Summary and Conclusion

Countries all over the world devote great attention to secure food to their nations in every possible way. Due to the high rate of population growth, an increasing interest in fisheries development started to prevail all over the world as part of the protein diet. It is worth noting that the economic value of fisheries emerges from being one of the renewable natural resources, which represents an economic activity that can generate a rewarding economic revenue. In Yemen, Fisheries Sector is one of the sectors constituting the national economy. As such, its development is considered part of the comprehensive economic development process. It is worth noting that fisheries development in Yemen encounters several obstacles and difficulties that should be overcome in order to increase per capita share and fish exports. Despite achieving self-sufficiency in fish, there exists no specific food security strategy. Per capita share of fish, which amounted to 9 kg/annum in 2004, is considered low compared to world per capita share of fish that amounted to 16.2 kg/year. Moreover, fish sector's contribution to GDP is still low as it reached about 1.5% in 2004. Based on that, the study focused on investigating the economic possibilities for developing Yemen's fish wealth through a set of defined goals that can help address the study problem and develop the production activity in the field of fisheries. These goals include:

- Studying the current situation of fisheries sector in Yemen through investigating the evolution of fish production, consumption and exports, with special reference to the role of processing and investment in the development of fish wealth, in addition to fish labor and different fishing units.
- Estimating the obstacles and problems obstructing fishermen in the studied sample and their suggestions for solving them.
- Estimating the production and economic efficiency of Fisheries Sector according to region, fishing method, and engine power of fishing boats.
- Assessing both surplus production and optimum production using Schaefer Model and Nerlove’s Partial Adjustment Model

- Investigating domestic marketin in Yemen by estimating intra-governmental fish transportation model.
- Economic evaluation of fish production in Yemen.
- A feasibility study of fish farming project proposal.
- Studying foreign marketing of Yemen's fish production and estimating the competitive advantage of Yemen's fish exports in some Arabian and International markets.
- Estimating the economic surplus of Yemen’s fish exports via estimating the partial equilibrium model.

To achieve these objectives, the study depended on secondary data obtained from different sources such as the Ministry of Fisheries, the Arab Organization for Agricultural Development, the FAO, the Academy of Scientific Research in Cairo, the Internet, and different Universities, in addition to primary data collected by sampling in three coastal regions, these are El-Hodeidah, Hadramout, and Aden.

The study consists of six chapters in addition to an introduction, an Arabic summary, and an English summary. Chapter one comprises a review of literature and the theoretical framework. Chapter two of the study focuses on the current situation of Fisheries Sector based on the fishing methods, fishing sources, production sectors, fishing regions and different fish kinds. It presents also fish consumption of both shallow and deepwater fish and fish prices, with special reference to processing and investment and the role they play in fish wealth development. In addition, chapter two investigates the current situation and geographic distribution of Yemeni fish exports, and investigates the factors leading to their instability. The main findings of chapter two reveal that:

- The share of traditional fishing in total fish production in Yemen is estimated at 98.5%, whereas the share of commercial fishing is estimated at 1.5% as an average of the period 1990-2005.
- The share of Hodeidah governorates in total fish production in Yemen is estimated at 32.2%, followed by Hadramout governorates, Al-Mahara and

Aden which shares are estimated at 22.42%, 18.76% and 15.80% as averages of the period 1990-2005.

- The number of fishing boats has been estimated at some 16.9 thousand in 2004, most of which are concentrated in Hadramout region representing 38.5% of the total fishing boats.
- In 2004, the number of fish projects increased by 50% compared to 2003.
- The number of fishing boats factories increased to reach 8 factories in 2004 compared to only 4 factories in 1990. In addition, the daily production capacity of ice increased to reach more than 1000 tons in 2004.
- The geographic concentration coefficient (Geni-Herchman) for fresh fish, frozen fish, shrimps and squid (calamari) was estimated at 74.4, 37.9, 81.8, and 64.2 respectively in 2003 compared to 95.0, 50.7, 34.9, and 79.5 respectively in 1999.

Chapter three presents and describes the study sample, sample selection, the social and economic properties of sample individuals, and the problems facing them. Findings reveal that:

- About 52% and 69.6% of the sample individuals in Hodeidahh and Hadramout governorates depend on gasoline as a fuel for their boats, whereas 69.9% of the sample individuals in Aden governorate depend on diesel.
- About 94.5% of the fishing boats of 150 horsepower or more depend on gasoline, whereas 88.4% and 60.8% of the fishing boats operate with 40-75 and 75-150 horsepower respectively.
- About 59%, 77.2% and 56% of the sample individuals in Hodeidahh, Hadramout and Aden governorates respectively depend on fiberglass boats, whereas the remaining sample individuals depend on Hori Boats for fishing.
- The main difficulties facing the sample individuals in the Red Sea fishery area comprise low harvest, violation of fishing laws, and low prices. On the other hand, the main difficulties facing the sample individuals in Aden bay and the Arabian Sea fishing area comprise low harvest and excess fishing.

Chapter four of the study investigates the economic and production efficiency of the Fisheries Sector and estimates the optimum fishing rates and optimum production. In addition, it refers to domestic fish marketing in Yemen by estimating the intra-governorate transportation model in order to determine the optimum distribution pattern for domestic fish production that realizes the minimum total local transformation distances between surplus governorates, i.e., supply governorates, and shortage governorates, i.e., demand governorates. Moreover, the chapter investigates the factors affecting domestic demand for animal protein. The main findings are:

- About 57% of the sample fishermen realized the optimum cost-minimizing volume of production estimated at 1.64 tons. On the other hand, about 59% of the sample fishermen in Hodeidahh region (the Red Sea fishing area) realized the profit maximizing volume of production estimated at 6.56 ton.
- The optimum cost-minimizing volume of production in Hadramout and Aden regions estimated at 1.24 and 3.36 tons respectively represents 58.2% and 78.3% of the sample individuals.
- The optimum cost-minimizing volume of production for boats of 40-75 horsepower is estimated at 0.56 ton. The optimum cost-minimizing volume of production is estimated at 2.01 tons, whereas the optimum profit-maximizing volume of production is estimated at 14.5 tons. Non of the sample fishermen with boats of 75-150 horsepower achieved these figures. The optimum cost-minimizing volume of production for boats with horsepower 150 or more is estimated at 7.5 tons. About 49% of the sample fishermen realized this volume of production.
- The optimum cost-minimizing volumes of production for deepwater fishing, sallow fishing, and mixed fishing methods are estimated at 1.83 tons, 1.43 tons, and 1.25 tons respectively.
- El-Hodeidahh and Aden governorates did not realize the maximum sustainable production despite the fact that the number of standard boats realizing the maximum sustainable production in Aden governorate surpasses the actual number. On the other hand, it was found that the actual

production in Hadramout governorate surpasses the sustainability realizing volume of production, which indicates excess fishing in the governorate.

- The actual volume of production for either shallow-water fish or total fish production is low indicating the wide range of possibilities for increasing the total volume of production in general, and shallow-fish production in particular. As regards deepwater fish, it was found that the optimum level of production is lower than the actual level of production indicating excess fishing of this type of fish, which requires imposing laws to control their fishing.
- The surplus and shortage of fish production are estimated at 161.0 and 113.9 thousand tons respectively.
- Surplus fish production is concentrated is Mahra and Hadramout governorates representing 44.5% and 37.9% of the total fish production surplus. Whereas the shortage in fish production is concentrated in Ibb, Taiz, Amant El-Aseema, and Sana'a governorates representing 15.4%, 14.6%, 12.8% and 10.4% respectively of total shortage in production.
- The undistributed volumes of production in Al-Mahara governorate, which can be exported, are estimated at 47.2 thousand tons.
- The price elasticity of demand for fish, meat, and poultry is estimated at -0.097, 0.31 and -0.34 respectively.
- Expenditure elasticity for fish, meat, and poultry is estimated at 0.0023, 0.0227 and 0.0078 respectively.
- Cross elasticities between fish, meat and poultry indicate the existence of a substitution relationship between fish and meat, and a lack of substitution relationship either between fish and poultry, or between meat and poultry.

Chapter five of the study presents an economic assessment of fish production is Yemen according to region and method of fishing and fishing areas. In addition, it presents a proposal for fish farming in Yemeni marine water. The main findings reveal that:

- Fish production activity in Hodeidahh governorate is preferable to fish production activity in Aden and Hadramout governorates where the estimated cost-benefit ratios reached 2.29, 2.17 and 1.63 in the three governorates respectively. In addition, the estimated cost-benefit ratio for the Red Sea and both Aden and the Arabian Sea fisheries reached 2.9 and 1.76 respectively indicating that fish production in the Red Sea fishery is most preferable to other fisheries. Moreover, the estimated cost-benefit ratio for boats with 40 to less than 75 horsepower, boats with 75 to less than 150 horsepower and boats with more than 150 horsepower amounted to 1.45, 1.44 and 3.06 respectively. As regards fish production methods, the estimated cost-benefit ratio for deep-water, shallow-water and mixed fish production methods amounted to 3.64, 2.14 and 1.78 respectively indicating that deepwater fish production is preferable to other methods of fish production.
- The internal rate of return (IRR) for either the current situation or the three engine power alternatives used in sensitivity analysis reached more than 50%, except for the first alternative (75-150 horsepower), the third alternative for Hadramout governorate, boats with 40-75 horsepower, and boats with 75-150 horsepower where the estimated IRR reached 42%, 285 and 26% respectively.
- The estimated cost-benefit ratio for the proposed fish farming in marine water project amounted to 1.5, whereas the estimated IRR amounted to 73%, 51%, 60% and 37% for the current situation and the three alternatives for sensitivity analysis respectively.

Chapter six of the study focuses on foreign marketing of fish. It investigates the competitive position of Yemeni fish in the Arabian, Asian and European markets via estimating the Almost Ideal Demand System, estimating the economic surpluses of Yemeni fish using the partial equilibrium model that measures three indicators. The first indicator measures the governmental revenues through measuring their changes and changes in foreign currency earnings. The second indicator measures the economic efficiency through

measuring the net loss incurred at the level of producer, consumer and the society. Finally, the third indicator measures welfare through measuring the changes in producer surplus and consumer surplus in the light of two assumptions, these are the prevalence of governmental intervention and absence of governmental intervention, during the period 1990-2004 which was divided into two sub-periods. The first sub-period, which covers the years 1990 to 1995, is considered a comparison period due to the fact that the GATT agreement (WTO) that started to be implemented by the end of 1995 had impacts on member and nonmember countries. The main findings of Chapter six are:

- The main factors affecting Yemen's share in the Arabian market of fresh, chilled and frozen fish include France's share of Arabian market imports and the real expenditure of the Arabian market on its imports of these types of fish. Other factors that were revealed by the other estimated equations include India's price and the share of both India and the Netherlands. In addition, the estimated elasticity of expenditure that reached 0.65 reveals that Yemeni fresh fish is a necessary good and that the demand for Yemeni fresh fish in the Arab market is inelastic. Moreover, the estimated price elasticity for Indian and both Thai and Portuguese prices that reached -0.71 and -0.62 respectively reveals lack of price competition between this type of Indian and Portuguese fish and Yemeni fish in the Arabian market.
- The most important factors affecting Yemen's share in the Asian market for fresh, chilled and frozen fish are Argentinean and Chilean shares, Indian and Spanish prices, real expenditure in the Asian market and Indonesia's share. In addition, there is a similarity between Indonesian and Yemeni exports of these types of fish in the Asian market. It was also found that a price competition exists between Spanish and Yemeni exports inside the Asian market.
- The most important factors affecting Yemen's share of fresh, chilled and frozen fish in the European market is Portugal's and Thailand's shares, Holland's price, real expenditure of the European market on its imports of

these types of fish, Argentina's share and price and Australia's share. The estimated elasticity of expenditure and price elasticity reveal that demand for Yemeni fish in the European market is inelastic and there exists a price competition between Argentinean and Yemeni prices inside that market.

- The most important factors affecting Yemen's share of Arabian market imports of dried, salted and smoked fish are Bangladesh and France's share and prices of Franc and UAE. The estimated elasticity of expenditure and price elasticity for these countries reveal a quantitative competition between both Bangladeshi and French exports and Yemeni exports of these types of fish. They also reveal a lack of price competition in the Arabian market between French and Yemeni fish on the one side, and between UAE and Yemeni fish on the other side.
- The most important factors affecting Yemen's share of the Asian market imports of these types of fish are UAE's share of Asian imports, the real expenditure of the Asian market on these types of fish, and the prices of UAE, France and Norway. The estimated elasticity of expenditure and price elasticity for these countries reveal that demand for Yemeni dried, salted and smoked fish in the Asian market is inelastic. They also reveal the existence of a price competition between the Norwegian and Yemeni prices of these fish, and a lack of quantitative competition between UAE and Yemeni exports to the Asian market of dried, salted and smoked fish.
- The most important factors affecting Yemen's share of Arabian market imports of fresh, chilled, frozen and salted crustaceans and molluscus include real expenditure of the Arabian market on its imports of these types of fish. The estimated elasticity of expenditure that reached 0.63 reveals that these types of fish are good with inelastic demand in that market.
- The most important factors affecting Yemen's share of Asian market imports of these types of fish are South Korean, Moroccan and Malaysian shares, USA's price, and the real expenditure of the Asian market on its imports of these types of fish. It was found that demand for these types of fish is inelastic. In addition, the estimated elasticities reveal a lack of competition

between Korean, Malaysian and Moroccan exports and Yemeni exports in the Asian market, and a lack of price competition between USA and Yemeni exports in the same market.

- The most important factors affecting Yemen's share of European exports are Australia and Indonesia's share, and the real expenditure of the European market on its imports of these types of fish. Investigations reveal a quantitative competition between both Australian and Indonesian exports and Yemeni exports of these types of fish.
- It was found that prepared and canned fish, crustaceans and molluscus' exports are still limited to a very small number of countries including Saudi Arabia and UAE. The most important factors affecting Yemen's share of Arabian market imports include Philippine's share, England's price, the real expenditure of the Arabian market on its imports of these types of fish. Investigations reveal a quantitative competition between Philippine and Yemeni exports, and a lack of price competition between the English and Yemeni fish in the Arabian market of these types of fish.
- Investigations reveal the existence of implicit support during the first sub-period, which then declined during the second sub-period. The change in governmental revenues and the existence of implicit support reveal that the government incurred burdens that reached US $ 35.1 million and US $ 25.1 million as averages of the two period respectively. On the other hand, governmental revenues increased to reach US $ 32.5 million and US $ 9.5 million as averages of the two periods respectively in the absence of governmental intervention.
- Hard currency earnings under the prevalence of governmental intervention conditions declined during the two periods to reach US $ 7.4 million and US $ 6.4 million as averages of the two periods respectively, whereas increased in the absence of governmental intervention to reach US $ 30.4 million and 9.6 million as averages of the two periods respectively.
- The estimated net impact for the two periods under the prevalence of governmental intervention conditions reached about US $ 12 million and US $ 7.2 million as averages of the two periods respectively, whilst reached US $ 34.8 million and US $ 16.9 million as averages of the two periods respectively in the absence of governmental intervention.

Recommendations

In the light of the study findings, the following recommendations are expected to contribute to achieving comprehensive development of the fisheries sector in the Yemen Republic:

- It is recommended to devote attention to the traditional fishermen (cooperative members and individual fishermen) due to the relative importance this category represents in total fish production. Therefore, training programs should be tailored to develop this category.
- Preventing excess fishing, especially excess fishing of deepwater fish.
- Promoting fish farming activity as one of the main pillars to developing Yemeni fish wealth, and promoting the establishment of fish farms as they proved to be economically feasible investments especially in marine water.
- Providing support and loans to the private sector for the purpose of establishing commercial fish farms to preserve the fish stock and increase fish production.
- Expanding the range of foreign marketing of Yemeni fish exports instead of concentrating on certain countries.
- Providing loans and support to fishermen to help them purchase modern boats (fiberglass boats), especially those with horsepower 75-150 or more because they proved to be efficient in fish investments, in order to reinforce their production potentials.
- Providing an efficient infrastructure to serve the purpose of domestic and foreign marketing of fish through the development of fishing ports to be properly equipped to offer the required services for the produced fish. This can be achieved by providing refrigerators of large capacities to preserve fish, abiding to official bids for selling in official rings, and banning monopoly acts.
- Providing maintenance workshops and spare parts for fishing equipments in order to help fishermen raise their production efficiency.
- Promoting the establishment of fish plants especially in fishing regions with surplus fish production such as Al-Mahara governorate.

- The developing of fishing boats manufacturing activity through expanding the establishment of boat plants and promoting the private sector.
- Removing all the institutional, organizational and administrative obstacles obstructing the fishing process shall lead to positive impacts on both the fishing boats and fishermen.
- Banning the use of harmful fishing materials and equipment, especially fishing nets with very small holes that trap young fish (fingerlings) thus negatively affect the fish stock.
- Enhancing fish production in the Red Sea and addressing the problems that caused its reduction especially during the last years.
- Providing extension services to fishermen so as to increase their experiences and enhance their fishing efficiency.