were surveyed to help develop a pricing structure for domestically traded grouper. There was no apparent demand for *live* grouper in the areas surveyed throughout East Timor,

⁷ [http://www.adb.org/Documents/Books/Live Reef Food Fish Trade/live_reef_complete.pdf](http://www.adb.org/Documents/Books/Live_Reef_Food_Fish_Trade/live_reef_complete.pdf) (first accessed on 9/1/2005)

although it was recognized that fresh or frozen grouper were served in 43% of the restaurants surveyed; Spanish mackerel and tuna were the other top sellers (Chan-Halbrendt *et al* 2006:28). The average menu price for grouper sold in the restaurants was \$8/kg while the restaurants' purchase price (from fishers or middlemen) was found to be around \$2.50/kg (Ako & Chan-Halbrendt 2005:29). This means that the added value to domestically supplied grouper benefits the restaurant owners and not necessarily the fishers or fish growers. Therefore, if farmers were to maximize profits from their portion of the cultured stock then they would need an aggressive marketing strategy geared towards the restaurant and tourism industries rather than trying to sell their product to local fish markets. In East Timor, the cultural phenomenon of eating live fish has yet to catch on as it has in Hong Kong or other Asian communities. Furthermore, there was no evidence of a preferred demand for any particular species of grouper in East Timor. This implies that domestic grouper prices would probably be affected more by an increase in supply rather than the value of specific grouper species. Once development in East Timor is such that the civil unrest and unstable governance can be tamed, the tourism industry may be able to influence a slightly higher demand for fresh, frozen, processed or even live grouper to the region.

International Demand for Live Grouper

The live reef food fish (LRFF) trade presently includes a wide variety of fish, but is dominated by several different species of groupers (Sadovy *et al.* 2003). The majority of live reef fish are imported into Hong Kong either for local consumption or for transshipment to Mainland China. It has been reported that Hong Kong exports between 20 – 60% of its total imports of live reef fish through China in order to meet consumer demand (Johannes 1995 and Chan 2000). It has also been estimated that the declared imports of LRFF to Hong Kong has an annual volume of 13,000-14,000 tons, making LRFF worth approximately 350 million US dollars with recorded imports into Hong Kong remaining fairly stable since 1999 (Muldoon *et al.* 2005)⁸. Due to the lack of live reef fish reporting regulations in Hong Kong an estimate of 15,000-20,000 tons is believed to be more reflective of the market volume per year delivered to Hong Kong, although higher volumes (>30,000 tons) may not be unrealistic (Sadovy *et al.* 2003). Sadovy *et al.* (2003) reported that between 15-40% of LRFF are supplied by wild-caught grow-out production units while only 10-15% of the LRFF are supplied by full-cycle hatcheries found throughout Southeast Asia. The same study found that during the 1990s high value species (e.g. humpback grouper) and low value species (e.g. orange-spotted grouper) accounted for less than 10% to 30%, respectively, of the total LRFF channeled through Hong Kong markets. In 2002 humpback and orange-spotted

⁸ Prior to 1999 the Asian economic crisis affected market prices of live fish in particular due to more conservative motives of the consumers, demonstrating yet another risk that this type of enterprise, dependent on foreign markets, can exhibit.

grouper supplied from regional sources and imported into Hong Kong was estimated to be between 10,000-12,000 tons for each species (Sadovy et al. 2003). Since the enterprise introduced here would be relatively small there should be little effect on international market prices for grouper with the addition of an East Timor grouper industry. For example, if Hong Kong's annual international demand for live grouper is a conservative 12,000 tons, an enterprise supplying 50 tons of marketable grouper would make up only 0.4% of the market share for live grouper exported to Hong Kong. Assuming the quality of the produce delivered to Hong Kong markets from East Timor is comparable to other small scale grow-out fish farms in the region, the overall sustainability and stability of such a venture would ultimately depend on an efficient mode of transshipment to the market and the international consumer preference for live reef fish.

Developing the Economic Model

The minimal degree of technical difficulty, affordable cost structure and the ease of constructing and maintaining near-shore grow-out mariculture farms makes this an ideal pro-poor development project in East Timor. In collaboration with the GRIM it was determined to use open-ocean floating net cages to grow-out grouper. This model assumes all farms will begin and end production at the same time in order to optimize space available on a one-time per harvest pickup and delivery schedule. In pursuit of a sustainable mariculture enterprise, this financial feasibility study assumes that all grow-out inputs are purchased directly from full-cycle grouper hatcheries as opposed to relying on fry and juveniles that would otherwise be caught in the wild before being grown in hatcheries or net cages. Until the situation and infrastructure in East Timor improves enough to support a full-cycle hatchery, inputs such as fingerlings will need to be imported at an additional cost to enterprise. Likewise, dry food pellets will be used in place of trash fish (wild-caught, low-valued fish) as feed to nourish the grouper in the proposed grow-out farms. Experimental work at The Southeast Asian Fisheries Development Center (SEAFDEC) comparing several diets showed that fishmeal could be substituted with high-quality terrestrial meals. For example, studies have been conducted to examine fermented blood products, dehulled lupin meal and meat and bone meal as partial substitutes of fishmeal in practical diets for grouper grow-out⁹. In addition, new standards concerning the certification of aquaculture products are realizing the importance of developing a more sustainable feed for fish farming by suggesting that aquaculture operations should use feeds and feed ingredients that are void of unsafe levels of pesticides, biological, chemical and physical contaminants and or other adulterated substances¹⁰.

⁹ http://library.enaca.org/ACIAR/AnnualReport/Annual_Report_2000-2001.pdf

¹⁰ <http://library.enaca.org/certification/publications/aquaculture-certification-guidelines-final.pdf>

Primary data was gathered on costs of grouper production in both GRIM (Bali, Indonesia) and East Timor. Surveys were used to collect baseline data to assess the communities' willingness to participate in an aquaculture project. Various income situations were assessed and used to evaluate opportunity costs. Secondary data was collected through extensive literature reviews and consultation with mariculture experts in various parts of the region (see Ako & Chan-Halbrendt 2005, Pomeroy *et al* 2004, Sutarmat *et al* 2003 and Sadovy *et al* 2003).

Technical Considerations for the Grow-out Production of Grouper

In this study a grow-out cycle is defined by the amount of time it takes to grow a 5-gram (5-10 cm) fingerling into a 500-gram marketable grouper. For the two species of grouper considered for this study the ideal market size was determined to be about 500 grams based on market trends; which ultimately mirror consumer taste preferences (e.g. texture, color, taste, type). It should be noted that different species of grouper have different growth cycles that will need to be carefully considered when working out a production schedule for planning and investment purposes since profits are solely dependent on the cash receipts obtained by selling the grouper immediately following a grow-out cycle (harvest). A typical grow-out cycle for orange-spotted grouper is 8 months while the higher valued humpback grouper takes a total of 18 months to grow-out. These are the production cycles used in this analysis. The analysis also assumes that there will be a 6-month initial start-up period that allows for the organization and construction of the infrastructures needed to culture grouper. It is assumed that the capital equipment (rafts, nets, boats) will be replaced every 3 years between grow-out cycles. Costs per cycle were calculated for each farm and then distributed into the annual cash flow analysis, adjusting for the discrepancy between production cycles and production years. As a result some years have more than one harvest while other years have none. In general, consideration should be taken to allow sufficient time to clean, inspect, repair and maintain the cages between all cycles regardless of reinvestment periods. A grow out period of 10 years was selected for the financial model due to East Timor's foreign investment law which provide incentives for projects that last longer than 5 years based on the region selected and the type of enterprise developed. For example, a condition of the 2005 foreign investment law in East Timor guarantees a tax deduction of \$300 for each Timorese worker that is employed for the entire year according to the location and nature of the project¹¹. Ten years equates to 12 production cycles when growing out orange-grouper and 6 cycles when growing out humpback grouper.

Based on production units in use by GRIM, each cage, or raft, is assumed to be 4m (W) x 4m (L) x 3m (D). Each raft is to be fabricated using local resources when

¹¹ Chan-Halbrendt 2005, personal communication

available (wood, bamboo, 55-gallon drums, etc) while other capital costs (hardware and motor boats) may need to be purchased abroad and imported taking advantage of East Timor's favorable investment climate with respect to tax exemptions on enterprise resources. For each farm there will be a shelter for feeding, maintenance, and storage of supplies. This shelter could also be used to house security personnel if needed. A key to successful grouper culture is to manage the proper stocking densities based on available space required. Sutarmat *et al* (2003:23) recommends stocking no more than 200 fish/m³ for fish 5-10 grams in weight and less than 20 fish/m³ for fish up to 500 grams; understanding that relative density increments in between should not be ignored. Hence, for this study 2 rafts will be required to support the initial stocking density for the grouper fingerlings while an additional 8 rafts will be needed to support 4 tons of groupers or roughly 8000 fish. This model assumes then that a total of 10 rafts (including nets) will be needed to grow-out approximately 4-tons of grouper. The shelter and the 10 rafts are collectively referred to hereafter as one farm. Cables are attached to each of the four corners and secured to moorings placed on the ocean floor to keep each farm securely anchored.

Two potential production sites were selected for this case study: Vemasse and Com. Both locations are on the protected northeastern shore of East Timor with access to the Wetar Strait and the Banda Sea. These sites were determined to be suitable for grow-out production based on the communities' willingness to participate, ideal marine conditions (e.g. water temperature, depth, currents, protection from storms, etc) and accessibility to transportation infrastructures (e.g. roads, airports, harbors, etc). These sites were selected through consultation with East Timor's Ministry of Agriculture, Forest and Fisheries (MAFF) along with mariculture experts and local planning agencies from GRIM and USAID. In this case study the sites were largely rural, pristine areas with little pollution. The exploration of alternative sites would warrant an investigation into other area-specific activities such as production industries, farming, tourism, housing and the potential for future development and their collective affect on water quality, security and competition for resources.

Marketing Scenarios

Using available data provided through GRIM, analyses were carried out in terms of assessing costs based on individual farms that would each have the potential to grow out approximately 4 tons of grouper per cycle. An estimate of at least 4 farm workers would be needed to maintain each farm on a daily basis. Time invested by each farm-worker is expected to be equivalent to the time (opportunity cost) that could otherwise be spent fishing. The entire grow-out enterprise is assessed in relation to 15 farms. At a production rate of 4 tons per farm, the enterprise would have the potential to culture 60 tons of marketable grouper during each production

cycle. Of the 60 tons, 80% of the total production, or 48 tons, would be marketed under the enterprise using one of the two following scenarios:

1. Grouper would be sold at farmgate prices in East Timor; or
2. Grouper would be shipped directly to Hong Kong and sold at wholesale market prices.

Live groupers can be shipped either by air or sea to the final markets although, since flights in and out of East Timor are costly and irregular, this study only considers shipping live grouper by sea. Accordingly, the second scenario requires the hiring of a tender boat to ship the fish to Hong Kong and thus, requires the enterprise to absorb the costs and risks associated with transporting fish (e.g. piracy and fish mortality). The size of the tender boat that may be available for hire in the event of a mariculture enterprise in East Timor can hold up to 60 tons of fish at a lease price of US\$130,000¹². This transportation cost to the enterprise is divided equally between the 15 farms and considered as the marketing cost per farm (see Table 2). The target production rate determined for the financial model is based on the carrying capacity of the particular tender boat identified by the authors. Furthermore, contracting an established tender boat to deliver the fish to the market will help to ensure the timeliness, freshness and technical personnel required to maintain a quality product following harvest.

The remaining 12 tons of cultured grouper will be allocated to the local communities responsible for managing and working the farms as in-kind compensation. Hence, the financial model will require that a grouper farming cooperative, or co-op, be organized in East Timor. It is assumed that such a co-op would be developed at rural sites where fishing was, or still is, practiced, thereby maximizing manpower and skill needed to establish a successful community-based organization. Wages assumed for each member of the co-op are provided in Table 3. The co-op will be responsible for managing production requirements, quality control measures, farm workers and cash flows associated with the grow-out of grouper. Thus, the co-op will be required to provide at least 48 tons of grouper to be marketed under the investment strategy allocated by the enterprise investor while the remainder, or up to 20% of the total harvest, will be available to the co-op as a production incentive. This gives the co-op an opportunity to sell its portion of the cultured grouper at wholesale prices in Hong Kong (with added shipping costs); sell the grouper domestically either at farmgate, market or restaurant prices; or the co-op could keep the grouper for consumptive value and distribute it throughout the local communities. Because East Timor uses US currency, all costs

¹² Contract would be inclusive of all costs required for transporting live fish (crew, fuel, maintenance, etc)
Personal communication, Hotung Institute (2005).

are in figured to the US dollars unless otherwise stated. An exchange rate of 7.75 was used to convert Hong Kong prices into US prices per kilogram for grouper. Based on 2005 estimates the farmgate prices for orange spotted and humpback grouper sold in East Timor were reported to be \$8/kg and \$25/kg respectively¹³. Average wholesale prices in Hong Kong for cultured orange-spotted and humpback grouper were found to be \$10.73/kg and \$63.02/kg respectively¹⁴. Baseline prices used to analyze the feasibility of scenario II (selling at wholesale market prices in Hong Kong) were \$10 and \$60 per kilogram for orange-spotted and humpback grouper respectively.

While the live reef fish trade has existed in neighboring countries such as Indonesia and the Philippines for decades now, such an endeavor would be new to East Timor. Unfortunately for the case of Indonesia and the Philippines the live fish trade in these regions has been highly uncontrolled and recently deemed illegal due to the destructive capacity in which these nations capture wild grouper for the LRFT. Fishers in these regions have destroyed entire reef ecosystems with unsustainable techniques developed such as the use of cyanide and dynamite to capture fish. Stocks of wild captured grouper in these regions have severely declined due to this type of 'fishing', which has forced the supply to be sought after in adjacent waters farther from the market centers (Hong Kong, mainland China, Taiwan and Singapore). This rapid decline of wild caught grouper has helped to shift interest in the market from a captured to a cultured product. Unfortunately the sustainability factor has not yet been promoted at the market level. The current market prices show that wild caught grouper are still more valuable than the cultured grouper. Wholesale prices at a Hong Kong fish market in July 2005 demonstrate this point by offering around US\$58 for cultured humpback grouper (*Cromileptes altivelis*) and US\$88 for the same species captured from the wild (<http://www.hk-fish.net>). Other markets show a weekly average price for live reef fish but are not as obvious to distinguish between captured or cultured fish.

Formulating a Financial Feasibility Analysis

In order to assess the financial feasibility of a grouper enterprise the reader is encouraged to develop an enterprise budget from the data obtained by primary and secondary sources as described in Tables 1-4. Enterprise budgets provide a representation of estimates of specific inputs and outflows associated with a business opportunity. These estimates most often include profits in the form of cash receipts (revenues) and costs associated with production cycles pertinent to the goals of the enterprise being considered. Enterprise budgets are used

¹³ See Ako and Chan-Halbrendt 2005

¹⁴ Prices were averaged from 2003-2006 estimates from Hong Kong Markets: Fisheries Enforcement Division, Agriculture, Fisheries and Conservation Department, HKSAR, China. http://www.hk-fish.net/eng/market_price/common_e_2006_sep.htm (HK Fish Net)

Table 1: Variable production parameters for a grouper grow-out production farm in East Timor¹⁵

Production Assumptions	Unit	Type	Orange-spotted	Humpback
Fingerlings	fish/farm	4 ton farm	10000	10000
Cost	US\$/fish		0.85	0.95
Stocking size	gram/fish		5 -10	5 -10
Harvest size	gram/fish		<500	<500
Stocking density	fish/m ³	5 gram/fish	200	200
Harvest density	fish/m ³	500gram/fish	20	20
Feed	US\$/kg		1.2	1.2
Feed Conversion Ratio (FCR)	per fish	dry pellet	1.4	1.6
Production Cycle	month		8	18
Survival Rate	% stock		70%	70%
Average prices used in baseline economic analyses	US\$/kg		\$10	\$60

Table 2: Annual project costs for a grouper mariculture enterprise in East Timor¹⁶

Project (Co-op) Costs	Total (US\$)
Car Lease	60000
Car mileage allowance	15000
Office equipment	2000
Supplies	12000
Office space	5000
Communication	6000
Utilities	6000
Political Risk Insurance to cover 15 farm	36050
Marketing Costs (<50 ton/cycle)	
Hiring of tender boat to transport fish to HK	130000

¹⁵ Variable production parameters were figured based on personal consultations with industry specialists and researchers from GRIM, the University of Hawaii at Manoa and the Hotung Institute in Hong Kong. Production parameters are composed of both biological and technological data referring to survival rates, feed conversion ratios (FCR) and growth rates.

¹⁶ Project and farm cost data were derived from GRIM's published information as well as through communications with mariculture experts and researchers in the region (Sutarmat *et al* 2003, Da Costa (2005) and Pomeroy (2005). Cost data was used to structure the baseline framework for the enterprise budget and cash flow analyses. Project costs that are built into the financial model include basic operation and management costs associated with running a grouper enterprise on a yearly basis. Co-op, insurance and marketing costs are shown.

Table 3: Payroll for a 10-year grow-out mariculture enterprise in East Timor (15 farms)¹⁷

Employees	Quantity	Monthly Wage	Period (Year)	Total Cost (US\$)
Grouper Co-op				
Farmers	60	100	10	720000
Local Business Manager	2	800	10	192000
Local Technician Administrative Assistant	2	600	10	144000
Quality Control Officers	2	400	10	96000
Drivers	2	600	10	144000
General Labor	2	300	10	72000
	2	200	10	48000
Technology Transfer				
Expatriate Business Manager	1	8000	2	192000
Expatriate Technical Manager	1	8000	2	192000
Mariculture Consultants	1	2500	2	60000
Training	1	1000	2	24000
			Payroll/Enterprise Total	1,884,000
			Payroll/Farm/Year Total	12,560

¹⁷ Local labor costs were based on average monthly incomes figured by surveys and personal communications as described in the data collection methods discussed earlier. This project allows for a stable monthly salary of \$100 per farm worker. Fifteen farms would employ 60 local farm workers. A grouper co-op would include these farm workers plus employment for 12 local administrative workers (6 employees per site). Local administrative duties would require business managers, technicians, administrative assistants, quality control officers, drivers and general assistants. This model will assume a total of 72 local workers will be employed under the grouper co-op and would work jointly with enterprise investors, managers, trainers and consultants. Since grouper mariculture would be a new industry to East Timor this analysis allows for a technology transfer cost that includes the hiring of project managers, quality control technicians and training personnel that will oversee the project during the first two years of grow-out production.

Table 4: Fixed capital investment costs for each grow-out grouper farm in East Timor (US\$)¹⁸

Equipment	# Units	Price/Unit	Cost/Farm
Raft	10	600	6000
Net-cage	10	500	5000
Shelter	1	1000	1000
Anchorage	4	200	800
Boat (w/motor)	1	3000	3000
Maintenance	1	3000	3000
Stock and Harvest	1	400	400
Quality Control	1	1000	1000
		Total	20200

extensively in assessing agriculture management options and in this case, will be used to develop and interpret the cash flow analysis with respect to culturing grouper in East Timor. The enterprise budget can also be used by itself to determine the feasibility of one scenario over another. The cash flow, or annualized enterprise budget, provides a decision maker with an internal rate of return (IRR) that can then be used to quantify investment returns given a particular production scenario for a period of time.

A cash flow, or discounted cash flow (DCF), is a decision-making technique that aids project evaluators by setting up an investment project as a net benefit stream over the projected term of the enterprise (e.g. 10 years). The process of project appraisal and evaluation can be considered in terms of three aspects of cash flow analysis (Campbell 2003:37): (i) *identification* of costs and benefits; (ii) *valuation* of costs and benefits and; (iii) *comparison* of costs and benefits. When comparing a stream of costs and revenues over time for the project it is helpful to use discounted cash flows in order to obtain realistic and comparable data points that can be used to assess the future profitability of an investment. In general, the Asian Development Bank (ADB 1997:37) uses a minimum discount rate of 10-12 % for projects developed in member countries to compare with the internal rate of return (IRR) of those same projects. The analysis outlined here calculated the cash flow stream in terms of a 12% discount rate. An IRR can be defined as the discount rate at which the net present value (NPV) of the enterprise becomes zero (Campbell 2003:44). In other words, the IRRs evaluated in this financial analysis reflect a 12% discount rate incorporated into a 10-year cash flow stream for a mariculture

¹⁸ Specific capital investment costs that were used for the financial analysis can be found in Table 3. A 3-year amortization period is assumed for capital equipment, meaning that these items will need to be replaced every 3 years while the expense is absorbed within the flow of funds over a 10-year enterprise.

enterprise in East Timor. Hence, all positive IRRs ($IRR > 0$) are representative of the percent of return an investor could expect on a particular initial investment under the assumed financial parameters.

Lastly, a sensitivity analysis should be performed to analyze the effects that select variables have on the profitability, or IRR, of the enterprise. Two variables that carry considerable uncertainty for the grow-out production of grouper in net cages are survival rates (SR) and the wholesale prices paid for cultured grouper. Survival rates largely correspond to keeping the fish alive during production cycles, and as is the case for Scenario II, keeping the fish alive during transportation. Variations in fish survival rates (50%-90%) were compared with changing wholesale market prices for humpback grouper (\$40-\$80), which collectively helps to highlight levels of profitability associated with grow-out production. Using the data obtained was found that positive internal rates of return ranging from 13% to 67% could be obtained if the higher valued humpback grouper were transported directly to Hong Kong and sold at an average wholesale market prices of US\$60/kg (see Table 5).

Table 5: Internal Rates of Returns (IRR) using survival rates (SR) and Price variances for humpback grouper sold in East Timor at farmgate prices (Farm\$) or marketed to Hong Kong (HK\$) *

Farm\$	SR 50%	60%	70%	80%	90%
15	-	-	-	-	-
25	-	-	-4	3	9
35	-3	7	15	23	31
HK\$	SR 50%	60%	70%	80%	90%
40	-	-2	7	16	24
60	13	26	38	53	67
80	36	55	74	95	117

*IRRs are in bold. Negative values are assumed to be not feasible and are represented by an (-).

In conclusion, the overall purpose of this study has been to encourage the sustainable development of grouper mariculture and its potential as a specific social development project in East Timor, and for transitional economies in general. It is recommended that if such an enterprise is to be developed in East Timor, then a proactive marketing strategy must be implemented to ensure buyers and investors that a sustainable and quality product can be delivered to an already flourishing live grouper trade. Eco-labeling, product certifications and environmentally friendly practices are a few additional concepts that would need to be explored in more detail if the culture of grouper were to become a successful venture in East Timor. Furthermore, with supporting institutions such as GRIM there could be opportunities for committed business entrepreneurs to promote a strong research oriented mariculture industry within East Timor. The productive

marine environment endemic to the region would ideally accentuate this type of endeavor.

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