Exportation of Processed Fishery Products from Mozambique:

Determinants and Technical Compliance Process

By

MENDIATE Rinaldo Ernesto Joao

DISSERTATION

Submitted in Partial Fulfillment of the Requirements

for the Degree

Doctor of Philosophy in International Development

GRADUATE SCHOOL OF INTERNATIONAL DEVELOPMENT

NAGOYA UNIVERSITY

Approved by the Dissertation Committee:

Naoko SHINKAI (Chairperson):

Kiyoshi FUJIKAWA

Shigeru OTSUBO

Approved by the GSID Committee: May 18, 2016

ACKNOWLEDGEMENTS

I am sincerely and heartily grateful to my main and sub-advisors, Professors Naoko Shinkai, Kiyoshi Fujikawa and Shigeru Otsubo for the support and guidance they showed me throughout my dissertation writing. I would like also to thank Professor Hiroshi Osada (retired), my previous sub-advisory, for the useful comments and ideas.

My studies in Japan would have not been possible without the Japanese Government Scholarship – *Monbukagakusho* – whom I would like to thank.

To all Shinkai's seminar members (April 2009 – March 2013) I would like to thank and wish all the best in their lives and academic journey. I am also grateful to my friends and colleagues, Christian, Carlos, Ando, Taka and Maloa, for their comments, ideas, support and encouragements.

To my wife, Lucia, others parents, for their incentive and support the annoying times I had while writing this dissertation.

To all my anonymous sources from where I got some data, information and resources, I want to say "thank you."

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LIST OF ABBREVIATIONS

°C	Degree Celsius
2SLS	Two Stage Least-Squares
ACP	Africa, Caribbean and Pacific
AOZ	Nitrofurans (3-Amino-2-Oxazolidinone)
APHIS	Animal and Plant Health Inspection Service, United States of America
BCR	Benefit-Cost Ratio
CA	Competent Authority
CAC	Codex *Alimentarius* Commission
CAC/RCP	CAC/ Recommended Code of Practice
CAP	Chloramphenicol
China (P.R.)	People's Republic of China
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Congo (D.R.)	Democratic Republic of Congo
CPF	Cumulative Percentage Frequency
CPI	Investment Promotion Centre, Mozambique [*Centro de Promoção de Investimento*]
DFID	Department for International Development, United Kingdom
DWFN	Distant Water Fishing Nations
EC	European Community
ECDPM	European Centre for Development Policy Management
EEZ	Exclusive Economic Zone
EP	School of Fishery, Mozambique [*Escola de Pesca*]
EPZA	Export Processing Zones Authority, Kenya
EU FVO	EU Food and Veterinary Office
EU	European Union
EU-RASFF	EC Directorate-General for Taxation and Customs Union, Audit and Anti-Fraud
Eurep-GAP	Eurep-Good Agriculture Practice
FAO	Food and Agriculture Organization of the United Nations
FAO-FISHSTAT	FAO's Fishery Statistical Collection
FDA	Food and Drug Administration, United States of America
FDI	Foreign Direct Investment

FFP	Fishery Development Fund, Mozambique [*Fundo de FomentoPesqueiro*]
FP	Fishery Products
FPA	Fisheries Partnership Agreements
GAP	Good Agriculture Practices
GATT 1994	General Agreement on Tariffs and Trade 1994
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GL Index	Grubel-Lloyd Index
HACCP	Hazard Analysis and Critical Control Point
Hg	Mercury (metal, chemical element)
HS	Harmonized Commodity Description and Coding System
ICEIDA	Icelandic International Development Agency
ICTSD	International Centre for Trade and Sustainable Development
IDPPE	National Institute for Developing Small Scale Fishing, Mozambique [*Instituto Nacional de Desenvolvimento de Pesca de Pequena Escala*]
IFAD	International Fund for Agricultural Development, United Nations
IIP	National Institute for Fisheries Resources, Mozambique [*Instituto Nacional de Investigação Pesqueira*]
IMF	International Monetary Fund
INE	National Institute of Statistics, Mozambique [*Instituto Nacional de Estatística*]
INIP	National Institute of Fish Inspection, Mozambique [*Instituto Nacional de Inspecção Pesqueira*]
I-O Table	Input-Output Table
IPEX	Institute of Export Promotion, Mozambique [*Instituto para a Promoção de Exportações*]
IPPC	International Plant Protection Convention
ISDB	Islamic Development Bank
ISO	International Organization for Standardization
ITC	International Trade Centre
IUCN	International Union for Conservation of Nature
IV	Instrumental Variables
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
Log	Logarithm

LS	Least-Squares
MARPOL	International Convention for the Prevention of Pollution from Ships
MoF	Ministry for Fisheries, Mozambique [*Ministério das Pescas*]
MPA	Marine Protection Area
MRLs	Maximum Residue Limits
MWh	Megawatt Hour
NAMA	Non-Agriculture Market Access
NES	Not Elsewhere Specified
NORAD	Norwegian Agency for Development Cooperation
NPV	Net Present Value
NTB	Non-Tariff Barriers
NTM	Non-Tariff Measures
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
OIE	World Organization for Animal Health
OLS	Ordinary Least-Squares
PAH	Polycyclic Aromatic Hydrocarbons
pH	Measure of Hydrogen Ion (Chemistry)
POP	Stockholm Convention on Persistent Organic Pollutants
PVB	Present Value of Benefits
PVC	Present Value of Costs
QUAD	United States of America, Canada, Japan and EU
SACU	Southern African Customs Union
SADC	Southern African Development Community
SE	Simultaneous Equation
SEM	SE Models
SPS Agreement	Agreement on the Application of Sanitary and Phytosanitary Measures
SPS	Sanitary and Phytosanitary Measures
TAC	Total Allowable Catches
TBT Agreement	Agreement on Technical Barriers to Trade Measures
TBT	Technical Barriers to Trade Measures
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNCBD	UN Convention on Biological Diversity
UNCED	UN Conference on Environment and Development

UNCLOS	UN Convention on the Law of the Sea
UN-COMTRADE	UN Commodity Trade Statistics Database
UNCTAD	UN Conference on Trade and Development
UNDP	UN Development Programme
UNECA	UN Economic Commission for Africa
UNEP	UN Environment Programme
UNFCCC	UN Framework Convention on Climate Change
USA	United States of America
USD	Dollar, USA
VAT	Value Added Tax
WHO	World Health Organization
WIOT	West Indian Ocean Region (for Tuna Fishery)
WTO	World Trade Organization

LIST OF METRICS

g	Gram (equal to 1×10^{-3} kilograms)
µg	Microgram (equal to 1×10^{-9} kilograms)
kg	Kilograms
mg	Milligrams (equal to 1×10^{-6} kilograms)
ppm	Parts per Million
Ton	Metric ton (tonnes) (equal to 1×10^{3} kilograms)

SUMMARY

EXPORTATION OF PROCESSED FISHERY PRODUCTS FROM MOZAMBIQUE: DETERMINANTS AND TECHNICAL COMPLIANCE PROCESS

The dissertation answer two questions: (1) what are the determinants of exports of fishery products from Mozambique, and (2) what are the costs and the benefits of complying with importer's technical regulations, standards, and measures. The questions raised are founded in recent literature which highlights the importance of technical measures to trade in the export and import of agro-food products. In fact, recent evidences emphasizes that technical standards and sanitary and phytosanitary standards designed to safeguard food safety, human, animal and plant health and life are acting as substantial obstacles to exports of fish and fish products. Therefore, apart from prices and consumer's incomes, agro-food products are highly sensitive to the degree of compliance to consumers' technical regulations and standards.

The dissertation starts, in the Chapter 2, by providing a general picture on the role of the technical measures to trade of world fishery industry, highlighting the concepts of “product”, “production and processing”, and “labeling and marketing” standards. From the world data, aquaculture production is underlined as the mode of production that is increasing the world supply, and especially, the trade fluxes from developing to developed countries. A general lesson from that chapter is that captures should be reduced – not necessarily stopped – whileenvironmental-friendly aquaculture should be promoted. That is why the chapter indicates that technological advances in fisheries science, higher incomes, health and sanitary consciences as well as the population structure, combined with lower or zero tariffs on imports, is pushing importing countries' governments to improve their means to control [imports] of agro-food. This is done by applying and enforcing stringent technical standards and regulations, which is affecting, particularly, fishery products. Its perishability nature and the wide evidences of fishery as being vehicle for food-borne illnesses are among the main reasons for the application of such stringent regulations and standards.

In the Chapter 3, Mozambique is analyzed. The dissertation assumes that the country has deficit in applying technical standards, taking as evidences the successive findings of failures to meet the EU legislations on food safety (data from others important markets were not found). The reasons for that are complex, but include the economic model chosen after the independence, long economic stagnation and backwardness created by the civil war, lack of

supportive infrastructure and equipment, and deficient control of the domestic refuse and sewage. This suggests that additional effort, to enforce the existing rules, institutions and laws shall be done. The chapter points out that 11 tariff line of fishery products are exported consistently, offering potential alternatives for product diversification, and through it, to market diversification. In this point, the dissertation criticizes and joins its voice to those who critics the fishing agreements, arguing that they lead to underinvestment infrastructures for compliance to technical measures, and they endangers the fishery resources, due to their “extractive” nature.

In the Chapter 4, the dissertation tests the significance of sanitary and environmental indicators to the exports of fishery products from Mozambique. An export demand equation under the assumption of imperfect substitute goods was taken, using the quantity of shrimps and prawns, frozen, as the dependent variable. The results points out that the export demand model for shrimps and prawns exported from Mozambique performs better with Spain and Portugal, the two main partners. In most of the cases, the fixed effect methodology performed better than the pooled least square since it corrected the majority of the wrong signals detected in the pooled least square and the t-statistics, by lowering the significance of these variables. Although the sanitary and environmental indicators are significant with some trading partners, the number of products being rejected, destroyed or deviated to others markets is increasing, as well as the number of mandatory quantity of samples to be tested at laboratories.

The Chapter 5 uses two products (frozen shrimps and prawns and dried fish), two equations (export demand and supply) and one technical indicator (costs for carrying laboratory analysis). The results would be stronger if more accurate instruments were used. Thought the effect of the endogenous variable, the technical indicator and others instruments performed to turn the independent variables statistically significant and with the correct signs. This indicates the relevance of this variable, meaning, thus, that carrying out laboratorial analysis on fishery products, prior to their exportation impacts the demand and the supply of exports. The country and time-frame effects showed significant results, and this indicates that fishery products are sensitive to the economic profile of the trading partners and to time-frame.

The Chapter 6 revises the costs for compliance faced by different developing fishing countries. In general, smaller and more vulnerable countries appear as more dependent on foreign aid, while relatively great economies tend to support their own compliance activities. The chapter also indicates that the empirical data suggests that costs for compliance are far below the benefits.

In Chapter 7, the estimates of the NPV (net present value)and BCR (benefit-cost ratio) for a proposal of a fishery laboratory in Mozambique provided positive, since the NPV is 643,071.00 USD, which means the inflows exceed outflows and the project is worthwhile.Considering that the laboratory will be funded by grants from foreign agencies, the costs of compliance with technical measures will be covered by the importers themselves and the costs will not entirely be passed to consumers.The BCR is 3.00 which reinforces the project is worthwhile and the proposed fish inspection laboratory can generate benefits three times bigger than the costs.Since the laboratorial costs are one of the most important problems faced by fishing firms, the net benefits reported represents the net impact of others standards and due to huge net BCR, firms will enjoy the advantages of complying with fish laboratorial analysis requirement.

The main conclusions of the dissertation are summarized below:

a) Beside prices and income, technical measures (sanitary and environmental aspects) are affecting the demand of exports of fishery products, from Mozambique, especially, frozen shrimps and prawns exported to EU;

b) From the worldwide trend and exporting successful developing countries, increasing-production strategy should be based on increase of aquaculture and a gradual decrease of captures;

c) Export-promoting strategy should be based on increase of quantities (produced and exported) and of quality (compliant to sound technical, health and environmental standards), than on prices;

d) The benefits of complying with technical measures are higher than the costs;

e) Above all: if the laboratorial costs of compliance are negligible, then problems of compliance should be found in errors of delivering the products, as for instance, the rupture of the cold chain. Therefore, the investment on the technical compliance structure shall be directed to upgrade the freezing equipment, storage and modern vessels.

CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1 PROBLEM, JUSTIFICATION AND OBJECTIVES

1.1.1 The Problem and Justification

This dissertation discusses the exportation of processed fishery products originated from Mozambique, highlighting the determinants and the compliance process with importer's technical regulations and standards. The focus on the two pillars – determinants and compliance process – can be justified, firstly, by the importance they represent for the production, processing and decision-making side by disclosing the most relevant variables that explain the export fluxes, and, secondly, by the importance of the technical measures which are affecting the trade of fishery products in the world (Panisello and Quantick 2001; UNECA 2005; UNCTAD 2005; Fliess and Schonfeld 2006; Murina and Nicita 2014).

With the *determinants* of exports of fishery products, this dissertation intends to find the factors associated with the demand and supply of exports. Here, both income and price effects are assessed, plus the variable which returns the effect of the technical measures to trade. The importance of the estimation of the determinants are justified by the possibility of revealing what are the marginal effects of the world incomes and prices to Mozambican exports of fishery products. The inclusion of technical measures to trade is in line with the UNCTAD's (2005:5) view which recognizes that the "*recent trend indicates increasing use of technical measures, as well as quantitative measures associated with technical measures, and decreasing use of all other measures*", most of them caused by the developed countries' investments in regulating health, environment and safety.

The *compliance process* with importer's technical regulations and standards is justified by its potential effect in enhancing, reducing or deviating exports, increase or decrease prices of exports, and the costs involved in the process. Indeed, the agro-food products are particularly targeted with stringent technical measures, impacting all the production and commercialization chains. In this regard, both UNCTAD (2005) and Murina and Nicita (2014) recognizes that exports of fishery products have been affected by substantial obstacles, especially the technical and sanitary and phytosanitary standards, resulting in relatively higher burdens for lower income countries.

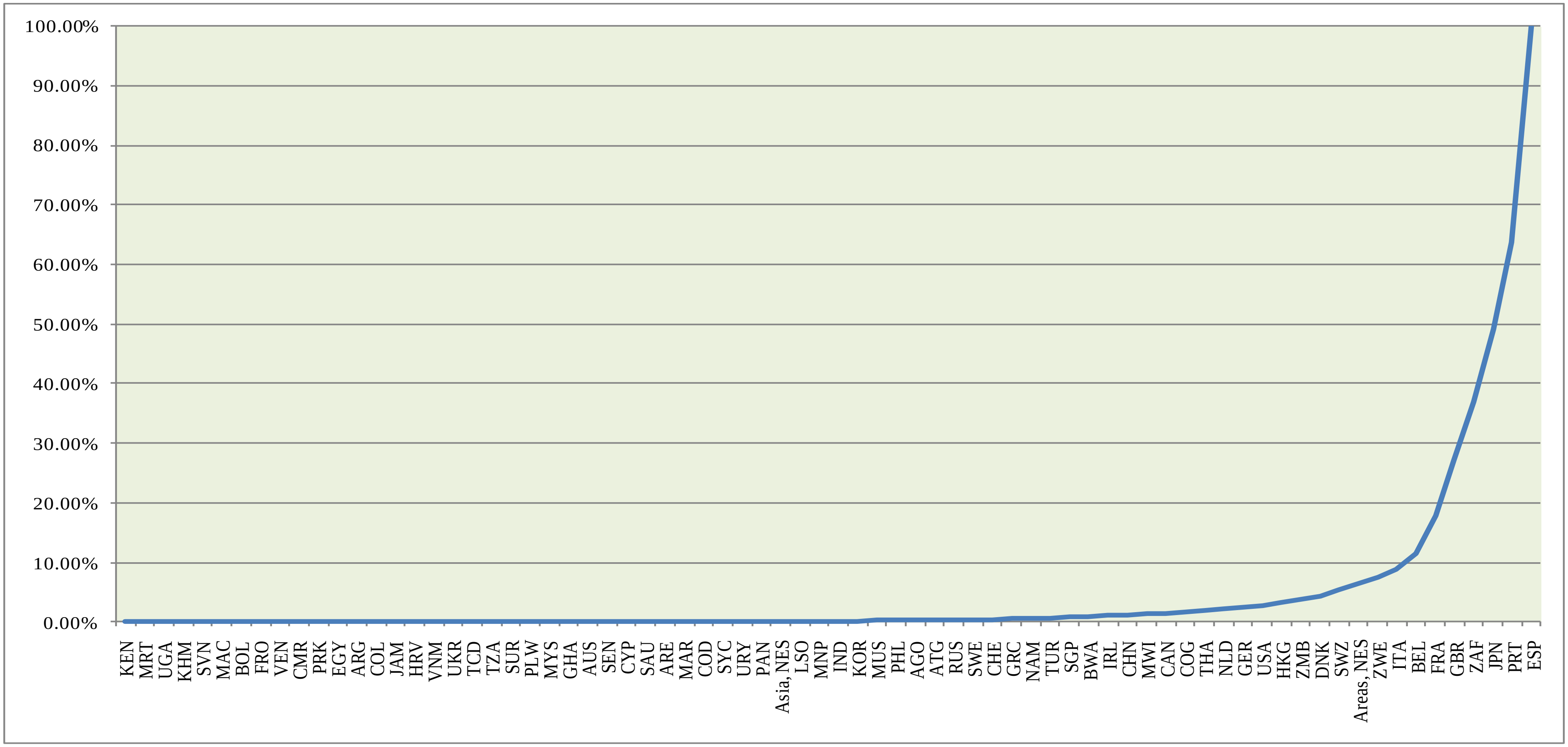
The selection of Mozambique is justified, not only by its current production and exporting performance's, but and mainly, by the potentiality the country offers to expand its current modest world production's share. In fact, by increasing both the production and the exportation, the country will achieve significant improvements on the human, rural and economic development spheres, as a result of increased governmental revenues, expanded GDP, and employment creation. As will be developed in Chapter 3, Mozambique exhibits excellent natural conditions favorable for fish, mollusks and crustacean diversity capture and aquaculture (Sousa et al. 2006; FAO 2007).

Plotting the export volume data (Figure 1.1), appears that EU (European Union) countries, Japan, and South Africa are the main destinations of fishery exported by Mozambique[1]. These countries are also the major importers of fishery products worldwide. Indeed, Spain and Japan appears in most of the data at the top 10 countries in terms of values of importation (FAO 2007; FAO 2008; FAO 2010). Spain (43.05 per cent), Portugal (18.97 per cent), Japan (14.39 per cent) and South Africa (13.85 per cent), altogether, represents above 90.00 per cent of fishery products demanded from Mozambique.

[1] The Figure 1.1 was done by summing yearly values and transforming them in relative numbers, the results were reorganized in descending order, and cumulated to obtain the cumulative relative frequencies. The Cumulative Percentage Frequency (*CPF*) was calculated from the summation and accumulation of the previous relative percentage frequencies, after being organized in ascending order, through the formula $CPF = \sum_{i=1}^{n} C_n$ where: n=77 importing countries (including "Others Asia" and "Areas NES"); and C_n stands for relative percentage frequencies. To deflect the prices we used the IMF Commodity Food Price Index.

Figure 1.1: Export Destinations of Mozambican Fishery Products

Data Source: UN COMTRADE



Note: KEN (Kenya); MRT (Mauritania); UGA (Uganda); KHM (Cambodia); SVN (Slovenia); MAC (Macao); BOL (Bolivia); FRO (Faeroes Islands); VEN (Venezuela); CMR (Cameroon); PRK (Korea, North); EGY (Egypt); ARG (Argentina); COL (Colombia); JAM (Jamaica); HRV (Croatia); VNM (Vietnam); UKR (Ukraine); TCD (Chad); TZA (Tanzania); SUR (Suriname); PLW (Palau); MYS (Malaysia); GHA (Ghana); AUS (Australia); SEN (Senegal); CYP (Cyprus); SAU (Saudi Arabia); ARE (United Arab Emirates); MAR (Morocco); COD (Congo, D.R.); SYC (Seychelles); URY (Uruguay); PAN (Panama); Asia, NES (Others Asian); LSO (Lesotho); MNP (North Mariana); IND (India); KOR (Korea, South); MUS (Mauritius); PHL (Philippines); AGO (Angola); ATG (Antigua and Barbuda); RUS (Russian Federation); SWE (Sweden); CHE (Switzerland); GRC (Greece); NAM (Namibia); TUR (Turkey); SGP (Singapore); BWA (Botswana); IRL (Ireland); CHN (China, P.R.); MWI (Malawi); CAN (Canada); COG (Congo); THA (Thailand); NLD (Netherlands); GER (Germany); USA (United States of America); HKG (Hong Kong, China); ZMB (Zambia); DNK (Denmark); SWZ (Swaziland); Areas, NES (Others); ZWE (Zimbabwe); ITA (Italy); BEL (Belgium); FRA (France); GBR (United Kingdom); ZAF (South Africa); JPN (Japan); PRT (Portugal); ESP (Spain)

1.1.2 Motivation: Mozambique, Fishery Products and Technical Measures to Trade

After a long and destructive civil war (1977-1992), Mozambican economy is growing rapidly. Foreign direct investments on services, mining and mineral resources are the main vehicles of that impressive growth, followed by agro-food sector, notably, the fisheries. The data in the Table 1.1 reveals that crustaceans are the second group of products among the top 10 commodities exported that have the highest value per unit (USD/kg), just behind electrical energy.

Table 1.1: Mozambique Top 10 Export Commodities: 2007-2009

HS 2002	**Value (Million USD)**			**Unit Value***		
	2007	**2008**	**2009**	**2007**	**2008**	**2009**
All	2,412.10	2,653.30	2,147.20			
7601	1,515.90	1,451.80		2.50	2.40	
9999	17.70	199.00	867.70			
2716	225.30	226.40	274.40	33.30	49.90	79.00
2401	50.50	193.00	179.30	3.20	3.40	4.10
2711	110.90	4.50	90.20	0.20		
0306	65.80	68.70	60.30	6.60	6.80	7.10
1701	59.00		58.30	0.40	0.40	0.40
1207	19.80	37.10	45.30			
2710	35.60	56.00	8.80			
5201	19.60	50.40	26.50	1.20	1.30	1.50

Note: Blue area added by the Author
* All unit values in USD/kg, except HS 2716 (electrical energy), which is USD/MWh
Source: UN-COMTRADE

Except for electrical energy (HS 2716), crustaceans are far ahead of all others products, actually doubling the second ranked in unit value terms (unmanufactured tobacco; tobacco refuse, HS 2401). Excluding the values for HS 7601, the share of the HS 0306 becomes 7.34 per cent and 5.72 per cent, respectively for 2007 and 2008. It becomes evident that the apparent low share of fishery products must be assessed removing the effect of megaprojects in the economy. As can be seen, the Mozambican top 10 export commodities are highly influenced by the outputs of megaprojects: aluminum and fossil fuel exports (HS 7601, HS 2711, and HS 2710).

From 2000 to 2010, Mozambique exported fishery products of 55 different tariff lines (*see* Annex 1); however, annual average is 28.30, which informs how asymmetric is the share. For instance, in 2006 it reached 32 different tariff lines of fishery exports, but in 2007 and 2010 it declined to 24. The mode of tariff lines is 27 and the standard deviation is 2.86. As said, these data reveals that annual persistent fluxes of exports are observed in only few tariff lines: 11, representing 20.00 per cent. The persistent tariff lines[2] are: HS 030219, HS 030379, HS 030559, HS 030611, HS 030613, HS 030614, HS 030619, HS 030623, HS 030729, HS 030741, and HS 030799.

Fishery products play, thus, a pivotal role in Mozambican economy. To secure that pivotal role several transformations had been implemented since the independence, in 1975. They comprise the introduction of aquaculture, the creation, merging, or expansion of firms, improving the management of fish stocks, construction of laboratories and equipments, and the enactment of supportive laws and regulations. More investments are planned and expected to be disbursed, which will impact, positively, on the quantity and quality of fishery produced, processed and exported. From 1975, several reforms had been implemented, like the created in 1991 of the IPEX (Export Promoting Institute – Mozambique) to assist exporters in promoting their goods, and the setup of the country-competent authority for exports of fishery (*see* Chapter 3).

Above all, investing in fisheries is a global trend, especially for sea-dependent less developed countries. This is a tremendous opportunity for them to take opportunity of recent changes in the fishery world, where developed countries production had started to drop in meeting their own demand, and the developing countries started to assume the power of the production and exportation (Le Sann 1998; FAO 2010). The impact of this shift can be seen by the tremendous role played by developing countries in the 1992's UNCED (United Nations Conference on Environment and Development) final documents, particularly in its "Agenda 21", as well as the preceding and following conferences (Edeson et al. 2001).

[2] The issue of *persistent fluxes of exports* raises the matter of sustainability of exports, which requires a deep understanding of the reasons for the low survival of the non-persistent lines of exports.

As the Chapter 2 will develop, the drop in fisheries captures in the world is explained, basically, by bad management of fish stocks and some climatic adverse conditions. At the same time, technical advances and human health improvements and consciences are imposing additional challenges to agro-food products, including fisheries. One of the main consequences of this phenomenon is that technical measures to trade represent the leading category notified by WTO Members in the context of NAMA (Non-Agricultural Market Access) inside the ongoing Doha Development Round, where around 36 per cent are pertaining to compliance procedures (Fliess and Schonfeld 2006:8).

The rapid increases in the number of surveys dedicated to food products and technical measures to trade is a clear indicator of the importance of this issues as a determinant of international trade (next, in the Chapter 7, a survey done in Mozambique under a World Bank project will be presented). For instance, a survey carried out in 2005-2006 by OECD (Organization for Economic Cooperation and Development) on what are the main concerns during the conformity assessment process, many respondents referred the existence of multiple and repetitive testing requirements, many disparities among importers countries regarding the main issues to be complied with, and the refusal by importers governments to recognize home-exporters tests reports, as items that are conducing firms to unnecessary compliance costs (Fliess and Schonfeld 2006:5-7).

From the social point of view, importers' standards, measures and regulations represent one of the efficient ways by which governments or countries' authorities can intervene in their domestic market, with the objective of preventing deceptive behavior, safeguarding crucial cultural (even political) aspects, or consumers costumes. In that end, those measures, standards, and regulations tend to address features such as symbols, languages, size, colors and shapes, and can incorporate others such as environment, climate or geographical-related factors (to meet different climatic conditions), technological or infra-structural problems.

There are many examples of technical measures compliance problems, most of them created by over-regulating rules imposed in developed countries markets, with special emphases on SPS (sanitary and phytossanitary measures) and TBT (technical measures to trade) (Miranda 2001; UNCTAD 2005; UNECA 2005, Murina and Nicita 2014). In fact, UNCTAD (2005:5) confirms that "*the global trend is increasing the use of TBT measures and decreasing the use of others*". UNCTAD (2005:7) also says that "*all continents and regional groups are implementing any kind of NTB* [non-tariff barrier]". Several studies are indicating that SPS and TBT measures are affecting developing countries exports, especially fishery products (UNESCAP 1996; Cato 1998; Cato, and Lima dos Santos 1998, Murina and Nicita 2014).

In summary, world fishery trade is occurring in an environment marked by several conditions (Murina and Nicita 2014), including economic, political, environmental, social and legal. Price fluctuations or production subsidies can be mentioned as economical factors, while the fishery negotiations under the Doha Development Round are examples of political aspects. Environmental factors are exemplified by fish stock preservative and management concerns, since many commercial species are at their limit of exploitation and are being legally regulated through imposition of either product or productions standards or measures.

1.1.3 Objectives

The dissertation attempts to (1) describe and analyze the determinants of exports of processed fishery products from Mozambique and (2) to estimate and analyze the costs and benefits of the compliance process to importer's technical measures. These objectives are meet through others and more specific objectives presented in each chapter.

The first objective is answered in Chapters 4 and 5. There, the determinants of the demand for exports (Chapter 4) and the equilibrium analysis of demand and supply of exports are estimated simultaneously (Chapter 5). For the second objective, the Chapter 7 provides the estimates of the NPV (net present value) and of the PVC (present value of costs) and PVB (present value of benefits)

– including the benefit-cost ratio – of technical measures compliance process by using the example of the construction of a fish laboratory in Mozambique.

1.2 DEFINITIONS

1.2.1 Fish and Fishery Products

In the dissertation, “fishery products” shall be understood at biological and trade perspectives. From the biological point of view, CAC (Codex *Alimentarius* Commission) (2003b:6) defines fish as “*any cold-blooded* (ectothermic) *aquatic vertebrates*”, excluding amphibians, aquatic mammals and aquatic reptiles. Thus, “fishery product” means *Pisces*, *Elasmobranchs*, *Cyclostomes*, *Mollusks*, and Crustaceans when are out of their natural habitat and destined for human consumption (CAC 1979:2; 2003b:6). Then, “fishery” refers to the sum of all fishing activities on a given resource, for instance, shrimp fishery, or activity of catching fish from one or more stocks or refer to a single type or style of fishing, e.g. trawl fishery[3]. Since there are no great differences between “fishery” and “fishery products”, the term is used in both senses and as appropriate its *strict* sense is specified.

From the trade point of view, the HS 4-digit (1992 Edition) covers products from HS 0301 up to HS 0307. Within these categories, the dissertation refers, separately and jointly, to marine, fresh river, lake or aquaculture products. Aquaculture means “*aquatic animal or plant production, or the farming or culture of seaweeds, shellfish and mollusks as well as fish farming in the rearing process that enhances production, feeding, and protection from predators*” (La Sann 1998:115). This aquaculture’s definition covers both full-cycle and short term cycle holding and feeding of wild-caught fish, usually to take advantage of market prices fluctuations.

The FAO website[4] considers that fish and fishery products are “processed” to retain quality, increase shelf life, add-value to products or to facilitate distribution. There are numerous stages and types of processing fish and fishery products. The most common practices in the first stages (which depends

[3] http://www.fishonline.org/information/glossary/ (17 January 2011)
[4] http://www.fao.org/fishery/topic/736/en (8 December 2012)

on the type of products intended at the end) includes evisceration, deheading, scaling, cutting, slicing fish into steaks, filleting, skinning, grinding of skinned fillets or the combinations of the above methods. In downstream stages, fish and fishery products are washed, chilled, frozen, smoked, heated, dried, packaged, or processed by combining two or more of the previous methods.

Throughout the dissertation, the names of the species and sub-species are presented in English or in others languages, including their scientific names, usually following the FAO's methodologies. The full list of the fishery species covered under this dissertation at HS-6 digit (1992 Edition), are presented in the Annex 1. The list, however, does not include "Preparations"[5] because there are no enough data on "preparations", at least for Mozambique.

1.2.2 Export/Exportation

"Export" or "Exportation" means a legal exercise of selling/sending goods, from a resident to a non-resident. As for fishery products and looking to the evidences collected during our study, products might be considered legally, and thus, accountably "exported" when a resident firm or vessel pass the products to other (foreign) firm or vessel, even when the products are still in Mozambican waters or boundaries. The same can be said for products transported by terrestrial vehicles, like dried fish.

Although the definition of 'exports' seems pacific, the measurement of what 'exports' are remains controversial, in the context of fish and fishery products, especially the products from captures in marine areas. Indeed, international trade in fishery products is determined by the flag[6] of the fishing vessel meaning that fishery caught by a 100 per cent A-country flag vessel in B's waters tend to be considered as A's landings, instead of B's exports. This approach is still under debate since it has consequences on several others issues, including the trade duties, investments on fishery industry, environmental sustainability and the technical compliance process.

[5] Preparations fish or of crustaceans, and others aquatic invertebrates (HS 16) refers to sausages and similar products, food preparations based on fish, crustaceans and others aquatic invertebrates, prepared or preserved products, extracts or juices of fish, crustaceans and others aquatic invertebrates, containing more than 20 per cent by weight of fish, crustaceans, mollusks or other aquatic invertebrates, or any combination.

[6] The flag in a vessel determines the origin of the vessel, and usually it should be operated by the citizens of that country. Therefore, when a vessel is operated by a foreigner is considered "foreign" vessel.

1.2.3 Determinants (of Exports)

"Determinant" means an independent variable or a set of independent variables correlated, significantly or influentially, with a dependent variable. Therefore, "Determinants of Exports" are all explanatory variables associated with exports of Mozambican fishery products in a statistical significant manner.

1.2.4 Compliance Process to Technical Measures

1.2.4.1 Compliance Process

Compliance Process, as defined by Hammoudi et al. (2009: 470-471) is a set of procedures used, directly or indirectly, for "*sampling, testing, inspecting, evaluating, assure the conformity, registration, accreditation and approval to export, as well as their combinations, as required by an importer's regulations or standards, as necessary steps for market entrance*".

1.2.4.2 Technical Measures in Trade

The dissertation takes the Sykes (1995), Deardorff and Stern (1999) and Matsushita et al. (2006) approaches on the technical measures to trade. For Sykes (1995:3, 78, 197) the problem of technical barriers to trade in international goods market comprises standards and regulations, as well as the sanitary and phytosanitary measures. Sykes (1995:78) explains that "*because agricultural issues were so contentious during the Uruguay Round* (…) *technical barriers issues related closely to agriculture were also negotiated separately. The result was a freestanding agreement on the application of* [*SPS*]", and that is the reason why the WTO multilateral agreements on technical measures appears divided in two, one for technical barriers to trade (TBT Agreement) and the other for sanitary and phytosanitary measures (SPS Agreement).

Following the same approach, Deardorff and Stern (1999) consider technical measures to trade as including standards, technical regulations, certification system and other devices developed to reduce uncertainties about the quality characteristics of goods purchased by firms and households. They are composed by "*health and sanitary regulations and quality standards, safety and industrial standards and regulations, packaging and labeling regulations, including trademarks, and advertising and media regulations*" (1999:97).

The same approach, but enriched with a legal point of view, is found in Matsushita et al. (2006) who consider technical measures to trade as including sanitary (and phytosanitary) measures. Their argument is founded by the *lex specialis* principle, which makes SPS measures more specific and thus, preceding the TBT, and all together, preceding the GATT 1994. In this regard, the SPS measures are established to ensure that buyers know what they buy and that it is safe for human health or for the environment, plant and animals, while the TBT measures targets to technical characteristics of products.

Although, legally, the two agreements appears separated, some problematic issues still remains, reminding how closely related the agreements are. In the Gruszczynski (2010:63-64) words "*measures which address certain aspects of food safety as well information on nutritional value*" are in the frontline of these measures difficult to classify whether they are strictly sanitary or strictly technical. This classificatory discussion makes easy to treat "food safety" issues as a genuine "technical measures to trade" topic.

1.3 LIMITATIONS AND SIGNIFICANCE

1.3.1 Limitations of the Dissertation

The dissertation starts by exploring the phenomenon of demand and supply of fishery products worldwide, with a special tonic in the supply of fisheries from Mozambique. Nevertheless, it does not claim to cover all the steps, institutions and traded fishery products. Moreover, the dissertation does not cover sports and artisanal fishing products, unless expressed. Probably due to difficulty of controlling and the remoteness in its occurrence, both sports and artisanal fisheries data usually are absent in most trade and economical studies. The analysis developed in this dissertation takes in account, only, commercial activity of fishery products destined to human consumption, excluding, thus, pet food and ornamental fish.

The dissertation also failed to cover or treat properly the following aspects:

a) In the Chapter 2, the dissertation does not cover all the steps, institutions, and sorts of fishery products, therefore, the rules and institutions described there might be partially applied to some category of fishery products. Equally, the dissertation does not assess, econometrically, the ex-vessel and export prices neither their complex links;

b) In the Chapter 3, it does not cover "sports" and "artisanal" fished products, because the scope of this dissertation was limited to commercial fishery products;

c) In the Chapter 4, due to data unavailability, the regression results' failed to determine the importance of sanitary and environmental issues for the demand in Japan;

d) In the Chapter 6, and also due to data unavailability, the dissertation does not present food safety regulations of others Mozambique major partners, like South Africa, Zimbabwe, Zambia, or Malawi; and

e) In the Chapter 7, most of the data used for calculate the NPV and BCR (benefit-cost ratio) were calculated from the data publicly available, and they might be different from the real data, in the field.

1.3.2 Significance of the Research

That [dissertation] is a modest contribution to the perception of two main questions within the trade of Mozambican fishery products, especially with regard to the determinants of exports and TBT/SPS compliance measures. Up to the author's best knowledge, this is the first study covering determinants of exports and compliance process in the Mozambican context. This seems to be true because Mozambique is one of the countries that face difficulties of producing studies and systematic analysis due to limited capacity for data collection and storage. Therefore, this dissertation represents a base from where further studies can depart from.

More specifically, two main aspects are original:

a) In the first pillar, the dissertation introduced and estimated the "border detected cases", variable used for first time in this type of regressions; and

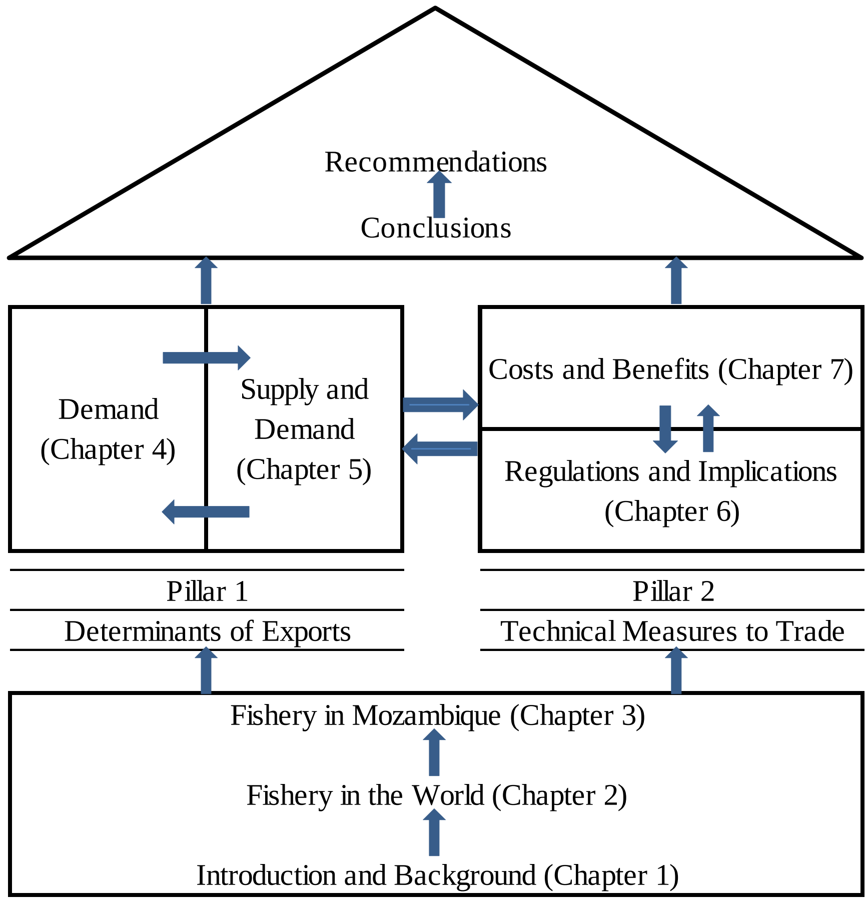
b) In the second pillar, the BCR estimates the ratio of PVB to the PVC.

1.4 PLAN OF THE DISSERTATION

The dissertation is structured according to the Figure 1.2, which also shows the relationship and logical sequence of pillars and chapters. The figure shows four main parts. At the bottom, there are three introductory chapters (Chapter 1 to Chapter 3). In the middle, there are two pillars, constituted by the first pillar (left side, Chapters 4 and 5) and second pillar (Chapters 6 and 7). The two pillars derive from the introductory chapters, and they sustain the Chapter 8 (on Conclusions and Policy Recommendations). The upper part of the figure is a triangle with upward point, to emphasize not only the policy implications but also further researches in this field.

In details, Chapter 2 begins with the general discussion on the technical measures in the international trade of fishery and agro-food products, looking to the way they are acting to influence and determine this industry, its trade and their institutions. The background provided in this chapter is particularly useful to the following chapters and sub-chapters. Essentially, the chapter describes how the technical measures to trade, in the context of fisheries resources emerged, and are enforced.

Figure 1.2: Dissertation Structure



Source: Author

The Chapter 3 turns to Mozambican case. Here, the dissertation argues that Mozambique is a low-standard and small country, which is supplying fishery products to high standards consumers. The chapter provides a background of how the Mozambican fishing industry is structured, by presenting the products, the production scheme, and the processing facilities. Equally, legal instruments applicable for fishery industry and exports, as well as their linkages with the international technical measures to trade are also provided.

The Chapter 4 focuses on the concerns regarding the sanitary and environmental conditions of fishery products resulted from food-borne diseases incidences originated from exports of fishery products. Here, the central question is whether these sanitary and environmental indicators are a determinant of the demand for exports of fishery products originated from Mozambique. The concentration on the demand side is based upon the assumption of unlimited supply of fishery products at a restricted price. Due to its leading role, shrimps and prawns are used as a case study, and the "border detection cases" are used to proxy the sanitary and environmental conditions that are affecting the exports of fish and fishery products originated from Mozambique. After using an export demand function and panel data, the chapter provides relevant conclusions for policy formulation.

The Chapter 5 addresses the same question like that of the Chapter 4. However, differently from the previous, this chapter answers the question on the determinants of exports by running, simultaneously, the demand and supply functions. Here, the chapter assumes that the exporting price influences the quantity supplied to the market. The system of two equations and two products (frozen shrimps and prawns and dried fish, *kapenta*), plus one variable which captures the influence of technical measures to trade on the price of supply constitutes the methodology. These products were selected due to their importance in the export fluxes.

After the estimations of both pooled LS (pooled least square) and cross-section fixed effects, the chapter concludes that incomes and prices are the determinant of the demand for exports, for shrimps and prawns and for dried fish. Making comparison between shrimps and prawns and dried fish, the results from the shrimps shows strong country-fixed effect with Spain and Portugal; and dried fish results are still puzzling and non-significant.

The Chapter 6 revises some of the most important food safety regulations, and their impacts at the macro and micro levels. The chapter emphasizes that the costs for compliance are dependent on the technical measure to be targeted and the economic status of the exporting countries. The costs of compliance would be less if technical regulations (including food safety regulations) were harmonized, as proposed by sound international bodies such as WTO, the CAC, the International Plant Protection Convention or the OIE. The reality, however, is that countries possesses enormous rights to regulate their own level of protection to protect their animal or plant life or health within their territory. A step-forward would be done if countries commit themselves to harmonize or to consider others' food safety regulations as equivalent, in a good-faith negotiation manner.

Chapter 7 takes up the problem discussed in the previous chapters, and estimates the NPV and BCR. The estimates suggest that the NPV is 643,071 and the BCR equals to 3, results that encourage the compliance to technical measures to trade and the investments into this sector.

The final chapter (Chapter 8) summarizes the dissertation, by revisiting the two general research questions. The data, the literature reviewed, and arguments lead to the conclusion that:

a) Technical measures to trade are important for the demand of exports, and they impacts the exports by decreasing the quantities of products that enter the markets;
b) The costs for compliance to technical measures are far below the benefits and this can encourage the establishment and enlargement of a strong fishery industry in Mozambique, whose strategy shall be to improve its production, and therefore, its quantities in the international market;
c) A balance between a responsible aquaculture production and limitation on captures seems to be the correct policy.

CHAPTER 2

WORLD TRADE OF FISHERY PRODUCTS: DETERMINANTS AND THE IMPORTANCE OF TECHNICAL REGULATIONS AND STANDARDS

2.1 INTRODUCTION TO CHAPTER 2

The international trade in fishery goods is determined by prices, incomes, production capacity, technology and costs, and, increasingly, by the technical measures, regulations and standards. The compliance to these technical measures is an indispensable tool for commercial policies, market access and entry and competitive advantage (Jussaume and Judson 1992; Wilson and Abiola 2003). Fishery products, due to its peculiar characteristics – high perishability, close connection to environment (Asche and Smith 2009:2) and importance for human consumption – stands as one of the most regulated products, affecting its tradability. The quasi-depletion and overexploitation status of most of the commercially important species (Gould 1972b; Clark 1973; Phillips et al. 2003; Röhr et al. 2005) is the other dimension which complements the reasons why fisheries are being regulated at every stage, from the production to commercialization.

This chapter show how the technical measures to trade are acting to influence and determine world fishery industry, trade and their institutions (rules, habits and main thoughts associated to the trade of fisheries). To validate this statement, two main arguments are presented in sections 3 and 4, where we describe the emergence and the role of the technical measures, regulations and standards in the actual fishing industry, trade and institutions. The arguments are based on the concepts of product, production and processing, and labeling and marketing standards, as provided and defined in the CAC (*see* CAC 1999a; 1999b).

Before proceeding to the main arguments, the chapter describes the picture of the fishing industry, trade and the institutions that governs fishery industry worldwide. “Fishing industry” is described by the FAO Fisheries Glossary[7] as composed by recreational, subsistence and commercial fishing, and includes industries and others activities dealing with culturing and preserving, harvesting, storing, processing, transporting, marketing, and selling fish or fish products, either wild (from the sea/ocean, river or lake) or from aquaculture. And institutions are defined as "*a set of habits and rules of morals, custom, and law, which have a common centre of goal, which are consistent with each other and which constitute a system*" (Schmoller 1900, quoted by Chavance 2009:5).

The definition of fishing industry shows the existence of three branches: recreational, traditional and commercial fishing. The recreational fishing integrates the process of harvesting fish for personal use, fun, or challenge, excluding sale, barter or trade. The traditional fishing comprises companies and individuals associated with lake, river, and sea resources from which indigenous, local, or impoverished people get food and fishery products in accordance with their traditional knowledge. And commercial sector comprises companies, firms and individuals associated to wild-catch or aquaculture resources and to carry several transformations to get products for sale, with the objective of delivering fish and other seafood products for human consumption or as input in other industrial processes.

As said, the section 2 presents a picture on the global production and consumption of fishery products, highlighting that developing countries are leading the production, while developed countries lead the consumption of high valued species. The section 3 links fishery products and the emergency of technical measures. The section emphasizes that such link between the 'fishing environment' and product standards is motivated by the necessity of safeguarding humans, animals and plants life and health. Using the data provided in tables and figures along the chapter we argue that technical measures are instruments to prevent diseases and to upgrade the nutritional utility arising from consuming fishery products.

[7] http://www.fao.org/fi/glossary/default.asp (10 February 2011)

The section 4 discusses the production, processing and labeling standards. Indeed, production standards intend to highlight the role of ecosystems and to integrate fishing industry in a global effort to protect health and environment. Labeling and marketing standards exist to disclose, to the public, the product and production and processing standards, acting, thus, as ‘meta-standards’ due to its role in describing others standards. Finally, section 5 presents some examples of successful countries from whom others exporting countries can learn.

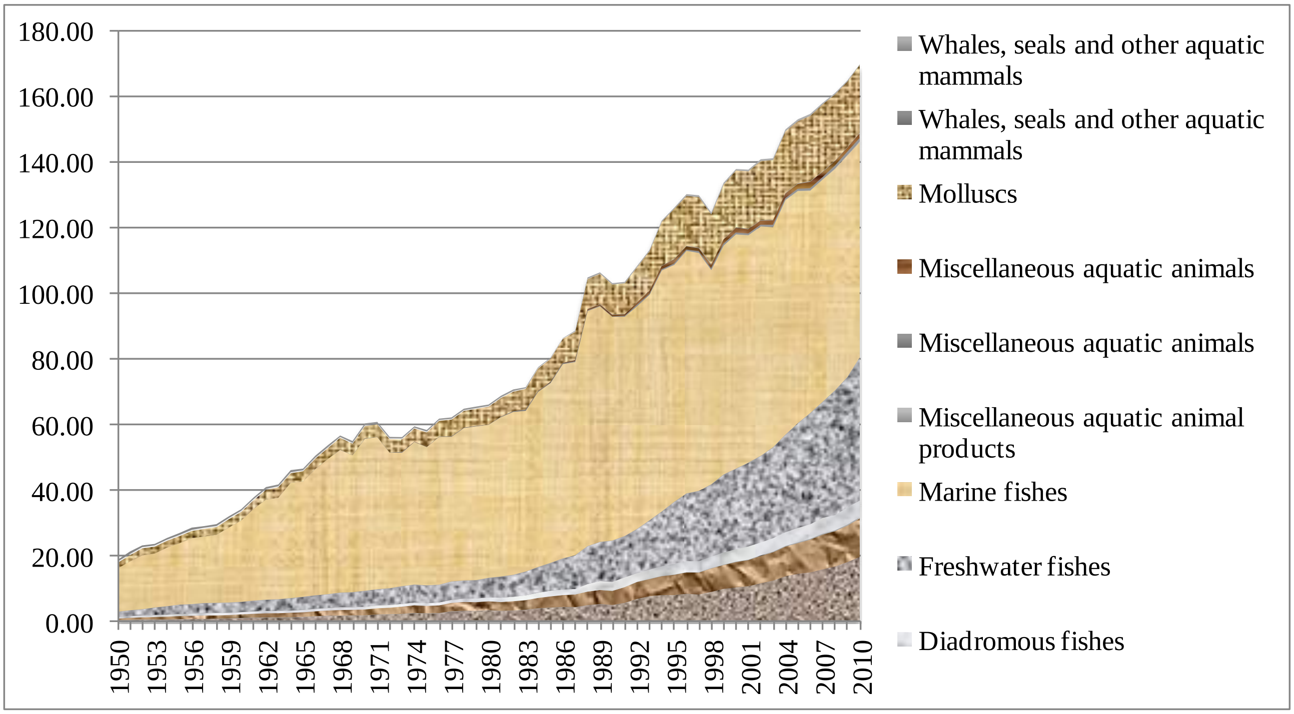
2.2 DETERMINANTS OF TRADE

2.2.1 Production Capacity and Processing Technology

The “production capacity” is one of the core determinants for supply of exports. As definition, “production capacity” is the total volume of products that a country can generate, attending the resources, technology, and time-frame. As for fishery, “production capacity” should attend the maximum sustainable yield, and combine the biomass, age structure, and distribution or the place of production, to avoid overcapacity or overfishing. The three basic variables crucial to measure the fishing production capacity are, (1) the current yield or catch, (2) the current fishing effort generated by the summation of all utilized fleet, full (i.e., at 100 per cent capacity of utilization), and (3) the total stock of the biomass. This is a challenge task, and there are no consensual data on the countries “production capacity”.

In the absence of data on the production capacity, it becomes important to understand the patterns of the total production and processing of fisheries resources in the world. There, two evidences appears: first, that nowadays more than 90 per cent of the marine fish production comes from only 10 per cent of the oceans, where fundamental processes for keeping light, carbon dioxide, oxygen, salt, and nutrients occurs – the continental shelf areas (Le Sann 1998:7), and, second, that the Northern hemisphere temperate waters are the most productive places, but in tropics and equatorial zones the species are more diversified and the ecosystem is more fragile, but the population size of each species is relatively reduced (Le Sann 1998:7).

Figure 2.1: World Production by Species 1950-2010 (Tons, Millions)

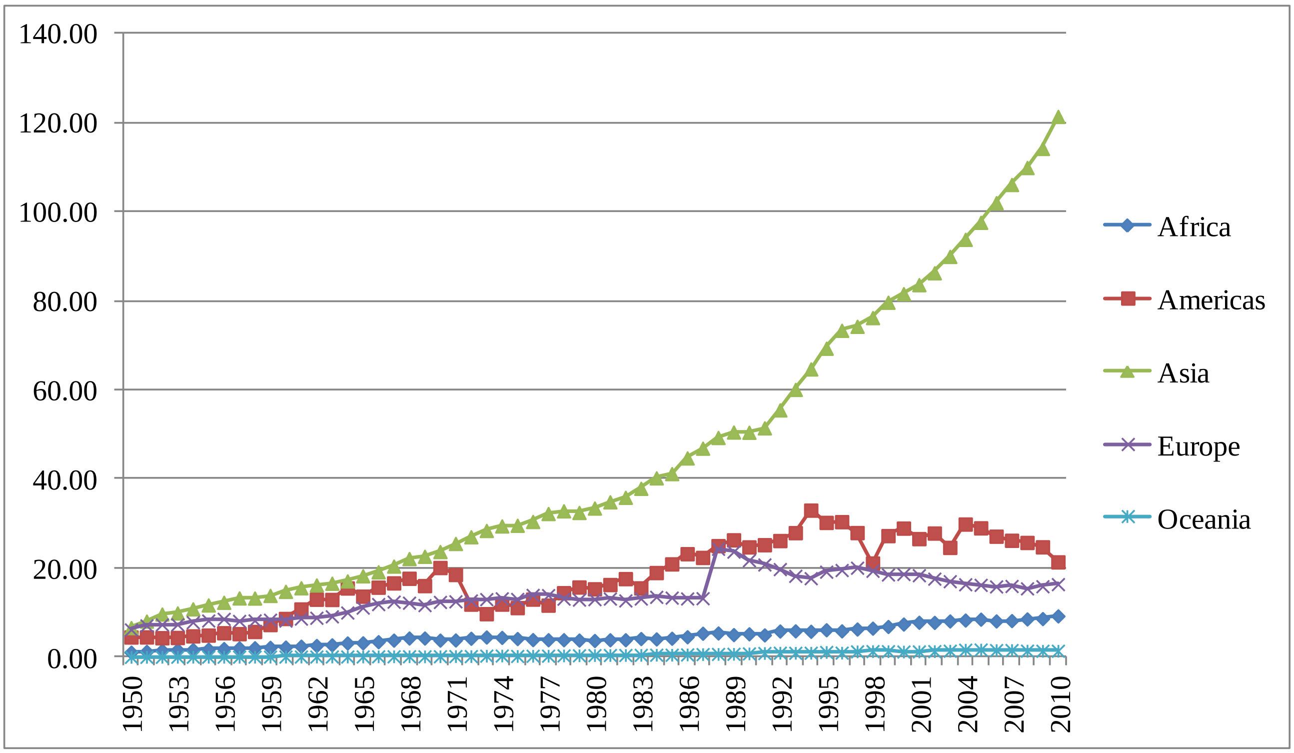


Data Source: FAO-FISHSTAT

The breakdown of the production' data into species reveals that aquatic plants (16.82 million tons), crustaceans (10.79 million tons), freshwater fishes (37.64 million tons), diadromous fishes (4.84 million tons), marine fishes (67.43 million tons), miscellaneous aquatic animals (2.32 million tons), mollusks (20.42 million tons), miscellaneous aquatic animals products (0.03 million tons) and whales, seals and other aquatic mammals (0.25 million tons) are the most harvested resources in the world, as for 2012.

Prediction done by OECD and FAO (2011:148) points out that world production is projected to reach 164.00 million tons in 2020, representing a growth rate of about 15 per cent. Again, aquaculture is expected to be the main engine for such increase. In fact, the Figure 2.1 shows how crustaceans' production is increasing, explained by aquaculture farming of crustaceans, especially prawns and shrimps, in Thailand, China (P.R.), Indonesia, Ecuador, India, Philippines, Vietnam, Taiwan, and Bangladesh (Le Sann 1998; FAO 2010). Due to their location in the Southern hemisphere, the general picture of global fish trade tends to consolidate the South as the main contributor for international fish trade (ECDPM 2006). In captures, while Asia-Pacific (except Japan) is producing more, Europe is decreasing (*see* Figure 2.2).

Figure 2.2: Fishery Production by Continents (Captures and Aquaculture, Inland and Marine) 1950-2010 (Tons, Million)



Data Source: FAO-FISHSTAT

Looking the world fishery production by continents in the Figure 2.2, Asia appears as the leading producer, while the Oceania is at the bottom. In the Asia-Pacific, China (P.R.), Thailand, Vietnam, Indonesia, Philippines, India, and Bangladesh are leading in aquaculture, accounting for almost 90 per cent of all world production, and almost 80 per cent in terms of values (FAO 2010). China (P.R.) alone is the top producer, worldwide, with production of 47.50 million tons in 2008, being 32.70 and 14.80 million tons from aquaculture and capture, respectively (Henson and Mitullah 2004; FAO

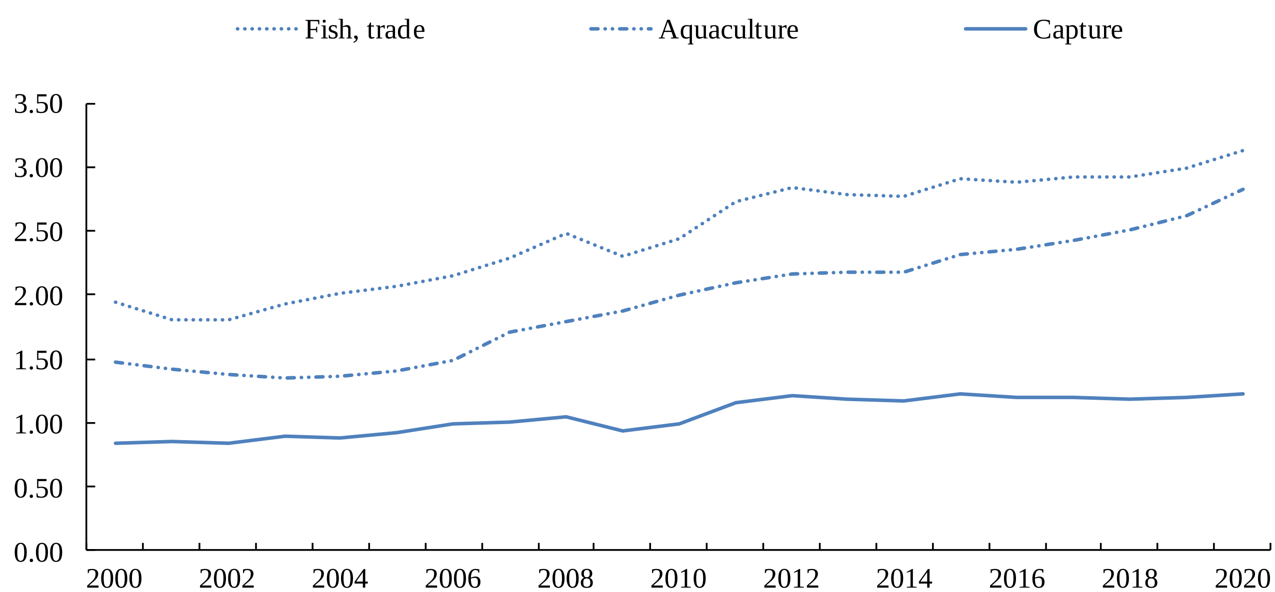
2010). In general, Asian producers grow their products by using antibiotics and labor-intensive, which is increasing output per unit. Although Europe possess an aquaculture industry in France and Spain, their production is reported as growing slowly, and is expected to be even worse in the coming decades (FAO 2010).

2.2.2 Prices, Income and Consumption

2.2.2.1 Prices of Fishery Products

Prices and consumers incomes are important determinants for supply and demand of exports of fishery products. Seafood and fishes (in general) are considered relatively less expensive food item, particularly when dried, smoked or in others traditional method of processing. Nevertheless, the projections done by OECD and FAO (2011:148) indicates the prices of fish and fishery resources (captured and aquacultured) tend to increase, as a result of the expected increase of the prices for important inputs, like fish-meals and feeds, caused by stagnated captures.

Figure 2.3: Rising World Prices: Farmed Fish Prices' Increasing more than Wild Fish (1000 USD per Ton)



Note: World fish price development in nominal terms between 2000 and 2020
Source: http://dx.doi.org/10.1787/888932427170

The price's rising tendency is also attributed to the projected growth of per capita income, rising world population and higher crude oil prices. In a study carried out by FAO (2010) to analyze the short- and long-term income elasticities for fish in the world, it concluded that, on average, less expensive fish (like mackerel, suary or horse mackerel) are inferior in the short-run, and long-run elasticities for fish tend to be lower (in absolute values) because technological advances, consumer's tastes and preferences can change and cheaper substitutes might become available in the market (FAO 2010: Box 17).

In the world market and using the experiences from different countries there are many factors affecting the establishment of price for fish and fishery products, notably the exporting price[8]. The frozen and dried products' prices are affected by external factors exogenous to fishermen and harvesters, such as seasonality, competition from direct and substitute sources, convenience to consumers, plus the intense competition for market share between the big exporters.

Ex-vessel price is what a wholesaling or others demanders pay to the primary producer, after deducting costs for harvest and landing the products to the specific selling site. The *export price* for a country A is the first-hand market price of goods purchased out of a country (let say, in B) but produced in A, both for retail and wholesaling, paid at the distribution point (as said in the "Introduction" of this dissertation, the wholesaling point can be either at the sea – vessel to vessel – or at the land-based distributor sites).

[8] Exporting price refers to the prices in the first-hand market.

Figure 2.4: Overview of the Determinants of Prices for Fishery Products: Mixed Sizes, Grading and Species

Type of Products	Ex-vessel prices	Export price (first-hand market)
Cephalopods	- Influenced by location or region; - Prevailing price for cephalopods; - Suitable margin of profit over costs	- Competitive prices, dependent on grades and quality; - Dependent on packaging, sanitary and technical issues
Crustaceans, frozen	- Supply chains linked to wholesaling stabilize or increases price	- Dependent to species (tiger prawn more priced); - Prices defined by major producers and exporters; - Dependent to wholesale markets; - Dependent on packaging, sanitary and technical issues
Crustaceans, fresh	- Suitable margin of profit over costs	- Dependent to species (tiger prawn more priced); - Dependent to wholesale markets; - Dependent on packaging, sanitary and technical issues
Marine fish, frozen	- Influenced by imported prices; - Suitable margin of profit over costs	- Mix of export and domestic market forces; - Dependent on packaging, sanitary and technical issues
Marine fish, fresh	- Strong completion with direct substitutes - Price volatility	- Mix of export and domestic market forces; - Dependent on packaging, sanitary and technical issues
Marine fish, dried	- Perceived as low eating quality; - Highly influenced by seasonality and marine fish availability	- Influenced by seasonality
Freshwater fish, fresh	- Suitable margin of profit over costs	- Mix of export and domestic market forces; - Dependent on packaging, sanitary and technical issues
Freshwater fish, dried	- Highly influenced by seasonality and freshwater fish availability	- Influenced by seasonality

Source: Author, adapted from various sources

2.2.2.2 Income Elasticity in the World, on Average

On average, with mixed processing techniques, almost all fishery products are income elastic, where freshwater fishes, crustaceans and cephalopods are in the leading positions, with positive income's coefficients of 2.80, 2.68, and 2.13 respectively. Although the overall results are correct and points a logical situation, the consumption of fish varies widely dependent on the economic position of the consumers (GDP per capita, for instance) and species of fish (Dey 2000). That is why demersal fishes exhibits elasticity near unit, with coefficients of 0.86.

On average, cephalopods and crustaceans are the two types of fishery which has positive income elasticity in all the three group of countries, although ranging from 1.50 to 7.60, which shows the differences between middle and law income groups of countries, and shows also that the demand for these products is elastic in all the groups. These findings are consistent with the logic and the theory which predicts that high-valued fish species are more income elastic than species associated with low-value (Dey 2000; Dey and Garcia 2008).

Figure 2.5: Consumption of Fish (kg per capita) and Income (GDP per capita, 2000 USD Constant) 1961-2009

Dependent (Log)	**Independent: GDP per capita (Log)**			
	World, Average	**High Income**	**Middle Income**	**Low Income**
All, average	1.59 (49.64)***	0.06 (1.49)	−0.20 (−1.23)	3.45 (8.23)***
Cephalopods	2.13 (26.61)***	1.87 (28.00)***	3.93 (6.29)***	7.60 (3.51)***
Crustaceans	2.68 (39.81)***	1.62 (48.67)***	1.50 (3.95)***	3.57 (3.27)***
Demersal fish	0.86 (16.64)***	0.17 (4.58)***	−0.45 (−2.46)**	4.28 (4.23)***
Freshwater fish	2.80 (22.36)***	1.58 (25.04)***	−0.28 (−2.73)***	3.24 (7.07)***
Marine fish, other	1.24 (16.20)***	−0.04 (−0.43)	−0.55 (−2.42)*	2.95 (4.92)***
Pelagic fish	1.10 (18.99)***	−0.43 (−6.80)***	−0.04 (−0.20)	3.47 (5.60)***

Note: t-statistics in parentheses
***, ** and * denotes significance at 1%, 5% and 10%, respectively

Data Source: FAO-FISHSTAT for fish consumption per capita; World Development Indicators – World Bank, for the GDP per capita (2000 USD constant)

2.2.2.3 Income Elasticity in the Low Income Group, on Average

Low income countries have positive and highly significant income elasticity to fish consumption for all kind of products, and amongst the poor consumers, most of them prefer low-price fish, according to their budget on fish (Dey 2000). The results of the low income countries are heavily affected by small islands developing countries, whose economies are entirely dependent in fish and seafood products. On average, their consumption is more sensitive to income than all others income groups' of countries and that is the reasons why the coefficients are particularly higher, ranging from 2.95 (for marine fish) to 7.60 (for cephalopods).

2.2.2.4 Income Elasticity in the Middle Income Group, on Average

Middle income countries have, considered jointly, negative and significant income elasticity for demersal fish (−0.45), freshwater fish (−0.28) and marine fish, others (−0.55); negative and not significant income elasticity for pelagic fish (−0.04). Attending the fish consumption patterns, the negative elasticity are not expected, but might be explained by the influence of geography, cultural factors, and accessibility to fishery: in fact, Central Asian countries have low consumption per capita and others countries such as India have consumption per capita of 4.5 kg/year because only one-third of its population eat fish (Dey and Garcia 2008:322).

The reason why cephalopods and crustaceans are positive and significant (3.93 and 1.50, respectively) in the middle income group of countries could be that some of these non-finfish species such as octopus, shrimps and prawns, squids, etc. have been aquacultured exhaustively in recent years around the World, increasing their geographical availability and making them accessible and affordable.

2.2.2.5 Income Elasticity in the High Income Group, on Average

High income countries consume more fish than developing countries, in total quantity. In fact, as for 2000, Japan, USA and EU were the major importers, sharing altogether above 69 per cent of the world imports. Japan alone was the world’s largest importer of fish and fishery products, with imports valued at 14.9 billion USD, the majority of them coming from developing countries. Amongst the reasons for such huge imports seems to be the falling production in North countries and the appearance of a significant demand there, motivated by the existence of riches and middle-class peoples. This explains why these countries imports, essentially, highly valued species, such as tuna, salmon, shrimps and prawns or ground-fish (May et al. 2003).

The income elasticity for marine fish, others (−0.04) and pelagic fish (−0.43) in the high income group of countries are negative. A study done by Dey and Garcia (2008) covering Bangladesh, China (P.R.), India, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand and Vietnam from 2001-2004, at the household level, found that only "*large pelagic and demersal species are of high value and tend to have positive elasticity*" (2008:330) above 1. This suggests that the results of mixed sizes of demersal and pelagic species might explain the inelastic findings.

2.2.2.6 Consumption Patterns

Looking to consumption patterns, fish and seafood are consumed according to several factors, like the scale of production, prices, brandings and life-styles (Le Sann 1998). Using Africa as example and looking to the production and availability of the products, it is pertinent to mention that the majority of the terrains in Africa are dry or very dry.

The climatic adversity affects the patterns of river, lake flows and the availability of fisheries resources from inland fresh-water sources, including inland aquaculture. Most of the African populations live in countries with no direct access to seas or oceans, or permanent water courses. Estimation made by Collier (2007) says 30 per cent of the current population is in that situation. It makes the consumption of seafood by those 30 per cent very difficult and almost impossible. This is exacerbated due to lack of an intra-African trade, which do not make an African country an alternative market to others' products, lack of appropriate infrastructures' and the presence of cyclical violent conflicts, which displace peoples and resources and affects people's daily intake of foods, minerals, vitamins and animal proteins.

Table 2.1: World Captures and Aquaculture Production and Utilization, including China (P.R.) (1994-2009)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Inland Production (Tons, Million)																
Capture	6.7	7.2	7.4	7.5	8.1	8.5	8.8	8.9	8.7	9	8.6	9.4	9.8	10	10.2	10.1
Aquaculture	12.1	14.1	16.0	17.6	18.5	20.2	2.2	22.5	24.0	25.5	25.2	26.8	28.7	30.7	32.9	35.0
Total Inland	18.8	21.4	23.4	25.1	26.6	28.7	30.0	31.4	32.7	34.4	33.8	36.2	38.5	40.6	43.1	54.1
Marine Production (Tons, Million)																
Capture	84.7	84.3	86	86.1	79.6	85.2	86.8	84.2	84.5	81.5	83.8	82.7	80	79.9	79.5	79.9
Aquaculture	8.7	10.5	10.9	11.2	12	13.3	14.3	15.4	16.4	17.2	16.7	17.5	18.6	19.2	19.7	20.1
Total Marine	93.4	94.8	96.9	97.3	91.6	98.5	101	99.6	101	98.7	101	100	98.6	99.2	99.2	100
Total Capture	91.4	91.6	93.5	93.6	87.7	93.8	95.6	93.1	93.2	9.5	92.4	92.1	89.7	89.9	89.7	90
Total Aquaculture	20.8	24.6	26.8	28.8	30.6	33.4	35.5	37.9	40.4	42.7	41.9	44.3	47.4	49.9	52.5	55.1
Total World Fisheries	112	116	120	122	118	127	131	131	134	133	134	136	137	140	142	154
Utilization (Tons, Million)																
Human Consumption	79.8	86.5	90.7	93.9	93.6	95.4	96.9	99.7	100.7	103.4	104.4	107.3	110.7	112.7	115.1	117.8
Non-Food Issues	32.5	29.6	29.6	28.5	24.6	31.8	34.2	31.3	32.9	29.8	29.8	29.1	26.3	27.1	27.2	27.3
World Population (Billions)	5.6	5.7	5.7	5.8	5.9	6	6.1	6.1	6.3	6.4	6.4	6.5	6.6	6.7	6.8	6.8
World Per Capita Supply (kg/year)	14.3	15.3	15.8	16.1	15.8	15.9	16.0	16.2	16.0	16.3	16.2	16.5	16.8	16.9	17.1	17.2

Data Source: FAO-FISHSTAT

2.2.3 Costs of Production and Technology

The costs of production and the technology are important for the supply side. Broadly, "costs of production" comprises all the expenses necessary to maintain a producing and processing plant, including the costs for keeping the equipments and technology up-to-the date. For fisheries, production costs are also divided into "variable" and "fixed" costs. Variable costs comprise a huge set of items, the most representative being the costs for raw material, supervision, maintenance, etc. Fixed costs integrate the costs for distribution, for sale, running bureaucratic tasks, as well as the investments made.

The FAO website[9] presents an indicative list of the costs of producing 1 kg of finished fishery products, taking examples from different [finished] products, countries, economical status, and plant sizes. By species, fresh sole in the USA costs 4.8 USD/per kg, while canned shrimps (135 g) in Indonesia costs 2.7 USD/per kg and dried fish in African countries costs 0.34 USD/per kg. Captures fishery products using boats are calculated as costing 0.23 USD/per kg, ranging from 0.02 USD/per kg in Morocco (purse seiners) up to 0.43 USD/per kg in Seychelles (boats).

Advances in fishing technologies – aquaculture techniques, potent vessels and trawlers, gears – particularly from the 1970s increased the total production, dawned production costs and prices, but also increased concerns regarding environmental and social impacts of them to the species and to the ecosystem. For some endangered marine and freshwater species' production and product standards were raised, to minimize their accidental capture, as endangered species'.

2.3 THE EMERGENCY OF TECHNICAL MEASURES ISSUES

The combination of high income, increased consumption of fishery and raised conscience about the importance of environmental issues explains, greatly, the importance given to the product, production, labeling and marketing standards as a determinant of trade of fishery products. The

[9] http://www.fao.org/docrep/003/V8490E/v8490e06.htm (26 February 2013)

exporting countries and firms must do a permanent effort to comply with these technical, sanitary and environmental measures, standards and regulations. This section is devoted to establish such a link: between high incomes, increased consumption and raised conscience on sanitary and environmental issues.

2.3.1 Regulations and Standards for the Place and Mode of Production

The picture of the global production of fishery tells, for instance, that crustaceans' production is increasing, pushing the global production upwards. However, crustaceans are among the species highly dependent on mangroves and sea-grass sensitive ecosystems, for their reproduction and escaping from predators (Boesch and Turner 1984; Robertson and Duke 1987; Rönnbäck 1999); it makes their ecosystem an important issue at the international trade. Also, the majority of the "most harvested species" lives, reproduces, or seeks out food around the coastal areas, rivers, lakes, basin or seas, ecosystems where much kind of juveniles' fishes depend upon.

The coastal areas are the most affected ecosystems, to where polluting and destroying human land-based activities are settled (cities, industries, urban transport emissions, and urban wastes). Le Sann (1998:19, 59, 61) estimates as 44 per cent the share of these human activities in the actual marine pollution sources, 33 per cent coming from airport activities, and 12 per cent from marine transports. Therefore, human consumption for fishery is rising at the time seafood products are suspected to be linked to poisoning outbreaks (WHO and FAO 2005), having been linked to 237 outbreaks in the USA, between 2000 and 2002 (De Waal 2003:76). Worldwide seafood are reported as having transmitted several sorts of harmful agents, like biotoxins (ciguatera), histamine, viruses and bacteria, salmonella, chemical residues, drugs, microbiological contaminants, nitrofurans, and parasites. Some of the cases detected might have been brought by imported products.

Scientific data available in the WHO and FAO (2005:18) study reveal that some microbes like V. *Cholerae* O1 are able to survive for extended periods in warm-water environment, with salinity of

0.25–3.0 per cent. Crustaceans and mollusks, particularly, are harvested into these aquatic environments. Indeed, looking to the scientific studies (WHO and FAO 2005) one can recognize that exporting countries (located, mainly, in equatorial and inter-tropical zones) are dependent on their coastal waters, ecosystem where the optimum temperatures for some microbes usually occur throughout the years[10].

Like the place, the mode of production is becoming increasingly regulated. In *latu sensu*, the mode of production includes the non product-related standards, like the labor conditions, the animal welfare, assurance systems, traceability, etc (Korinek et al. 2008:8, Box 2). For fisheries, new standards are being designed to impact on the harvesting modes, to reduce the adverse consequences on species and to the environment. For instance, the abnormal climatic conditions caused by *El Niño*, will make importers to raise their concerns over the place where the fisheries were produced.

Some international agreement provides good examples of how the place and mode of production are regulated:

a) The *UN Fish Stocks Agreement* (Agreement for the Implementation of the Provisions of the UNCLOS, of 10 December 1982, relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks) sets out in its Article 5, useful principles forcing UN Members to implement conservative and best-practice management techniques for fisheries, through the “precautionary principle”. It call UN Members for minimizing ocean and seas pollution, protecting biodiversity in marine and another aquatic environment, preventing or eliminating over-fishing and excess fishing capacity, promoting and conducting scientific research for support fishery activity, and developing appropriate technologies supporting conservation and management.

   The UN Fish Stocks Agreement is becoming particularly important now because, according to recent FAO’s publications (FAO 2008; FAO 2010), the proportion of marine fish stocks

[10] The optimum temperature for growth of *V. Cholerae* O1 is 37ºC. The optimum pH for growth of the same species is 7.6, although *V. Cholerae* can grow in a pH of 5.0 to 9.6 (WHO and FAO 2005:21).

considered as underexploited or moderately exploited had declined from 40 per cent in the mid-1970s to 15 per cent in 2008, while the overexploited, depleted or recovered stocks increased only 32 per cent in 2008.

b) The *CITES* (Convention on International Trade in Endangered Species of Wild Fauna and Flora) was established to impede or control the international trade of specimens of wild animals and plants threatened on their survival, with extinction, incompatibility with their survival in future or other environmental reasons.

c) The *Ramsar Convention* (Convention on Wetlands of International Importance especially as Waterfowl Habitat) established to force conservation and sustainable management of wetlands. Through the Resolution IX.421 of 2005 (paragraphs 30 and 31), governments in the world were asked to establish costal and MPA (marine protected areas) as important steps towards fisheries resources better management, which means that fisheries in these areas (especially aquaculture) shall be practiced in such a way that might not pose risk to ecosystem and surrounding beneficiaries.

Essentially, the increased regulation over the place and mode of producing fisheries is a clear indicator that the past and current modes are failing. For decades, fishing was carried out by targeting specific species of high commercial value (known as “monospecies fishing”). The non-targeted or small fishes were considered over-quota and were discarded or landed and sold as “black fish” to illegal or black market (Le Sann 1998; FAO 2010).

In some developing countries zones, coastal communities have the bad habit of removing mangroves, as the coastal cities were expanded, or to use them as aquacultures plants sites. Since mangrove is the coastal ecosystem where much kind of juveniles’ fish and shrimps live and seek out food, some importing countries are asking their partners to trace all the information regarding the mode, the place and others production’s conditions. These *eco-labeled* fisheries tend to increase and the consumers tend to pay a premium for them, signaling their commitment to demand seafood from well-managed stocks or from sustainable aquaculture (UNCTAD 2007; FAO 2010).

2.3.2 Regulations and Standards for Product's Characteristics

The trade of fishery products in the world is one of the most regulated, controlled and monitored by the authorities. Since seafood products are linked to harmful agents and disease outbreaks, technical measures have been established to face the issue. According to Korinek et al. (2008:8, Box 2), in the agro-food industry, product standards are being used to regulate the maximum or minimum levels of pesticides, drug residues, additives, contaminants, fat, or protein contents, to generate healthy and safe products, in their final forms.

If higher income countries' are increasing their demand for fisheries in a scenario marked by environmental problems, the product standards should be viewed as legitimate responses to safeguard environment, or to upgrade the nutritional contents which satisfies the consumers. These countries, due to their technological, educational, nutritional and public health advances will tend to fix more stringent product standards than others (Unnevehr and Roberts 2002; Martinez et al. 2007; Ishikawa and Okubo 2010), and the resultant gap represents a problem for developing countries' exports. For fisheries, product standards will address the conditions of the seas and waters where they were captured, their food chain and their common diseases. Since fish and others seafood products from polluted and dirty waters might represent source of disease (WHO 2012), products technical regulations will be imposed by asking producers to supply clean, safe and nutritious products.

The imbalance here is: developed countries have relatively large assimilative capacity[11], but they tend to be less likely to tolerate pollution and mismanagement; developing countries are more likely

[11] Assimilative capacity is defined by Mikić (1998:351) as the capacity of the environment to absorb or tolerate pollutants. This capacity is influenced by physical ability of factors (waters, air, land, willingness to tolerate pollution, etc).

tolerant to environmental degradation. Therefore, developing countries will tend to have comparative advantage on environmentally sensitive goods while the opposite no (Mikić 1998).

2.3.3 Regulations and Standards for Processing, Labeling and Packaging

The processing of fisheries is highly regulated, due to their high perishability. Very recently, the fear of bioterrorism was added (Jaffee et al. 2005; Pan et al. 2010). Although countries have different processing standards, the most widely used are the HACCP (Hazard Analysis and Critical Control Points). Some authors attributes to the implementation of HACCP as a cause of worldwide improved practices in hygiene, dropped contamination of raw and foodstuffs, and increased level of awareness among technicians and ordinary public (Panisello and Quantick 2001).

The "labeling standards" are defined in Korinek et al. (2008:8, Box 2) as including [the labels] used to describe the ingredients of the products. In that sense, they act to disclose, to consumers and authorities, the characteristics for the products, to prevent distortions, deception or confusion (Sykes 1995). For example, marketing labeling act to prevent unfair competition, enabling market's price arrangements to be applied uniformly, taking into account the fishes sizes, freshness, weights, etc. The marketing standards reveal, thus, details to the market which prevents and/or ensures that products are sold complying with the minimal biological sizes established under environmental laws and regulations.

The CAC urges countries and trading partners to disclose all information regarding the presence of allergenic substances in foods, their functional use, and the specific name of food additives, including their durability. The CAC also requires traders to reveal the name or the correct designation of food, listing the ingredients, specific conditions of storage, name and address of manufacturer or packer, count, weight, volume, etc. Specifically connected to fishery resources, some labeling requires producers and packers to inform about the sustainability of the resources and inputs used for the product, the techniques used to avoid or minimize the 'by-catch' (including the way it were discarded), explain the fishing techniques and areas (precise geographical locations). In summary, labels (shall) disclose information that can be traceable.

2.3.4 How Technical Measures Impacts Developing Countries' Exports?

Differently from prices, incomes, capacity and costs of production, the technical measures to trade in fishery require a much more attention. First of all, developing countries are low income economies, facing poor and underdeveloped infrastructures for water, cooling, processing and storage, or for appropriate sewage. Secondly, most of them [developing countries] are located in inter-tropical warm zones or in coastal zones with moderate salinity and occurrence of essential nutrients and zooplankton blooms, which is linked to more probability of infection by microbes (WHO and FAO 2005:21). Thirdly, this increased importance of technical measures to trade pose a crucial challenge for expanding, diversifying and sustaining their production and exportation share, with entirely endogenous sources. In fact, most of the developing countries who managed to succeed in their export have received important exogenous supports, including from the trading partners themselves. The next section describes some of them and their strategies on managing the limitations imposed by the technical measures to trade.

2.4 LEARNING FROM SOME SUCCESSFUL CASES

In Africa, Egypt, Tunisia and Morocco are among the successful countries in fisheries, which managed to increase their production and exportation by investing in modern fleets, navigation equipments, and size of gear used, especially for their sardines (*Sardina pilchardus*)[12]. Others African successful countries include Kenya, Namibia, Madagascar, Mauritania, South Africa and Senegal. Outside Africa, Bangladesh and Thailand provides good examples. Then, the question here is: *in a so regulated world, with several stringent technical standards and specific conditions, how*

[12] http://www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_AtlanticSardineReport.pdf (11 February 2013)

these [*developing*] *countries are performing?* The question can be answered by looking to some examples coming from others fishery producers.

2.4.1 African Developing Countries

To improve its exports, Kenya made investments in freshwater fish's production as well as in diadromous fishes, species relatively easy to develop in their geographic conditions (Henson and Mitullah 2004). As for 2010, freshwater fishes were representing more than 99.96 per cent of its total output. Kenya, as well as Uganda and Tanzania had several problems in complying with the EU standards and as a result, their exports of Nile perch were banned in a number of occasions (Henson and Mitullah 2004; Frohberg et al. 2006; Ponte 2005).

The advantage of Namibia is its 1,500 km along the Atlantic Ocean, its cities located far from the coast (which reduces pollution from land-based human settlements), favored by modern fishing ports, well equipped vessels, and its location along the Benguela current, which favors the abundance of Cape horse mackerel and Cunene horse mackerel.

Facing a huge pressure on its captured resources, Madagascar invested hard in the aquaculture marine plants for shrimps and prawns, establishing joint-ventures with foreign partners (Jonker et al. 2005). According to FAO website[13], Madagascar's production from aquaculture is around 50 per cent, and the existence of such joint-ventures seems to explain the improvement in quality standards and assurance of the HACCP steps.

Mauritania, in the other hand, decided to give licenses to foreigner's vessels to fish in its waters. Now the country possesses fishing agreements with Chinese (P.R.) and EU firms, but critics argue that more jobs would be created if the fish were processed in land-based plants (West Africa Trade Hub 2008).

[13] ftp://ftp.fao.org/FI/DOCUMENT/fcp/en/FI_CP_MG.pdf (4 March 2013)

Figure 2.6: Examples of How Exporting Countries Solved Technical Impediments to Trade

Country	**Technical Problem Faced**	**How They Solved**
Bangladesh (a)	1997: Inspectors from EU FVO doubted the reliability and efficiency of the controlling function by the government. Frozen shrimps exports fall to zero between August-December 1997	- Firms made additional investments to ensure HACCP - Special loans programs were designed - Support from numerous agencies (FAO, WHO, WTO)
Kenya (b, c, d)	1997-2000: Nile perch exports were banned in the EU	- Enterprises complied with the EU standards - Hygienic and pesticides residue tests improved - Non-complainants exited the market
Senegal (e)	1990s: Export of fishery products to EU were frequently contemned by bacteria or chemical products, resulting in frequent refusal and incineration at border, or returned back	- Upgrading the institutional mechanism and the competent authority - Providing equipments to laboratories - Restructuring fisheries sector enterprises - Staff training for enterprises and the competent authority
Tanzania (b, c)	1997-2000: Nile perch exports were banned in EU market in a number of occasions	- Imposition of stringent and pro-active compliance actions with EU standards - Improved adherence to existing international standards
Thailand (f)	2001-02: EU established zero tolerance for chloramphenicol and nitrofuran chemicals	- Establishment of probiotic farming - Farming of disease-resistant *Litopenaeus vannamei* shrimps - Establishment of more laboratories for providing diagnostic test services
Uganda (b, c, d)	1997-2000: Nile perch exports banned in EU in a number of occasions	- Restructuration of entire regulatory and inspection system - Hygienic and pesticide residue tests improved - The Department of Fishery assumed the role of the "Competent Authority" with respect to all fish safety issues

Source: (a) Rahman (2002); (b) Frohberg et al. (2006); (c) Ponte (2005); (d) Henson and Mitullah (2004); (f) Manarungsan et al. (2005)

South Africa also maintains a long tradition of exporting fishery products. It possesses one of the strongest food legislation in Africa, as well as processing and storage facilities, which is helping local producers and SACU (Southern African Customs Union)[14] countries to improve the quality of the exported products.

The Senegalese success in exports can be explained by the possession of relevant infrastructures for canning and producing fish-meals, apart from improvements in its vessels and equipments (FAO 2010). The Senegalese example is important since it is connected with a poor performance in the sanitary indicators, with frequent detections of cholera and salmonella microbes within their exports. The processing plants were reported as being dirty and unsafe, and the personnel poorly trained and equipped. To face with these recurrent problems, the government and fishing stakeholders developed a comprehensive program which equipped the country with new legislations, modern laboratories and more skilled and trained stuffs (Niang 2005).

2.4.2 Other Developing Countries

Outside Africa, Bangladesh and Thailand deserve a mention: Bangladesh possesses a vast list of banishments of its exports both in the EU and in the USA markets, most of them motivated by its poor performance in controlling and enforcing technical and sanitary measures (Rahman 2002). Although the problems are still observable, most of them were tackled by investing in the HACCP compliance steps (Rahman 2002).

From the Thai example, one can learn that successful exporting countries shall upgrade their horizontal chains and promotes sound land-based processing and shipping facilities. The Thai approach in establishing probiotic farming (which uses microbiological formulation to keep ponds of feed wastes clean and adds nutrients to farmed shrimp) and producing disease-resistant shrimps is a clear example that the best way of dealing of technical standards problems is to take a proactive attitude (Manarungsan et al. 2005).

[14] SACU is a custom union among Botswana, Lesotho, Namibia, South Africa and Swaziland.

2.5 CHAPTER 2 SUMMARY

In this chapter, a general picture on the role of the technical measures to trade in determining the world fishery industry, trade and their institutions was described, oriented by the CAC's concepts of "product", "production and processing", and "labeling and marketing" standards (CAC 1999a; 1999b). The chapter also defined some relevant concepts discussed throughout it.

This chapter showed that the aquaculture production is the responsible for increased world supply capacity of fisheries products, and the trade fluxes are clearly directed from developing countries to developed ones. Indeed, aquaculture is more controllable, both in terms of outputs and in the environmental and sanitary parameters that usually constitute constrains for developing countries exports. That sudden increase is attributed to technological advances in fisheries science, governmental policies as well as to the improvements in meeting the consumers' demand. According to the data available, there are no any significant fluxes neither inside developing countries nor from developed to developing countries. And it is in the developed countries where stringent technical standards and regulations are applied, motivated by their higher incomes, better health patterns, advanced well-being status and the relatively higher presence of elder, richer and middle-class peoples, more educated and more health conscious.

The chapter illustrated that the increased in demand in developed countries explains the prevalence of some fishing agreements between some developing countries and DWFN (distant water fishing nations). The existence of such agreements splits exports from developing countries into two groups: exports originated from DWFN high sea vessels and exports originated from the countries' plants and firms, to whom stringent technical regulations and standards are more prone to be applied.

Apart from average fishery prices, whose projections point a slight increase in the next years, sanitary issues and environmental standards are affecting the trade. The increased income, public awareness regarding the health conditions of the food they demand, associated with several others social indicators, imply that fishery exporters shall be more proactive in changing and adapting their production, labeling and marketing standards, following the trend in the world market.

Developing countries, like Mozambique, interested in improving fishery exports shall invest in aquaculture, while understanding that it is in the tropical zones where optimum environmental conditions favor the appearance of outbreaks and the development of harmful microbes that most often have been affecting the trade of fishery in the world. Indeed, due to aquaculture's vulnerability to bad sewage and refusal in coastal cities and human settlements, sound investment on health management and biosecurity shall be prioritized.

The examples from some developing countries from Southeast Asia and Sub-Saharan Africa (Bangladesh, Kenya, Senegal, Tanzania, Thailand, or Uganda), although are not the best and immune to sudden technical problems, reveals their commitments in improving the sanitary and environmental standards on the place and mode of production, the fisheries environment, including processing, labeling and packaging standards. They succeeded in upgrading sanitary measures, infrastructures and equipments as well as in building institutional mechanisms (legal) and sound conformity assessment network.

The scenario provided in the Figure 2.6 has two main implications at the technical standards and regulations ground: first, captures should be controlled; and second, aquaculture need to be regulated. In a scenario where captures should be controlled, aquaculture will be the alternative technique for production, to keep the production in accordance with the increased world demand. And if aquaculture is to be fomented, it should be also regulated to avoid damaging the environment since climate change effects are expected to be greater in coastal areas, where the majority of farms are located (ICTSD 2009:2).

CHAPTER 3

MOZAMBIQUE IN THE WORLD'S FISHERY MARKET: LOW-STANDARD COUNTRY SUPPLYING TO HIGHER-STANDARD CONSUMERS'

3.1 INTRODUCTION TO CHAPTER 3

It becomes clear, from the Chapter 2 that developing and tropical countries are producing fishery products while developed and temperate countries are importing them. This is also true for the Mozambican exports. In fact, since its inception (back to late 1950s), the industrial fishing and large scale fisheries production and exportation in Mozambique was designed to serve the relatively high-standards consumers in Portugal, Zimbabwe (at the time, South Rhodesia), South Africa, as well as European consumers.

Following Bhagwati and Srinivasan (1999) and the WTO SPS and TBT Agreements, we define low/high-standard countries in the context of technical measures to trade, as countries possessing and effectively applying low/high mandatory regulations laying down products, production process, and labeling issues capable to protect human, animal, plant life and health. We assume these levels of standards as affecting international trade of fishery and others agro-food products.

The problem of a technically low standard country supplying high standard consumers is a consequence of free trade, because the effectiveness of tariffs to regulate markets and products externalities is diminishing, leaving 'standards' and others non-tariff issues as the main tools to regulate market imperfections (Casella 1999). Indeed, as will be explained later in this chapter, Mozambique enjoys relevant duty free preferences. And because Mozambique is low-standard and small country (simultaneously), the level of technical standards included in products supplied to domestic market (by domestic and foreign firms) is considered low.

Both in theory and in practice, countries can decide to lower their standards to attract foreign capitals and investments, especially when unemployment is huge. However, technical standards that the fishery products must meet are fundamental, since they have to do with human, animal, plant health or life or to national welfare. Therefore it seems reasonable to consider the Mozambican "low-standards" status as a result of a gap in compliance to technical measures, than as a deliberate strategy. This gap shall be filled by increasing the degree of compliance to sound international norms, regulations and standards, and exploiting the opportunities provided by the export-expansion potential.

Departing from the general picture provided in the Chapter 2, this chapter brings the following information to the dissertation: firstly, it provides a useful background of how the Mozambican fishing industry is structured (the sections 2 and 4 describe the products, production, processing and trade of fishery products in Mozambique, and legal instruments applicable for fishery industry and exports); and secondly, it provides a linkage between the status quo and the way the country, as a whole, is complying with relevant international technical measures to trade (sections 3 and 5).

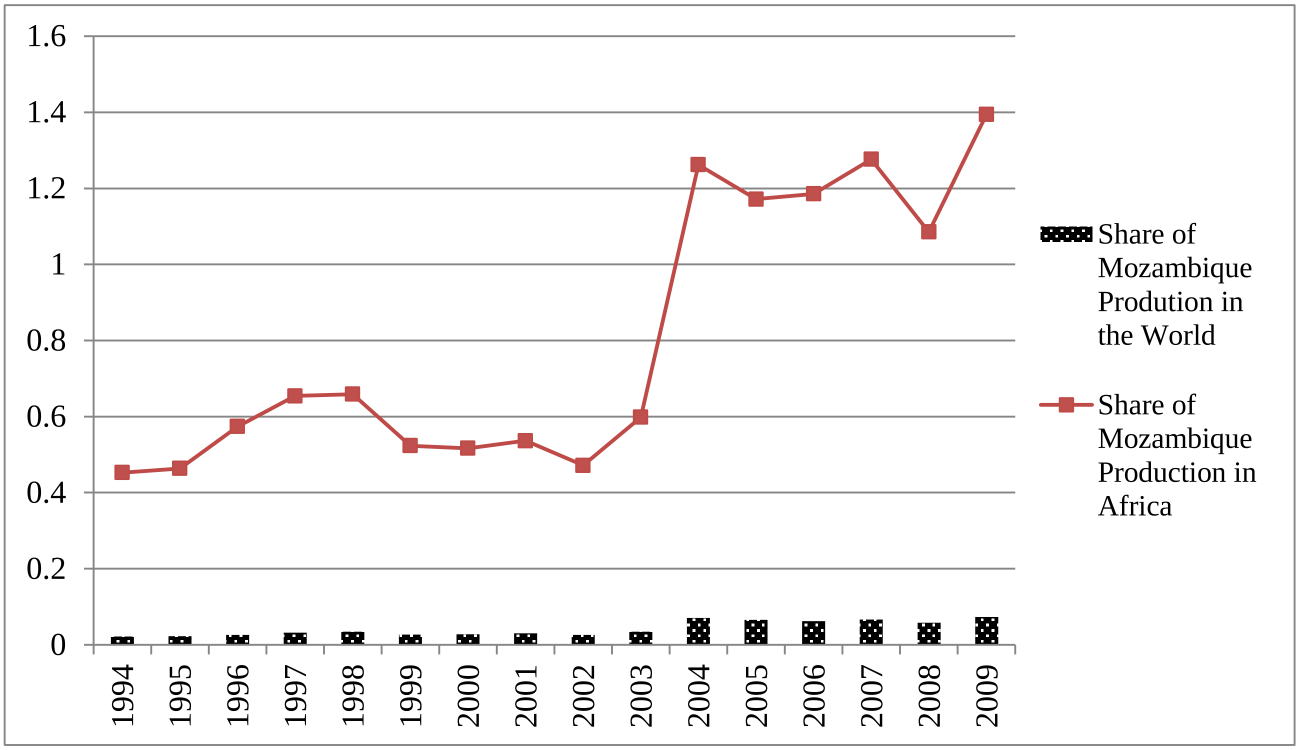
More detailed, the chapter is structured as follows: the section 2 is about the Mozambican production, processing and trade of fishery products; section 3 describes and discusses the fishing agreements between Mozambique and the EU; the section 4 is about the domestic legal framework relevant for fisheries; and section 5 is about investments, assistance and public support for Mozambican fishery exporting sector.

3.2 Fishery Products, Production, Processing and Trade

3.2.1 Fishery Products and Production

The data of Mozambican fishery industry – production, processing facilities – are available basically since the independence, not having so much data referent to the previous period. The share of Mozambican production of all species from all fishing areas (1994-2009) is provided in the Figure 3.1. The picture in the Figure 3.1 shows that Mozambican export portfolio was broadening in terms of the quantity shared with the world and African continent during the period, and the exporting fluxes improved slightly the market share.

Figure: 3.1: Share, in Percentage of Quantity, of Mozambique Production of Fishery Products (All fishing areas, all species): 1994-2009



Data Source: FAO-FISHSTAT

The structure of the fishery industry is an inheritance from the Portuguese, but most of the data are available only from 80's, when the country started to rearrange the public institutions, to adhere international bodies, conventions, protocols, and organizations, and started to set-up new rules and regulations, different from the colonial ones. In Mozambique, fishing activities occur in three main areas: aquaculture, coastal and high sea areas. Aquaculture firms are scattered in familiar and commercial plants, most of them located near important rivers or in estuaries. In the coastal zones, artisanal and semi-industrial firms dominate the activity, although some industrial vessels are found. Shrimps and prawns and demersal species are the main resources. In the high and deep-sea, some semi-industrial, but basically industrial vessels operate, by national firms (*joint-ventures*) but dominated by foreign vessels, under the fishing agreements.

In total, Mozambican waters comprise an area of 100,000 km^2, plus 13,000 km^2 of territorial sea, where the country produces several fishery products. The total production in inland and marine areas, in quantity, is provided in the Figure 3.2[15], for 1950 to 2010. In general, quantities increased and the marine production is the engine of that increase. Since 1950s, the marine production is growing, on average, 1.05 million tons per year, while inland production increases only by 0.45 million tons per year. In 2010, aquatic plants, crustaceans, marine fishes and mollusks accounted for 0.58 per cent, 10.43 per cent, 88.05 per cent, and 0.94 per cent, respectively. From 2002 to 2003, the total production increased 142.14 per cent, and the marine production alone grew at 277.52 per cent, while production decreased 1.02 per cent in the same period. Before the 2002 "boom", marine production was having a negative growth tendency, going gradually towards 20,000 tons. However, inland production was experiencing a slow growth, having reached its peak in 2004-2008, with 24,000 tons, on average.

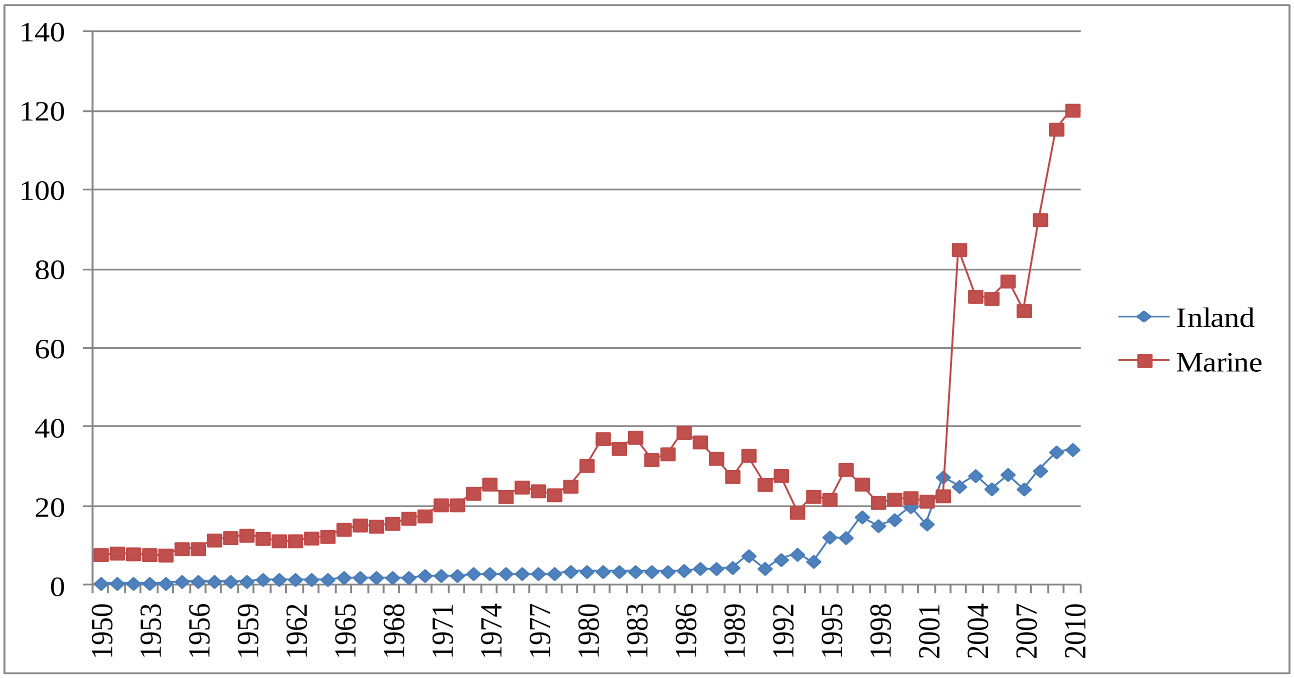
The 2007 fishing census reported that artisanal fishing is done by around 280,000 fishermen, both in marine and inland areas. For domestic supply of fishery products, they are the most important actors, since their catches are exclusively geared towards local consumption. However, some artisanal fishermen operating in Cahora Bassa and in Niassa Lakes are reported as selling their dried products to neighboring countries, Malawi, Zambia and Zimbabwe.

According to the 2007 census, the semi-industrial fisheries was carried out by 100 vessels involved basically in harvesting shrimps and prawns. Their vessels are reported as delivering significant "by-catch", which they sell to artisanal fishermen or to supply in the main urban areas of the country, like Maputo, Beira, Quelimane or Nampula. Equally, semi-industrial firms operate in Cahora Bassa

[15] Due to lack of a complete control of the production and frequent underestimation of the artisanal harvests, the country's total production may be bigger than the reported.

reservoir and in the Niassa Lake, capturing demersal fish (*kapenta*[16]) for domestic consumption and for exporting to the SADC region.

Figure: 3.2: Inland and Marine Mozambican Total Production (1000, Tons): 1950-2010



Data Source: FAO-FISHSTAT

The 2007 census reported also that industrial fisheries were composed by 123 vessels, the majority of them operating in the Sofala bank, to capture deep water shrimps, known as *gamba*. The majority of industrial fleets are joint-ventures with European and Japanese firms (Jonker et al. 2005). The majority of the products is processed on-board and exported to EU and Japan, with small units going to SADC and others countries. Additionally, industrial fleets capture deepwater lobster and others commercial species.

The aquaculture production is targeted to the production of tiger shrimps and Indian white prawns, most of them occurring offshore Beira, Quelimane and Pemba. Aquaculture farms located in Manica, Niassa, Tete, Sofala and Zambezia are also producing tilapias, which is supplied in the domestic

[16] According to http://en.wikipedia.org/wiki/Kapenta (6 January 2011), *kapenta* originates from Lake Kariba (Zambia/Zimbabwe), and was introduced to Mozambique in Cahora Bassa dam, from Lake Tanganyika (Burundi/Congo (D.R.)/Tanzania/Zambia). It is a freshwater sardine of the species of *Limnothrissa miodon* and *Stolothrissa tanganicae*.

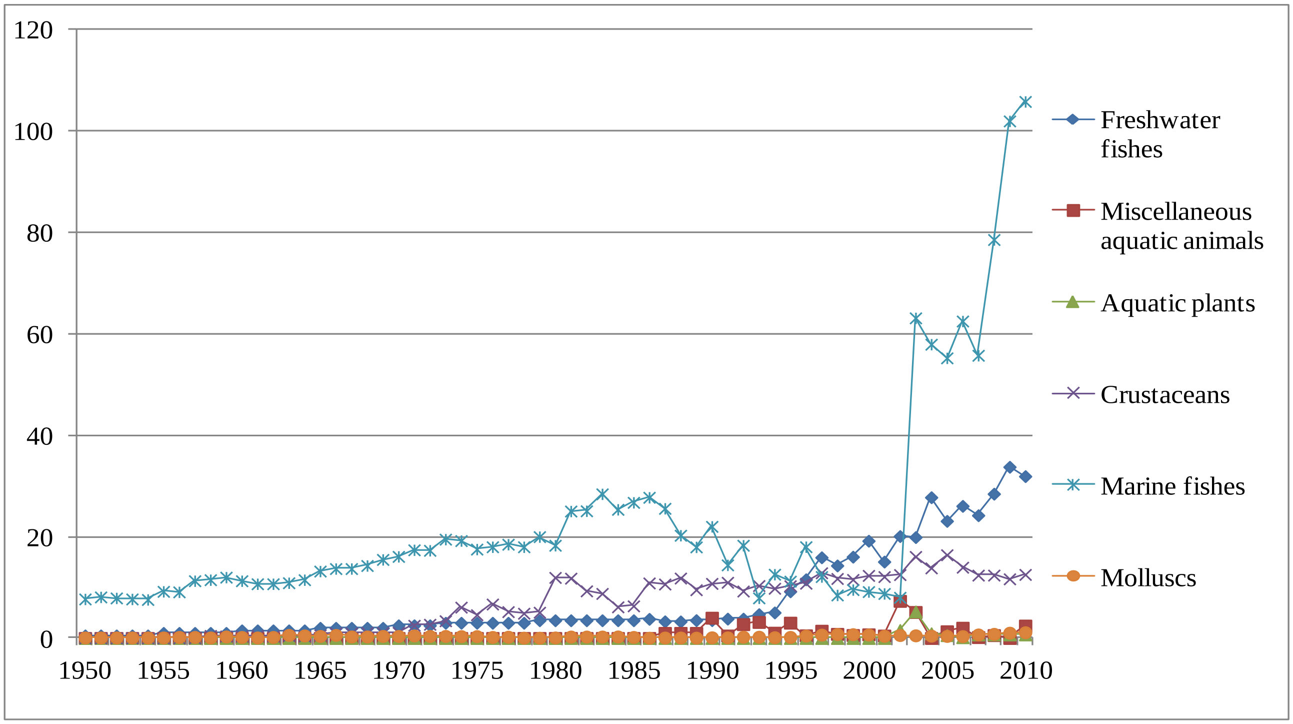
market. In both cases and due to their land-based production, this industry is particularly vulnerable to fish diseases and veterinary effort shall be done to improve it.

Comparing captures and aquaculture, the data from FAO-FISHSTAT reveals that in Mozambique captures are declining and aquaculture industry is developing fast. This development occurs in the Central (Sofala and Zambezia) and North (Nampula and Cabo Delgado) provinces. Inland catch species includes tilapia (*Oreochromis mossambicus*), carp, and small pelagic which are found in Niassa and Cahora Bassa Lakes, in small lakes, rivers and in the interior regions of the Niassa, Tete, Manica, Inhambane, Gaza and Maputo Provinces.

Despite the increase in aquaculture output, the general production seems to be below the potentiality for fishing, which is estimated to be around 240,000 tons per year. Recent data estimates harvesting of around 120,000 tons. From 2002, Mozambique started to implement aquaculture units of production, with production of around 900 tons per year, but the target is to reach 5,000 tons per year (FAO 2007). The development of aquaculture industry is being possible with private investment and is aimed at expanding fisheries exports. That is the reason why this industry is actively incentivized by the government, although modestly developed and equipped.

As said, the production of shallow-water shrimp fishery occurs mainly at the Sofala Bank, but their captures seems to be decreasing. The shrimps are fished both by industrial, semi-industrial and artisanal fishery (Palha de Sousa et al. 2006:207). The main shrimps species caught are *Penaeus Indicus, Metapenaeus Monoceros* as well as *Penaeus Japonicus, Penaeus Latisulcatus*, and *Penaeus Monodon* (Sousa et al. 2006:207). Industrial shrimp's aquaculture production is done in Inhassunge, Zambezia Province, by Aquapesca, a Mozambican-French *joint-venture*. It is an intensive production process. After capturing the hatcheries in their wild environment in the mangroves along the Indian Ocean coast, they are cultured in controlled environments through an intensive production, during which supplementary foods, fish-meals, fertilizer and appropriate management techniques are used intensively.

Figure 3.3: Captures and Aquaculture, Inland and Marine Production in Mozambican, by Species (1000, Tons): 1975-2009



Data Source: FAO-FISHSTAT

Breaking down the production data provided in Figure 3.2, it is observable, in Figure 3.3, that marine fishes are the most harvested species in Mozambique, followed by freshwaters fishes, crustaceans, and mollusks. The production of aquatic plants and "miscellaneous aquatic animals" occupies the bottom of all Mozambican production. In the Figure 3.3 one can see the increased production verified from 2002 was due to marine fishes and fresh-water production.

Mozambique reports a huge production of octopus, calamari, and others products, most of them catch by industrial and semi-industrial vessels. Aquatic plants are produced in aquaculture firms mainly in Pemba (Cabo Delgado Province), by 'Indian Ocean Aquaculture', another Mozambican-French *joint-venture*.

3.2.2 Processing of Fishery Products for Export

The idea that Mozambique is a "*low-standard country supplying high standard consumers*" can be observed in the following statements, made by the EU FVO officers, after visiting laboratories, firms, vessels and institutions responsible for food safety and health: From the first field mission:

> *Establishments visited on land did not comply with approval conditions, despite the reduction in the number of premises approved by the Competent Authority for export to the European Union;*
> *Testing of potable water in each establishment was considered to be insufficient and did not meet EU requirements;*
> *No HACCP system was in place, while evidence of monitoring of "Own-Checks" by Inspectors was inadequately recorded (and thus not verifiable).*
> Source: EC (1998:5)

Three years later (28 May – 01 June 2001) the EU FVO field mission inspected how the country performed from the previous mission. Their main conclusions were:

> *The Mozambican legislation cannot be considered as equivalent to EC legislation for potable water, additives and heavy metals;*
> (…) *The official supervision of establishments and vessels is still deficient, in particular the follow-up of the problems identified by the inspectors, the reporting of the inspection visits and the assessment of the own-checks;*
> *The procedure for issuing export health certificates is in place and can be considered as satisfactory. Nevertheless, the model of the export health certificate is not in compliance with the EC requirements.*
> Source: EC (2001:17)

A third mission was intended to assess the public health controls (microbiological checks of total Coliforms, *Enterococci*, *Staphylococcus*, Salmonella, Vibrio *parahaemoliticus* and Vibrio cholera, as well as the content of sulphites, and heavy metals) and the conditions of production of fishery products in Mozambique. They concluded:

[The] *official analyses of water/ice* (…) *performed by the Laboratory of the Ministry of Health* (…) *every two months* (…) *did not respect the requirements of Council Directive 98/83/EC for both microbiology and chemistry;*

From a general point of view, INIP's control system performance on FP [fishery products] *intended for export to the EU cannot be considered as satisfactory and reliable* (…). *Furthermore, the sanitary situation found in the recently de-listed establishments demonstrates that they were in such a state for a long time and should have been proposed for de-listing well before;*

(…) *the 2005 residue monitoring plan*[17] *sent to the Commission services presented numerous deficiencies, mainly due to the limits of detection for CAP* [chloramphenicol], *AOZ* [nitrofurans] *and also to the analysis methods used. The residue monitoring plan is not implemented in the field by INIP;*

Despite the (…) *structure and layout of premises in some establishments was considered acceptable, the CA control activities and enforcement powers revealed numerous and serious deficiencies. Therefore, INIP cannot guarantee that the special conditions governing imports of FP originating in Mozambique, as laid down in Commission Decision 2002/858/EC, are respected;*

In addition, the situation found in some establishments, the limited official controls performed on FP as such and the absence of a residue monitoring plan make that potential risks for the safety of the FP exported from Mozambique and for the European consumer health are not excluded.

Source: EC (2006:9)

As can be noted, the third inspection mission raised several and profound concerns regarding the sanitary compliance of fisheries products. The fourth mission concluded:

The origin of the primary products processed in the listed establishments as the mission found that quite often the fishing vessels are either not under the sanitary control of the CA (pirogues, artisanal fishing vessels, uncontrolled semi industrial fishing vessels) or, if under CA supervision, not in compliance with the sanitary requirements;

The programme for the monitoring of contaminants (heavy metals, PAH [Polycyclic Aromatic Hydrocarbons], *dioxins) is very partially implemented, and concerns only heavy metals;*

The analyses of potable water and ice which do not cover all parameters of Directive 98/83/EC;

Several other fishing vessels (…) *visited did not present good structural and hygiene conditions;*

As a consequence, based on the findings presented above, the current system of official controls and of export certification, although adequate in certain respects and showing

[17] According to the EC (2006:8) in 2005 Mozambique sent a residue monitoring plan to the EU which exhibited innumerous deficiencies and discrepancies.

clear improvements since the last 2006 FVO mission, cannot be considered in compliance with the requirements of Community legislation.
Source: EC (2007:14)

Although there is no any public data regarding what others importers think, the EU concerns can be considered as representative for the demand side. In all the inspections, the EU officers were checking whether the conditions of production, storage and expedition to abroad of fishery products were equivalent to their requirements (as required by the Council Directives No. 91/493/EEC of 22 July 1991 laying down the Health Conditions for the Production and the Placing on the Market of Fishery Products, and No. 92/48/EEC of 16 June 1992 laying down the Minimum Hygiene Rules Applicable to Fishery Products Caught on Board of Certain Vessels in Accordance with Article 3(1)(a)(i) of the Council Directive No. 91/493/EEC of 22 July 1991).

Unsurprisingly, the EU FVO inspectors insisted in health and chemical tests and conditions, which mean the problems encountered are recurrent and prevail for long time. In fact, they reflect the fragilities of the fishing structure and technical compliance from its inception. The argument here is that better structures and infrastructures for fishery industry could increase export efficiency and improve export diversification.

Historically, in Mozambique, commercial operations began under the colonial era, and commercial fishing was concentrated on shrimp, and the operations were carried out by Portuguese or other foreign interests, almost with no Mozambicans involved. With independence, the fishery sector faced a tumultuous time, especially when the Portuguese leaved massively the country, back to Portugal or others countries. Due to political reasons, the processing and exportation of fisheries had followed three phases. The first, prior to 1975, in which both the fishery policies and outcomes were under the Portuguese colonial authorities, and the relationship between Mozambique (considered an overseas Province of Portugal) and Portugal (metropolis) was performed following colonial interests. The second, from 1975 to 1990, market by socialist and communist policies, where the government was in control of the economy, including banking, agriculture, and fisheries. The third phase, from

1990s to now, was characterized by liberal economic policies and attraction of private and foreign capitals.

The combination of factors (massive departure of skilled Portuguese, communist policies and civil war) in the second phase resulted in the collapse of infrastructures, legislations and all the required capabilities to improve the degree of compliance to technical measures in trade. At the early years of the independence, firms were nationalized and the government starting running them, following import-substitution and export-promotion policies. In the subsequent years, no significant investments were done on them and by the end of the civil war, the sector was under legislated, equipped and with no trained human skills working on it.

The effects of the collapse of the central planning economy model amplified by the negative impact of the civil war took the economy to stagnation and backwardness. It was only in the late 1980s, and the beginning of 1990s when the country started to implement decisive progresses to end the 16 years civil war and to liberalize the economy (WTO 2001:xvii). It means when Mozambique started to rebuild its infrastructure for attending export standards, others competitors (Indian Ocean countries, for instance) were already advanced on the issue, and their share in the market was relatively high.

Except for some particular firms and plants, the overall processing process is poorly developed, enforced and regulated in Mozambique. In rural areas or in peri-urban sites, after captures fish is transported to markets under poor means for conservation. Most of the fish are usually sold dried (sun-drying), smoked, or salted, reducing their market price (FAO 2007). The semi-industrial operators' can use their inland-facilities for processing, and industrial vessels are generally equipped with processing facilities and, thus, they don't use land-based units.

Mozambique is also poorly equipped to produce canned products or others prepared products (containing more than 20 per cent by weight of fish, crustaceans, mollusks or other aquatic invertebrates, or any combination (HS 1603; HS 1604; and HS 160525)[18]). Because of this, fishing industry in Mozambique seems to be an extractive activity. And since the processing is very weak, Mozambique is frequently challenged by demanding countries with claims that its products are not meeting the highest international safety standards and are susceptible of being contemned by microbes, pollutants and others organic agents.

As pointed out by the EU FVO inspections (EC 1998; EC 2001; EC 2006; EC 2007), another problem which need urgent control is that of domestic refuse and sewage facilities, in cities, since most of them are located near the Indian Ocean, where the highest percentage of population lives and where the significant amount of GDP is created. Thus, pollution in ports, domestic refuse from near main urban areas like Maputo, Inhambane, Beira, Quelimane, Nacala, and Pemba, industrial park in these areas, damage the reputation of sanitary safety on exporting agro-food commodities. Worsening the situation, source of contamination like heavy metals from mineral informal activities in Manica and Niassa Provinces, refuse from tourism sector, chemical waste, pollutants from agriculture activities with pesticides, deforestation, and soil erosion are appearing yearly with no any governmental strong intervention.

That poor picture on the compliance to sound technical measures will impact, negatively, on the demand for exports to fisheries products from Mozambique. Indeed, since the majority of exports are destined to high income countries where food safety requirements are a serious concern (Athukorala and Jayasuriya 2003:1396), more market access will be possible only after taking in account the importance of technical measures as a crucial determinant for the supply and demand of exports.

[18] HS 1603 refers to "*extracts and juices of meat, fish, crustaceans, mollusks or other aquatic invertebrates*"; HS 1604 refers to "*prepared or preserved fish, caviar and caviar substitutes prepared from fish eggs*"; and HS 1605 refers to "*crustaceans, mollusks and other aquatic invertebrates, prepared or preserved*".

3.2.3 Domestic Market, Imports and Exports of Fishery Products

3.2.3.1 Domestic Market and Consumption

Domestic consumption of fishery is basically supplied by artisanal and semi-industrial firms. The artisanal supplies are delivered to the market either in formal or informal circuits and the basic mode of delivering is as fresh, salted and dried or smoked. On average, in rural and inland zones, the consumption is low, and the freshwater are the most sold products.

In rural areas, fish is consumed fresh, dried or smoked, and in urban areas it is mainly frozen, fresh and dried. In urban and villages, domestic and imported marine fish tend to be high. The domestic consumption is estimated to be at 7-10 kg per capita per year, just above half of the world consumption rate[19].

3.2.3.2 Imports and Exports

Mozambique is both exporter and importer of fishery products. The list of products of exportation is presented in Annex 1. Recent figures (from 2000) points out that the main species imported are frozen cavala and horse mackerel, from Namibia and South Africa, and, in small amounts, some dried cod and frozen tuna, imported from Portugal and Thailand, respectively. Exports are constituted, essentially, by frozen shrimps and prawns (HS 030613) and dried fish, *kapenta* (HS 030559), exported to EU, Japan and South Africa, and to SADC countries, respectively.

The Figure 3.3 shows how quantities of fisheries exported are below that of importations. Before 2003 the picture was the opposite and in the period 1992-2002 exports quantities were clearly higher than the imports. What are the reasons for this? First, after the end of the civil war the country per capita GDP was one of the lowest in the world and imports were restricted. Second, from 2000s the domestic consumption is stimulated by the emergence of urban middle-class persons and the demand for fisheries products is increasing.

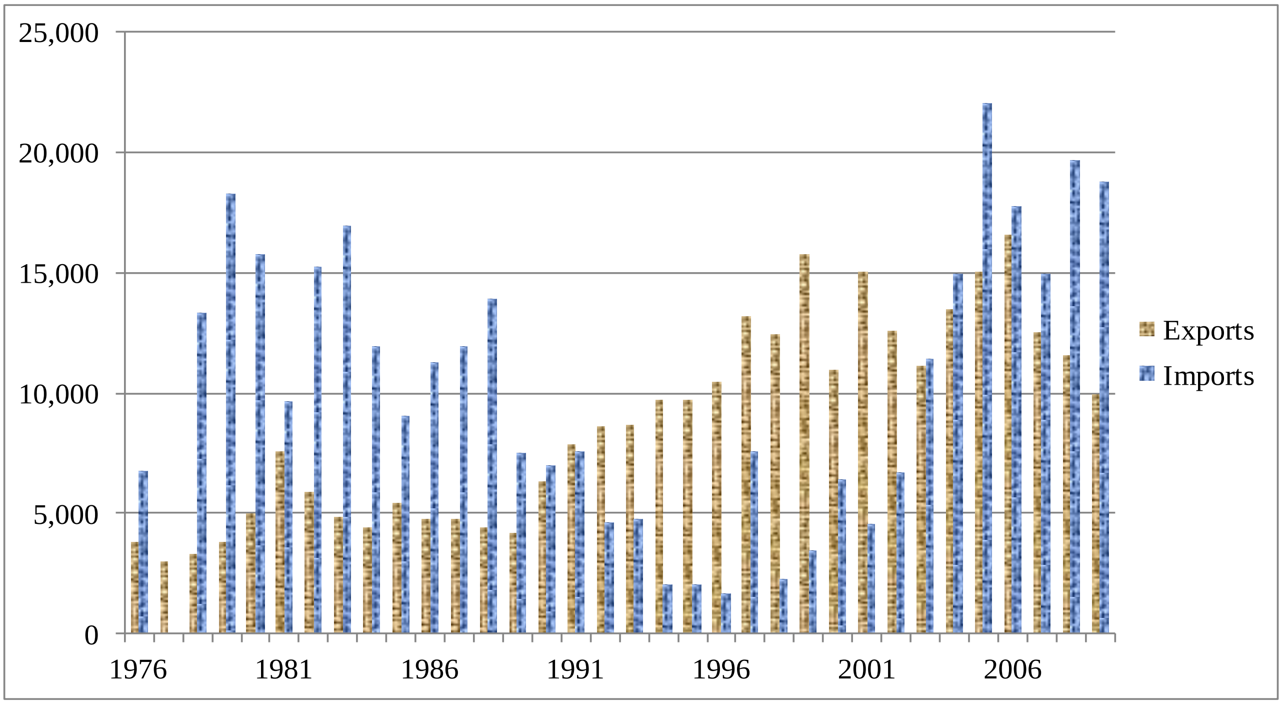
[19] http://www.fao.org/fishery/countrysector/naso_mozambique/en (26 February 2012)

Looking to the values of exports and imports, the differences are clear: on average, exports values are 6 times higher than imports, which mean that Mozambique is exporting few amounts of high value products (shrimps and prawns) and importing big amount of less valued products (horse mackerel and cavala). For instance, in 2002, the country exported 122.84 million USD, but imported only 10.99 million USD. Tables 3.2 and 3.3 show detailed figures.

One central question is how much of Mozambican exports contain imports, or, in others words, how important is the intra-industry trade in Mozambique fishery products (HS 03) exported to the world? This question is always answered using the Grubel-Lloyd Index (GL) and the input-output tables (I-O tables), but despite our desperate search, there were no publicly available I-O tables for Mozambique. Nevertheless, it seems that fishery products will contain some amount of imported components, derived mainly from processing (boxes, plastics), labeling (paper) and laboratorial inputs (laboratorial tests on sanitary and chemical parameters in South Africa or Portugal).

Looking to how the values exported by Mozambique to the world expanded (same markets) and to items exported (using HS 03, at 6-digit level) (Figure 3.4), there are interesting suggestions: in quantities, exports are concentrated in shrimps and prawns and in dried fish (*kapenta*). Shrimps and prawns are the leading items in quantity terms, and are destined to the same markets, namely Spain, Portugal, Japan and South Africa. In others words, no substantial changes occurred in terms of exports destines and export contents in 2001/02 and 2009/10.

Figure 3.4: Fish and Fishery Products: Quantities (1000 Tons) Exported and Imported by Mozambique, 1976-2009



Data Source: FAO-FISHSTAT

The composition of exports of fishery products had not changed substantially. Comparing different fishery products exports and their main destinations across time (2001-02 and 2009-10) the conclusion remains the same that fishing industry didn't expanded exports and didn't added value to them (although the level of disaggregation of the data is HS 6-digit). The export diversification at the extensive margin[20] of fishery products from Mozambique can be estimated by looking to the share of each species of fishery exported, comparing several years. The next table shows the profile:

Table 3.1: Export Diversification of Fishery Products from Mozambique (1980-2010), in Percentage

Products	**1980**	**1990**	**2000**	**2010**
Crustaceans	100.00	97.92	66.49	86.09
Fish	0.00	2.08	29.69	10.43
Molluscs	0.00	0.00	>1.00	>1.00

Data Source: FAO-FISHSTAT

[20] Diversification at the extensive margin can be measured simply by counting the number of active export lines, regardless of the weight of the shares of the products.

From the Table 3.1, crustaceans (shrimps and prawns) were the sole category exported in the 1980, with 100 per cent; then, 97.92 per cent in 1990; 66.49 per cent in 2000 and 86.09 per cent in 2010. For fish the results are: 2.08 per cent in 1990; 29.69 per cent in 2000 and 10.43 per cent in 2010. Molluscs and others aquatic invertebrates share's is >1 per cent in almost all the time-series.

As well known, one important point in discussing diversification of fishery products exports by just counting export lines is that the weight of the shares are misrepresented. Therefore it is important to count more the active export lines that are more important in world trade and, thus, represents a significant expansion of exports. Nevertheless, shrimps and prawns and others valuable fishery products are available in Mozambique and the country has a huge potential to expand its extensive margin of diversification.

Plotting the HS 06-digit on the tariff lines of fishery exported with the Mozambican GDP (in 2000 USD) the results shows the diversification of exports and GDP are negatively (but not significantly) correlated. One of the reasons which explain why exports from Mozambique are concentrated in few products (shrimps and prawns and fish) can be its lower economic size, considered as the GDP per capita. In fact, concentration of exports in fewer products has been correlated with the level of economic development, where developed countries tend to have more diversification than developing ones.

Table 3.2: Mozambican Export of Fishery Products 1976-2009

Commodity		**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Crustaceans	Qty	3,800.00	3,000.00	3,300.00	3,800.00	5,000.00	7,600.00	5,900.00	4,800.00	4,400.00	5,400.00	4,754.00	4,761.00
	Val	12,430.00	9,613.00	12,150.00	15,400.00	20,592.00	52,449.00	38,524.00	31,200.00	28,264.00	33,402.00	34,423.00	38,243.00
Fish	Qty	3.00	-	-	-	-	-	-	-	-	-	-	-
	Val	4.00	-	-	-	-	-	-	-	-	-	-	-
Fish, crust., mol. Aqu. invertebrates	Qty	-	-	-	-	-	-	-	-	-	-	-	-
	Val	-	-	-	-	-	-	-	-	-	-	-	-
Molluscs, aquatic invertebrates	Qty	-	-	-	-	-	-	-	-	-	-	-	-
	Val	-	-	-	-	-	-	-	-	-	-	-	-
Total Exports	Qty	3,803.00	3,000.00	3,300.00	3,800.00	5,000.00	7,600.00	5,900.00	4,800.00	4,400.00	5,400.00	4,754.00	4,761.00
	Val	12,434.00	9,613.00	12,150.00	15,400.00	20,592.00	52,449.00	38,524.00	31,200.00	28,264.00	33,402.00	34,423.00	38,243.00

Commodity		**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Crustaceans	Qty	4,395.00	4,149.00	6,204.00	7,742.00	8,147.00	8,431.00	8,470.00	7,302.00	10,137.00	7,181.00	8,314.00	7,507.00
	Val	39,867.00	32,492.00	50,349.00	62,981.00	65,976.00	70,304.00	67,761.00	63,187.00	86,168.00	79,515.00	87,382.00	67,561.00
Fish	Qty	-	49.00	132.00	99.00	430.00	265.00	506.00	2,280.00	17.00	5,585.00	3,170.00	4,515.00
	Val	-	83.00	280.00	259.00	440.00	497.00	577.00	1,838.00	11.00	4,383.00	2,984.00	5,001.00
Fish, crustaceans, mol. aquatic invertebrates	Qty	-	-	-	-	-	-	252.00	-	231.00	215.00	220.00	353.00
	Val	-	-	-	-	-	-	185.00	-	134.00	129.00	145.00	247.00
Molluscs, aquatic invertebrates	Qty	-	-	-	-	33.00	3.00	480.00	89.00	50.00	181.00	720.00	3,420.00
	Val	-	-	-	-	37.00	1.00	240.00	85.00	30.00	288.00	745.00	2,189.00
Total Exports	Qty	4,395.00	4,198.00	6,336.00	7,841.00	8,610.00	8,699.00	9,708.00	9,671.00	10,435.00	13,162.00	12,424.00	15,795.00
	Val	39,867.00	32,575.00	50,629.00	63,240.00	66,453.00	70,802.00	68,763.00	65,110.00	86,343.00	84,315.00	91,256.00	74,998.00

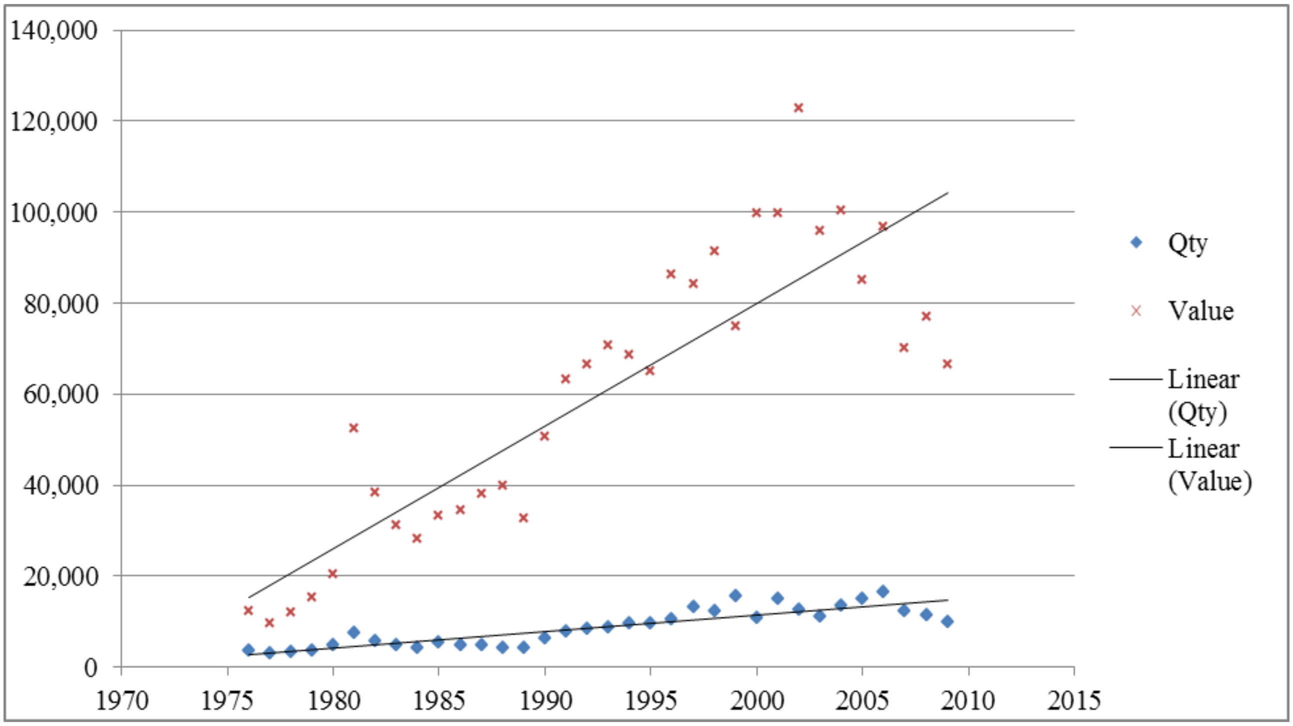
Commodity		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Crustaceans	Qty	7,265.00	8,450.00	8,835.00	6,444.00	6,205.00	7,361.00	14,617.00	10,034.00	10,041.00	8,520.00
	Val	95,903.00	94,028.00	117,069.00	79,036.00	94,746.00	77,975.00	90,816.00	65,824.00	68,668.00	60,392.00
Fish	Qty	3,244.00	6,363.00	2,532.00	4,265.00	6,648.00	6,669.00	1,814.00	2,249.00	1,212.00	1,033.00
	Val	3,482.00	5,229.00	4,807.00	16,518.00	4,843.00	5,359.00	5,299.00	3,907.00	6,566.00	4,799.00
Fish, crustaceans, molluscs and other aquatic invertebrates	Qty	263.00	27.00	1,017.00	246.00	45.00	379.00	32.00	60.00	120.00	267.00
	Val	250.00	36.00	497.00	163.00	64.00	198.00	60.00	83.00	1,226.00	1,080.00
Molluscs, aquatic invertebrates	Qty	153.00	162.00	181.00	186.00	544.00	589.00	107.00	137.00	193.00	76.00
	Val	254.00	423.00	467.00	301.00	816.00	1,504.00	523.00	376.00	453.00	355.00
Total Exports	Qty	10,925.00	15,002.00	12,565.00	11,141.00	13,442.00	14,998.00	16,570.00	12,480.00	11,566.00	9,896.00
	Val	99,889.00	99,716.00	122,840.00	96,018.00	100,469.00	85,036.00	96,698.00	70,190.00	76,913.00	66,626.00

Note: Quantity (Qty) in Tons and Value (Val) in Nominal, 1000 USD

Data Source: FAO FISHSTAT

As shown in the Figure 3.5 the slope of the value curve is more upward oriented than that of the quantity exported, suggesting export's unit values are increasing faster than the evolution of the unit of quantities.

Figure 3.5: Quantities and Values of Fishery Products Exported 1976-2009



Source: Author (Calculations)

From oral sources interviewed in Beira (shrimps and prawns, frozen, mixed species and sizes) and Tete (*kapenta*, dried, mixed sizes) in November 2013, the exporting prices of these two products are determined as follow: for shrimps and prawns in the EU, as a result of the market forces, but dominated by the demand; *Kapenta* is sold in Zambia, Zimbabwe and in others locations at prices discussed and fixed by the markets forces, either in Mozambique and abroad, heavily dependent on freshwater substitute fishes.

3.3 MOZAMBIQUE AND FISHING AGREEMENTS

The "fisheries agreements" are defined as formal documents signed between States whereby the vessels[21] of one State are allowed to fish in the EEZ of another, in exchange for financial compensation, market access, or others accorded benefits (La Sann 1998; ECDPM 2006). Criticisms of those fishing agreements (Grynberg 2003; Mwikya 2006; ECDPM 2006) consider they are the reason why countries are investing so less in infrastructures for compliance to technical measures. The reason is that fishing agreements provides revenues, and it can incentives an "extractive" trade, at the expenses of investments in a true commercial endogenous fishing industry.

In Mozambique and up to our knowledge, only few studies on fishing agreements are available, one done by Kusi Consultores in 2008 and the other by the Oceanic Development, in 2011. However, the scope of these studies were limited to the agreements themselves, not looking to the compliance with technical measures to trade. From 2007 to 2009, 205 fishing licenses were issued, under the fishing agreement between Mozambique and EU, and on average, for each year, the fishing agreement generated catches of 3,380 tons of fish, and the highest average catches were taken in 2010 (4,820 tons). Excluding upstream and downstream, onboard employment under the fishing agreement was estimated as being 1,086 full-time, including EU nationals and ACP (Africa, Caribbean and Pacific) citizens (Kusi Consultores 2008; Oceanic Development 2011).

Like in others developing countries, Mozambican fishing agreements with the EU are criticized due to its "extractive" nature, in the high-sea. Nevertheless, the fishing agreements are one of the pillars for the North-South relationship (Mwikya 2006; ECDPM 2006). In fact, the majority of the discussions regarding the fisheries agreements are related to its correlation with overexploitation (Grynberg 2003; Mwikya 2006), in the sense that (overexploitation) tend to occur because these fishing agreements are not based on scientific criteria of sustainable exploitation.

[21] Fishing vessel: according to Article I(a) of the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, means "*any vessel used or intended for use for the purposes of commercial exploitation of living marine resources, including mother ships and any other vessels directly engaged in such fishing operations.*"

The rationale behind the overexploitation can be explained in the following way: since the amounts of the payments depend on the share of granted exploration, developing countries tend to grant permission for large quantities, to increase their revenues; the DWFN that receive permission to fish tend to maximize their business, over-exploiting species with high commercial value. Following this argument, Grynberg (2003) says when countries enter in negotiations with EU they no longer have sufficient bargain stock power.

Looking to the food security issue in Mozambique, the study done by the Kusi Consultores (2008) says there is no any positive impact. In fact, products caught under the fishing agreements are exported directly from the vessels, onboard, and no fish is discharged in Mozambique. Due to usage of advanced and powerful vessels and their target on migratory species (tuna), EU fleets can impact on the availability of fisheries resources for the coastal communities, especially for large pelagic fishes. Kusi Consultores (2008:23) points out that the EU vessels working in Mozambican EEZ have no "*any interaction with the national economy, neither providing employment, fish for national consumption, raw material for processing or any other form of added value*".

In fact, the scarcity of studies on fisheries agreements in Mozambican case leads many to consider that the real benefits captured from them are unknown, and probably are negative. Nevertheless, as for June 2012, the country had negotiated 4 fishing agreements with the EU, accounting from the independence (the first in 1987 and prorogued in 1990-1991 and in 1992-1993[22]; the second in 2004-2006; the third in 2007-2011 and the last entered into force in 2012[23]).

At the international level, the legal foundations for these fishing agreements are established in the UNCLOS[24] and especially in its Article 62. Based in that Article 62, the EU adapted the scope of its preferential trade packages with the ACP countries to incorporate clauses to enable them to force

[22] According to Kusi Consultores (2008:21) in the periods with no formal agreements between Mozambique and EC, European ship-owners continued to fish shrimps under private licenses.
[23] Except the first agreement, all others were negotiated under the Fisheries Partnership Agreements (FPA). These FPA are more close to the WTO rules and contains clauses regarding the necessity of carrying scientific studies, transference of technology, establishment of joint-ventures, inclusion of local workers, etc.
[24] The UNCLOS entered into force in 16 November 1994 (Mwikya 2006:3)

ACP countries to enter in bilateral fishing agreements. For the developing countries perspective, the fishing agreement seems to be impositions rather than options.

The basic question here is how fishing agreements impacts the determinants of trade and the compliance to technical measures? Our basic argument is that the existence of fishing agreements with DWFN – which returns significant revenues – can decreases the motivation to improve the skills and technologies necessary for compliance to international technical and sanitary measures. The fishing agreements exist where the level of sophistication in fishing is low, and by getting easy revenues, governments hamper the growth of truly endogenous fishing industry.

As pointed out (La Sann 1998; Grynberg 2003; Mwikya 2006; ECDPM 2006; Kusi Consultores 2008), fishing agreements are not connected to the remaining industries in the country, including the domestic fishing firms. When trying to maximize their harvests (remember that fisheries are finite resources), it is not surprising claims that indicates that vessels under these fishing agreements tend to use more unsustainable fishing techniques, hampering the capacity of the fishing industry to grow in the future.

Our point is: if Mozambique can export fishery resources and get considerable revenues without doing any effort and any significant investment, it can perpetuate, at domestic sphere, low technical and sanitary standards, and can lead to low investment in infrastructures, laboratories and others facilities, including human resources, that would became crucial if the production were completely integrated into the domestic production chain. Since vessels fishing under the fishing agreements don't use Mozambican ports, facilities, infrastructures, human resources (except for emergencies and connected situations), they don't insert any incentive to upgrade processing or storage facilities, as well as train local staffs with advanced techniques and technologies.

Inspired from Mwikya (2006) we can identify others potential negative impacts to the degree of compliance to technical measures: (a) the rules of origin accorded between Mozambique and EU usually considers the products as originated from Mozambique if the crew of the vessel is either

Mozambican or from EU, then possible joint-ventures between Mozambican and others non-EU partners can be virtually discouraged; (b) in such a case, fishery products from firms owned by nationals of others countries are not considered as 'originated from Mozambique', which can discourage both investment in fishing infrastructures and establishment of more *joint-ventures*.

Finally, these agreements are considered as explicitly not fair. The prices paid for the resources captured in Mozambican EEZ are considered as below the prices of the market. International studies points out that under the fishing agreements, the developing countries are selling fisheries products very cheap, representing an insignificant portion of the real value of the resources, valued by the market value.

3.4 DOMESTIC LAWS AND FISHERY TECHNICAL COMPLIANCE PROCESS

In Mozambique, four instruments are crucial for exports and for the compliance to technical measures by the fishing industry: the Fishery Act (*Lei No. 3/90, de 26 de Setembro*), the Regulation of Inspection and Assurance of Quality of the Fishery Products (*Decreto No. 17/2001, de 12 de Junho*), the General Regulation for Aquaculture and its Annexes I, II, III, IV, V and VI (*Decreto No. 35/2001, de 13 de Novembro*), and the decree with establishes the INIP (National Institute for Fish Inspection – *Instituto Nacional de Inspecção do Pescado*), as the CA (competent authority) (*Decreto No. 18/2005, de 24 de Junho*). Additionally, innumerous circulars (*ordens de serviço*) most of them issued by the CA complement the network of domestic legislation governing exports of fisheries products.

3.4.1 The Fishery Act (*Lei No. 3/90, de 26 de Setembro*)

The Fishery Act (*Lei No. 3/90, de 26 de Setembro*) regulates the fishing activities, both marine and inland, and establishes the roles of the Government departments and offices directly or indirectly linked to the fishing sector.

According to the law, the Council of Ministers of Mozambique (the Cabinet) has powers to "... *administrate and promote the development of fishing industry* [towards an] *optimal and rational use of* [fisheries] *resources* ..." (Article 5) and to "*set up general guidelines for the development of fisheries sector*" (Article 6:1). The Cabinet has also power to "*promote and conclude negotiations of international agreements*" (Article 7) as well as to prepare and "*updating of development plans' and to take the necessary measures for their implementation*" (Article 8:1).

The law establishes that the Ministry of Fisheries shall act to manage the sector. Others low-profile autonomous institutions, like the Fisheries Development Fund (FFP), the National Institute for Fisheries Research (IIP), the National Institute for the Development of Small Scale Fishing (IDPPE) and the Fisheries School (EP) acts to implement ground level activities. At provincial level there are Provincial Fisheries Directorates and/or Provincial Fisheries Administrations. The inspection and certification of fish and fisheries products is carried out under the scope of the Fisheries Law and the Regulation of Inspection and Quality Assurance Fishery Products (*Decreto No. 17/2001, de 12 de Junho*).

3.4.2 The Regulation of Inspection and Assurance of Quality of the Fishery Products (*Decreto No. 17/2001, de 12 de Junho*)

This regulation describes the fishing inspection process in Mozambique and sets out the hygienic and health requirements, as well as the steps necessary to maintain quality in the fishing industry, by specifying how the handling, processing, export and import processes should be carried. One of the objectives of the regulation is to ensure that firms achieve the sufficient compliance levels (on the ground of health and hygiene) required by the markets.

Essentially, the document reflects the significant role which the EU has in the Mozambican fishing industry. Most of the rules are tied with EU norms and rules, the most explicit being the Articles

2:2(22), 2:2(23), 14(i), 15:1, 31:16, 39(i), 41:2(a)(iii), 47:7, 47:8, 47:9, 58:4, 59:4, 65:7, and 71:2. The annexes of that Regulation also contain a lot of references to EU.

The implementation of this regulation is under the INIP, the CA. In that capacity, INIP carries out sanitary controls of fishery products (captures and aquaculture)[25] and prepares reports on fishery inspections, sanitary licensing and certification, as well the resources necessary in that task.

3.4.3 The General Regulation for Aquaculture and its Annexes I, II, III, IV, V and VI (*Decreto No. 35/2001, de 13 de Novembro*)

This regulation applies to any aquaculture activity carried out by any physical or legal person, either national or foreign in Mozambique. The regulation contains the requirements and others premises for establishment of firms, licensing and authorization procedures, taxes, penalties and inspection, as well the general condition for hygiene, treatment of animal diseases and environmental management procedures at the firm level.

According to the regulation, marine shrimps can be cultured either in extensive or semi-intensive systems, while the artisanal production shall be only extensive. Marine shrimp's culture shall be only semi-intensive and extensive system, instead of intensive to avoid damaging the environment which usually comes when the production is intensive, highly dependent on commercial feeds. The extensive and semi-intensive methods are based on the use of organic and inorganic fertilizers, such as phytoplankton, zooplankton, bottom-dwelling invertebrates and smaller fish and results on less pressure to the mangroves and surrounding ecosystems.

3.4.4 Competent Authority: INIP (*Decreto No. 18/2005, de 24 de Junho*)

The INIP is the competent authority for fishing inspection in Mozambique. Its functions includes that of licensing fishing vessels that transport fish and fisheries products, including inspection of

[25] Sanitary measures of others animal products as well as the phytossanitary measures are under the responsibility of the Ministry of Agriculture (WTO 2001:35).

processing plants, to certify imported and exported products and to carry out laboratory analyses on these products.

3.5 INVESTMENTS AND GOVERNMENTAL SUPPORT

Since Mozambique is a low standard country, it is understandable that a huge portion of governmental support and international technical cooperation goes to infrastructures for increasing the degree of compliance to technical measures, while the private investments are destined to set-up units and/or to establish plants and renew vessels and production equipment's.

The data from CPI (Mozambique Centre for Investment Promotion – *Centro de Promoção de Investimento*) regarding domestic and foreign private investments approved, covering the period from 1990-2009[26] (except for 1995, there were no data in the CPI Excel files) provides a general picture on the private investments.

Making constant (2000) the values for investment, one can conclude that in all 20 years analyzed, 1994 was the year the fishery sector received the greatest amount, having received 94.43 million USD, in investments done in Zambezia Province by 'Aquapesca', and 'Krustamoz'. That amount represented around 14.36 per cent of all the investment made in Mozambique in that year. Excluding 1995's data, FDI in these 20 years amounted to 84.11 million USD (25.05 per cent), domestic private investment reached 21.81 million USD (6.50 per cent) and the loans were 229.85 million USD (68.45 per cent). The total is 335.88 million USD.

In general, the investments are decreasing, after the greatest period of 1994-2000. Excepting Manica Province, which did not receive any project in that period, Zambezia was the most benefited province, having received around 39.12 per cent of all the projects amounts. Maputo Province (and City) comes in the second place, having received 24.85 per cent of the projects amounts, and the

[26] Private investments data are available from 1990s.

third was Sofala, with 16.76 per cent of the amounts. Gaza is the province less benefited with investments in that period, having received a modest 0.08 per cent.

Gaza and Niassa received few projects, just 1 and 2, respectively. Maputo, Sofala and Tete received, respectively 24, 21 and 19 projects, while Zambezia received 15 projects. It means that each project in Zambezia had received, on average 8.75 million USD, while in Gaza the average per project is 0.14 million USD; in the others words, on average each project in Zambezia is bigger than the average of each other's projects in others provinces. The investments are concentrated in Central provinces (Tete, Manica, Sofala and Zambezia), followed by South provinces (Maputo, Inhambane and Gaza) and finally by the North provinces (Niassa, Nampula, and Cabo Delgado).

Technical assistance seems to be a useful tool used by the fishing stokeholds to improve the conditions regarding standards required at the international level. Therefore, taking advantage of its membership to international organizations, Mozambique got technical and financial support from UN agencies such as FAO, WHO (World Health Organization), including from the CAC.

Other international cooperation partners for fisheries in Mozambique includes the EU, the DFID (Department for International Development) (UK), the IFAD (International Fund for Agricultural Development), the NORAD (Norwegian Agency for Development Cooperation), and the ICEIDA (Icelandic National Agency for Development Cooperation).

At regional level, Mozambique is Part of the SADC and of SADC Protocol on Fisheries, which sets the terms of activity and regional cooperation in fisheries. Mozambique is also Part of the Cotonou Agreement between the ACP and the EU, whose Protocol 1, Annex XIV, deals with fish products. Mozambique is Member of the WIOT (Organization of the Western Indian Ocean Tuna) and because of this the country receives technical support to monitoring and controlling tuna fishing vessels.

Compiling data from OECD regarding the inflow ODA (official development aid) in Mozambique, it becomes clear that EU (as community and by individual countries) and Japan are the main supporters of the fishing sector. Funds from the EU and their countries had been used in fishing vessels, artisanal fishing, repairs and maintenance of infrastructures, experiments on fishing techniques, education campaigns, human resources training and scientific research, supporting governmental administrative branches to raise legal norms, standards and regulations, and set-up fishing and fisheries databases. The Japanese ODA (grants and loans) have been directed to infrastructures, fishery development and construction, rehabilitation or maintenance of ports, vessels, fishing facilities and connected services, as refrigeration and markets.

As is presented in Chapter 7, domestic public support data are difficult to get, unless one get access to governmental data. However, most of the projects implemented in the fishing sector are done with shared sponsorship between Mozambican authorities and international partners.

3.6 CHAPTER 3 SUMMARY

Mozambique is a low-standard country, at least for fisheries supply (EC 1998; EC 2001; EC 2006; EC 2007), but the share of Mozambican production in the world – all fishing areas and all species – in the period 1994-2009 shows an increased tendency, having jumped from 0.021 per cent and 0.452 per cent for the world and Africa, respectively, in 1994 to 0.073 per cent and 1.394 per cent for world and Africa, respectively, in 2009.

Exports to high standard countries happens due to existence of tariff concessions and bilateral agreements wherewith EU inspectors visits domestic plants, vessels and others connected infrastructures, checking their working conditions for further approval. Indeed, the funds provided through ODA and others sort of international assistance acts to minimize the gap in compliance with technical measures. The construction of laboratories, equipment for testing, and capacity building have been carried out with a strong international support.

A general finding is that in the production and exportation, the future rests in the aquaculture, than in the captures, and shrimps and prawns and fish offer more confidence as the targeted product.

Indeed, if the country wants to promote this sector, the focus shall be placed on the role of the government:

a) First, by providing support and incentives to the firms, such as fiscal arrangements in the acquisition of vessels with capacity to operate in high sea and Mozambican EEZ (followed by cancelation of the agreements with the DWFN);
b) Second, by enhancing the country capacity to deal with illegal fishing and marine pirates in the Indian Ocean, by expanding monitoring and surveillance actions;
c) Third, by setting facilities that will enhance market competiveness, like research and capacity building, and;
d) Finally by promoting private sector to set-up fishery processing plants in Mozambique, in order to increase the value added to the products, diversify products and markets.

Exporting prices for shrimps and prawns in the EU market and for the *kapenta* in Zambia, Zimbabwe and others countries are fixed by market forces, respectively. The idea of diversifying products and markets is fundamental: now, exports are intensely directed to EU, Japan and South Africa. Therefore, an improvement in the performance of fishery sector in Mozambique has to be done taking in account the possibility of diversifying products, by processing them, as well as by diversifying markets. The rate of export survival, given by the export tariff lines (*see* also Introduction and Background) seem to fluctuate a lot: the life and death of tariff lines flows is clear on that. This suggests the country should adopt economic policies to improve the survival rates of all the potential export lines.

CHAPTER 4

PERFORMANCE ON SANITARY AND ENVIRONMENTAL INDICATORS AND THE DEMAND FOR EXPORTS OF FISHERY PRODUCTS: THE CASE OF SHRIMPS AND PRAWNS FROM MOZAMBIQUE

4.1 INTRODUCTION TO CHAPTER 4

As presented in the Chapter 2, the international trade of fishery products is increasing, and with it, the concerns regarding the sanitary and environmental conditions of these products (De Waal 2003; Ababouch 2006; Buzby et al. 2008). In fact, over the past decades, several foodborne diseases incidences originated from inadequate sanitary and environmental factors were reported worldwide, mainly in developed countries. Such impressive detected cases are explained by the improved hazards detection methods (De Waal 2003; WHO and FAO 2005; Ababouch 2006) and by the developed countries' dependence on fishery originated from developing countries (De Waal 2003; Ababouch 2006).

The figures on the border detection cases reveal that all species of fishery can be vehicles of illnesses to human, especially those caused by pathogens (Salmonella *spp*, Vibrio *parahaemolyticus*, Staphylococcus *aureus*, Escherichia *coli*, Vibrio Cholera), parasites (*Nematodes*, *Cestodes*, *Trematodes*), toxins (Paralytic shellfish poisoning, Neurotoxic shellfish poisoning, Diarrhetic shellfish poisoning, Amnesic shellfish poisoning and Ciguatera fish poisoning), decomposition (Histamine, Putrecine, Cadaverine), environmental contaminants and pesticides (Mercury, Cadmium, Lead), drugs (Banned or prohibited), additives (Sulphites, Nitrates, Cyclamate) or by strange objects in foods (Plastic or Metal fragments) (Ababouch 2006).

To reduce the probability of occurrence of foodborne diseases, importing countries are reorganizing their food safety systems, increasing the number of border mandatory inspections, and enforcing stringent risk analysis (WHO and FAO 2005; Buzby et al. 2008; Korinek et al. 2008). They are also exchanging and spreading information on the safety of food and feed, and especially of seafood (Jussaume and Judson 1992; Buzby et al. 2008; Korinek et al. 2008). This suggests that the perception about the sanitary and environmental conditions of the exporting country (a subjective matter) might be a crucial determinant of the trade in agro-food and fishery products.

Mozambique is a sea-dependent developing country, where seafood products and fishing activities play a crucial role. The recent development strategies point that agro-food industries shall be restructured to induce economic growth and promote job creation. To meet these targets, both production and exports shall be expanded, and the strengths and weaknesses at the supply and demand sides shall be assessed, and where appropriate, shall be corrected.

The selection of the case study is explained by the importance of shrimps and prawns at the domestic level (*see* Table 3.1, where crustaceans – shrimps and prawns – represented 100 per cent of fishery exported in the 1980; 97.92 per cent in 1990; 66.49 per cent in 2000 and 86.09 per cent in 2010). Indeed, shrimps and prawns generate valuable exchange earnings in Mozambique, which are increasing at an annual average of 8.65 per cent. The commercial fishing industry – also, highly dependent on shrimps and prawns – provide employment, and has potentiality of being expanded by doubling or tripling its actual size.

Mozambican small share in the world market, however, imply the market – and especially, the demand side perceptions – are crucial. Therefore, this chapter assesses how the perception about the performances on sanitary and environmental indicators is correlated with the demand for exports of fishery products, specially the frozen shrimps and prawns. The sanitary and environmental conditions of the exporting country are represented by the “border detected cases”, as reported by the importer’s food and feed safety authorities. Concretely, “border detected cases” comprises a set of notifications reported as hazards to health or to the environment, including to animals and plants.

In this chapter the demand side is focused because it departs from the assumption that the world’s supply price elasticity is infinite, i.e., there is an unlimited supply of fishery products at a restricted price. In such a case, when the demand happens to decreases, the supply side will change its output (for instance, by diminishing its production), but keeping the prices unchanged. With this strategy, it is considered that fishery products will be available for export.

After this "Introduction", the Chapter follows, in section 2, by reviewing the literature on the importance of technical measures and quality, emphasizing that the consumers are concerned with the health and environmental issues, and the governments will act to safeguard these policies. The section shows the data on the trade of shrimps and prawns and how the sanitary and environmental issues are affecting their tradability. The section also contains data and discussion about the Mozambican trade of these products.

The section 3 is about the methodology, estimation and the data used. Here, the export demand model is presented and the data sources are also shown. The descriptive statistics provides information on the unit of measurement. In the section 4, the results of the estimation are presented, including the cross-section country fixed effects: at the beginning, the results for all the four trading partners; then, due to poor performance of the variable we wanted to control, one trading partners was dropped. However, the results of the second calculations were still not satisfactory. The third tentative, which drops Japan and Italy seems to work, since both the sanitary and environmental variable and the partners incomes' shows the correct signs and are significant. The conclusions and policy implications appears in the section 5.

4.2 LITERATURE REVIEW ON THE IMPORTANCE OF TECHNICAL MEASURES AND QUALITY

4.2.1 Importance of Quality in Goods (and Services)

There are innumerous publications in economics, dealing with the importance of quality of the products and services supplied (Grunert 2005; Hammoudi et al. 2009). In fact, economic is full of studies postulating that consumers are looking for goods embodied with an specific quality, and in an asymmetrical distributed information scenario, the demanders are, somehow, skeptical about the real features of the products (or services) being sold.

These types of assumptions have been made previously for the demand of food. In his study, Grunert (2005:369) stated "*quality and safety perception is linked to food choice and consumer demand … food quality and safety are central issues in today's food economics* …" In fact, recent studies (Grunert 2005; Hammoudi et al. 2009) are revealing that "objective food safety" – borders inspection, withdrawal of suspected unhealthy products, prohibition of certain additives on products, etc – is also affecting the "subjective food safety", which deals with consumer's behaviors and attitudes. Because of that, importing countries are urging exporting countries to care about the sanitary conditions of the exported products, which require a rigorous laboratorial analysis prior exportation.

4.2.2 Trade in Shrimps and Prawns and Sanitary and Environmental Conditions

4.2.2.1 Shrimps and Prawns: Trade Figures

Shrimps and prawns comprehend large number of species of the sub-order *Decapoda Natantia*, all of them used for human consumption (Holthuis 1980). Although they are among the most valued fishery products, specially the *Panaeidae* family (FAO 2010), some species are not yet exploited commercially (Holthuis 1980). They are found and harvested in any latitude, but the most traded in the world are the warm-water shrimps, caught in the inter-tropical waters. Recent data indicates that a significant amount of shrimps and prawns comes from aquaculture farms, influenced by the reduction in marine and inland captures (FAO 2010).

The world's shrimps and prawns trade and production figures are presented in the figures above. By production, Asia and Americas share the first and second positions. As for 2006-09, Asia production reached 3,332,937 tons (52.33 per cent) while Americas reached 2,499,539 tons (39.25 per cent). In exports, Asia and Americas are leading, having exported as much as 3,462,130 tons (51.56 per cent) and 1,912,753 tons (28.49 per cent), respectively. For imports, Europe, Americas and Asia were in the top three, with imports of 2,915,116 tons (44.28 per cent), 1,896,260 tons (28.81 per cent) and 1,591,546 tons (24.18 per cent), respectively. By countries, the main shrimps and prawns importers are the EU, Japan and the USA (FAO 2010).

Table 4.1: Shrimps and Prawns Trade, Quantity (Tons)

	Trade Flow	1981-85	1986-90	1991-95	1996-00	2001-05	2006-09
Africa	Export	98,830.0	130,618.0	158,501.0	176,780.0	216,045.0	228,717.0
	Import	168.0	9,205.0	19,235.0	16,488.0	33,343.0	87,439.0
	Production	90,526.0	129,309.0	146,581.0	188,104.0	211,942.0	148,143.0
Americas	Export	659,130.0	870,098.0	1,193,821.0	1,451,898.0	1,965,067.0	1,912,753.0
	Import	687,577.0	1,068,223.0	1,358,115.0	1,602,407.0	2,098,396.0	1,896,260.0
	Production	1,120,642.0	1,501,316.0	1,771,906.0	1,993,383.0	2,535,802.0	2,499,539.0
Asia	Export	848,414.0	2,036,453.0	2,797,515.0	2,813,384.0	3,739,248.0	3,462,130.0
	Import	999,913.0	1,710,958.0	1,906,930.0	1,805,318.0	2,091,597.0	1,591,546.0
	Production	839,581.0	1,710,289.0	2,669,498.0	2,799,925.0	3,260,291.0	3,332,937.0
Europe	Export	261,517.0	480,069.0	568,398.0	833,639.0	1,183,130.0	1,081,649.0
	Import	541,840.0	1,093,275.0	1,618,890.0	1,919,146.0	2,960,615.0	2,915,116.0
	Production	246,758.0	367,355.0	418,688.0	464,624.0	524,686.0	365,583.0
Oceania	Export	72,190.0	69,154.0	61,708.0	77,583.0	66,110.0	29,109.0
	Import	17,842.0	29,302.0	40,795.0	52,806.0	95,791.0	92,629.0
	Production	68,476.0	62,758.0	56,252.0	66,138.0	54,297.0	22,686.0
World	Export	1,940,081.0	3,586,392.0	4,779,943.0	5,353,284.0	7,169,600.0	6,714,358.0
	Import	2,247,340.0	3,910,963.0	4,943,965.0	5,396,165.0	7,279,742.0	6,582,990.0
	Production	2,365,983.0	3,771,027.0	5,062,925.0	5,512,174.0	6,587,018.0	6,368,888.0

Data Source: FAO-FISHSTAT

The shrimps and prawns trade value appear in the Table 4.2. World trade (exports plus imports) reached 81,591.91 million USD, in the period 2006-09. Asia captured the major share of this trade, accounting for 32,728.33 million USD (40.11 per cent), followed by Americas (22,954.60 million USD, 28.13 per cent) and Europe (22,854.95 million USD, 28.01 per cent). The figures on exports values followed the same trend, where Asia accounted for 55.74 per cent, Americas for 23.50 per cent and Europe for 15.69 per cent. Africa and Oceania appears at the bottom, sharing 4.09 per cent and 0.95 per cent, respectively. As for imports, the figures on values for 2006-09 suggest that Europe and Americas share the top positions, with imports of 39.40 per cent and 32.41 per cent, respectively. Asia, Oceania and Africa follows, with 25.65 per cent, 1.65 per cent and 0.90 per cent of import values, respectively.

Table 4.2: Shrimps and Prawns Trade, Value (USD 1000, Nominal)

	Trade Flow	1981-85	1986-90	1991-95	1996-00	2001-05	2006-09
Africa	Export	545,063.0	829,555.0	1,065,037.0	1,228,626.0	1,726,082.0	1,606,630.0
	Import	581.0	37,646.0	91,795.0	80,867.0	152,293.0	384,771.0
	Total Africa	545,644.0	867,201.0	1,156,832.0	1,309,493.0	1,878,375.0	1,991,401.0
Americas	Export	4,832,285.0	6,520,186.0	8,561,301.0	10,987,535.0	10,106,178.0	9,217,839.0
	Import	5,378,470.0	8,371,391.0	11,728,175.0	11,853,131.0	16,132,277.0	13,736,765.0
	Total Americas	10,210,755.0	14,891,577.0	20,289,476.0	22,840,666.0	26,238,455.0	22,954,604.0
Asia	Export	4,788,971.0	13,606,649.0	22,313,621.0	23,009,204.0	23,430,335.0	21,858,564.0
	Import	7,119,980.0	13,283,199.0	13,046,617.0	16,594,123.0	13,503,826.0	10,869,769.0
	Total Asia	11,908,951.0	26,889,848.0	35,360,238.0	39,603,327.0	36,934,161.0	32,728,333.0
Europe	Export	930,838.0	2,778,306.0	3,286,740.0	4,169,866.0	5,734,961.0	6,154,388.0
	Import	2,018,459.0	6,234,969.0	9,590,360.0	11,643,756.0	15,132,918.0	16,700,562.0
	Total Europe	2,949,297.0	9,013,275.0	12,877,100.0	15,813,622.0	20,867,879.0	22,854,950.0
Oceania	Export	708,700.0	794,026.0	683,702.0	839,425.0	784,229.0	372,723.0
	Import	145,570.0	226,125.0	344,431.0	506,643.0	668,645.0	689,903.0
	Total Oceania	854,270.0	1,020,151.0	1,028,133.0	1,346,068.0	1,452,874.0	1,062,626.0
World	Export	11,805,857.0	24,528,722.0	35,910,401.0	40,234,656.0	41,781,785.0	39,210,144.0
	Import	14,663,060.0	28,153,330.0	34,801,378.0	40,678,520.0	45,589,959.0	42,381,770.0
	Total World	26,468,917.0	52,682,052.0	70,711,779.0	80,913,176.0	87,371,744.0	81,591,914.0

Data Source: FAO-FISHSTAT

According to the data in Table 4.2, in the world, import nominal values exceed the nominal value of exports, and the trend points out that the differences are widen. For instance, for 2006-09 period, world imports were as much as 42,381.77 million USD, while exports were around 39,210.14 million USD. As for 2008, the world top importers of shrimps and prawns (in volume) were USA, Japan, EU-27, and Hong-Kong (FAO 2010). In the EU-27, Spain, France, Italy, the UK and Belgium were the major markets, but Spain alone imported around 20 per cent of all products destined to the EU. The world major suppliers were China (P.R.), Thailand, Indonesia, Bangladesh, India, Ecuador, and Argentina (FAO 2010), and most of the production where from aquaculture plants.

4.2.2.2 Shrimps and Prawns: Sanitary and Environmental Concerns

Many countries – concretely the major importers – are detecting several irregularities, brought to them by fresh, cooked, boiled or frozen shrimps and prawns, despite the implementation of the HACCP. Apparently, the implementation of the HACCP, whose goal is to generate safe food, remains a challenge at the exporters' side. The Figure 4.1 reports cases of crabs, lobsters, crayfish, and shrimps and prawns rejected at the EU and Japanese borders due to sanitary and environmental rejected: the products were redirected to others markets, returned to their origin or destroyed at the importer's borders, dependent on each case. The figures show that unauthorized food additives, prohibited or abnormal levels of chemical products, and pathogenic micro-organisms are the main concerns reported by the EU and Japan.

The general principles and requirements of food law and procedures on food safety by the EU are described in the European Parliament and Council Regulation (EC) No. 178/2002 of 28 January 2002, which mandates exporting firms to be approved by a competent authority and to accept to be inspected periodically by the EU technical teams.

The EU's marketing standards for fishery products appears in the Council Regulation (EC) No. 2406/96 of 26 November 1996. This regulation describes the sizes and freshness standards of fishery products accepted in that market. Third countries exporting firms must be in capacity to run periodic tests to control for Staphylococcus *Aureus*, and Escherichia *Coli*, as well as to carry out tests in all the surfaces that touches fishery products. Additionally, exporting firms shall, regularly, check the sanitary conditions to its personnel and equipments.

The requirement for exporting seafood products to Japan is the Food Sanitation Act (Act No. 233 of December 24, 1947), enacted to prevent sanitary hazards resulting from foods and drinks (JETRO 2006). The act is enforced by a Food Safety Commission and is composed by the Ministries of Agriculture, Forestry and Fisheries and of Health, Labor and Welfare. Due to high dependency on imported seafood, Japan is particularly vulnerable to unsafe products (Jussaume and Judson 1992; GAO 2008).

As for shrimps and prawns, Japan requires two checking points, one at the exporting countries and the other at the Japanese borders. However, is not uncommon checking the products during their retail and distribution stages (GAO 2008). Despite the exporter's sanitary and environmental control measures, the Figure 4.1 shows that Japan continues to report significant figures of imported hazards detected at its borders.

In the Figure 4.1, the increased number of unauthorized food additives detected is explained by the increasing trade of processed foods and by the tendency of using preservers'. The figures on the abnormal level of chemical products are explained by the trend of altering the water's chemical characteristics to enhance its safety, to avoid contamination at the production, processing and transportation phases. The huge numbers of pathogenic micro-organisms detected constitute evidences that processed crustaceans can be vehicle of diseases, justifying, thus, the increased number of banishments, withdrawal or the incinerations of the fishery products at borders (Tauxe et al. 1994; WHO and FAO 2005).

All these reasons, together, disclose the vulnerability of the developing and tropical countries as fishery exporters: they are the main exporters. Their bad sanitary and environmental conditions, plus the usage of unsafe water sources tend to favor cyclical and recurrent appearance of health and environmental problems. In fact, the majority of exports rejected at the EU and Japanese borders are originated from developing countries of Southeast Asia (including China), Latin America and Sub-Saharan Africa.

Figure 4.1: Number of Notifications at the Importer's Borders due to Sanitary, Environmental and Others related Reasons: Crustaceans, World

Hazard Category	Importers	1980-85	1986-90	1991-95	1996-00	2001-05	2006-10	2011-12	Total
Sanitary Reasons									
Allergens	EU	-	-	-	-	-	1	-	1
	Japan	-	-	-	-	-	-	1	1
	Sub-Total	-	-	-	-	-	1	1	2
Biotoxins	EU	1	-	-	2	6	1	-	10
	Japan	-	-	-	-	-	5	2	7
	Sub-Total	1	-	-	2	6	6	2	17
Food additives and flavorings	EU	-	-	-	1	140	166	30	337
	Japan	-	-	-	-	-	211	34	245
	Sub-Total	-	-	-	1	140	377	64	582
Organoleptic aspects	EU	-	-	-	1	9	12	10	32
	Japan	-	-	-	-	-	-	-	-
	Sub-Total	-	-	-	1	9	12	10	32
Pathogenic micro-organisms	EU	2	1	1	93	186	42	15	340
	Japan	-	-	-	-	-	35	28	63
	Sub-Total	2	1	1	93	186	77	43	403
Residues of veterinary medicinal products	EU	-	-	-	-	313	257	30	600
	Japan	-	-	-	-	-	5	4	9
	Sub-Total	-	-	-	-	313	262	34	609
Sanitary Reasons	Total	3	1	1	97	654	735	154	1,645

Hazard Category	Importers	1980-85	1986-90	1991-95	1996-00	2001-05	2006-10	2011-12	Total
Environmental Reasons									
Chemical contaminants	EU	-	-	-	-	-	1	-	1
	Japan	-	-	-	-	-	236	143	379
	Sub-Total	-	-	-	-	-	237	143	380
Foreign bodies	EU	-	-	-	-	-	1	-	1
	Japan	-	-	-	-	-	1	2	3
	Sub-Total	-	-	-	-	-	2	2	4
Heavy metals	EU	-	1	-	-	35	104	5	145
	Japan	-	-	-	-	-	5	2	7
	Sub-Total	-	1	-	-	35	109	7	152

Industrial contaminants	EU	-	-	-	-	-	5	4	9
	Japan	-	-	-	-	-	-	-	-
	Sub-Total	-	-	-	-	-	5	4	9
Radiation	EU	-	-	-	-	1	1	2	4
	Japan	-	-	-	-	-	-	-	-
	Sub-Total	-	-	-	-	1	1	2	4
Environmental Reasons	Total	-	1	-	-	36	354	158	549

Hazard Category	Importers	1980-85	1986-90	1991-95	1996-00	2001-05	2006-10	2011-12	Total
Others (related to Sanitary and Environmental Reasons)									
Labelling absent, incomplete or incorrect	EU	-	-	-	-	6	2	-	8
	Japan	-	-	-	-	-	-	-	-
	Sub-Total	-	-	-	-	6	2	-	8
Non-pathogenic micro-organisms	EU	2	-	-	5	28	2	-	37
	Japan	-	-	-	-	-	3	1	4
	Sub-Total	2	-	-	5	28	5	1	41
Not determined	EU	-	-	-	-	-	1	-	1
	Japan	-	-	-	-	-	13	7	20
	Sub-Total	-	-	-	-	-	14	7	21
Packaging defective or incorrect	EU	-	-	-	-	1	3	1	5
	Japan	-	-	-	-	-	-	-	-
	Sub-Total	-	-	-	-	1	3	1	5
Poor or insufficient controls	EU	-	-	-	2	2	36	37	77
	Japan	-	-	-	-	-	-	-	-
	Sub-Total	-	-	-	2	2	36	37	77
Others	Total	2	-	-	7	37	60	46	152
All Hazard Categories	Total	5	2	1	104	727	1,149	358	2,346

Data Source: EU RASFF and Japanese Ministry of Health, Welfare and Labor (Imported Foods Inspection Services)

4.2.3 Shrimps and Prawns from Mozambique

4.2.3.1 Shrimps and Prawns Production

As described in the Chapter 3, Mozambique production (for export) of fishery products are concentrated on frozen shrimps and prawns, followed by dried fish, *kapenta*. The production of shrimps and prawns production is a mixture of captured and aquacultured products, the last one gaining an increased importance in recent years. Captures are carried out by the commercial and artisanal firms. The aquaculture production is strongly concentrated in the commercial sector, in marine waters, and significant investment, inputs, as well as others production's factors are being addressed to make viable this activity.

The Table 4.3 provides figures on the 2006-2011 shrimps and prawns production:

Table 4.3: Shrimps and Prawns Production in Mozambique 2006-2011 (Tons)

	2006	**2007**	**2008**	**2009**	**2010**	**2011**
Captures Production						
Commercial	7,393.06	7,046.54	5,395.21	5,339.77	5,654.11	4,620.66
Artisanal	1,367.67	838.01	2,087.35	2,508.62	4,320.49	1,825.98
Sub-Total	8,760.73	7,884.55	7,482.56	7,848.39	9,974.60	6,446.64
Aquaculture Production						
Marine	995.53	693.08	602.02	374.62	667.65	506.97
Sub-Total	995.53	693.08	602.02	374.62	667.65	506.97
Total	**9,756.26**	**8,577.63**	**8,084.58**	**8,223.01**	**10,642.25**	**6,953.61**

Data Source: Ministry of Fishery – Mozambique

In the Table 4.3, the overall trend indicates a slight decreasing of commercial captures and aquaculture production, while the artisanal captures are increasing modestly. Taking 2006 as the year-base, the 2011's production decreased 28.74 per cent, negatively affected by marine aquaculture (49.15 per cent) and by the decreases in commercial captures (37.51 per cent). The reasons for such sudden decreasing production in 2011 are found by combining the price of inputs (price of oil in the international market) and biomass availability, affected by adverse climatic conditions in the Indian Ocean.

The most important destinations of the Mozambican exports of shrimps and prawns are the EU, Japan and South Africa. In the EU, Mozambican shrimp's exports are destined to Mediterranean countries, notably to Spain, Portugal and Italy. The EU alone has been responding for more than 70 per cent of the quantities exported and more than 75 per cent of the values, being the remaining shared by the others markets, notably by Japan and South Africa.

The direction of exports to EU countries is explained by cultural and historical linkages (colonization by Portugal), the existence of fishing agreements between EU and Mozambique (EC 1987a; EC 1987b; EC 2003), the presence of EU fishing multinational subsidiaries in Mozambique, favorable prices in the EU, existence of unilateral preferential trade agreement between ACP countries and EU, and the established huge demand for highly valued shrimps in many EU countries.

Since Mozambique is poorly equipped to process fishery products, shrimps and prawns are modestly treated, consisting basically of removing objectionable materials, cleaning and control for specific parameters required for health and sanitary standards, usually at land-based processing units (aquaculturers and semi-industrial firms) and at sea (industrial capturers firms) (EC 1998c; EC 2001; EC 2006; EC 2007). Typically the outputs are block frozen headless shrimps and prawns.

The crustaceans' producers, processing plants and exporters comprehend either joint-venture with foreign and entirely national firms. Although the most important exporting companies are subsidiary of foreign firms, it seems that their sanitary and environmental compliance level is poor. For Japan, however, there is no any border notification concerning shrimps and prawns or fisheries originated from Mozambique for 1990 to 2011 and in 2013-2014, according to the Japanese Ministry of Health, Welfare and Labor (Imported Foods Inspection Services): the sole detected case is of 2012.

In fact, located in tropical zone and surrounded by others low-income countries, Mozambique report several cases of infectious and environmental-caused diseases. Moreover, the living, production and consumption conditions have been influenced by a destructive civil war (1977-1992), disorganized and dirty slums surrounding the main cities and villages, and by the deteriorated system of water supply, which is permeable to contamination. Additionally, the domestic system for waste management in cities is inappropriate to deter the outbreak of infectious diseases and the contamination with chemical products, like pesticides and heavy metals, plastics, chlorines, fossil fuel burning and waste residues.

4.2.3.2 Shrimps and Prawns: Problems Created by Cholera Outbreak

The evident example of the effect of the sanitary and environmental conditions in the trade of shrimps and prawns was the partial banishment of fishery from Mozambique, exported to the EU market, when in 1997-98 a cholera epidemic emerged in West Indian Ocean African countries, affecting Kenya, Uganda, Tanzania, and Mozambique. Believing that cholera agent can contaminate animals and animal products, the EU reacted by imposing a provisional prohibition on imports to "*fresh fishery products*" (Article 2, Commission Decision No. 97/878/EC of 23 December 1997). The decision, however, was not applicable to "*fishery products caught, frozen and packaged in their final packaging at sea and landed directly on Community territory*" (Article 1, Commission Decision No. 97/878/EC of 23 December 1997).

Under that decision, exports of frozen and processed fishery products (except sterilized products) were only possible after a rigorous and repeated microbiological sampling test and detection methods for the presence of Salmonellae and vibrios. According to Article 6 (Commission Decision No. 97/878/EC of 23 December 1997), all expenditures incurred by the application of these stringent sampling and detection methods were charged to the consignors, consignees, or to agents. After reviewing the previous provisional decision, the EU reaffirmed their prohibiting-decision, and enacted another decision, Commission Decision No. 98/84/EC of 16 January 1998, maintaining all the measures previously taken.

Despite the WHO intervention claiming that fish were unlikely means for transmitting cholera (Oxfam 2002:105), the banishment only terminated in July 1998, according to the Commission

Decision No. 98/418/EC of 30 June 1998. The removal of the prohibition was decided after affected exporting countries agreed to provide appropriate guaranties to protect fishery, by carrying-out rigorous and additional medical supervisions on all personnel working and handling the products, in line with the Commission Decision No. 95/328/EC of 25 July 1995.

4.3 METHODOLOGY AND DATA

4.3.1 Export Demand Approach

To study if the performance on the sanitary and environmental indicators is one of the determinants for the demand of fisheries products exported by Mozambique, we use the export demand function, assuming that the world's supply price elasticity is infinite. To capture the major trading partners, the export demand model was setup covering Spain, Portugal, Japan and Italy. These countries are well known for their stringent standards and regulations to control for the sanitary and environmental conditions of the agro-food products.

Along the economic and trade literature, the demand equation was used by others studies to capture others determinants. For instance, in the food intake studies, population's age structure (Parks and Barten 1973), household sizes, degree of urbanization (Capps and Havlicek 1984); geographic distribution of the consumers, population density in cities, occupation of household head, educational level, employment status and age of household manager, number of children, ethnicity and religion (Cheng and Capps 1988), are among the variables studied. In the international trade, it was enlarged to predict the factors influencing the demand of exports originating from developing countries (Sato 1977; Lawrence 1990).

Assuming an imperfect substitute model, where neither imports nor exports are perfect substitutes for domestic goods, the country imports from, and exports to, are expressed in the following way:

$$(4.1) \qquad \log QTY_{i,t} = a_0 + a_1 \log PRI_{i,t} + a_2 \log PSU_{i,t} + a_3 \log YIM_{i,t} + \varepsilon_{i,t}$$

Where: *QTY* is the quantity of exports demanded; *PRI* is the price of exports; *PSU* is the domestic prices of substitutes in the trading partners' markets; *YIM* is the real incomes of the trading partners; and ε is the error term. Since the equation (4.1) is specified in logarithms, a_1, a_2 and a_3 are elasticities of the export demand function: a_1 is the export price's elasticity; a_2 is the substitute price elasticity; and a_3 is the income elasticity. The a_0 is the constant term, the subscripts t represents years and i represents trading partner country i for Mozambique.

The equation (4.1) presents the basic determinants of exports: prices (of exports and of substitute good) and income. To study the impact of sanitary and environmental measures in the demand for shrimps and prawns a new variable was added: the number of border's detected cases as violating sanitary and environmental standards and measures. Then, the equation (4.1) can be specified as follows:

$$(4.2) \qquad \log QTY_{i,t} = a_0 + a_1 \log PRI_{i,t} + a_2 \log PSU_{i,t} + a_3 \log YIM_{i,t} + a_4 SEC_{i,t} + \varepsilon_{i,t}$$

Where: *SEC* stands for the sanitary and environmental conditions, captured by the number of cases detected at the importer's borders. From the theory of the export demand function, the expected signs are: positive for a_2 and a_3; negative for a_1 and a_4.

4.3.2 Data Sources and Description of the Variables

The export demand equation in (4.2) is composed by the quantity of exports demanded, the price of exports, the prices of substitute good, importers' incomes and a sanitary and environmental indicator, which capture the conditions of exports. All the variables are annual observations, referent to 1990-

2014. The observed products are shrimps and prawns, frozen (HS 030613), all sizes, from captures and from aquaculture farms.

As for Spain, Portugal and Italy, data for *QTY*[27], *PRI* and *PSU* come from the UN-COMTRADE, EUROSTAT and INE-Mozambique (National Institute for Statistics – *Instituto Nacional de Estatística*); for Japan, from Japanese Customs Clearance Statistics and INE-Mozambique. The prices of substitute goods in Spain, Japan, Portugal, and Italy were, respectively, the Argentinean, Indonesian, French and Ecuadorian frozen shrimps and prawns (all sizes), since they are the most important suppliers into respective countries.

The *PRI* and *PSU* are expressed as "unit values", i.e., values (in USD) divided by volumes (in Kg). Critics of the "unit value approach" claims that the reliability of this methodology in providing results at HS 06-digit level might pose some problems, because at that level, the products are not fully distinguished, equalizing, erroneously, important differences that comes from more processing inputs. Therefore, as pointed out by Bacchetta et al. (2012:39) "*what will be observed will not be the price of a good but an average price of several (unobserved) sub-goods*." Although this is true, these were the best possible data found.

The *YIM* is the trading partners' GDP per capita (2000 USD, constant) and it comes from the World Bank's World Development Indicators. Finally, *SEC* reports the number of detected cases at the borders, representing the degree of performance in sanitary and environmental conditions at the supply side.

[27] Data on Population is from World Development Indicators

Figure 4.2: Descriptive Statistics (1990-2014)

		QTY	***PRI***	***PSU***	***YIM***	***SEC***
Spain	Mean	0.0990	8.78	8.10	23,796.55	1.80
	Median	0.1092	8.60	7.73	24,996.14	1.00
	Maximum	0.2200	26.64	13.48	27,661.02	13.00
	Minimum	0.0096	2.99	5.37	19,151.88	0.00
	Std. Deviation	0.0458	5.15	1.71	2,878.20	2.97
	Observations	25	25	25	25	25
Portugal	Mean	0.1563	8.93	9.10	17,521.18	0.60
	Median	0.1318	8.60	8.97	18,365.50	0.00
	Maximum	0.5272	32.45	10.93	19,489.27	3.00
	Minimum	0.0249	2.99	7.19	14,245.50	0.00
	Std. Deviation	0.1120	6.09	0.86	1,727.36	0.87
	Observations	25	25	25	25	25
Italy	Mean	0.0021	10.49	6.91	29,868.71	0.28
	Median	0.0015	6.52	6.73	29,965.99	0.00
	Maximum	0.0066	59.30	9.77	32,830.73	1.00
	Minimum	0.0000	2.99	4.69	26,476.76	0.00
	Std. Deviation	0.0020	13.29	1.35	1,979.82	0.46
	Observations	25	25	25	25	25
Japan	Mean	0.0086	23.45	10.95	34,594.66	0.03
	Median	0.0100	8.80	10.84	34,172.55	0.00
	Maximum	0.0171	185.24	13.86	37,595.17	1.00
	Minimum	0.0001	2.99	8.70	31,174.96	0.00
	Std. Deviation	0.0058	45.21	1.63	1,891.13	0.20
	Observations	25	25	25	25	25

Source: Author (Compilation)

Figure 4.3: Summary of the Data, Sources, Descriptions and Units of Measurement

Variable	**Description**	**Unit of Measurement**	**Source**
$QTY_{i,t}$	Quantity of exports of frozen shrimps and prawns to country *i* per capita, demanded from 1990 to 2014	Kg	UN-COMTRADE; EUROSTAT; Japan Customs Clearance Statistics; INE-Mozambique
$PRI_{i,t}$	Price of exports of frozen shrimps and prawns of Mozambique in country *i* (2000 USD, constant)	Unit value USD	UN-COMTRADE; EUROSTAT; Japan Customs Clearance Statistics; INE-Mozambique
$PSU_{i,t}$	Domestic prices of substitutes in the country *i* (2000 USD, constant)	Unit value USD	UN-COMTRADE; EUROSTAT; Japan Customs Clearance Statistics; INE-Mozambique
$YIM_{i,t}$	Per capita real incomes (GDP per capita) of the country *i* (2000 USD, constant)	USD	World Bank's World Development Indicators
$SEC_{i,t}$	Sanitary and environmental conditions (detected cases in the country *i*'s borders)	Number	EU-RASFF; EC 2001; EC 2006; EC 2007; Japanese Ministry of Health, Welfare and Labour

Source: Author

Although the sources for *SEC* are the best available information on the problems in food imports in EU and Japan, they present some limitations:

a) Since the border detected cases come from samples, it seems reasonable to assume that the data covers only a small per cent of shrimps and prawns or of fishery products. However, since seafood are the most targeted products, the relative number of inspection may be higher in that group than in others less likely to be in violation of food safety standards;

b) The data do not reveal from which company the detected fishery products comes from and what are the quantities, in tons or kg, whose import was refused; and

c) The border detected cases data do not provide information on the total number of food shipments that received approval to enter the EU or Japanese markets for the years covered in our sample. Therefore, it is not possible to estimate the share of shipments refused entry, out of the total imports.

The Figure 4.2 reports the descriptive statistics of the variables. The number of observations (25) refers to annual observations from 1990 to 2014. For these years, data on quantities and values of exports of shrimps and prawns from Mozambique are available. Since the regression is a panel data, the descriptive statistics is presented in country-by-country format.

Figure 4.4: Panel Unit Root Test: Methods (Levin, Lin & Chu Method)
H_0: Each individual time series contains a unit root
H_1: Each panel time-series is stationary

	Level, None	**Level, Intercept**	**Level, Trend, Intercept**
Variable	**Statistic**		
$QTY_{i,t}$	−1.64 [reject the H_0]	−2.72 [reject the H_0]	−4.12 [reject the H_0]
$PRI_{i,t}$	−1.56 [reject the H_0]	−2.45 [reject the H_0]	−3.32 [reject the H_0]
$PSU_{i,t}$	−1.81 [reject the H_0]	0.28	−1.06
$YIM_{i,t}$	0.07	−2.11 [reject the H_0]	−0.21
$SEC_{i,t}$	−3.37 [reject the H_0]	−2.49 [reject the H_0]	−1.39 [reject the H_0]

Source: Author

Panel data contains, inside it, a time dimension; therefore it is normal to look for unit roots (in panel data), applying “panel data unit root tests”. To test for the stationarity of the panel data, we used the Levin et al. (2002) unit root test. Contrarily to the normal time-series unit root testing, in the panel data the unit root test consider the asymptotic behavior of the time-series and the cross-sectional dimensions. The Levin et al. (2002) unit root method tests the panel time-series data, hypothesizing, as a null hypothesis, that each individual time series contains a unit root (H_0), against the alternative hypothesis that each panel time-series is stationary (H_1), where the lag order p is permitted to vary across individuals. In the Levin, Lin & Chu method, the probabilities for Fisher tests are calculated using an asymptotic Chi-square distribution.

The results provide an expected figure, since the majority of specifications support the alternative hypothesis, that each panel time-series is stationary. The PSU failed to reject the H_1 hypothesis when specified with intercept and with intercept and trend and *YIM* failed to reject the H_1 hypothesis when specified without intercept and trend.

4.4 RESULTS AND DISCUSSION

4.4.1 Results of the Estimations

For the regression, we applied OLS (ordinary least squares) on panel data. As said previously, the website of the Japanese Ministry of Health, Welfare and Labor[28] only shows information on border's detected cases from June 2006. Therefore, as for Japan, the panel data was constructed by putting dots (.) in the times-series from 1990 to 2005, and zero (0) onwards up to 2014, except for 2012, where data shows 1 case. In each table are shown the number of observations, the coefficient of determination (the R-squared, including the adjusted R-squared).

Table 4.4: Results of the Export Demand Equation (Equation 4.2)
Dependent Variable: $\log QTY_{i,t}$

Variable	**Pooled LS**		**Country Fixed Effects**	
	(1)	**(2)**	**(3)**	**(4)**
Constant	38.20 (6.61)***	36.35 (6.23)***	34.79 (3.04)***	33.07 (2.90)**
$\log PRI_{i,t}$	–0.85 (–4.14)***	–0.94 (–4.48)***	–0.85 (–6.23)***	–0.79 (–5.60)***
$\log PSU_{i,t}$	2.98 (4.47)***	3.19 (4.76)***	1.09 (1.75)*	0.96 (1.53)
$\log YIM_{i,t}$	0.90 (5.13)***	0.76 (4.90)***	0.17 (1.92)*	1.98 (1.76)*
$SEC_{i,t}$		0.16 (1.08)		0.10 (1.52)
Observations	100	100	100	100
R-squared	0.37	0.39	0.74	0.74
Adj. R-squared	0.35	0.36	0.72	0.72

Note: *t*-statistics in parenthesis
*** and **denotes significant at 1% and 5%, respectively

Source: Author

The objective of the regression was to test, using Mozambican shrimps and prawns exports as a case study, whether the sanitary and environmental indicators were determinants for the demand of exports. In the columns 1 and 3, only the traditional variables of the export demand model are

[28] http://www.mhlw.go.jp/english/topics/importedfoods/index.html (29 December 2015)

presented, while the columns 2 and 4 shows the results of the model, when the *SEC* is included. The columns 1 and 2 show the results of OLS pooled cross-section panel and the columns 3 and 4 show the results of effects specification on the country fixed effects regression.

The Table 4.4 results are generally as expected, except for *SEC*. In the columns (1) and (2) all the variables are performing well, but *SEC* appears positive (and not significant), which makes no sense in the logic behind this estimation. In fact, in column (4), *PSU* is positive, as expected, but with no significance, an estimation which includes *SEC* as a variable. The positive sign of the *SEC*'s coefficient should be attributed to the inclusion of Japan in the estimation, because in the entire 25 years length time-series only 1 sanitary and environmental problem was detected at its borders, as from imported products originated from Mozambique. Moreover, data on border detection cases are not available for Japan before 2006. The next table shows the results of all countries, except Japan[29].

Table 4.5: Results of the Export Demand Equation (Equation 4.2) (except Japan)
Dependent Variable: $\log QTY_{i,t}$

Variable	**Pooled LS**		**Country Fixed Effects**	
	(5)	**(6)**	**(7)**	**(8)**
Constant	44.62 (4.23)***	45.11 (4.38)***	17.88 (1.69)*	14.62 (1.39)
$\log PRI_{i,t}$	–0.84 (–2.68)***	–1.03 (–3.18)***	–0.79 (–4.61)***	–0.66 (–3.72)***
$\log PSU_{i,t}$	2.43 (2.29)**	2.43 (2.34)**	1.12 (1.86)*	1.01 (1.71)*
$\log YIM_{i,t}$	1.43 (2.81)***	1.46 (2.91)***	0.52 (0.49)	0.18 (0.18)
$SEC_{i,t}$		0.18 (0.88)*		–0.11 (–1.95)*
Observations	75	75	75	75
R-squared	0.38	0.41	0.82	0.83
Adj. R-squared	0.35	0.38	0.81	0.82

Note: *t*-statistics in parenthesis
*** and **denotes significant at 1% and 5%, respectively
Source: Author

The results are still unexpected, since *SEC* appears positive and significant in column (6), although negative and significant – as expected, in column (8) – but *YIM* appears as not significant in that

[29] As the Annex 3.1 shows, in the recent 25 years Japan is decreasing total imports of shrimps and prawns from the World and from Mozambique at an average of 5,005 tons and 73.40 tons from the World and Mozambique, respectively.

column. Once again, the sign for *SEC* in column (6) may not be caused only by Japanese figures. In a global view, the results from the Table 4.5 are similar to those found in the estimation with all the countries. In fact, looking to the data of *QTY*, Japan and Italy exhibits very fluctuating behavior, comparing to others trades partners (Spain and Portugal). As for Italy, while its total imports from the World are increasing at 2,229 tons per year, in the last 25 years (1990-2014), imports from Mozambique are decreasing by 15.29 tons per year, especially from 2004 onwards where on average Italy imported 36.52 tons, while in the previous years (1990-2003) was importing at 235.92 tons on average, per year (*see* Annex 3.2).

Let's turn to estimations with these stable partners.

Table 4.6: Results of the Export Demand Equation (Equation 4.2) (except Japan and Italy)
Dependent Variable: $\log QTY_{i,t}$

Variable	**Pooled LS**		**Country Fixed Effects**	
	(9)	**(10)**	**(11)**	**(12)**
Constant	–10.24 (–1.92)*	–16.67 (–3.46)***	8.84 (1.17)	1.12 (0.17)
$\log PRI_{i,t}$	–0.57 (–3.47)***	–0.24 (–1.47)	–0.69 (–4.50)***	–0.36 (–2.47)**
$\log PSU_{i,t}$	0.14 (1.69)*	0.10 (1.16)	0.75 (1.83)*	0.69 (1.80)*
$\log YIM_{i,t}$	1.58 (5.34)***	1.22 (7.28)***	0.55 (0.73)	1.34 (2.03)**
$SEC_{i,t}$		–0.16 (–4.17)***		–0.15 (–2.38)**
Observations	50	50	50	50
R-squared	0.53	0.66	0.62	0.73
Adj. R-squared	0.50	0.63	0.59	0.70

Note: *t*-statistics in parenthesis
***, ** and * denotes significant at 1%, 5% and 10%, respectively
Source: Author

The Table 4.6 reveals that the export demand model with Spain and Portugal performs better. In the majority of the estimations the variables are significant and exhibit the expected signs. The magnitudes of the coefficients are acceptable. In column (12), all the variables are correctly significant, and the R-squared – overall fit of the regression line – exhibits acceptable regression line in the scatter plot.

4.4.2 Discussion on the Determinants of Export Demand

4.4.2.1 Performance of All Export Demand Variables

Tables 4.4, 4.5 and 4.6 altogether points that the export demand model for shrimps and prawns exported from Mozambique performs better with Spain and Portugal. Japan and Italy are reducing the quantity demanded and adding them to the model affects the signs and the magnitude of the coefficients. Nevertheless, the poor results might also be caused by the data's level of aggregation (HS 1992, 6-digit) because at that level, products are not differentiated enough to be fully distinguished. For instance, substitute prices tend to be highly sensitive to the species and level of aggregation of the products because fisheries are not homogenous at the consumers' point of view. Previous studies of the export demand of fishery products faced this type of problem, also (Burton 1992; Lambert et al. 2006). Therefore, more studies should be carried out to dismiss whether these "mixture of results" holds or not.

4.4.2.2 Results of the Cross-Section (*Country*) *Fixed-Effects*

The results of the country fixed effects appear to perform better than the pooled LS regression, taking into account the sings of the coefficients. In fact, in most of the cases, the fixed effect methodology performed better than the pooled least square since it corrected the majority of the wrong signals detected in the pooled least square, but lowering the significance of these variables. This means that the adjustment for unobservable cross-section inter-connections worked to correct the signs of the coefficients, especially for *YIM* and *SEC*.

4.4.2.3 Results for the Sanitary and Environmental Indicators

The sanitary and environmental indicators are significant and with correct sign when Japan is removed from the equation. In fact, column (8) on country-fixed effect, *SEC* is significant, but a structural variable like *YIM* happen to be not significant; when Italy is also removed, both the *SEC* and *YIM* gains their correct signs and significance. This means that they tend to be important to the fluxes of quantities exported to Spain and Portugal, the two main partners. More studies should be carried out as soon as Japan discloses its reports on the years prior to 2006.

The results for *YIM*, significant and with correct sign with Spain and Portugal should be interpreted carefully to avoid misunderstanding: Spain and Portugal are increasing their demand for shrimps and prawns and most of the Mozambican recent exportation is directed to them.

Although the results appears as significant only with some trading partners, it should not be interpreted that the performance on sanitary and environmental conditions is not important in the trade of agro-food in these others countries. In fact, the number of products being rejected, destroyed or deviated to others markets is increasing, as well as the number of mandatory quantity of samples to be tested at laboratories.

4.5 CHAPTER 4 SUMMARY

In trying to test whether the sanitary and environmental conditions of the suppliers was determinant for the demand of shrimps and prawns exported from Mozambique, an export demand model with panel data, covering Spain, Japan, Portugal, and Italy, the main destinations, was estimated. In the estimation, others variables belonging to the structural export demand model were also estimated (prices and income). The export demand was analyzed by making an assumption of infinite supply price elasticity.

The shrimps and prawns, frozen, (HS 030613) were chosen due to its role as the major fishery product exported by Mozambique, to where the country is concentrating its production effort, by providing appropriate inputs, factors of production and extending the production capacity, as well as by improving the technical conditions (sanitary, health, and environmental conditions and standards) (Chapters 6 and 7 will treat these points).

The main motivation of doing this was to make a contribution to the literature on the impact of sanitary and technical measures to trade on agro-food products, known as one of the most difficult issues to be measured (Deardorff and Stern 1999; UNCTAD 2005; Fliess, and Schonfeld 2006). In fact, the majority of the studies measure it by estimating, quantitatively, the trade effect of standards, regulations, bans and prohibitions, without considering the number and the quantity of the products detected at the importers' borders – this is an alternative approach to study the effect of NTBs to trade, specifically, the TBT and SPS. However, the absence of publicly available data in most of the countries might limit the usage and widespread of this approach.

An impacting limitation of this analysis is the shorter number of observations per year (25 years, 4 cross-sections) and the usage of unit value to represent both exporting prices and substitute prices in the partner's (domestic) markets, due to lack of better data. Longer time-series and proper data for prices might return more promising results. After several estimations, the results show that the border detected cases are only significant for the trade with Spain and Portugal, which cannot be translated as meaning that others countries are careless about the issue.

The results for the elasticity of per capita income might impact the projections of private and public revenues from the exports. The estimation in column (12) reports elasticity of 1.34 with Spain and Portugal, meaning the more theses partners grow, the potential to expand exports of shrimps and prawns also increases. As for crustaceans, we found, in Chapter 2, income elasticity of 2.68 in developed countries and 3.57 in low income countries (*see* explanation on the magnitude of the coefficient on page 25). The result in column (12) confirms the growing importance of shrimps and prawns, including fish, in the world and the opportunity to be captured.

As for the column (12), the result of *PRI* tells the exporting price influences the demand for shrimps and prawns in Spain and Portugal, by decreasing the demanded quantity by 0.36 per cent when *PRI* increases by 1 per cent. This is a result of the increased world competition in that market and the availability of many others exporters, like Southeast Asia and Latin American traders, and many others shrimps and prawns species (Holthuis 1980). The reverse also can be said for *PSU*.

Attending that the estimation of the export demand function was done assuming the infinite supply price elasticity, the next chapter will relax this assumption and assume that changing exporting price affects the supply of exports of fishery products. Equally, the next chapter will see the differences of elasticity across fishery products, by comparing frozen shrimps and prawns, and dried fish, *kapenta*.

CHAPTER 5

SIMULTANEOUS MODEL OF THE SUPPLY AND DEMAND FOR MOZAMBICAN EXPORTS OF FISHERY PRODUCTS: FROZEN SHRIMPS AND PRAWNS AND DRIED FISH (*KAPENTA*)

5.1 INTRODUCTION TO CHAPTER 5

Previous study on the determinants of the export of Mozambican fishery products have been carried out considering the effect of sanitary and environmental measures on the export demand, assuming the world's supply price elasticity as infinite (Mendiate 2013). However and as pointed out by Goldstein and Khan (1978:275), "*unless export production is subjected to constant or increased returns to scale, it is unlikely that an increase in the world demand for a country's export can be satisfied without any increase in the price*", making important to study both the demand and also the supply variables to see the effect of the price of export.

In addition to this assumption – the effect of the export price on the supply – this chapter will study the differences of price, income and technical measure elasticity across fishery products, by comparing frozen shrimps and prawns, and dried fish (*kapenta*). Essentially, this is a comparison between the first and second most important products in Mozambican rank of fishery exports.

Apart from the effect of the price of exports, the chapter considers the case of meeting the international technical and sanitary standards from the supply side and assesses their effects on the export's supply price, as an instrument. Therefore, the determinants of export demand and export supply are explored by studying the prices and incomes elasticities of frozen shrimps and prawns and dried fish.

Taking the research question raised in Chapter 4, the exercise here to see whether others elements explains the demand and supply of exports of fisheries products from Mozambique, taking quantities and prices as endogenous, or, more precisely, whether the set of these instrumental variables have effects on dependent variable through the endogenous variable. Therefore, the simultaneous equilibrium model of demand and supply of exports is the methodology used, under the assumptions of a static and perfectly competitive world fishery market – under this assumption the price will act to equilibrate supply and demand. The hypothesis behind the system of equation departs from the idea that quantities and prices are endogenous and, thus, the elements that will impact on the quantity of exports demanded will be, amongst others, the supply' compliance to technical measures, represented by the costs of running laboratorial chemical and sanitary analysis, and that effect is observed through an endogenous variable.

This assumption of supply sensitivity on "the costs of compliance to technical measures to trade," makes sense because the costs might impact on the export price, as well as the entire production, processing, packaging, labeling and advertising stages. As will be clarified, the costs of compliance to technical measures to trade are assumed as the [costs] necessary to cover laboratorial tests on water, ice, fishery products, vessels, and others equipments that enter into contact with fish. This means that Mozambique supply will contribute to the change in the export price of its own fishery products in the trading partners markets'.

The section 2 revises the literature on simultaneous equation, concentrating on the estimations using fishery products. Section 3 presents the methodology, by specifying the models and by identifying and estimating the models. Section 4 presents the data, their sources and the tests for stationarity. Section 5 presents the results and discuss the findings, paying an attention on the estimates for income and price, as well as the comparison between estimations for shrimps and prawns *vs*. dried fish.

5.2 SIMULTANEOUS EQUATION: LITERATURE REVIEW FOR FISHERIES

Throughout the literature, domestic and international trade policies have been studied using the simultaneous equation. However, as for the fisheries international trade, there are just few examples

(DeVoretz 1982; Herrmannl and Lin 1988; Traesupap et al. 1999). The majority is concentrated on processed fisheries goods of the developed countries (DeVoretz 1982; Herrmannl and Lin 1988; Traesupap et al. 1999), and are heavily concentrated on the determination of the incomes and prices' elasticities.

DeVoretz (1982) used a simultaneous equation model to study domestic and export markets of canned salmon in Canada (species: Sockeye, Pink, Chum, and Coho). Results suggests price dependent model performs better than the quantity dependent model; and disaggregated species increases the knowledge about the operation of the markets since more disaggregated data tend to show greater elasticity value than its aggregate counterpart.

Herrmannl and Lin (1988) estimated simultaneous equation model to verify the demand of exports of the Norwegian Atlantic salmon in the USA (United States of America) and the EC (European Community). They constructed three structural equations representing the demand and supply of Norwegian Atlantic salmon in the USA and the demand for Norwegian Atlantic salmon in the EC. They reported that the demand for Norwegian Atlantic salmon was highly seasonal and highly price and income elastic for the both markets (USA and EC). All the substitutes (Chinook in the USA, and frozen Chinook, Sockeye and Coho in the EC) were found weak.

Traesupap et al. (1999) developed a simultaneous equation model for the supply and demand of shrimp in the domestic market of Japan. They studied the effects of changing exchange rates and the stock holdings of shrimp, with monthly data. They reported that the supply of Japan was inelastic to its own-price and the price was with less importance. Equally, the Japanese demand for shrimp was found to be price and income inelastic, and heavily dependent upon cultural factors.

Summarizing, the studies of fisheries products using simultaneous equation approach shows the lack of consensus about the magnitude of the parameters estimated, since they appear to vary greatly; for some studies the elasticities for income and prices have been found with wrong signs, or sometime without any statistical significance.

5.3 METHODOLOGY: SIMULTANEOUS EQUATIONS

To study the determinant of the supply and demand of exports of fishery products from Mozambique (frozen shrimps and prawns and dried fish), assuming that supply's effort to comply to technical measures impacts the exporting price, a system of two structural equations, one for the demand and other for the supply of exports, is estimated. Although the two equations express different relationships and can stand by themselves at a *ceteris paribus* interpretation, they are linked because an export happens only when supply and demand intersect.

5.3.1 The Nature of the Simultaneous Equations

The identification and estimation of SEM (simultaneous equation models) can be traced back in 1940s, when Trygve Haavelmo developed this methodology in 1943. Since then, many studies appeared, most of them concentrated in the equilibrium between the quantities demanded and supplied. The SEM are used in equilibrium ($QTY_D = QTY_S$, i.e. quantity demanded is equal to the quantity supplied) to model the values of two (or more) endogenous variables in a system of equations, where each equation has its own *ceteris paribus* interpretation (Anderson 1991; Greene 2008). For the models used in this chapter, prices and quantities are considered as endogenous variables, while the others are exogenous.

The exogenous variables are independent of the disturbance term of their structural equation, and therefore they can be estimated by using the OLS. However, for the system of equations, OLS is a biased estimator, and, thus, several methods are available and the 2SLS (two-stage least squares) or 3SLS (three-stage least squares) are the most used.

In the SEM, IV (instrumental variables) appears to provide consistence in the estimation, due to the correlation between the explanatory variable and the regression's errors (Adkins and Hill 2008;

Greene 2008). Instruments are series uncorrelated with the error term, but correlated with the right hand side variables.

5.3.2 Specification of the Models

To reach the objective of this study, two structural econometric models are specified, using two products: export demand and supply models for frozen shrimps and prawns (HS 030613) and dried fish, salted (HS 030559). The Mozambican export of fishery products' story says the export prices are a result of several factors, the most important being the foreign competitors, the price of relevant inputs, transportation costs and the linkage between exporters and importers (firms shareholders, for instance): the negotiations between exporters and importers, supply and demand, determine the value for each unit of export.

5.3.2.1 Demand of Mozambican HS 030613 and HS 030559 Exports

The demand model, either for frozen shrimps and prawns and for salted dried fish exported from Mozambique to foreign markets can be, basically, stated as determined by exporting and substitute prices, consumers incomes, and unmeasured disturbances factors. The equation can be represented as follow, in linear form:

$$\log QTY_{Di,t} = \pi_{10} + \pi_{11}\log PRI_{i,t} + \pi_{12}\log PSU_{i,t} + \pi_{13}\log YIM_{i,t} + v_{1i,t} \quad (5.1)$$

Where: QTY_D is the quantity of exports demanded; PRI is the price of export in the partners' markets; PSU is the price of substitutes in the partner's market; YIM is the income of the partners; and v_1 is the error term, which represents all others unmeasured disturbances that are impacting the demand. The π_{10} is the constant and due to logarithmical form of the model, the coefficients π_{11} … π_{13} are demand elasticities. According to the theory, it is expected negative signs for π_{11} and positive signs for π_{12} and π_{13}. The subscripts t denotes years, while i represents trade partner country i for Mozambique.

Due to low performance of the sanitary and environmental conditions (*SEC*) variable in the models for large number of countries (Mendiate 2013), it was dropped in the present export demand model.

5.3.2.2 Supply of Mozambican HS 030613 and HS 030559 Exports

The supply model can be expressed as dependent to the price of export, the production capacity of the supplier, and the costs of production. The equation can be shown below, in a log-log linear form:

$$(5.2) \qquad \log QTY_{Si,t} = \pi_{20} + \pi_{21}\log PRI_{i,t} + \pi_{22}\log CAP_t + \pi_{23}\log WAG_t + \pi_{24}\log CLA_t + v_{2i,t}$$

Where: QTY_S is the quantity of exports supplied; *PRI* is the price of export and *CAP* is the supplier's production capacity. To capture the costs of production, we used *WAG* for the average wage per-worker, and *CLA* for costs of laboratory analysis. The v_2 is the error term, to represent unobservable factors that are affecting the supply of exports. The π_{20} is the constant and the subscripts t and i denotes years and trade partner country i for Mozambique, respectively.

Again, due to logarithmical form of the model, the coefficients $\pi_{21} \dots \pi_{24}$ are supply elasticities. Following the theory, the coefficients for *PRI* and *CAP* should be positive, because both exporting price and production capacity affects the quantity of supply, positively; the coefficients for *WAG* and *CLA* shall be negative, because they capture the costs of production, negatively correlated with the exporting price.

5.3.3 Identification and Estimation

The error terms (v_1 and v_2) of the export demand and export supply models are assumed as being uncorrelated with each other. The "exclusion restriction" of the models is supported by the presence of exogenous variables not contained in the other equation.

5.3.3.1 Identification of the Equations

An equation is considered identified if and only if the other contains at least one exogenous variable (with non zero coefficient) that is excluded from the first equation. In that sense, a test of identification was carried out to assure the consistency of the estimated parameters. Following Greene (2008:356), the order condition for identification (which assure that the structural equation's parameters has at least one solution) seems to be achieved in the system of equation because the two equations are over-identified. The over-identification here means the equations have more instruments (other than exogenous variables) than the minimum necessary to run an IV estimation.

Let g denotes the total number of endogenous variables in the system and k is the total number of variables missing from a particular equation, then we have:

a) Export demand equation (equation 5.1): g=2 (the total number of endogenous variables in the system of equations); k=3 (the total number of variables missing from this particular equation, i.e. the supply's variables *CAP*, *WAG* and *CLA*); then $k>g-1$

b) Export supply equation (equation 5.2): g=2 (the total number of endogenous variables in the system of equations); k=2 (the total number of variables missing from this particular equation, i.e. the demand's variables *PSU* ad *YIM*); then $k>g-1$

The rank condition for identification, which ensure that there is exactly one solution for the parameters of the structural equations (Greene 2008:368) were verified by checking the presence of the variables in the system of equation:

Equation	*QTY*	*PRI*	*PSU*	*YIM*	*CAP*	*WAG*	*CLA*
Demand	1	1	1	1	0	0	0
Supply	1	1	0	0	1	1	1

Studying the 2×7 matrix, above: in the export demand equation, the remaining sub-matrix of the columns corresponding to the variables that do not appear in that equation has rank 1, thus equal to $m - 1$ (where m is the number of equations in the system). Equally, in the second equation the rank of the sub-matrix of the remaining columns of the variables that do not appears in that equation is 1. Therefore, the two equations satisfy the rank condition and the parameters of the equations are indentified.

5.3.3.2 Estimation of the First Stage

The first stage equations for each endogenous variable *QTY* and *PRI* in terms of exogenous variables *PSU*, *YIM*, *CAP*, *WAG* and *CLA*, the intercept and the residuals, can be found from the following algebraic transformations: assuming that the market clearing equilibrium is represented by the equilibrium condition, $QTY_{Di,t} = QTY_{Si,t}$, then:

(5.3) $$\pi_{10} + \pi_{11}\log PRI_{i,t} + \pi_{12}\log PSU_{i,t} + \pi_{13}\log YIM_{i,t} + v_{1i,t} = \pi_{20} + \pi_{21}\log PRI_{i,t} + \pi_{22}\log CAP_t + \pi_{23}\log WAG_t + \pi_{24}\log CLA_t + v_{2i,t}$$

(5.4) $$\pi_{11}\log PRI_{i,t} - \pi_{21}\log PRI_{i,t} = (\pi_{20} - \pi_{10}) + \pi_{22}\log CAP_t + \pi_{23}\log WAG_t + \pi_{24}\log CLA_t - \pi_{12}\log PSU_{i,t} - \pi_{13}\log YIM_{i,t} + (v_{2i,t} - v_{1i,t})$$

(5.5) $$(\pi_{11} - \pi_{21})\log PRI_{i,t} = (\pi_{20} - \pi_{10}) + \pi_{22}\log CAP_t + \pi_{23}\log WAG_t + \pi_{24}\log CLA_t - \pi_{12}\log PSU_{i,t} - \pi_{13}\log YIM_{i,t} + (v_{2i,t} - v_{1i,t})$$

(5.6) $$\log PRI_{i,t} = \frac{(\pi_{20} - \pi_{10})}{(\pi_{11} - \pi_{21})} + \frac{\pi_{22}}{(\pi_{11} - \pi_{21})}\log CAP_t + \frac{\pi_{23}}{(\pi_{11} - \pi_{21})}\log WAG_t + \frac{\pi_{24}}{(\pi_{11} - \pi_{21})}\log CLA_t - \frac{\pi_{12}}{(\pi_{11} - \pi_{21})}\log PSU_{i,t} - \frac{\pi_{13}}{(\pi_{11} - \pi_{21})}\log YIM_{i,t} + \frac{(v_{2i,t} - v_{1i,t})}{(\pi_{11} - \pi_{21})}$$

$$(5.7) \quad \log PRI_{i,t} = \Omega_{30} + \Omega_{31}\log CAP_t + \Omega_{32}\log WAG_t + \Omega_{33}\log CLA_t + \Omega_{34}\log PSU_{i,t} + \Omega_{35}\log YIM_{i,t} + v_{3i,t}$$

Where, Ω's are the parameters of the first stage equation for the log*PRI*. More details on the equation are provided in the Annex 4. The estimation of the equation (5.7) is provided for in the section 5.5.1.

5.4 DATA, SOURCES AND TESTS

5.4.1 Data and Description

5.4.1.1 Quantity of Exports

The quantity of exports (*QTY*) accounts for the total of fishery products exported to individual partners' markets, per capita[30], expressed in kgs. For the shrimps and prawns equations, the quantity refers to exports destined to Spain, Portugal, Japan and Italy. For the dried fish (*kapenta*), the *QTY* refers to the quantity exported to South Africa, Zimbabwe, Malawi and Zambia. Both quantities are a mixture of all the sizes and a mixture of wild and aquaculture harvests.

As expressed in the section 5.3.1, the assumption made here is the quantity demanded equals the quantity supplied, i.e. the shrimps and prawns as well as the dried *kapenta* produced by the firms and fishery actors, every year in the time series, is sold abroad; the difference between the supply and the demand is small enough to be negligible. Additionally, it is assumed that in each respective market, consumers and producers agree about the conditions for market clearance.

Data for the *QTY* of shrimps and prawns are from the UN-COMTRADE, EU EUROSTAT, Japanese Customs Clearance Statistics and INE-Mozambique. Data for the *QTY* of dried fish are from UN-COMTRADE, complemented by the INE-Mozambique in all the periods where the UN-

[30] Data on Population is from World Development Indicators

COMTRADE's don't show trade fluxes. In general, these are the main sources of statistical data for trade fluxes, including the value of the exports.

5.4.1.2 Exporting Price

The exporting prices (*PRI*) are expressed in unit value, since they arise from the ratio between the value of exports, in USD and the quantities (all sizes, captures and aquacultured), in kgs. This variable is inflation-adjusted and expressed in 2000 USD, taking the IMF Food Commodity Index. Data comes from UN-COMTRADE, EU EUROSTAT, Japanese Customs Clearance Statistics, and INE-Mozambique, for frozen shrimps and prawns, and from UN-COMTRADE and INE-Mozambique, for dried fish.

5.4.1.3 Price of Substitute

The *PSU* stands for the price of substitute goods in the partners' domestic markets. For frozen shrimps and prawns the price of substitutes are the following: in Spain, Argentinean frozen shrimps and prawns, all sizes; in Portugal, French frozen shrimps and prawns, all sizes; in Japan, Indonesian shrimps and prawns, all sizes; and in Italy, Ecuadorian frozen shrimps and prawns, all sizes. The sources of the data are: UN-COMTRADE, EU EUROSTAT, Japanese Customs Clearance Statistics, and INE-Mozambique.

For the dried fish, the prices for substitutes are the following: in South Africa, dried fish imported from Namibia; Zimbabwe, imported from Zambia; Malawi and Zambia, dried fish from Tanzania, all sizes. In the same way, this variable is inflation-adjusted and expressed in 2000 USD, by using the IMF Food Commodity Index. Data are from UN-COMTRADE and INE-Mozambique.

5.4.1.4 Partner's Incomes

For the *YIM*, partners' income, the GDP per capita (expressed in 2000 USD) is used. Data source for the variable is the World Bank's World Development Indicators.

5.4.1.5 Production Capacity

The difficulty of estimating this variable was explained in Chapter 2, in the section 2.2.1. There it is explained that the sensibility of fishery products (its ecological endangered and vulnerability status) leads to a huge discussion about the real capacity of production of these resources.

A good proxy for the fishery production capacity would be the total allowable catch (TAC), which is the legal limit set by a government for a particular fishery or species for the fishing season, expressed in tons of live-weighed equivalence (usually, the TAC's data appear presented in fishing areas – marine and inland areas – and describes the ecological status of the adult species, recommending, thus, the appropriate fishing techniques). However, the TAC's are only available for captures, and there no any TAC for aquacultured products. Due to that limitation, the production capacity is proxied by the Mozambican GDP per capita, expressed in 2000 USD, deflated for real values. Data for this variable comes from the World Bank's World Development Indicators.

5.4.1.6 Production Costs

As defined in the section 2.2.3 of the Chapter 2, the production costs comprises the expenses required to keep a producing and processing plant working, and it includes the costs for equipments and technology, interests, etc. As for fisheries plants, the cost comes from raw material, supervision, maintenance, as well as the expenses necessary for distribution, sale, and running the offices.

For the supply function, the *WAG* represents the average wage of the workers in the fishing industry sector in Mozambique (commercial firms and farms), and is a proxy for the production costs. In reality, however, the cost with "wage" is only a piece on the production costs, and, attending the size of the companies and the magnitude of the increases, “wages” might increase without affecting significantly the production costs.

In Mozambique, however, fishing industry is characterized by low usage of technology and intensive usage of labor forces. The trend towards an adoption of new technologies is also very slow. This scenario means that the production process is highly dependent on labor force, which makes the assumption of “decreased supply with increased wages” very plausible.

To estimate this variable, several steps were observed:

a) Find the number of labor force in the fishing industry in Mozambique, per year: several estimates done by the MoF (Ministry of Fishery – Mozambique) contain the number of people directly employed in fishery sector, but we couldn’t access to these estimates. However, in 2003, the employment was estimated at more than 95,000 peoples, of whom 90 per cent employed in the artisanal sector[31]. The MoF, quoted by the given FAO website, estimated that about 1,000 people were employed on the commercial farms on a full-time basis in 2003.

b) The labor force in the vessels was constituted, overwhelmingly, by low educated workers, while the administrative tasks were performed by secondary educated peoples. The commercial farms employ workers with some technical and managerial skills.

c) To find the number of labor force in the commercial fishing industry, we took the 2003’s data, multiplied by the rate of growth of the economy, measured by GDP growth rate. With this methodology, the previous and after 2003’s data on commercial sector employments were estimated.

d) Salary of the labor force employed in the fishing industry in Mozambique, per year: to estimate this, we used two periods: 1990-2007 and 2008-2014: in the first period, a certain minimum wage was established for all sectors of the economy; in the second period, the

[31] http://www.fao.org/fishery/countrysector/naso_mozambique/en (12 February 2013)

minimum wage is differentiated across economic sectors and it is determined according to the monthly food basket, general performance of the economy, inflation/consumer price index and the performance of the given sector in the economy. The *kapenta* industry has its own minimum wage, usually slightly below the minimum wage for the remaining fishing industry.

e) The incidence of minimum wages in the whole Mozambican labor force is around 70 per cent[32]. Assuming this as true for fishery industry, it means the minimum wage can be used as a proxy of the wages in the fishing industry as well.

f) The minimum wage for 2010 is known[33]. Taking the inflation rate as the main determinant for the net wage, the wages previous to 2010 can be estimated. The wages for shrimps and prawns sector and dried fish is equaled, except from 2008-2014.

g) Finally, the wages (given in Metical) are deflected to 2000 constant prices, using the Mozambique Consumer Price Index. Then, they are exchanged to USD using the exchange rate of Metical-USD for the year 2000.

5.4.1.7 Costs for Laboratorial Analysis

Finally, we calculated the costs for laboratorial analysis, *CLA*. The *CLA* captures the costs involved for laboratorial analysis, incurred by firms. Laboratorial analyses are of great importance for traders of fishery products since it is one of the conditions for export entrance in the demanding markets. The structure of the costs involved covers physical, chemical and microbiological parameters, and this is an important step to get a health certificate for export.

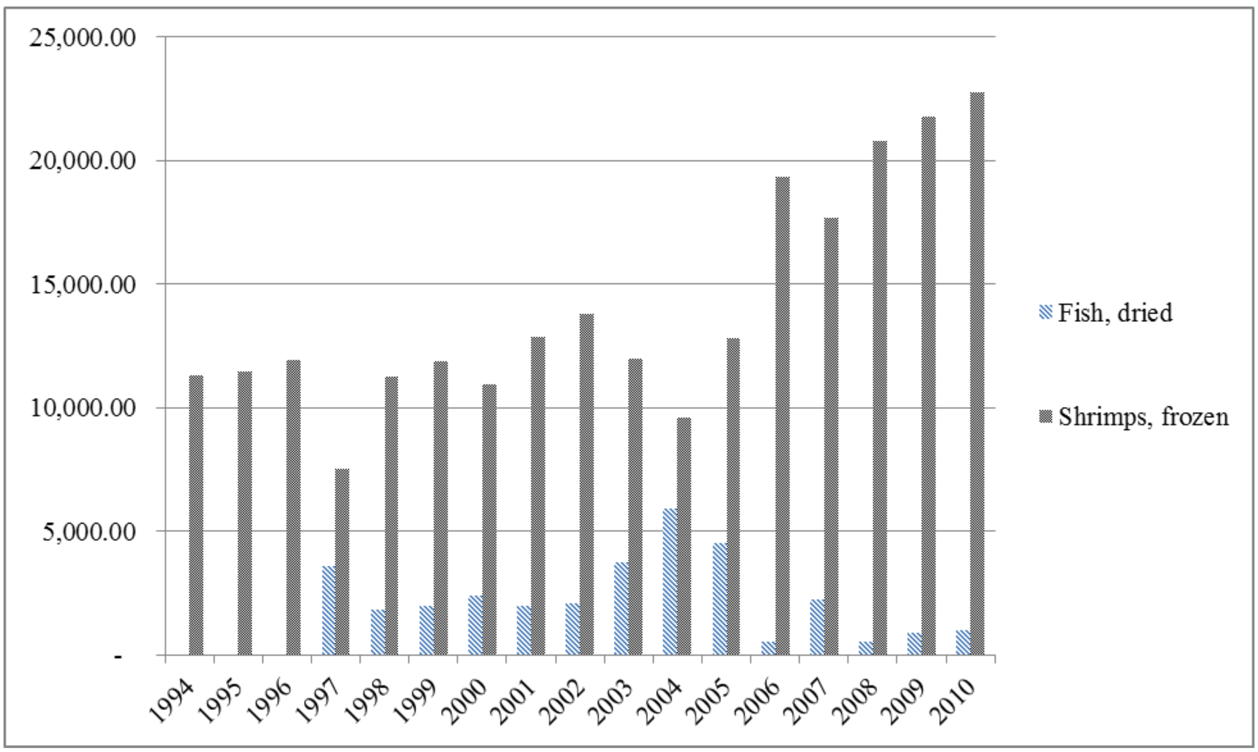
In laboratories, the analyses cover items such as water quality (pH), the presence of metals, plastics, and others possible residues, the freshness of the products, as well as the salinity content. More detailed analysis provides information regarding the microbiological status of the products, by

[32] http://www.wageindicator.org/documents/publicationslist/publications-2011/MOZAMBIQUE.pdf (1 March 2013)
[33] http://www.meusalario.org/mocambique/main/salario/salario-minimo (1 March 2013)

detecting some harmful bacteria (for instance Salmonella, V. *parahaemolyticus*, Staphylococcus *aureus*, *Listeria monocytogenes*, E. *Coli*, including fecal coliforms, and others). Due to the importance in preventing food-borne diseases, it seems reasonable to assume that all exporting firms will support a certain amount of costs for such laboratorial tests, independently of exporting frozen shrimps and prawns or dried fish.

To find the costs incurred by firms to carry out the laboratorial analysis, we defined the costs of laboratorial analysis per unit of fishery products. From the survey, the INIP Mozambique provided the following costs, in USD[34], representing the situation in 2002: 34.80 and 30.80 for shrimps and prawns, fresh and frozen, respectively; and 25.20 and 20.20 for fish, frozen and dried, respectively.

Figure 5.1: Costs for Tests in a Mozambican Laboratory (Yearly, USD): Fish, dried vs. Shrimps, frozen



Source: Author, from Annex 2's calculations.

[34] Author's responsibility for the conversion from Metical's to USD.

To generate data on costs for laboratorial analyses representing the country, in all the time-series period (1990-2014, for shrimps and prawns, and 2000-2014 for dried fish), the following calculations were done (more details, Annex 2):

a) Transform the quantities of frozen shrimps and prawns and dried fish exported, from tons to kg (Column B);

b) From the INIP's 2002 data on the costs of laboratorial analysis per unit, and using the inflation rates of the previous years and following years, we estimated what would be the costs of laboratorial analysis, per unit (Column D);

c) In the absence of an international standard saying the number of samples of fishery products to be checked by domestic laboratories (the unit for laboratorial test), we considered expert's ideas about this issue. And according to Bowser (1993):

> "*The number of fish selected and examined is determined by statistical principles that consider number of fish in the population, expected incidence of the disease organism and desired level of confidence that the pathogen is not present. The number of fish to be sampled is determined by the inspection team by examining various statistical tables …*"

d) From the previous idea and also considering the Bowser's (1993) statement that when the total population [of fish or species of fishery products] exceed 2,000 fish, laboratories tend to examine 60 individual fish taken randomly, we got an average weight of tiger prawns, *Panaeus monodon*, (all sizes, male and female) and for freshwater sardine (all sizes, male and female) of the species *Limnothrissa miodon* and *Stolothrissa tanganicae,* known as *kapenta*;

e) From Wikipedia site[35], we found that, on average, tiger prawns are weighted as 197.50 grams. Since we couldn't find weights for the freshwater sardine, we estimated the weight of marine sardines, estimated to be around 162.50 grams. In this regard, 60 individual fish

[35] http://en.wikipedia.org/wiki/Penaeus_monodon and http://en.wikipedia.org/wiki/Sardine (23 January 2013)

necessary for an one-time laboratorial test implies the following quantities: 11.85 kgs for shrimps and prawns and 9.75 kgs for fish (Column E);

f) Assuming that firms/vessels exported once per-month (Column C), this implies that the quantities of one-time laboratorial tests are monthly data;

g) Then, the one-firm yearly costs for laboratorial tests is given by multiplying monthly laboratorial costs per unit and the number of months per year, 12 (Column F);

h) Finally, to generate country data, we assumed the number of exporting firms/vessels as the same as that provided by the EU third-country establishments lists website. To estimate the number of firms/vessels for each of the year of the time-series, we considered the country data on GDP growth, annual (Columns G and H);

i) To estimate how many, from these exporting firms/vessels are running shrimps and prawns or dried fish business, the estimated number of firms/vessels were divided according to the share in exports, of each cluster of fishery products (Column I);

j) Costs of laboratorial analyses per-group of species exported (shrimps and prawns, frozen *vs*. dried fish (*kapenta*)), per year, are calculated (Figure 5.1).

After getting the results on the costs for laboratorial analysis, they were weighted to capture the relative importance of the trading partners. This is inflation-adjusted by using the Mozambique Consumer Price Index, and expressed in USD, after conversion from Metical's to USD.

5.4.2 Summary Table and Descriptive Statistics

The Table 5.1 displays the summary statistics. The observed period is 1990 to 2014, for shrimps and prawns and 2000-2014 for dried fish. As for fishery products, this period contains two momentums: first, the effect of *El Niño* in the oceanic waters', and second, the recent world economic slowdown (2008-2011). The impacts of these two events in the world fishery industry need to be estimated. We assume that these events did not impacted significantly on the fishery industry in Mozambique because a major portion of shrimps and prawns comes from aquaculture farms and the *kapenta* fishery comes from inland waters, far from Indian Ocean.

Table 5.1: Summary of the Data, Sources, Descriptions and Units of Measurement

Variable	**Description**	**Measurement**	**Source**
$QTY_{i,t}$	Quantity of exports of frozen shrimps and prawns (1990-2014) or dried fish (2000-2014) to country *i* per capita	Kg	EUROSTAT; Japan Customs Clearance Statistics; UN-COMTRADE and INE-Mozambique
$PRI_{i,t}$	Price of frozen shrimps or dried fish of Mozambique in country *i* (2000 USD, constant)	Unit value USD	EUROSTAT; Japan Customs Clearance Statistics; UN-COMTRADE and INE-Mozambique
$PSU_{i,t}$	Prices of substitutes in country *i* (2000 USD, constant)	Unit value USD	EUROSTAT; Japan Customs Clearance Statistics; UN-COMTRADE and INE-Mozambique
$YIM_{i,t}$	Per capita GDP of the country *i* (2000 USD, constant)	USD	World Bank's World Development Indicators
CAP_t	Production capacity (proxy: Mozambican Per capita GDP, 2000 USD, constant)	USD	World Bank's World Development Indicators
WAG_t	Wage (average) of the fishery industry in Mozambique (2000 USD, constant)	USD	Author's estimation, from various sources
CLA_t	Costs for laboratorial analysis in Mozambique, per specie of fishery product (2000 USD, constant)	USD	Author's estimation, from various sources (*see* Annex 2)

Source: Author

The descriptive statistics appears in the Tables 5.2 and 5.3. There, the data on the trading partners are presented. The supply side typical variables are presented on the rows for Mozambique – *CLA*, *CAP* and *WAG*.

Table 5.2: Descriptive Statistics – Equation for Shrimps and Prawns, Frozen (1990-2014)

		QTY	*PRI*	*CLA*	*PSU*	*CAP*	*YIM*	*WAG*
Spain	Mean	0.0990	8.78	9,126.39	8.10	327.62	23,796.55	61.81
	Median	0.1092	8.60	8,167.60	7.73	319.78	24,996.14	58.10
	Maximum	0.2200	26.64	17,308.09	13.48	535.73	27,661.02	90.10
	Minimum	0.0096	2.99	267.73	5.37	174.51	19,151.88	54.01
	St. Deviation	0.0458	5.15	5124.41	1.71	116.70	2,878.20	10.29
	Observations	25	25	25	25	25	25	25
Portugal	Mean	0.1563	8.93	10,219.36	9.10	327.62	17,521.18	61.81
	Median	0.1318	8.60	7,988.08	8.97	319.78	18,365.50	58.10
	Maximum	0.5272	32.45	65,127.10	10.93	535.73	19,489.27	90.10
	Minimum	0.0249	2.99	873.09	7.19	174.51	14,245.50	54.01
	St. Deviation	0.1120	6.09	12,098.95	0.86	116.70	1,727.36	10.29
	Observations	25	25	25	25	25	25	25
Italy	Mean	0.0021	10.49	8,376.90	6.91	327.62	29,868.71	61.81
	Median	0.0015	6.52	7,988.08	6.73	319.78	29,965.99	58.10
	Maximum	0.0066	59.30	15,355.86	9.77	535.73	32,830.73	90.10
	Minimum	0.0000	2.99	938.81	4.69	174.51	26,476.76	54.01
	St. Deviation	0.0020	13.29	3,660.96	1.35	116.70	1,979.82	10.29
	Observations	25	25	25	25	25	25	25
Japan	Mean	0.0086	23.45	8,274.10	10.95	327.62	34,594.66	61.81
	Median	0.0100	8.80	7,821.09	10.84	319.78	34,172.55	58.10
	Maximum	0.0171	185.24	15,355.86	13.86	535.73	37,595.17	90.10
	Minimum	0.0001	2.99	1,245.88	8.70	174.51	31,174.96	54.01
	St. Deviation	0.0058	45.21	3,391.33	1.63	116.70	1,891.13	10.29
	Observations	25	25	25	25	25	25	25

Source: Author (Compilation)

Table 5.3: Descriptive Statistics – Equation for Fish, Dried (2000-2014)

		QTY	*PRI*	*CLA*	*PSU*	*CAP*	*YIM*	*WAG*
South Africa	Mean	0.00053	1.80	2,919.79	3.68	327.62	5,601.70	61.81
	Median	0.00020	0.81	2,147.85	3.59	319.78	5,820.66	58.10
	Maximum	0.00326	7.99	8,547.24	8.24	535.73	6,090.27	90.10
	Minimum	0.00004	0.18	324.09	0.56	174.51	4,854.37	54.01
	St. Deviation	0.00082	2.43	2,666.35	2.35	116.70	470.96	10.29
	Observations	15	15	15	15	15	15	15
Zimbabwe	Mean	0.27959	2.94	3,432.94	1.17	327.62	468.04	61.81
	Median	0.06435	2.14	2,493.00	0.89	319.78	443.24	58.10
	Maximum	2.86582	10.79	7,512.05	2.34	535.73	679.87	90.10
	Minimum	0.01469	0.57	598.17	0.24	174.51	326.57	54.01
	St. Deviation	0.72056	2.48	2,433.55	0.74	116.70	109.63	10.29
	Observations	15	15	15	15	15	15	15
Malawi	Mean	0.00982	1.31	2,852.72	1.20	327.62	236.55	61.81
	Median	0.00870	0.72	2,147.85	0.17	319.78	228.08	58.10
	Maximum	0.03136	4.21	9,723.03	14.18	535.73	274.35	90.10
	Minimum	0.00177	0.20	542.86	0.04	174.51	205.43	54.01
	St. Deviation	0.00764	1.31	2,520.77	3.60	116.70	25.22	10.29
	Observations	15	15	15	15	15	15	15
Zambia	Mean	0.09934	4.29	2,210.89	2.46	327.62	784.97	61.81
	Median	0.01758	2.05	1,939.20	0.26	319.78	764.70	58.10
	Maximum	1.11997	21.35	5,908.76	32.39	535.73	1,032.80	90.10
	Minimum	0.00016	0.37	598.17	0.12	174.51	582.62	54.01
	St. Deviation	0.28415	5.63	1,606.46	8.28	116.70	156.72	10.29
	Observations	15	15	15	15	15	15	15

Source: Author (Compilation)

5.4.3 Test for Unit Root

As said in the Chapter 4, the time set dimension of the panel data deserves an analysis of the unit root test (for panel data). Once again, the Levin et al. (2002) method is used. The test hypothesizes that that each individual time series contains a unit root (H_0), against the alternative hypothesis that each panel time-series is stationary (H_1). For the unit root test we assumed (1) neither intercepts nor trend, (2) intercepts, but no trend and (3) both trend and intercept. The results are provided in the Figure 5.2.

Figure 5.2: Panel Unit Root Test: Methods (Levin, Lin & Chu Method)
H_0: Each individual time series contains a unit root
H_1: Each panel time-series is stationary

Variable	**Level, None**	**Level, Intercept**	**Level, Trend, Intercept**
		Statistics	
$QTY_{i,t}$ (Shrimps)	−1.71 [reject the H_0]	−4.76 [reject the H_0]	21.50
$PRI_{i,t}$ (Shrimps)	−0.41	4.09	−4.29[reject the H_0]
$PSU_{i,t}$ (Shrimps)	−2.86 [reject the H_0]	0.14	−2.58 [reject the H_0]
$YIM_{i,t}$ (Shrimps)	3.14	−2.65 [reject the H_0]	0.43
CAP_t (Shrimps)	−0.88	−5.07 [reject the H_0]	2.25
WAG_t (Shrimps)	10.71	−3.20 [reject the H_0]	2.86
CLA_t (Shrimps)	−1.89 [reject the H_0]	0.93	−2.11 [reject the H_0]

$QTY_{i,t}$ (*Kapenta*)	−2.59 [reject the H_0	−0.66	−5.76 [reject the H_0]
$PRI_{i,t}$ (*Kapenta*)	−2.10 [reject the H_0]	−3.62 [reject the H]	−2.26 [reject the H_0]
$PSU_{i,t}$ (*Kapenta*)	−2.51 [reject the H_0]	−1.71 [reject the H_0]	−5.71 [reject the H_0]
$YIM_{i,t}$ (*Kapenta*)	5.22	5.36	−1.29 [reject the H_0]
CAP_t (*Kapenta*)	−2.92 [reject the H_0]	−1.39 [reject the H_0] $_0$]	−3.58 [reject the H_0]
WAG_t (*Kapenta*)	10.52	3.59	2.61
CLA_t (*Kapenta*)	−2.72 [reject the H_0]	−3.06 [reject the H_0]	−2.04 [reject the H_0]

Source: Author

The unit root test for the data on frozen shrimps and prawns is, mainly, stationary when trend and intercept are added. The majority of the specifications in the unit root test for the data on dried fish reject the H_0 hypothesis, which confirms that each panel time-series is stationary.

5.5 RESULTS AND DISCUSSION

5.5.1 Results of the First-Stage Regression

In the first stage, the 2SLS methodology is devoted to find the endogenous and exogenous variables that can be attributed to the instruments. Therefore, the equation (5.7) was estimated using OLS regressor.

Table 5.4: Results of the First Stage: Shrimps and Prawns, Frozen (1990-2014) and Fish, Dried (2000-2014)
Dependent Variable: $\log PRI_{i,t}$

Independent Variables	Shrimps and Prawns, Frozen		Fish, Dried	
	Pooled LS	**Fixed Effect**	**Pooled LS**	**Fixed Effect**
Constant	0.92 (0.19)	16.87 (1.01)	11.27 (1.10)	6.96 (0.67)
$\log CAP_t$	–0.22 (–0.18)	1.06 (0.71)	5.59 (0.99)	5.73 (1.10)
$\log WAG_t$	0.28 (0.11)	–0.82 (–0.29)	–9.61 (–0.99)	–10.24 (–1.15)
$\log CLA_t$	0.31 (0.87)	0.27 (1.31)	–0.23 (–1.31)	–0.24 (–1.48)
$\log PSU_{i,t}$	0.66 (1.95)*	0.69 (1.43)	0.07 (0.56)	0.05 (0.37)
$\log YIM_{i,t}$	0.18 (0.66)	–1.62 (–0.98)	–0.14 (–0.09)	0.78 (0.85)
Observations	100	100	60	60
R-squared	0.11	0.12	0.15	0.24
Adj. R-squared	0.06	0.05	0.08	0.12

Note: *t*-statistics in parenthesis
* denotes significant at 10%, respectively

Source: Author

Overall, the results are poor, since almost all of them are not significant and the signs are unexpected, particularly on the dried fish side. The signs for *WAG* are unexpected, except for pooled LS on shrimps and prawns. The results of dried fish have, in general, more problems with signs and the dimension of the coefficients. Nevertheless, all the variables will be jointly estimated either as instruments or as exogenous variables in the 2SLS and their interpretation will be based on the overall size of the *F*-statistics.

5.5.2 Results of the Second-Stage Regression

In this stage, each variable in the model is estimated in OLS regression, on the set of instruments. In the second stage, the 2SLS makes a regression of the original equation – the demand of exports for shrimps and prawns and for dried fish (equation (5.1), separately) – with all of the variables replaced by the fitted values from the first-stage regressions, and the coefficients of this regression are the estimates of the 2SLS.

To estimate the coefficients we specified the regression as follows:

- Dependent variable: $\log QTY_{Di,t}$;
- Endogenous variable: $\log PRI_{i,t}$;
- Exogenous variables: Constant, $\log YIM_{i,t}$ and $\log PSU_{i,t}$;
- Additional instruments: $\log CAP_t$, $\log WAG_t$ and $\log CLA_t$;
- Others instruments (the right-hand side variables not correlated with the disturbances): Constant, $\log YIM_{i,t}$ and $\log PSU_{i,t}$.

As said, the above specification satisfies the order condition for identification, which makes requirements on the number of instruments being at least equal or more than the number of coefficients in the equation specification. It also satisfies the rank condition on the existence of solutions for the parameters of the structural equations.

Below are the results of the regression of $\log QTY_{Di,t}$ on the $\log PRI_{i,t}$, $\log YIM_{i,t}$ and $\log PSU_{i,t}$ with the instruments listed. The instruments are considered relevant as they are correlated with the endogenous variables regressors in the first stage. Moreover, the F-statistics[36] provides the relevance of the instruments, departing from the rule of thumb than F-Test results should be bigger than 10.

[36] F-statistics is about the jointly significance of a group of instrumental variables.

5.5.2.1 Results for Shrimps and Prawns, Frozen

The results for the demand of shrimps and prawns, frozen are presented. The results of columns (1) and (2) are satisfactory, except for *YIM*, whose coefficient is negative and significant. The suspicion here is the reduction of the imported volumes by Italy and Japan in recent years. In this regard, the two countries are dropped, and columns (3) and (4) report the results:

Table 5.5: Results of the 2SLS: Export demand equation: Shrimps and Prawns, Frozen
Dependent variable: log$QTY_{Di,t}$
Instruments: Constant, logCLA_t, logCAP_t, log$PSU_{i,t}$, logWAG_t, and log$YIM_{i,t}$

Variables	**Spain, Portugal, Italy and Japan**		**Only Spain and Portugal**	
	Pooled LS (1)	**Fixed Effects (2)**	**Pooled LS (3)**	**Fixed Effects (4)**
Constant	38.40 (5.83)***	41.66 (2.90)***	–14.73 (–1.79)*	31.78 (1.49)
log$PRI_{i,t}$	–1.87 (–3.14)***	–1.70 (–4.01)***	–0.13 (–0.22)	–1.94 (–1.95)*
log$PSU_{i,t}$	3.47 (3.97)***	1.64 (2.06)**	0.4 (0.60)	0.41 (1.69)*
log$YIM_{i,t}$	–2.82 (–4.36)***	–2.79 (–2.00)**	2.88 (4.40)***	1.41 (2.07)**
Observation	100	100	50	50
R-squared	0.18	0.63	0.46	0.18
Adj. R-squ.	0.15	0.61	0.42	0.13
F-statistic	15.12	35.94	10.71	12.81

Note: *t*-statistics in parenthesis
***, ** and * denotes significant at 1%, 5% and 10%, respectively
Source: Author

The results in column (4) show good outputs, since all of the coefficients of the variables exhibits correct signs and are significant.

The magnitude of the coefficients tells that when the exporting price increases by 1 per cent, the quantity of exports demanded goes dawn by 1.94 per cent, attending the country fixed-effect. The magnitude of the fixed effect estimation says when country [effects] is considered, the quantity of exports demanded fall slightly more than when these effects is removed (–0.13).

The *PSU* remained stable in all the results, with correct signs and significant in the majority of the results. This means pooled and countries effects are significant for the *PSU*, and this explanation makes sense due to differences of the prices of shrimps and prawns in the international market and the presence of substitutes. Because consumers can buy shrimps and prawns from Mozambique, the increase in 1 per cent of the prices of the substitute products in the main trading partners will generate an increased purchase of shrimps and prawns from Mozambique by 0.41 per cent.

The *YIM* is significant and with correct sign with Spain and Portugal only. Accounting the country fixed effect, the results suggests that increasing 1 per cent of income of the trading partners will result in an increased demand for shrimps and prawns from Mozambique of 1.41 per cent.

All the results also are consistent with those presented in Table 4.6 in the Chapter 4: the elasticity of price of export decreased from –0.36 in Chapter 4 to –1.94 in the SE and IV estimations. The *PSU*'s elasticity also decreased from 0.69 to 0.41. The *YIM*'s elasticity rose from 1.34 to 1.41.

The instruments used in this regression are considered as having effects on the dependent variable only through endogenous variable.

5.5.2.2 Results for Fish, Dried (Kapenta)

The result for the demand of exports of dried fish was also estimated. As said, dried fish (notably, *kapenta*) is the second single fishery specie products exported by Mozambique, destined basically to South Africa, Malawi, Zimbabwe and Zambia, neighbor countries and all of them located in hinterland (except South Africa).

Although additional should support what seems logic, it can be said that *kapenta* is not reaching higher standards consumers because is poorly processed, stored, and transported in inappropriate vehicles, reducing its quality, average prices, and raising sanitary and environmental concerns. Since transportation facilities are poor, the trade occurs with neighbor countries', impeding the widespread of this product in sound international destines.

The objective of running this estimation was, then, to submit the first and the second main products with the same regression tests to compare their performance in terms of elasticity for price and income, in the presence of SE of demand and supply of exports.

Table 5.6: Results of the 2SLS: Export demand equation: Fish, Dried (*Kapenta*)
Dependent variable: $\log QTY_{Di,t}$
Instruments: Constant, $\log CLA_t$, $\log CAP_t$, $\log PSU_{i,t}$, $\log WAG_t$, and $\log YIM_{i,t}$

Independent Variables	**South Africa, Zimbabwe, Zambia and Malawi**	
	Pooled LS (5)	**Fixed Effects (6)**
Constant	19.82 (7.09)***	–4.61 (–0.33)
$\log PRI_{i,t}$	–0.99 (–0.58)	–1.47 (–1.03)
$\log PSU_{i,t}$	0.16 (0.61)	–0.11 (–0.43)
$\log YIM_{i,t}$	–1.14 (–3.19)***	2.50 (1.20)
Observation	60	60
R-squared	–0.13	0.18
Adj. R-squared	–0.19	0.09
F-statistic	7.71	12.25

Note: *t*-statistics in parenthesis
*** denotes significant at 1%
Source: Author

The table below shows the results where, generally speaking, the results are poor: in column (5) there are some inconsistent signs (*YIM*), and R-squared (–0.13), which tells about the bad quality of the regression line fit. The *F*-statistic also is below 10, which combined with the overall results suggests that better data, longer time-series are needed for this fishery product. In the column (6), the *PSU* holds an unexpected sign – probably caused by the quality of data for calculation of unit values – but the overall estimations are not significant.

In general, the results for dried fish are less clear and that was anticipated, meaning further research should be done. But the question here is: how to interpret the results for dried fish compared to the results displayed in Figure 2.5 where cephalopods, crustaceans, demersal fish, freshwater fish, marine fish and others and pelagic fish have positive and significant income elasticity? The answer is that freshwater fish – general category where *kapenta* belongs – is composed by a variety of sub-set of species and, as recent findings suggests (Dey 2000; Dey and Garcia 2008), fish is heterogeneous product and the income elasticity patterns will reflect this.

The poor findings in income and in substitute prices elasticities can also be explained by the fact that as hinterland countries, Malawi, Zambia and Zimbabwe might have available lower-priced substitutes which can provide proteins and others important food intakes, like maize, cassava, and poultry, usual items which consumers tend to respond quickly when prices and income changes. Moreover, because of lack of appropriate conservation facilities, exporters tend to sell as much as they can in shorter period of time, and in most of the cases they apply a reasonable exporting price enough to recover the fixed costs. This mean the exporting price and the price of substitutes are severally affected.

The meaning of non-significance of right-side coefficients regressed with *CLA* as an instrumental variables means that laboratorial testing is still puzzling in this kind of export, since *kapenta* producers are still aside in terms of satisfying sanitary and environmental standards and regulations.

5.6 CHAPTER 5 SUMMARY

The chapter uses two products (frozen shrimps and prawns and dried fish), two equations (export demand and export supply) and one proxy of technical measure to trade (cost for sanitary and laboratorial analysis) to see how the demand and supply of Mozambican fishery products perform simultaneously. The results would be stronger if more accurate instruments were used, especially for dried fish.

After running the system of equations and followed the required assumptions, the results of the SE regression – using 2SLS technique – points that the basic determinants of the exports are export prices, substitute prices, and partners incomes. As an IV, the indicator for technical measures to impacts the quantity demanded through the estimated price only in Spain and Portugal. The influence of the *CLA* on *QTY* through *PRI* is partially confirmed by looking on the correct sign of the first stage estimation for shrimps and prawns (0.31 and 0.27, respectively for pooled LS and country fixed effect.

In the 2SLS, as for the shrimps and prawns, the country effects showed positive results, and this suggests that fishery exports are sensitive to the economic profile of the trading partners. However, the magnitude of the parameters estimated is still puzzling, since they vary greatly depending on pooled LS and country fixed effects. An additional problem is that in some specifications the elasticities for income and prices returned wrong signs, or were simply not statistically significance. The results of *F*-statistic suggest that, for shrimps and prawns, the instruments are relevant, but for dried fish others instruments should be applied, based on poor results presented.

Matching the results of frozen shrimps and prawns and dried fish it is observable that the majority of the specifications for the shrimps and prawns are statistically significant, while the dried fish's specifications perform poorly. In the same way, the shrimps and prawns seems to be more sensitive to country effects, compared to dried fish. This can be explained by the export destines' and the nature of the products: shrimps and prawns are destined to developed countries, where incomes and consumption behaviors are higher; contrarily, dried fish are exported to SADC countries, with very low incomes and very unpredictable level of consumption.

The results of the income elasticity for dried fish in follows the empirical evidences because in the majority of the studies the elasticity is also not clear. Nevertheless, exhaustive data for dried fish needs to be careful collected in Mozambique (as exports) and in destines (as imports) since it is suspected due to existence of informal export-import channels, the data of that significant flux of trade is not properly captured in official records and also in the estimations.

Other interesting conclusion is that Spain and Portugal are the main partners in overall fishery products exported from Mozambique, and this means that any policy or decision to be made by Mozambique in that regard should pay attention to the trade and economic profile of these two countries. The comparison between shrimps and prawns and dried fish suggests that the former is the most important and decisive product in all the species exported by the country, and that pivotal role should guide any future policy and investment in the sector.

For dried fish, despite the results of the estimations, one of the strategy the country can adopt is to improve is production to push downwards the price for *kapenta* in the regional market and, thus, to increase its consumption in the long run. Taking into account the average high income elasticity observed in the global data, this means the larger the production the larger will be the profit of the farmers, at long term.

CHAPTER 6

FOOD SAFETY REGULATIONS AND MEASURES AND THE EXPORTS OF FISHERY PRODUCTS FROM DEVELOPING COUNTRIES

6.1 INTRODUCTION TO CHAPTER 6

The data provided in the previous chapters shows how the supply of exports of fishery products is increasing in the world (Chapter 2) and in Mozambique (Chapter 3). However, Chapters 4 and 5 illustrates that the quantities supplied to exporting market, although necessary, are not sufficient and depend on the degree of compliance to technical measures. This chapter provides an overview of some food safety regulations which are important for the compliance to technical measures to trade in the context of a developing-exporting country.

The increasing importance of the compliance process to technical measures for exports of agro-food products is proved by the importance given to the issue by recent publications and surveys. A study carried out by Swann et al. (1996) on the impacts on British trade over the period of 1985-1991 they had concluded that adherence to British standards had raised both imports and exports. Otsuki et al. (2001a; 2001b), studying compliance costs with aflatoxin standards imposed by the EU in the period 1989-1998, found in the 9 African countries sampled that the implementation of that standard would reduce African exports of cereals by 64 per cent. Niang (2005) studied the costs of compliance to export standards in the fisheries industry in Senegal, to assess its vitality and perspective in holding the EU market.

Some international organizations are also supporting the studies for assess the role of the compliance process, particularly for agro-food items. For instance, UNCTAD (2007) carried out a study in Samoa, Solomon Islands, and Vanuatu, to identify and quantify the compliance costs of agricultural and food product's safety and quality requirements imposed by the importers. The World Bank, through its Agriculture and Rural Development Department is also devoted to disclose the picture of the quantitative impact of SPS and TBT issues in developing countries trade (Cato et al. 2005; Niang 2005; Manarungsan et al. 2005). Since the developed countries markets are the main targets, they were also studied (*see* Jonker et al. 2005; Lamb et al. 2005; and Willems et al. 2005). By its turn, the WTO maintains a detailed databank useful for tracing political and diplomatic issues raised by the compliance with technical measures.

In almost all the studies, researchers are interested to inventory the existing food safety regulations and standards[37] in the developing countries and compare them with those of the major importers of their products (usually, Japan, EU, USA, Australia, New Zealand, and UK, separately, or OECD group), or with those of the international organizations (CAC, FAO, ISO, IPPC, OIE, or WHO). The comparisons intend to check whether the discrepancies on the food safety regulations are expressive or not, providing, thus, a preliminary idea on the possibilities of trading agro-food products.

In this chapter, "food safety standards, regulations and measures" will be taken as a set of legal instruments or administrative provisions, either compulsory (regulations) or voluntary (standards and measures), which provide a comprehensive description of how to handle, prepare and store food and feed aiming at protecting human health and life and consumer's interest. Commonly, it applies to all stages of production, processing and labeling, marketing and distribution of food and feed, and usually it includes others matters with a direct or indirect impact on food and feed safety.

The rest of the chapter follows in this sequence: in the section 2, economic impact of food safety regulations is provided, looking at macro and micro-levels. The section 3 provides some legal instruments that are relevant for the international trade of fisheries products, either at the WTO or at the major importing countries in the world. Section 4 presents a small contribution on how to reduce the negative consequences resulted from differences in food safety regimes throughout the world. And the section 5 provides a brief summary of the main findings.

[37] There are also private food safety standards, the most famous being the Eurep-GAP, BRC (British Retail Consortium) and SQL (Safe Quality Food). More details in Trienekens and Zuurbier (2008: 112-114).

6.2 EXAMPLES OF ECONOMIC IMPACT OF FOOD SAFETY REGULATIONS

To capture the costs of technical measures to trade and general importer's safety requirements, there is common to distinguish "macro" and "micro" level costs. In the UNCTAD (2007) study, "macro" level costs are those incurred by the public institutions, while the "micro", are those incurred by producers and traders, when they effort to meet the demand exigencies. In all the cases, the macro and micro costs of compliance were calculated from country and firm levels survey and interviews.

6.2.1 Example of Impacts at Macro-Level

At macro-level, the costs for compliance to technical measures are motivated by the adoption of the HACCP, CAC standards, connected domestic legislations, establishment of certification units, training, improve infrastructures and facilities, and acquisition of modern vessels and equipments, technologies and specific fishing devices, including the costs for governmental inspection, testing, monitoring and control the compliance process.

The Table 6.1 presents the results of macro-level impacts done in some developing countries, by showing the additional costs required for compliance. Although the methodologies of estimating the costs were different, all the studies relied on the detailed data provided during the field-survey. The study carried out by UNCTAD (2007) in Samoa, Solomon Islands, and Vanuatu had estimated to be about 5.4 million USD the aggregate "macro" cost of compliance with the SPS standards and others quality requirements, distributed in the following way: Solomon Islands: 3.6 million USD (67 per cent); Samoa: 927,000 USD (17 per cent); and Vanuatu: 860,000 USD (16 per cent).

As already said, the World Bank had supported some surveys to determine the costs of compliance with foreign standards and regulations. For the Thai case, Manarungsan et al. (2005) estimated as 1,804,525 USD the cost of setup laboratories to monitor the presence of banned chemical in frozen shrimps exported to EU. In the Bangladesh case, Rahman (2002) quotes Cato and Lima dos Santos (1998) describes that the total costs incurred by the public sector to fund the fisheries plants' upgrading effort to match HACCP, quality control measures and monitoring the compliance process itself was calculated as having reached 2,400,000 USD.

Table 6.1: Selected Cases-Study showing the Macro Economic Impact of Complying with Technical Measures to Trade (Fishing Sector)

Country	**Period**	**Technical and Sanitary Items**	**Estimated Additional Costs (USD, Nominal)**
Bangladesh (a)	1997-98	- Upgrading processing plants to match HACCP - Implementation of quality control measures - Monitor HACCP compliance	2,400,000.00
Samoa (b)	2005-06	- Review and updating legal instruments - Develop capacity to test for microbiological pathogens (histidine and histamine)	927,000.00
Solomon Islands (b)	2005-06	- Review and updating legal instruments - Acquisition of equipments for refrigeration - Upgrading water disposal systems in the processing plants	3,590,000.00
Thailand (c)	2001-02	- Laboratory set-up to control for chloramphenicol and nitrofurans	1,804,525.00
Vanuatu (b)	2005-06	- Review and updating legal instruments - Develop quarantine and export capacity	860,000.00

Note: (a) Rahman 2002; (b) UNCTAD 2007; (c) Manarungsan et al. 2005
Source: Author (Compilation)

The implementation of HACCP, required in the Bangladesh case, was a component of the so-called Good Aquaculture Practice (GAPs), required by the EU. Essentially, the GAPs is a set of responsible environmental and sanitary practices at the farm level which is believed to generate products with good quality, and which minimize the possibility of contamination with pathogen, chemicals, and filths-resulted agents. In Bangladesh, the implementation of HACCP required the formation of an expert team to perform hazard analysis and takes decisions and a description of important norms and procedures applicable for shrimps and prawns producers' farms (Rahman 2002).

The review of legal instruments, required in the Samoa, Solomon Islands and Vanuatu cases were linked, essentially, to the modernization of the quarantine procedures and enforcement into the three countries, to comply with the international obligations, while ensuring sustainability and good environmental management practices (UNCTAD 2007).

The establishment of sound laboratories and equipments for fisheries, in the Thai case, intended to allow the country with the necessary scientific tools to control health and sanitary parameters in fish, food and feed. The areas of expertise covered included the microbiology, disease control, and human capacity building (Manarungsan et al. 2005).

6.2.2 Example of Impacts at Micro-Level

The micro economic impact of the compliance process can be illustrated by evaluating the costs incurred by firms. They include additional changes in producing systems, additional infrastructures and upgrading, training, consultancy services and certification costs.

At the theoretical ground, the most famous model which illustrates the general steps followed by food firms in their compliance effort (basically for technical and sanitary measures in international trade) was proposed by Henson and Heasman (1998:13). It is commonly known as the "food compliance process model". It is composed by 9 basic steps. This model is suitable for normal situations, but it seems not to describe what the scenario is when the importing countries adopt the so-called precautionary principle, allowed, for instance, by the WTO SPS Agreement.

The Henson and Heasman (1998) compliance process model derives from a firm survey done in UK food sector. The model can be explained, summarily, in the following way: the process starts when food firms *identify the regulation*, the new legal document issued by the authorities. Then, firms expend internal administrative efforts to *interpret the regulation* by assessing its scope and which firms and producers are covered by it. If the concerned firm is covered by the new regulation, they apply the necessary effort to *identifying the changes required*, because some of them might be already under compliance in the firms. In that stage, some powerful firms might be tempted to *influence the regulation* to make it more adaptable to their internal capabilities.

If the changes required by the new regulation are not already in application, then the concerned firms *decide to comply* it. Therefore, the firms *specify the method of compliance* attending the firms' capacities and the costs involved in the compliance. The next stage is to *communicate* the compliance method within the firms to all involved in the implementation of the required changes, a step that precedes the effective *implementation* of the new standards. Henson and Heasman (1998:21) consider that the implementation is "a long-term process". Finally and regularly, the compliance process is *evaluated* and *monitored*.

Table 6.2: Selected Cases-Study showing the Micro Economic Impact of Complying with Technical Measures to Trade (Fishing Sector)

Country	**Period**	**Technical and Sanitary Items**	**Estimated Additional Costs (USD, Nominal)**
India (Kerala) (a)	1997-98	- EU requirements for fishery products (antibiotics, chlroramphenicol, and nitrofurans), heavy metals (lead, cadmium and mercury) and dioxins	102,900.00 to 450,000.00
Samoa (b)	2005-06	- EU requeriments for tuna (diagnostic of histidine and histamine)	64,130.00
Solomon Islands (b)	2005-06	- EU requirements for frozen and canned fish - Acquisition of equipments for refrigeration - Upgrading water disposal system at processing plants	182,857.00
Thailand (c)	2001-02	- EU requirements for monitor chloramphenicol and nitrofurans in frozen shrimps	4,301,790.00

Note: (a) Henson et al. 2004; (b) UNCTAD 1997; (c) Manarungsan et al. 2005
Source: Author (Compilation)

The Henson and Heasman (1998) model do not highlight what happens to quantities traded partially because their model follows straight steps, from identification of the changes required up to the implementation, evaluation and monitoring. However and looking to what happened to many developing countries fishing nations, the best way in approaching the technical and sanitary compliance process is to consider the "precautionary approach", characterized by sudden and quick imposition of new or additional product, processing and labeling or marketing standards, by the importers.

At practical ground, estimations of "micro" costs, all of them to meet EU requirements are presented in the Table 6.2. Once again, they were obtained after a comprehensive firm level survey, and they refer to the estimated amount of additional financial resources needed to meet the technical and sanitary items listed.

6.2.3 Lessons from the Examples of Macro and Micro Costs of Compliance

Except for Indian case (Kerala, South-west part of the country), all others are national studies. The first lesson from these three countries is that the macro costs for compliance exceeds the micro costs by larger differences in the small islands countries, Samoa and Solomon Islands. It is understandable looking to their economic fragility (compared to Thailand) which requires much more national level efforts than the Thai case.

In fact, the macro costs accounts for national effort done by public and quasi-public institutions, and most often they are collected from donor community or international cooperation agencies. As pointed out, these results are, probably, affected by the global trend of funding public sector projects, neglecting the assistance of both public and private (Jaffee et al. 2005).

In the Thai case, firms spent more than public sector to face the external market technical regulations requirements. In general, it seems that the Thai firms are more consolidated as exporter firms, than the firms in others two countries and they are more prepared to support their own restructuring steps. Another way of reading these results is to consider the nature of the compliance effort needed. It is possible that for the Samoa and Solomon Islands, the compliance effort need required a more active role by the public institutions, and the Thai case probably demanded more firms' actions than the governmental role.

Table 6.3: Compliance Costs over Exporting Values: Samoa, Solomon Islands and Thailand

Country	Costs		Export Value (a)	Cost/Value (b)
	Macro	Micro		
Samoa (2006)	927,000.00	64,130.00	8,102,267.00	0.11
Solomon Islands (2006)	3,590.000.00	182,857.00	12,879,149.00	0.28
Thailand (2002)	1,804,525.00	4,301,790.00	1,629,741,702.00	0.00

Note: (a) data from UN-COMTRADE, for HS 03 (fish, crustaceans, mollusks, aquatic invertebrates, NES);
(b) The denominator refer to the macro-costs, only
Source: Author (Compilation)

The second lesson is visible in the Table 6.3 which divides the estimated additional costs and the amounts coming from the export of fisheries products of the remaining countries (Samoa and Solomon Islands, for 2006, and Thailand for 2002). It is observable that small islands incurred in more effort to comply, since their costs accounts for 11.44 per cent and 27.87 per cent for Samoa and Solomon Islands, respectively. Thai effort (0.11 per cent) was less than 1 per cent of their export values in 2002, which can also explains why the fishing exporting firms took a more preeminent role in supporting the effort.

Although it is difficult to make a generalization about the magnitude of the costs and benefits of compliance, Jaffee et al. (2005:xvi) believe that the overwhelming empirical data indicates that the costs are less than assumed, since they tend to be far less than the value of exports.

6.3 Global, Regional and National Fish Trade Regulations

6.3.1 Global Level: UN System and WTO Agreements

As for the international trade of fisheries, the UN system focuses on food security, food safety and better management of the resources. The first (food security) is under the responsibility of FAO, while the second (food safety) and the third (management of resources) are under the WHO/FAO and UNEP, respectively (Trienekens and Zuurbier 2008:109).

The WTO institutions comes from the GATT, whose creation was intended to provide a comprehensive liberalization of trade in goods by reducing tariffs, changing to tariffs the non-tariff measures and eliminating all the domestic policies intended to violate the basic rules of free international trade, like subsidies and others governmental support.

Although seven WTO agreements[38] are associated with market access for agro-food products in many respects (UNCTAD 2007:23), two of them will be detailed, due to their complementarity and direct impact in the trade of fisheries products: (1) the Agreement on the Application of Sanitary and Phytosanitary Measures and (2) the Agreement on Technical Barriers to Trade.

6.3.1.1 The Agreement on the Application of Sanitary and Phytosanitary Measures

This agreement was discussed and approved to establish a reasonable and acceptable equilibrium between the necessity to protect human, animal and plant health and safety on the one hand and the smooth international exchange of goods, on the other. To impede unnecessary obstacles to trade, this agreement encourages traders to use international standards, like those established by CAC, the International Plant Protection Convention and by the OIE (World Organization for Animal Health), on their food safety, animal and plant health needs. This allows the countries to base their domestic policies on scientific principles and not maintain them without sufficient scientific evidences.

According to Annex A:1 of the SPS Agreement, sanitary or phytosanitary measures are measures applied:

> a) *To protect animal or plant life or health within the territory of the Member from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms;*

[38] According to UNCTAD (2007:23) they are: Agreement on Sanitary and Phytosanitary Measures (SPS); Agreement on Technical Barriers to Trade (TBT); Agreement on Subsidies and Countervailing Measures; Agreement on Import Licensing Procedures; Agreement on Anti-Dumping; Agreement on Rules of Origin; and Dispute Settlement.

b) *To protect human or animal life or health within the territory of the Member from risks arising from additives, contaminants, toxins or disease-causing organisms in foods, beverages or feedstuffs;*
c) *To protect human life or health within the territory of the Member from risks arising from diseases carried by animals, plants or products thereof, or from the entry, establishment or spread of pests; or*
d) *To prevent or limit other damage within the territory of the Member from the entry, establishment or spread of pests.*

In the Article 2, WTO Members receive right to take sanitary and phytosanitary measures necessary to "*protect human, animal or plant life or health, provided that such measures are not unjustifiable protective measures*". In that regard, the sanitary or phytosanitary measure shall be applied "*only to the extent necessary to protect human, animal or plant life or health*". Their application shall be similar and cannot discriminative between WTO Members in identical or similar conditions.

The Article 3 urges Members to harmonize their sanitary and phytosanitary measures on as wide a basis as possible, to avoid dispersion of sanitary regimes. One of the methods to reach such objective is to base the sanitary or phytosanitary measures on international standards, guidelines or recommendations, when they exist. However, if there is a scientific justification, or as a consequence of the level of sanitary or phytosanitary protection a Member determines to be appropriate "*a Member is allowed to introduce or maintain sanitary or phytosanitary measures which result in a higher level of sanitary or phytosanitary protection than would be achieved by measures based on the relevant international standards, guidelines or recommendations*".

Even if the measures are different from their own or from those used by others partners trading the same product, the Article 4 obliges WTO Members to accept these sanitary or phytosanitary measures as equivalent to their own. This obligation is subjected to an objective demonstration, by the exporting country, that its measures achieve the importing partner's appropriate level of sanitary or phytosanitary protection. Therefore, to certify if the exporting country compliance framework is appropriate, the importing country might request to access, inspect, or test the sanitary and phytosanitary procedures, one of the practices frequently used by EU.

The Article 5 obliges WTO Members to "*base their sanitary or phytosanitary measures taking into account the risk assessment techniques developed by the sound international organizations*". Therefore, the assessment of risks shall be done taking into account the available sound scientific evidence, the relevant processes and procedures, production methods, sound inspection techniques, sampling and testing methods, prevalence of specific diseases or pests, relevant ecological and environmental conditions, and quarantine or other treatments. And if the relevant scientific evidence is not sufficient, a WTO Member "*might provisionally adopt sanitary or phytosanitary measures on the basis of available pertinent information, including that from the relevant international organizations as well as from sanitary or phytosanitary measures applied by other Members*" (Article 5, SPS Agreement).

To create a transparent and predictable environment in international trade, WTO Members are obliged to promptly disclose, by publishing, their sanitary or phytosanitary requirements, and, except in urgent circumstances, are urged to "*allow a reasonable interval between the publication of a sanitary or phytosanitary regulation and its entry into force*" to give sufficient time for like-products producers in exporting countries (particularly the developing and least developed countries), "*to adapt their products and methods of production to the requirements of the importing Member*". Therefore, longer time-frames for compliance should be accorded on products of interest to developing country whenever the appropriate level of sanitary or phytosanitary protection allows scope for the phased introduction.

Although the SPS Agreement emphasizes the non-discrimination language, what happens in practice is that importing countries tend to pay more attention on foreign products, whose production and processing phases happened in other countries, where they don't have full control. Contrarily, the domestic like-products tend to receive less attention since they were produced under the full control of the governmental authorities.

6.3.1.2 The Agreement on Technical Barriers to Trade

The Agreement on Technical Barriers to Trade (TBT Agreement) defines, in its Annex 1:1 that Technical Regulation is a "*document which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory*". Usually it includes or deals with terminology, symbols, packaging, marking or labeling requirements as they apply to a product, process or production method. On the other hand, a "standard" is defined as "*document approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory*". A standard might include or deal exclusively with requirements such as terminologies, symbols, packaging, marking or labeling items as they apply to a product, process or production method.

The Article 2 deals with the preparation, adoption and application of technical regulations, and obliges WTO Members to "*ensure that products imported from the territory of any Member shall be accorded treatment no less favorable than that accorded to like products of national origin and to like products originating in any other country, in respect of technical regulations*". The technical regulations might be adopted only to fulfill legitimate objectives like national security requirements, prevention of deceptive practices, protection of human health or safety, animal or plant life or health, or the environment, which means they cannot be prepared, adopted or applied with a view to or with the potential effect of creating unnecessary obstacles to international trade.

To ensure predictability and harmonized understanding, WTO Members are urged to use relevant international standards or the relevant parts of them, as a basis for their technical regulations. The exception here is when these international standards or their relevant parts appears be an ineffective or inappropriate means for the fulfillment of the legitimate objectives pursued, due to fundamental climatic or geographical factors or fundamental technological problems. In the Article 2.7, Members are urged to "*consider as equivalent, the technical regulations of other Members, even if they are* *different from their own, provided that they adequately fulfill the objectives of their own regulations*". Another important feature to allow the compliance with the national treatment and most-favored nation principles is that Members shall specify their technical regulations on products in terms of performance rather than in terms of design or descriptive characteristics.

The Article 2.9 establishes that when a relevant international standard does not exist or the contents are not in accordance with that of the relevant international standards WTO Members are obliged to "*inform others Members at an early appropriate stage to enable them to become acquainted with it, and, if requested, to provide particulars or copies of the proposed technical regulation, identifying the parts that are different from relevant international standards*". In the Article 2.11 and 2.12, WTO Members are urged to publish their technical regulations, and to allow a reasonable interval between the publication of it and its entrance into force.

By the Article 12, WTO Members are urged to "*provide differential and more favorable treatment to developing country, by considering their socio-economic conditions as well as the financial and trade needs*", with the objective of ensuring that the technical regulations, standards and conformity assessment procedures do not create unnecessary barriers to exports from the developing and least developed countries.

6.3.2 National Level: Requirements of the World's Main Importers

The successive rounds of multilateral trade negotiations have examined the impact of national food safety requirements on the patterns of trade.

6.3.2.1 European Union Requirements

The EU is one of the markets where changes in legislation and regulations pertaining foodstuffs changes continuously (Henson et al. 2004; UNTACD 2007), and their regulations covers all the steps, from production to marketing of fisheries products, including auctions. Just by looking at the

EU legislation[39] regarding food safety, one will realize that this is a horizontal objective that is taken in account in several others areas, like environment, consumer protection, rural development and health.

Through its network of regulations, directives, decisions and policies, the EU possesses strong and stringent rules governing health and sanitary issues for capture, aquaculture, processing, transportation, labeling, storage and marketing of fisheries products, either domestically produced or imported from abroad. For aquaculture and processing plants, the EU legislation require that processors and exporting firms comply to its standards regarding the structure of buildings, lighting, refrigeration, ventilation and others hygienic issues. The most important is the EU Council Directive No. 91/493/EEC, of 22 July 1991, laying down the Health Conditions for the Production and the Placing on the Market of Fishery Products and all the subsequent corrections, amendments and implementation measures[40]. The most recent implementation measure is the Commission Regulation (EC) No. 466/2001 of 8 March 2001 setting Maximum Levels for Certain Contaminants in Foodstuffs.

The general requirement for fish processing facilities, required by the EU is the compliance to HACCP, observing all its steps. Therefore, fish processing plants are obliged to:

a) Conduct biological, chemical or physical hazard analysis, to determine the food safety hazards, as well as to identify the critical points to be controlled to prevent, eliminate or reduce the health risk up to an acceptable level;

[39] http://europa.eu/legislation_summaries/glossary/food_safety_en.htm (9 June 2012)

[40] The EU Council Directive No. 91/493/EEC, of 22 July 1991 was corrected by the Council Directive No. 91.493/EEC of 22 July 1991; amended by the Council Directives No. 95/71/EC of 22 December 1995, and No. 97/79/EC of 18 December 1997; and its implementing measures are the Council Directive No. 92/48/EEC of 16 June 1992 laying down the Minimum Hygiene Rules Applicable to Fishery Products Caught On Board of Certain Vessels; The Council Decision No. 93/140/EEC of 19 January 1993 laying down the Detailed Rules relating to the Visual Inspection of Detecting Parasites in Fishery Products; The Commission Decision No. 94/356/EEC of 20 May 1994 laying down Detailed Rules for the Application of Council Directive No. 91/493/EEC as regards Own Health Checks on Fishery Products; The Council Directive No. 95/71/EEC of 22 December 1995 fixing Sanitary Rules Governing the Production and Placing on the Market of Fishery Products; The Commission Decision No. 95/149/EC of 8 March 1995 fixing the Total Volatile Basic Nitrogen (TVB-N) Limit Values for Certain Categories of Fishery Products and Specifying the Analysis Methods to be Used; and the Commission Regulation (EC) No. 466/2001 of 8 March 2001 setting Maximum Levels for Certain Contaminants in Foodstuffs. The Commission Regulation (EC) No. 466/2001 of 8 March 2001 was corrected by a Corrigendum to Council Regulation (EC) No. 466/2001 of 8 March 2001.

b) Establish critical limits for each critical control point, which is the determination of the critical limits (minimum and maximum values) for an (un)safe human consumption, including the establishment of critical point monitoring requirement, and the frequency of such monitoring activity;

c) Conduct corrective actions, when monitoring suggests that a risk to human, animal or plant health or life is present, and record all the procedures, which imply that fish processing facilities shall maintain HACCP important documents available for further verifications. At the end, they should validate the HACCP, which means to check if the HACCP is working perfectly, as expected.

The EU require importing countries to comply with these rules, although they might take into account some particularities of the importing country, like its legislation, strength of the competent authority, health conditions during production, storage, and transportation and the level of confidence that the importer shows regarding the compliance with the EU regulations and standards[41] (Henson et al. 2004:13).

The countries exporting to the EU are visited, regularly, by the EU FVO (Food and Veterinary Office) to ensure that the EU legislations on food safety, animal health, plant health and animal welfare is correctly implemented and enforced. According to the Annex I of the EU Commission Decision No. 94/360/EC of 20 May 1994, the level of physical check of "*fish products in hermetically sealed containers intended to render them stable at ambient temperatures, fresh and frozen fish and dry and/or salted fishery products*" must be checked at 20 per cent, and these procedures are done in such a "*way that it is not possible for an importer to predict whether any particular consignment will be subjected to a physical check*" (Article 2 of the Commission Decision No. 94/360/EC, of 20 May 1994).

[41] The EU disclose to the public, the cases of imported food and feed products into its Member countries, notified at the borders or withdrew from the commercial circuit, through its Rapid Alert System for Food and Feed (RASFF). The RASFF information points out the causes of notification, the country where the products comes from and the food or feed concerned.

6.3.2.2 Japanese Requirements

Japan is one the markets which applies strict product guidelines and standards (Wang and Caswell 1998; Cato et al. 2005; Jonker et al. 2005). The risk assessment body works as a "Food Safety Commission" composed by the Ministry of Health, Labor, and Welfare and Ministry of Agriculture, Forestry, and Fisheries (GAO 2008:16).

As for fisheries exports and imports, four regulations are crucial: the Act on the Protection of Fishery Resources; the Food Sanitation Act (Law No. 233, of 24 December 1947 – last amendment was through the Law No. 87, of 26 July 2005); the Law Concerning Standardization and Proper Labeling of Agriculture and Forestry Products; and the Quarantine Act (JETRO 2010). Although all of them contain useful commands for fisheries trade, the most important are the Food Sanitation Law and the Quarantine Law (Act No. 201 of 6 June 1951) (Henson et al. 2004).

The JETRO (Japan Trade External Organization) (2006) contains a useful summary of the Food Sanitation Law. The Article 7 contains a "precautionary approach" command, since it prohibits the sale of any newly developed food before hearing experts' opinions. The Article 10 contains general prohibition of manufacture, import, process, use, storage or display of food additives, except natural flavoring agents and others food additives used for food. Article 11 prohibits importation of pesticides, and Article 16 prohibits the usage of toxic containers or packages for food products.

According to the Law No. 233 of 24 December 1947 and its last amendment done by the Law No. 87 of 26 July 2005, imported foods are inspected following an annual plan issued by the Minister of Health, Labor and Welfare. The same minister shall be informed of any import of food, food additives, apparatus, and container/package destined to sale or use in business of food products (Article 27).

The labeling standard for food products appears at the Chapter 2 of the Law No. 233 of 24 December 1947. Every food container shall disclose on the container/package, name, food additives, storing conditions, "use-by-date" or "best-before-date", the address of manufacturing or processing plants, name and percentage, by weight, of each ingredient. When an ingredient is meat, the container shall make visible, in the package, the word 魚肉 (*gyoniku*) in Japanese, to mean fish meat (Article 21:t). Fish sausage, ham or fish-paste cake (*kamaboko*), tightly packed into hermetic container, its method of pasteurization and the water pH level shall be also disclosed to the public through the labels (Article 21:y and z). In Japan, the law mandates that fillet fresh fish, shucked fresh shellfish, raw oysters, or frozen products shall contain, in the labels, a statement to the effect that the product is intended to be consumed raw.

Regarding the food additives, fresh fish including tuna, yellowtail, might not have carbon dioxide added. For aquaculture products, some antibiotic or antimicrobial substances used to increase production are allowed to remain, which is said to be 0.10 ppm of the antibiotic oxytetracycline (JETRO 2010:20). For frozen foods, frozen fillets of fish and stripped shellfish for sashimi, the number of bacillus per specimen of 1 g. shall be 100,000 or less and the test for the colon bacillus shall provide negative results. For the processed marine products frozen after heat processing, the maximum limit of bacilli shall be 3,000,000 or fewer per one g. of specimen, and the test for *Escherichia-Coli* must be negative (JETRO 2010:21).

The Quarantine Law, marine products originated from areas contemned by cholera are subject to inspection; if cholera bacteria are detected, the cargo might not be imported into Japan and must be decontaminated or disposed of in some other manner (Henson et al. 2004; JETRO 2010). As a part [to CITES], Japan refuses the trade of species of fauna and flora listed in the CITES annexes as endangered species.

6.3.2.3 USA Requirements

In the USA, the FDA (U.S. Food and Drug Administration) is the governmental body responsible for implementing the mandatory safety program for all food products, including fish and fishery (Loader and Hobbs 1999; Lamb et al. 2005). The FDA also publishes an extensive compilation of advances on hazards that affect fish and fishery products and the effective way of controlling or preventing their occurrence, the Fish and Fisheries Products Hazards and Controls Guidance[42].

As in others huge importers, the USA requires that all fish imported be handled observing the HACCP steps, from the harvest up to the post-harvest stages. There is possible to an exporting country to get an equivalence certificate regarding the risk assessment management procedures. In such a case, both the exporter and the USA's FDA shall enter into a written understanding.

All food products, before entering the USA market shall prove the level of acceptable risks to APHIS (Animal and Plant Health Inspection Service, USA Department of Agriculture) or to FDA, at risk of being refused entrance or being subject to several sampling and laboratory analysis at the border (Lamb et al. 2005). For pesticides residues there is a fixed maximum limit (for Hg, the reference dose: is 0.1 mg methylHg/kg body weight per day; *see* also Table 6.4) and for salmonella the tolerance is zero (Lamb et al. 2005).

Specifically for shrimps and prawns, the USA requires the exporters to observe eight relevant legal instruments: the Food Drug and Cosmetic Act; the Fair Packaging and Cosmetic Act; the Nutrition Labeling and Education Act; current Good Manufacturing Practice Regulations; the Color Additives Regulation; the Food Additives Regulation; the Food Labeling Regulation; and the Low Acid Canned Food Regulation (Henson et al. 2004). Additionally, shrimps importers will be subject to control the compliance with the domestic production standards; thus imports will be prohibited if it is found that the harvest manner threatens marine species, especially the marine turtle (Lamb et al. 2005).

[42] http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/default.htm (16 November 2012)

Figure 6.1: Examples of Maximum Allowed or Recommended Levels of Mercury (Hg) in Fish in various Countries and by WHO/FAO

Country or Organization	**Fish type**	**Maximum Allowed/ Recommended Levels in fish*1**	**Type of Measure**	**Tolerable Intake Levels*1**
Australia	Fish known to contain high levels of Hg, such as swordfish, southern bluefin tuna, barramundi, ling, orange roughy, rays and shark	1.0 mg Hg/kg	The Australian Food Standards Code	Tolerable weekly intake: 2.8 µg Hg/kg body weight per week for pregnant women
	All other species of fish and crustaceans and mollusks	0.5 mg Hg/kg		
Canada	All fish except shark, swordfish or fresh or frozen tuna (expressed as total Hg in edible portion of fish)	0.5 ppm total Hg	Guidelines/Tolerances of Various Chemical Contaminants in Canada	Provisional tolerable daily intake: 0.47 µg Hg/kg body weight per day for most of the population and 0.2 µg Hg/kg body weight per day for women of child-bearing age and young children
	Maximum allowable limit for those who consume large amounts of fish, such as Aboriginal people	0.2 ppm total Hg		
China	Freshwater fish	0.30 mg/kg	Sanitation Standards for Food	
Croatia	Fresh fish		Rules on quantities of pesticides, toxins, mycotoxins, metals and histamines and similar substances that can be found in the food	
	Predatory fish	1.0 mg Hg/kg		
	Tuna, swordfish, mollusks, crustaceans	0.8 mg methyl Hg/kg		
	All other species of fish	0.5 mg Hg/kg		
		0.4 mg methyl Hg/kg		
	Canned fish (tin package)			
	Predatory fish	1.5 mg Hg/kg		
	Tuna, swordfish, mollusks, crustaceans	1.0 mg methyl Hg/kg		
	All other species of fish	0.8 mg Hg/kg		
		0.5 mg methyl Hg/kg		
European Community*2	Fishery products, with the exception of those listed below	0.5 mg Hg/kg	Various commission decisions, regulations	
		Wet weight		

	Anglerfish, atlantic catfish, bass, blue ling, bonito, eel, halibut, little tuna, marlin, pike, plain bonito, Portuguese dogfish, rays, redfish, sail fish, scabbard fish, shark (all species), snake mackerel, sturgeon, swordfish and tuna	1 mg Hg/kg Wet weight	and directives	
Georgia	Fish (freshwater) and fishery products	0.3 mg Hg/kg	Georgian Food Quality Standards 2001	
	Fish (Black Sea)	0.5 mg Hg/kg		
	Caviar	0.2 mg Hg/kg		
India	Fish	0.5 ppm total Hg	Tolerance Guidelines	
Japan	Fish	0.4 ppm total Hg/kg 0.3 ppm methyl Hg (as a reference)	Food Sanitation Law-Provisional regulatory standard for fish and shellfish	Provisional tolerable weekly intake: 0.17 mg methyl Hg (0.4 mg/kg body weight per day) (Nakagawa et al. 1997)
South Korea	Fish	0.5 mg Hg/kg	Food Act 2000	
Mauritius	Fish	1 ppm Hg	Food Act 2000	
The Philippines	Fish (except for predatory)	0.5 mg methyl Hg/kg	Codex *Alimentarius*	
	Predatory fish (shark, tuna and swordfish)	1 mg methyl Hg/kg		
Slovak Republic	Freshwater non-predatory fish and products thereof	0.1 mg total Hg/kg	Slovak Food Code	
	Freshwater predatory fish	0.5 mg total Hg/kg		
	Marine non-predatory fish and products thereof	0.5 mg total Hg/kg		
	Marine predatory fish	1.0 mg total Hg/kg		
Thailand	Seafood	0.5 mg Hg/g	Food Containing Contaminant Standard	
	Other food	0.02 mg Hg/g		
Country or Organization	**Fish type**	**Maximum Allowed/ Recommended Levels in fish*1**	**Type of Measure**	**Tolerable Intake Levels*1**
United Kingdom	Fish	0.3 mg Hg/g Wet flesh	European Statutory Standard	
United States of America	Fish, shellfish and other aquatic animals (FDA)	1 ppm methyl Hg	FDA action level	USA EPA reference dose: 0.1 mg methyl Hg/kg body weight per day
	States, tribes and territories are responsible for issuing fish consumption advise for locally-caught	0.5 ppm methyl Hg	Local trigger level	

	fish; Trigger level for many state health departments			
FAO/WHO/ CAC	All fish except predatory fish	0.5 mg methyl Hg/kg	FAO/WHO/ CAC Guidelines level	JECFA provisional tolerable weekly intake: 3.3 µg methyl Hg/kg body weight per week
	Predatory fish (such as shark, swordfish, tuna, pike and others)	1 mg methyl Hg/kg		

Notes: *1. Units as used in references. "mg/kg" equals "µg/g" and ppm (parts per million). It is assumed here that fish limit values not mentioned as "wet weight" or "wet flesh" are most likely based on wet weight, as this is normally the case for analysis on fish for consumers.

*2. The European Commission, in February 2002, revised the previous maximum limit values for mercury in a small number of specific fish species for consumption (Commission Regulation No. 221/2002 of February 2002). These changes are not reflected in the table.

Source: http://www.chem.unep.ch/mercury/report/Chapter4.htm (10 January 2013)

Figure 6.2: Comparison of Food Additives Policies for Fish, Mollusks and Crustaceans (Including their Preparations, excluding Prepared Meals Containing these Ingredients)

Markets	Food Additives Policies	Source
EU	Fish, mollusks and crustaceans are the foodstuffs which might not contain added colours, except: - Fish roe (colour: amaranth; maximum level: 30 mg/kg) - Smoked fish (colour: annatto, bixin, norbixin; maximum level: 20 mg/kg) - Fish paste and crustaceans paste (100 mg/kg); pre-cooked crustaceans (250 mg/kg); salmon substitutes (500 mg/kg); surimi (500 mg/kg); fish roe (300 mg/kg); smoked fish (100 mg/kg); and fish based proteins (100 mg/kg) may use single or a combination of the following additives: Curcumin, Tartrazine, Quinoline Yellow, Sunset Yellow FCF/Orange Yellow S, Cochineal, Carminic acid, Carmines, Azorubine, Carmoisine, Ponceau 4R, Cochineal Red A, Allura Red AC, Patent Blue V, Indigotine, Indigo carmine, Brilliant Blue FCF, Green S, Brilliant Black BN, Black PN, Brown HT, Lycopene, Beta-apo-8-carotenal (C 30), Ethyl ester of Beta-apo-8-carotenic acid (C 30) and Lutein	(a)
Japan	Japan prohibits any foodstuffs containing the following added colours: - Carmine - Beta-apo-8-carotenal (C 30), Ethyl ester of Beta-apo-8-carotenic acid (C 30) - Betacarotene from Blakeslea trispora - Azorubine (E 122) Some antioxidants are allowed for fish and fishery products: - Butylated Hydroxyanisole (BHA)on fish and shellfish dried, salted or frozen (0.2 g/kg) - Butylated Hydroxytoluene on fish and shellfish dried, salted or frozen (0.2 g/kg) - Sodium Nitrite on fish ham and fish sausage (0.050 g/kg) - Copper Chlorophyll on fish-paste products (0.030 g/kg) - Sodium Copper Chlorophyllin on fish-paste products (except surimi) (0.040 g/kg) - Sodium Chondroitin Sulfate on fish sausage (3.0 g/kg) - Sodium Saccharin on Fish/shellfish (1.2 g/kg); on fish paste (0.30 g/kg); and on dried fish or shellfish (1.0 g/kg) - Sorbic Acid on dried fish or shellfish (excluding smoking cuttlefish & octopus) (1.0 g/kg); and on fish-paste products (2.0 g/kg) - Propylene Glycol on smoked cuttlefish (2.0%)	(b)

Source: Author (Compilation from EC 1994a (a); and from Japanese Standards for Use of Food Additives (b))

6.3.3 Differences in National Food Safety Regulations

6.3.3.1 The Case of Mercury (*Hg*)

The Figure 6.4 is a clear illustration how countries approaches the food safety issue in a variety ways. Considering the CAC (WHO-FAO CAC) standards as a basis for all fishery products destined for human consumption (except for predatory fishes), it is established that the maximum recommended level of Hg is 0.5 mg methylHg/kg per person per week, but it is 0.3 ppm methylHg per person per week in Japan, China (P.R.) (for freshwater fish) and also Georgia (for fishes including freshwater fishes).

6.3.3.2 The Case of Food Additives

The Figure 6.5 presents the differences on food additives in different countries. Food additives comprise the following category of products: color; preservative; anti-oxidant; emulsifier; emulsifying salt; thickener; gelling agent; stabilizer; flavor enhancer; acid; acidity regulator; anti-caking agent; modified starch; sweetener; raising agent; anti-foaming agent; glazing agent; flour treatment agent; firming agent; humectants; sequestrant; enzyme; bulking agent; and propellent gas and packaging gas (EU 1988).

The general principle is that countries allow the usage of food additives that are explicitly authorized by their domestic legislations. Nevertheless, these domestic quantities remain controversial since certain countries had established, clearly, their maximum levels, while others only require their usage up to "the necessary level" believed to achieve the desired effect.

6.4 REDUCING DIFFERENCES IN FOOD SAFETY REGULATIONS

As Figures 6.4 and 6.5 shows, exporters of fisheries products destined to these countries will have to make adjustments to keep their products under the legal allowed MRLs. The differences in these technical regulations[43] impacts on the design of product labeling, processing inputs, market entrance and market shift. As pointed out by Wang and Caswell (1998:115) "*these disparities result in significant different import requirements that may impede trade in agricultural and food products*." Therefore, what can be done to reduce the negative impacts resulted from these differences? The next sub-section provides possible answers.

6.4.1 Harmonization of Rules, Standards and Measures

Harmonization is already established under the WTO TBT Agreement (Articles 2.6, 5.5 and Annex 3G) and WTO SPS Agreement (Articles 3, 12.1, 12.4 and Annex A2). According to Sykes (1995:130-133), ISO and CAC pursue harmonization as their daily tasks. In these organs, countries are requested to harmonize their rules, standards and measures to avoid unnecessary differences between them. Nevertheless, there are still important differences between countries, especially between those exhibiting asymmetric economical status, like developing and developed countries. In fact, the process of harmonizing food safety regulations is highly dependent, and thus, sensitive to cultural, political, and social aspects.

Consumers' habits towards food and the importance they give to them (example: differences on the degree of tolerance of certain food additives or ingredients), when significantly different across countries, as well differences of languages, species and modes of foodstuffs, might affect the draft of a "harmonization" project. Moreover, domestic forces (private sector *vs.* public sector) and international forces (Martinez et al. 2007), like asymmetries between countries regarding their interests in the world trade of fishery products and their relative capacity to deal with complex documents (usually harmonized texts are complex), have contributed to the failure of this approach.

More reasons why countries resist harmonizing their food safety regulations are summarized in Gruszcznski (2010:76-78). Essentially, the reasons presented are:

[43] Hobbs et al. (2002:79) compared the incentive structure for change in food safety legislations in UK, Canada and Australia and found, amongst others, that the incentives were different and there were proliferation of standards.

a) Differences in food safety legislations provide and reflect a comparative advantage of a particular country or group of countries. Therefore, that country or group of countries possesses a competitive position (provided by that different food safety legislation);

b) Higher (or stringent) food safety standards increases the competitive position of others industries in the domestic economy;

c) Competing food safety legislations will eliminate (automatically) the worst legislations and promotes the best ones;

d) Some differences in food safety regulations are obvious, and countries will be tempted to maintain them.

6.4.2 Equivalence or Mutual Recognition

As correctly pointed by Panisello and Quantick (2001:172), "*throughout the world, food safety is based in different types of HACCP programmes*", due to differences and diversity of countries, personnel skills and industry/firms capabilities. That is why the equivalence or mutual recognition appear stipulated in the WTO TBT Agreement (Articles 2.7, 6.1, 6.3, and 11.2-6) and WTO SPS Agreement (Article 4), amongst others international documents. The problem seems on the desire of accepting others as equivalent, which is still problematic. In fact, countries are reluctant to concede equivalence or mutually recognized status, usually with allegations that their risk assessment systems varies profoundly.

The main problem with the equivalence or mutual recognition is the sensitivity of the issue: food safety regulations reflect the domestic or regional social, human and sanitary achievement, which is greatly different across countries. One of the examples of that is the periodicity for revision or upgrading of these regulations: the EU, for instance, is very active, detailed, and from time to time changes their food safety regulations. Contrarily, others countries and markets enforce less complex and less detailed regulations. This also makes this approach a difficult solution.

6.4.3 Coordination

Due to the limitations imposed by both harmonization and mutual recognition, the truly and in good-faith coordination between countries seems to be the solution. This solution can be implemented either at the harmonization phase, or when conceding equivalence to others. However, this is a strictly political sphere, which require much more than mere economic reasons.

6.5 CHAPTER 6 SUMMARY

This chapter outlined that the macro costs and micro costs for compliance are different and their relative importance depends on the technical measure to be targeted and the economic status of the exporting countries. Nevertheless, small and more vulnerable countries are more dependent on foreign aid, while the relatively robust economies have conditions to set up by their own means, several and more proactive compliance activities. Although it is difficult to make a generalization about the magnitude of the costs and benefits of compliance, Jaffee et al. (2005:xvi) believe that the overwhelming empirical data indicates that the costs are less than assumed, since they tend to be far less than the value of exports.

To regulate the proliferation of different and conflicting technical regulations, especially the food safety regulations, there are several institutions that are trying to tackle this issue, being the WTO, the CAC, the IPPC (International Plant Protection Convention) and by the OIE some of these. However, countries, under their sovereign powers, still possesses enormous exceptions, inside the WTO multilateral agreements (TBT and SPS, basically), to protect animal or plant life or health within their territory, from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms, from additives, contaminants, toxins or disease-causing organisms in foods, beverages or feedstuffs, from diseases carried by animals, plants or products thereof, or from the entry, establishment or spread of pests; or from the entry, establishment or spread of pests.

That is why there are various differences among national legislations pertaining to the importation of foodstuffs. The EU appears as the most dynamic market, updating and broadening it, constantly. Japan and USA also offers to their partners, a very strict legislation on the ground of food and feed imported to them. The chapter offers two examples, one from the example of mercury, and other from food additives, and the differences inside them can be solved recurring to good-faith harmonization or mutual recognition.

CHAPTER 7

COSTS AND BENEFITS OF COMPLIANCE WITH TECHNICAL MEASURES: INVESTING IN FISH INSPECTION LABORATORIES

7.1 INTRODUCTION TO CHAPTER 7

In Chapter 2, the dissertation found that the technical measures to trade are determining the world fishery industry, specially the so called “product”, “production” and “processing” standards (CAC 1999a; 1999b), namely environmental and sanitary parameters. The Chapter 2 also showed that trade fluxes are oriented from developing to developed countries, and there are technologies available to close the gap in compliance to technical measures to trade.

In Chapter 3 the dissertation shows the picture of Mozambique as a low-standard country in supplying fisheries products (EC 1998; EC 2001; EC 2006; EC 2007), despite the increase in its world share in production (all fishing areas and all species). In general, the country faces lack of appropriate policies for the fishery sector, sound and supportive infrastructures and conditions. The country is also getting some ODA and a variety of international assistance to minimize the gap in compliance to technical measures – the construction and equipment of more laboratories for fish inspection would improve the conditions of supplying a variety of fisheries products’ in the targeted markets.

In Chapters 4 and 5, the dissertation found that sanitary and environmental conditions of the supply are important for the demand of shrimps and prawns exported from Mozambique to targeted markets, Spain, Portugal, Italy, Japan and others. These chapters contribute to those concerned with the current status of existence of high level of rejections of exports from developing country products trying to enter major markets for fish products, which remind us the need for significant improvement of technical and sanitary parameters along the fish food chain. Summarizing, the two chapters launch the awareness that carrying out laboratorial analysis on fishery products, prior to their exportation, is crucial as far as the fisheries products are concerned.

The previous Chapter 6 emphasizes that both macro and micro costs for compliance with technical measures depends on the economic status of the exporting countries, where the small and more vulnerable ones, dependent on foreign aid and assistance, facing the more expensive costs. The chapter also emphasizes the need of more and deep harmonization, which should be done through an increased development and wider usage of internationally, scientifically based and agreed technical measures to trade and standards.

This Chapter 7 departs from all the background provided – the determinants of exports and the compliance process to technical measures to trade in fishery products – and defends that investing in a fishery laboratory, modern and well equipped, will improve the fluxes to the world. The chapter's objective is to provide both the public and private sector in fishing sector to setup and improve infrastructures of product testing and inspection, aiming at preventing chain risk-based food-borne illness coming from possible contamination by pathogenic bacteria, viruses, histamine, biotoxins and others agents.

Departing from the assumption that the government and firms wishes to improve local production and exportation – to avoid the negative effects of non-compliance to technical measures to trade – this chapter projects an investment in fishery inspection laboratory in Mozambique, and in that regard it describes and estimates, quantitatively, the costs and the benefits of this relevant infrastructure of compliance with food standards, particularly of fisheries products. The chapter considers that the necessary conditions for improving exports are there: market access agreements with the world major consumers, financing channels, available know-how and the best practices used in the exporting chain, natural conditions in Mozambique favorable for fish production either inland or marine, etc. At the demand side, the most important factor is there: the increased consumption of a variety of fishery products.

The departing points is the existence of a Fish Inspection Laboratory in Maputo which is performing as an example of how Mozambique is trying to comply with the importer's technical measures in trade. The benefits accruing from this laboratory – improving quality of the products and the competitiveness in international markets – are far less than the costs. The chapter uses the information collected from the laboratory for fish inspection established in Maputo, Mozambique, in 2002, as the baseline and good example.

With the project of a laboratory, we expect the same sort of benefits and costs than that of the Maputo's. The reason why an investment on laboratory is proposed is to serve more and growing firms which cannot be served by the actual laboratory for a variety of reasons.

In proposing the laboratory, we carry out the cost and benefits analysis. The reasons for that typology of analysis is basically to highlight how the Mozambican economy and the export strategy in agro-food products (fishery, in this case) can deliver an economic growth and welfare, if adequate and well equipped infrastructures like laboratories, equipped with trained and skilled human capital and knowledge, as well as good institutions is setup. The analysis carried out in this chapter can serve as an indicator for future plans on the expansion on the number of agro-food laboratories in the country. By looking to the time span, the analysis also deliver the temporal frame in which the investments made can be enjoyable by the society and, particularly, by the exporters of fishery products, by improving the quality of products delivered to their markets.

More specifically, the methodology used to estimate the costs and the benefits is a combination of two complementary techniques: the estimation of NPV, and the calculation BCR. NPV is the present value of the cash flows of a project – infrastructure, in this case – at a required rate of return, compared against the initial investment, calculating the return on investment; the BCR is the ratio of the PVB to the PVC over a certain time horizon.

Any analysis of the costs and benefits of compliance to technical measures to trade should be done taking into account some important simplifying assumptions: in our analysis, we froze all others correlated possible benefits: this assumption seems to be relevant for the analysis of the benefits accruing from the proposed laboratory. The second important assumption is 50% of exporting firms in Mozambique will use the laboratory in the next 30 years. At present, fish inspection is carried out in Maputo (Mozambique) or in foreign countries such as South Africa and Portugal; firms located not far from the proposed laboratory site will prefer to use this.

After this Introduction, the following sections review literatures and provide background on economic issues supporting the idea of construction of fish inspection laboratory. There are description of the current situation, the main actors in the value chain, the potential available in the intervention area, description of the Maputo Fish Inspection Laboratory, the main objectives and services expected from a fish inspection laboratory. Further, the methodology used is presented which is to estimate the costs and benefits of compliance to technical measures to trade. For this end, data were collected, through a questionnaire and from others sources. It finalizes with a section on Chapter 7 Summary and main conclusions.

7.2 LITERATURE REVIEW AND ECONOMIC ANALYSIS

7.2.1 Literature on Costs to Compliance to Technical Measures to Trade

Except the study done by Wilson and Tsunehiro (2004b) for the World Bank Technical Barriers to Trade Survey, there is no available information about the existence of any quantitative estimation of the compliance costs, with technical measures in Mozambique, covering specifically fisheries products. However, in some African countries these studies had been carried out (Henson and Mitullah 2004; Niang 2005; Ponte 2005).

The World Bank Technical Barriers to Trade Survey was carried out to collect, at global level, the agricultural, manufacturing, and trade firms’ perception around the impacts of technical requirements by bigger markets such as the EU, the USA, Japan, Canada, and Australia. Apart for Mozambique, others 16 developing countries, covering more than 20 industries and 689 firms were surveyed. Due to its importance in providing a broader perception over the impact of the technical barriers to trade, we will summarize the study focusing on the results about Mozambican firms and industries.

The study collected the answers from interviewers in 10 firms in Mozambique (4 firms producing, processing and exporting fish and fisheries products and livestock; 3 firms in raw agriculture products; 1 for processed food and tobacco; 1 for primary metal and metallic ores; and 1 for transportation equipment and automotive parts, and dealers). In general, the survey reported that the costs of the factors of production of the firms in Mozambique (raw materials, intermediate inputs, and salaries) are higher, reaching more than 3.4 million USD, against sales of 2 million USD. On average, firms are incurring losses.

Mozambican firms have high export share in their total sales, situation similar to that of others African countries surveyed (Kenya and Uganda), and as for 2003, Mozambique was exhibiting the highest export growth, amongst all 17 countries studied (42 per cent). When asked how they rank different factors on a firm's ability to expand domestic sales, Mozambican firms pointed law demand (60 per cent) and distribution problems (60 per cent) as the most important impediments to business operations. Equally, they considered low demand (90 per cent), product quality (90 per cent) and port charges and delays (80 per cent) as the most important factors on a firm's ability to expand its exports.

The presence of mandatory domestic and foreign technical regulations question returned an expected answer, since 100 per cent of the firms surveyed pointed the existence of these regulations in their export market, and all of them pointed these regulations as important for their sales expansion in foreign markets. Curiously, only 50 per cent of the firms pointed out that technical regulation are important to expand sales in the domestic market. The surveyed were asked to compare the costs of compliance with domestic and foreign technical regulations. That study had defined technical regulations as including "*performance standards, product quality standards, certification* *requirement, consumer safety standards, labeling requirement, and health and environmental standards*" (Wilson and Tsunehiro 2004b:23).

In Mozambique, 50 per cent considered performance standards as about the same between domestic and foreign technical regulations; 60 per cent considered product quality standards of foreign nations as less expensive than Mozambican ones; 50 per cent of the firms pointed that certification standards of foreign nations are less expensive than Mozambican ones; 50 per cent of firms considered foreign regulations on consumer safety as less expensive than Mozambican ones; 50 per cent of firms considered labeling standards as about the same between foreign and Mozambican; and 40 per cent considered health and environmental regulations imposed in foreign countries as about the same with domestic, while others 40 per cent considered these regulations as being less expensive in foreign countries than in Mozambique.

Mozambican firms, on average, pointed that the investment costs to comply with technical requirements, as a share in sales, is around 45.51 per cent. That was the highest mean amongst all the 17 countries surveyed. The second country facing highest share of investment costs was Uganda, who pointed out 10.50 per cent, followed by Kenya, who reported 10.06 per cent. That so high share in Mozambique might discourage export activities, or might induce exporting firms to look around and find others trade partners, less stringent in technical measures.

Regarding the tests to certify the conformity with technical standards and regulations, Mozambican results shows that products exported are tested for conformity to the EU market (60 per cent). Such high level of conformity assessment to the EU market seems to be an isolated case, since the surveyed firms reported that they don't do this test when exporting to others destinations (in the survey, they were Australia, Canada, Japan and USA).

The results on whether the testing for compliance assessment were done within the firm, by a private testing facility, or by an agency of the government, in Mozambique got 70 per cent of firms testing through a government agency. Indeed, the survey reported that Mozambican firms believe that conducting tests within firms is more costly (6.5 per cent more costly) than doing it outside.

The survey also tested the effort of duplication of testing procedures to meet foreign requirements, once domestic requirements have been met. In Mozambique, 70 per cent of the firms reported that they have to perform significant, while 20 per cent said they have no any duplication (a single test works for domestic and foreign market).

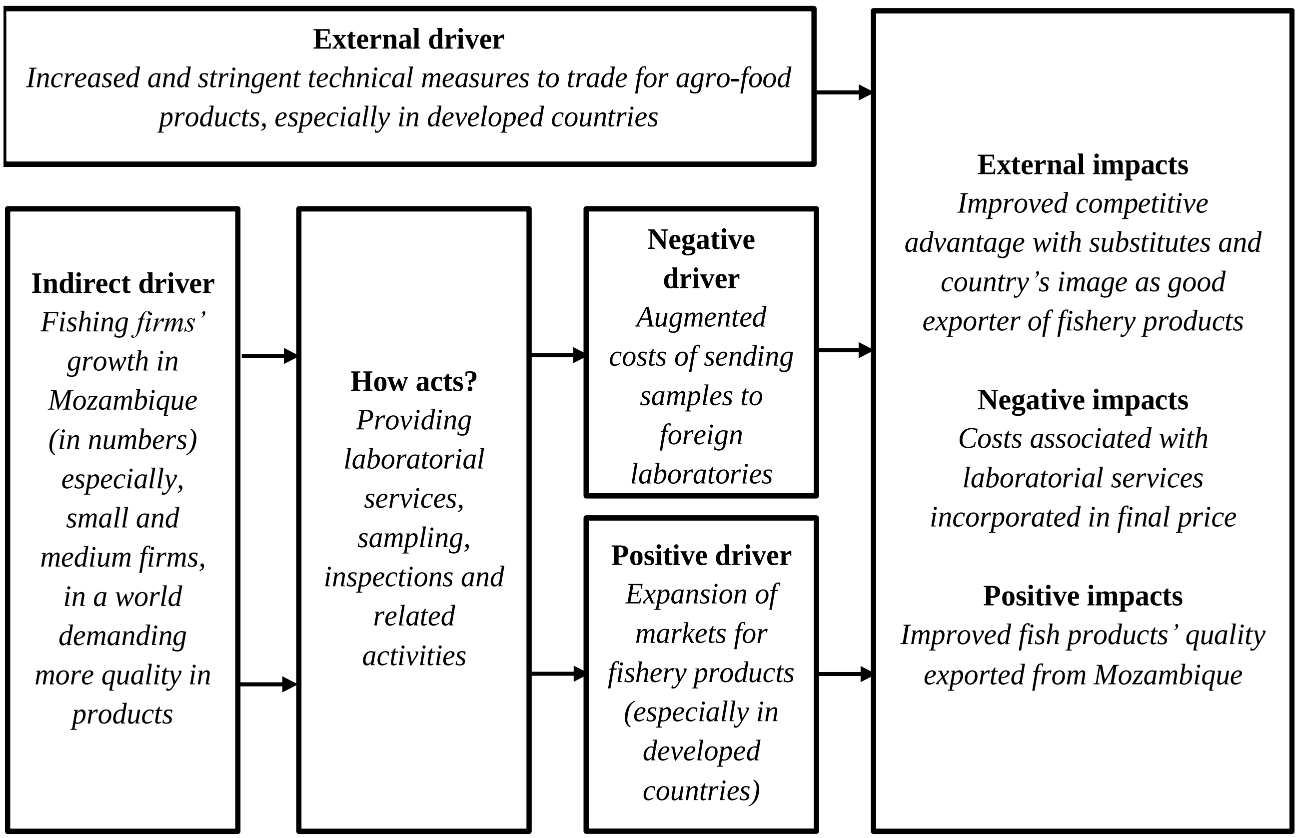
The strongest part of this survey was the wide coverage of industries in Mozambique, since their average perceptions might contains the perception of the fishery exporters. Moreover, it seems that the fishery industry was reasonable represented in the sample, attending the total number sampled in Mozambique (10 firms). In broader view, this study followed the common methodology used in studies aiming at exploring the perception about the incidence of technical measures to trade (*see* UNCTAD 1997; Aloui and Kenny 2005; Manarungsan et al. 2005; Niang 2005). Like other's studies, the questionnaires were responded by firms, associations of processors, exporters, farmers, governmental staffs, and private stakeholders (UNCTAD 1997; Aloui and Kenny 2005; Manarungsan et al. 2005; Niang 2005).

Despite these strengths, this survey only expresses the perception of the respondents. In fact, the study itself recognizes that

> *"One of the weaknesses of interviews is that … both national governments and the private sector may be reluctant to divulge information on limitations in food safety and agricultural health capacity and standards-related trade problems for fear of exposing their weaknesses to importing countries* […] *on the contrary, there may be incentives for national governments and the private sector to exaggerate weaknesses in food safety or agricultural health capacity and standards-related trade problems in view of potential flows of technical assistance"*
> Source: Wilson and Tsunehiro (2004b:11).

The Figure 7.1 summarizes how the fish inspection laboratory will act, the drivers and the impacts – environmental, economic and sanitary. The laboratory acts in providing laboratorial services, sampling, inspections and related activities. The external driver is the increased and stringent technical measures to trade for agro-food products, imposed especially in developed countries (*see* Chapter 2). After establishment of the laboratory, the country improved its competitive advantage and captured the chain of the substitute goods; the laboratory is driven, indirectly, by the growth in numbers of small and medium firms, in a world which is demanding more quality in products traded.

Figure 7.1: How Acts and the Drivers and Impacts of the Fish Inspection Laboratory



Source: Author (Adapted)

The negative driver for the laboratory was the augmented costs of sending samples to foreign laboratories – South Africa and Portugal, in most of the cases – and the positive driver is the expansion of markets for fishery products, especially in developed countries. The costs associated with laboratorial services incorporated in final price can be a negative impact of the laboratory but the improved fish products' quality exported from Mozambique can be pointed out as a positive impact. However, taking the Maputo laboratory case, the costs were incurred by the public sector exactly to avoid pressing, excessively, the parameters of the costs function.

The volume of the fishery products which will be tested in the laboratory has been estimated on the basis of an average of country's total production per year, including the projected increase in aquaculture and captures (*see* Chapter 3). The size of the demand for laboratorial services is assumed as being the same of the Maputo's laboratory and takes 12 months as the period of activity.

The time horizon assumed is 30 years, from the year it will be established. The cost of the investment is similar to that of Maputo laboratory and the construction period is also of 2 years. The laboratory is assumed as being fully operation from the 3rd year. The sources of finance, at current prices, are both public and private. Public sources include ODA from relevant partners and Governmental grants. Private funds to be invested, including for replacement of short-life components and equipment's are loans.

7.2.2 Current Situation and Actors in the Value Chain

After independence, all fishing sector was nationalized and due to a destructive civil war, most of the supportive infrastructures were destroyed or paralyzed. With the cease-fire agreement, in 1992, the sector was restructured and privatizations had begun (*see* Chapter 3). Estimates of the size of the sector – number of formal and informal fishing firms, their exact production, main products harvested and traded – remain difficult to get due to poor data coverage and informal and undocumented market. Nevertheless, an estimate of fishing sector and its annual growth rate was tempted in Annex 2, column H.

Presently, and as part of institutional arrangements to improve its technical compliance process[44], image and promote exports, there is one certified fish inspection laboratory in the country. Before

[44] Some of these conventions include: UN Convention on Biological Diversity (CBD), the UN Framework Convention on Climate Change (UNFCCC), the CITES, the Basel Convention, of 22 March 1989, on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Mozambique is also a member of the International Union for Conservation of Nature and Natural Resources (IUCN), the Ramsar (Ramsar Convention of 2 February 1971 on Wetlands of International Importance especially as

the 2002's Maputo Fish Inspection Laboratory, Mozambique had two small and limited inspecting facilities, one in Inhambane (funded by ICEIDA) and other in Beira (funded by DANIDA) (ICEIDA and MoF 2004:6, 16).

The history of the 2002's brand new Maputo Fish Inspection Laboratory is well documented in ICEIDA and MoF (2004). The summary that will follow comes from there: the works on the Maputo Fish Inspection Laboratory started in February 2000 in the Maputo harbor, but the floods that affected the Southern part of Mozambique influenced the building process. In March 2001, electricity facilities were provided, and at that time the Japanese government was funding the restructuring process of the fishing harbor in Maputo. Subsequent delays resulted in the completion of building works in June 2002, and its inauguration in August 2002. The costs for that construction, as well as for consultancy and stuff trainings were entirely supported by the ICEIDA.

The 2002's laboratory established in Maputo represented a positive outreach, as it serves the small and medium fishery firms from all over the county. Although it is important for domestic purpose, the laboratory was established to respond the importers' requirements with respect to food safety and sanitary concerns, by performing microbiological tests and controlling the implementation of HACCP. The laboratory was established to receive all the fishery products for exportation, coming from the increasing number of firms, plus others food factories and laboratories. The laboratory is owned and also operated by the Mozambican Government, through the INIP.

As shown in the Chapter 4 (section 4.3.2), few years before the establishment of that laboratory, Mozambique experienced a major banishment of fishery products in the EU. From August 2002, with the laboratory installation, Mozambique dropped considerable its dependence on foreign laboratories (Portuguese and South African) for sample for microbes and chemical analysis (pesticides, heavy metals, or prohibited hormones). The laboratory was equipped with new and

Waterfowl Habitat), UNCLOS (United Nations Convention on the Law of the Sea), POPs (Stockholm Convention on Persistent Organic Pollutants) and MARPOL (International Convention for the Prevention of Pollution from Ships).

modern equipment’s, enabling the country to perform microbiological and physicochemical analyses, as well metrology and quality control, reducing, thus, the time required for certification. However, due to lack of appropriate and permanent personnel and enough funds to maintain normal operations, the laboratory was not accredited, according to ISO 17025.

Despite the well-equipped laboratory in Maputo, firms still faces poor inspecting facilities exacerbated by constrains in transporting samples from far locations to rigorous tests in Maputo – small and basic services for testing are available in fishing ports and vessels. Low rigorous inspection services is seen as impeding micro and small fishing firms to increase their export volumes to major world markets.

As seen in Chapter 3, the main actors in the inspecting chain are government – MoF and its dependencies (fish inspectors, staff of fisheries departments, environmental health departments, provincial, districts and local competent authorities, extension workers, etc) – producers and exporters firms (private sector operators, fishers, aquaculturists, processors and traders), where some informal actors can also be added.

The supply and demand for inspection services is not yet clear in the country, despite modest records available in the dependencies of the MoF. On average, in a year, inspecting requests come from approximately 150 different firms, representing more than 2000 individual tests. The most requested services are MRL for pesticides, heavy metals, tests for E. coli, total coliforms, Salmonella *spp*. and Vibrio parahaemolyticus.

Tentative data on pricing, selling of inspection services is also provided in Annex 2, columns D and F. Pricing is over-watched by the MoF to regulate the demand and the supply, based in the strategy of attracting demand. Due to its initial stage and its role in keeping food safety, there is no competition on prices among small and big inspecting laboratories. Prices are, however, dependent on raw material and costs of equipment, most often imported.

7.2.3 Main Services from Fish Laboratory Inspection and Objectives

Based in international norms adopted by the country, a normal fish inspection laboratory is setup to gather, record, and maintain the following services:

a) Assess the effectiveness of HACCP framework in achieving safe fish and fish products results, by assessing environmental contaminants on products – MRL for pesticides, dioxins, heavy metals or PCBs, microbiological tests for pathogens on water, ice and swabs from equipment and facilities, tests for E. coli, total coliforms, faecal coliforms, Salmonella *spp.*, Staphylococcus aureus, Listeria monocytogenes, Vibrio parahaemolyticus (on bivalve molluscs), checks for toxic fish species, tests for biogenic amines and biotoxins (histamine), assays for veterinary drugs and chemical residues in harvested products;

b) Test total volatile basic nitrogen (TVB-N) and trimethylamine–nitrogen (TMA-N) assays on samples of fish to assess its freshness, and identify frequent or potential hazards and determine their risks to public health;

c) Information from fish handlers and proprietors, coming from routinely monitoring and inspections, as well as to investigate, apply, and support appropriate enforcement action to guarantee appropriate compliance with food safety legal requirements;

d) Identify common contraventions of food safety legislation, measures and standards, especially related to organoleptic or sensory tests on fish, assessing quality or fitness for human consumption, parasite checks;

e) Provide advice and information to government, fish industry workers and managers and others stakeholders, contribute and facilitate improvements in hygiene standards for fish and fish products, and to recommend practical good hygiene practices, in accordance with sound guidelines and sector-specific codes of practice.

In that regard, fish inspection laboratory's objective is to help the determination on whether fish and fish products are produced, stored, handled, and distributed hygienically, including to oversee whether fish and fish products are safe to human consumption or processing (including the so called "preparations"), forecasting possible incidents with food, such as poisoning or injury from consumption of fish and fish products.

As far as the marketing strategy is concerned, a fish inspection laboratory will not have to invest a lot in convincing firms and potential clients to use its services because the fishery market is oriented to stimulate stakeholders to test their products based on sound parameters. Certification from international bodies is a must of reliability, quality assurance and excellence of services supplied.

7.3 OPERATIONAL AND BUSINESS STRATEGIES

7.3.1 Operational Costs and Capital Investments

The costs of compliance with technical measures are defined as "the additional costs necessarily incurred by government or private enterprises in meeting the requirements to comply with a given standard in a given external market" (Jaffee et al. 2005:67). The costs are "additional" when they don't belong to the "normal" cycle of the governmental or private sector costs and are incurred forced by the necessity of meeting a specific standard.

The "non-recurring costs" are investments made in a limited timeframe to reach the conditions established by the standards (Jaffee et al. 2005). Due to their time-limited characteristics, many developing countries prefer them. They can have an impact on the recurring costs, in the sense that the well done "non-recurring projects" can decrease the scope of some recurring costs. The "non-recurring costs" comprises several activities as for instance, upgrading legislations, setting-up infrastructures, training personnel, implanting HACCP, etc. The "recurring costs", contrarily, are the costs for maintaining regular surveillance and laboratory sampling and testing activities plus the additional production costs associated with enhanced food safety controls (Jaffee et al. 2005:67).

The costs of compliance can be direct or indirect. Direct costs are those [costs] associated with specific compliance process projects', while the indirect [costs] are connected to the process only indirectly (Jaffee et al. 2005:67). Examples of direct costs of compliance includes the costs resulted from incremental production patterns, to contract skilled and more qualified labor, or others investments' made. Intuitively, it is easy to realize that the direct and additional costs necessary to comply with technical measures tend to decline over time, probably as a result of efficiency improvements arising from previous investments and also from increased experience.

The indirect costs of compliance can be exemplified by some evidences, like market repositioning, product repacking, industry or firm's bad reputation at the demand side, risks of losing market by fault of others firms of the same industry/country, change in culture and attitude, start-up learning costs, amongst others.

Literature on the costs of compliance to technical measures to trade is vast and reveals its complexity and the difficult task of knowing its real scope. Antle (1999: 609-615) explores several types of costs, depending on the structure and the depth of the technical regulation or standard imposed. Nevertheless and for simplification – the chapter will not discuss further the issue – the costs of compliance can be summarized, according to Antle (1999), in macro and micro levels: macro costs involve administrative costs and taxation associated, regulatory impact associated to the routine of CA; and micro costs, namely, the firm level costs[45].

Capital investments for a fish inspection laboratory will be composed basically by equipment needed to perform services. The equipments are technical devices capable of collecting samples, treat, process, and record, including auxiliary devices (inventory, generators, fencing, safety equipment's and uniforms), their transportation and installation.

The projected staff can be seen in the Table below, whose composition is similar to any other like laboratory, projected to give the laboratory an international level. Staffing costs reflects the salaries paid in Mozambique for nationals' officers and low-skilled personnel, considering an annual

[45] Antle (1999:610-611) considers when the costs at firm level are large enough will impact the market equilibrium price; when the technical regulations is stringent enough will lead to technologies modifications and this will also impact prices, including the parameters of the cost function.

increase in the number of the staff. The first years there will be training, both intensive and normal, domestically and abroad.

Table 7.1: Projected Staffing Costs for Fish Inspection Laboratory

Position	Main Task	Number
Laboratory manager	– Manage the plant	1
Operation managers	– Operating the laboratory	2
Staff/Officers	– Oversee all HACCP steps – Control food poisoning: pathogenic bacteria, viruses, natural toxins – Control possible illnesses: from pesticides, other chemicals, heavy metals, parasites – Control filthy and strange objects on products: glass, metal, foreign body	25
Engineering, maintenance, cleaning	– Engineering, maintenance and cleaning services	8
Finance and administration	– Finance and administration expertise	3
Guards and drivers	– Security and logistic services	7
Total		46

Source: Author

There should be training and capacity building to the staff to perform basic sampling collection and check, improve fishery legislation, machine operations, plant management and routine maintenance, and carry about the safety procedures, etc. Samples and products from firms destined to inspection will be delivered to fishing inspection plant by firms or by appropriate supply channels in use and after few years' further development of the collecting scheme should be developed.

7.3.2 Operational Benefits

The benefits of compliance with technical measures can be defined as the positive outcomes resulted from the additional costs incurred to rearrange the legislation, production, processing and marketing processes. For fishery products, some examples of "benefits" include: reductions in health risk and in risk of morbidity and mortality (Antle 1999)[46] improved quality of products; increased the confidence of the consumers on the products exported; avoiding border detections or border's complaints; reduction of the probability of being prosecuted by a client; or improve firms or product's reputation or image.

While costs are easily assessable, benefits are usually less perceived, especially when surveys are done at micro level. In fact, several surveys reports that, at micro level, firms and farms tend to perceive little benefits, compared to costs (UNCTAD 1997; Henson et al. 2004; Wilson and Tsunehiro 2004b; Aloui and Kenny 2005; Jaffee et al. 2005; Manarungsan et al. 2005; Niang 2005).

7.4 METHODOLOGY

To estimate the costs and benefits of compliance process in Mozambique, in the fishery sector, and to use the results as a basis for an analysis, the chapter uses the NPV and, complementarily, the BCR. There are also supplementary formulas of the PVB, and the PVC. The reasons for the complementarity between NPV and BCR is particularly interesting specially when the investor is facing budget constraints and, due to that reason, wants to deeper its analysis on the efficiency of the project, by running the two methodologies and comparing their results.

One of the advantages of using NPV for costs and benefits is this methodology can be used to evaluate the impact of isolated standards, regulations and technical measures or the impact of aggregated standards or projects, offering, thus, an alternative methodology when data on single projects are not publicly available. However, "*the magnitude of measured net benefits/costs is inversely related to the chosen discount rate*" (Antle 1999:616).

A key problem of this methodology (NPV) is that the results of the comparison between benefits and costs are highly sensitive to the structure of the data. In projects, it is relatively easy to collect

[46] Antle (1999: 607-609) also adds others benefits of taking care on technical measures to trade: reduction in costs of treating and averting illnesses, preventing people from being disabled because of illnesses and the foregone incomes due to loss of work time. According to Loader and Hobbs (1999:685) "*firms response to legislation concerned with food safety may be different to responses to other legislation … given the sensitive nature of food safety issues and the … importance perceived by them.*" This will impact on the costs for compliance in different styles.

data on the different types of costs, but the same is not easy for the benefits. Therefore, data on the "benefits" tend to be highly overrepresented due to the difficult in isolating "specific benefits" resulted from "specific costs".

Regarding the BCR, it is sensitive to the classification of the project as benefits or as costs (in monetary terms), and therefore, it tends to reward monetary costless projects, regardless of the nature of others net benefits. The NPV returns the present values of all costs and all benefits of a project over some interval of time *t*. Then, the NPV can be calculated from the following equation:

$$(7.1) \qquad NPV(i, N) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$$

Where: t is the time of the cash flow; i is the discount rate; N is the upper limit of the time t sequence; and R_t is the net cash flow at time t. It means the highest NPV (i, N) would be chosen when it comes to the issue of comparing mutually exclusive alternatives, as the highest NPV means the project would be worthwhile[47].

Complementing the NPV results, the chapter uses the BCR (equation 7.2), which returns the ratio between the present benefits to the present costs, respectively the PVB (inflows) and the PVC (outflows), as below:

[47] For decision: $NPV>0$ means the project would be worthwhile and should be accepted; $NPV=0$, the project neither adds nor subtracts value and, thus, it can be accepted since the rate of return is being obtained; $NPV<0$ the project would be not worthwhile and should be refused.

$$(7.2) \quad BCR = \frac{PVB}{PVC} \qquad \text{Where: } PVB = \sum_{t=0}^{N} \frac{B_t}{(1+i)^t} \qquad \text{And: } PVC = \sum_{t=0}^{N} \frac{C_t}{(1+i)^t}$$

From equation 7.2, a project is worthwhile if the *BCR* is greater than 1.

7.4.1 Data and Sources

There are two types of data: data for assessing the costs, and for assessing the benefits. The first group of data includes, broadly, costs of preparatory phase (procurement preparation, technical studies), construction costs (human resources, equipment, water and electricity, taxes), costs of investment (in machinery, human resources, laboratorial materials, environmental license, taxes) and operational costs (administrative costs, human resources, and others related). For simplicity, the calculation does not consider some of the critical variables when the cost in infrastructure is concerned: the dynamics of prices (changes in prices of goods and services during the construction phase), delays on the realization of the works, changes at the firm level (changes in the volumes of production and exportation), etc. The analysis also minimizes the probability of the distribution and occurrence of these critical variables.

The values projected as costs are similar that of the Maputo's Fish Inspection Laboratory, collected from a questionnaire (*see* Annex 4) send and filled by the INIP, in Maputo, during December 2014 to January 2015. The questionnaire contains numerous questions aiming at collecting data for costs[48], benefits and the comparison between costs and benefits, detailed laboratory objectives, and construction steps. Small amount of secondary data were also collected from literature and exporting firms.

[48] An exchange rate of 1 USD to 35 Metical is used.

As total benefits it is considered that firms are saving their money from stopping send samples to laboratories far from their ports or others countries, including travel time wasted; reduction in money devoted to operating costs for laboratorial analysis; capture of premium price in international market, by maximizing the prices; and above all, minimized border rejected cases, by equalizing the quantity of products inspected for exportation to that which delivered target markets. Since the data used comes from different sources and uses different monetary units, all the data on costs and benefits were converted to USD, and then adjusted to account for the time value of money and to make these values comparable.

7.4.2 Calculating the Present Value for Benefits

As pointed out, the best variables for assessing the PVB for setting a laboratory are difficult to collect due to lack of appropriate information: in fact the best variables would be:

a) Number of firms willing to use the laboratory, to avoid having products rejected at borders;

b) Effectiveness of the laboratory in equalizing quantities exported to quantities entered in markets;

c) Effective cost of being rejected at borders;

d) Average number of border detected cases (developing countries) associated with lack/poor laboratory analysis of fishery products.

As b) makes clear, if a laboratory facility is to avoid border rejections, then the total of exports equals the total of delivery in the targeted market. Therefore, to measure the benefits of compliance process in Mozambique, the values of exports of fish and fishery products, processed (at HS 6-digit, all species) to the world are used to represent the all possible benefits. All data are from UN-COMTRADE (HS 03 – Fish, crustaceans, mollusks, aquatic invertebrates, NES), expressed in constant USD.

An important question is: how to extract the real benefits coming from the laboratory? For simplicity, the chapter considers as delivered all the products inspected and destined for exportation (i.e., all products inspected by the laboratory is considered as having reached its intended export market).

7.4.3 Calculating the Present Value for Costs

The PVC of the costs was calculated at 5 per cent discount rates i (the reasonable average rate of inflation during last few years), and with different time of the cash low t (t_1~t_{30}). The structure of the costs comprises (a) total cost for construction of the laboratory, including costs of furnishing/equipments; and (b) costs accrued by firms for laboratorial analysis. Due to data unavailability, the structure of the costs regarding operational costs of the laboratory (water and energy, wages for the stuff, laboratorial material – reagents, solvents, chemicals – sample collection, outsourcing of tests), calibration, maintenance expenses, stuff training, accreditation, as well as the indirect (recurring and nonrecurring costs) are only approximations, using as a basis the framework provided in Annex 3 of this dissertation.

The t_1 is considered as the startup of the laboratory; the implementation of the project is the considered as starting in t_3. The sources to financing the laboratory is considered as ended with the inauguration of the laboratory in t_2, meaning there are no longer investment financing t_2 afterwards. There is a consideration of replacement of short-life equipment's of the laboratory every 10 years (t_{10}, t_{20} and t_{30}). This seems to update the staff with new knowledge and understanding of food safety issues as well as legislation and control approaches, once priorities, concerns, technology, research and equipment in the fishing inspection sector are constantly evolving and changing.

As for the human resources and labour costs associated, it considers 30 skilled technicians at 10,000 USD per person/year, in a competitive labour market, and 5,000 USD per person/year for non-skilled workers, in a non-competitive market; and an average of real growth rate of the labour cost equals to the country GDP annual growth rate.

The costs of others factors are resumed in Annex 5. Electricity, water, maintenance costs, sampling and testing products are assumed as increasing at an annual rate of 5 per cent, the average inflation rate in recent 10 years (2004-2013).

7.5 RESULTS AND DISCUSSION

7.5.1 Result for the Net Present Value

The NPV calculated for the establishment of the fishery laboratory in Mozambique is 643,071.00 USD: the inflows exceed outflows. The value is more than 0 (*NTV*>0), meaning the project is worthwhile and is returning significant benefits to the economy and the fishing sector.

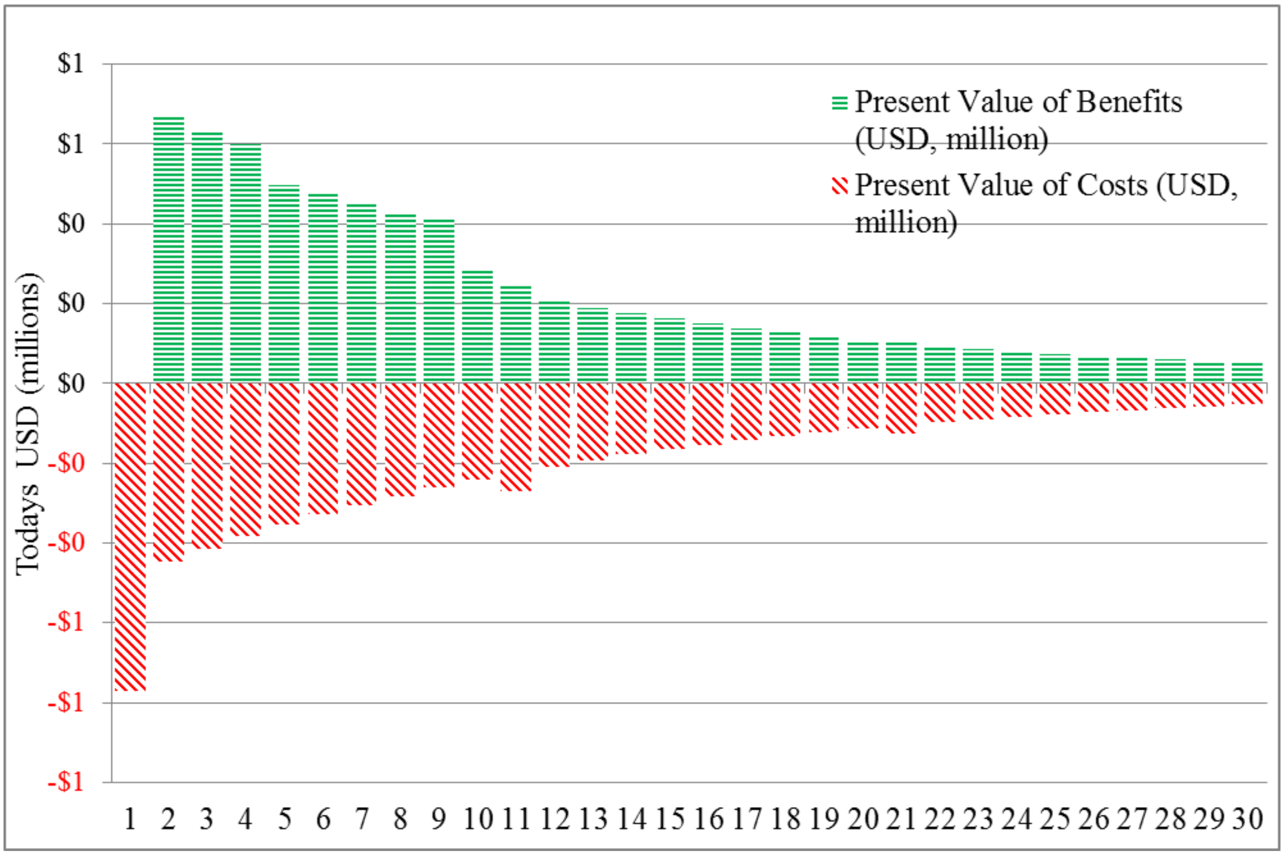
Considering that the laboratory and respective furniture's will be funded by grants (and ODA loans) from foreign agencies, from EU, Japan or others, the costs of compliance with technical measures will be covered by the importers themselves: the costs of compliance to technical measures will not entirely be passed to consumers in EU, Japan, and South Africa through higher exporting prices because the costs of compliance acts like a subsidy on production.

7.5.2 Result for the Benefit-Cost Ratio

The BCR is 3.00 (*BRC*>1) which reinforces the project is really worthwhile. The results suggest that a Fish Inspection Laboratory had a benefit: BCR of 3 means the benefits are three times bigger than the costs and this mean, on average, fishery industry can still yield a positive net benefit even when the PV of costs for compliance are doubled or tripled. These results are quite consistent with others findings (in fact, in the section 6.2.3 we found that the Thai effort to comply with technical standards was less than 1 per cent, attending the export values in 2002).

Since the laboratorial costs are one of the most important problems faced by fishing firms in Mozambique, the net benefits reported here can represent the net impact of others standards. Moreover, due to huge net BCR captured by the firms of industry, it seems to be acceptable to assume that different firms, with different production and technical compliance strategies, geography, scales and sizes will enjoy in some degree the advantages of complying with fish laboratorial analysis requirement.

Figure 7.1: PVB and PVC: Investing in a Laboratory for Fishery Inspection in Mozambique



Source: Author (Calculations)

The relatively low PV of costs suggests, thus, that a modern and more mature fishery industry is possible in Mozambique. This fact can be validated also if we assume that the costs for laboratory installation and fishing harbor in Maputo (for instance) were supported by foreign partners – ICEIDA and JICA (Japan International Cooperation Agency). Therefore, the importer's constraints, either non-tariff barriers or truly justifiable impediments of trade, can be supported by the Mozambican firms. Thus, domestic polices appear as the most important aspects that the fishery industry is dependent upon. If at the domestic level the country can control diseases or pests, the realization of economies of scale can be done.

7.6 CHAPTER 7 SUMMARY

This chapter estimates the costs and benefits of compliance with technical measures required in the international trade of fishery and agro-food products, by calculating the NPV and also the BCR. To capture an importer standard or technical regulation, we estimated the costs and benefits accruing from a hypothetical Fish Inspection Laboratory to be established in Mozambique, funded by ODA grant provided by donors and by the Government. The chapter presents the laboratory acts – providing laboratorial services, sampling, inspections and related activities – external, indirect, negative and positive driver. It presents also the negative and positive impacts.

The results presented in the chapter emphasize that improving technical measures compliance infrastructures' can reduce transaction costs of firms and increase their ability to engage in new markets. Thus, laboratory offer a potential for positive aggregate output in the fishery sector, accruing from reduced costs, plus the higher unit values paid from "extra" price.

Although we consider the general findings as correct, the estimations are only approximations and this was caused by the lack of detailed structure on the costs faced by the exporting firms and the existing agro-food laboratories. This suggests that further studies and field-survey data are highly required. In the same way, due to data unavailability, time, and the quantity of work required, this chapter does not provide a cost-benefit assessment of the entire structure of fishery technical measures compliance process in Mozambique: for sure, that would be desirable. Therefore, one obvious research recommendation is to challenge further researchers to run such type of work, preferably assessing project/policy by project/policy. In fact, this chapter analyses solely the costs and benefits of one possible investment project, which might have substantial positive impact for the exporting segment in Mozambique.

The balance between PV of costs and PV of benefits of carrying laboratorial analysis and underlines that despite some exporting problems caused by lack of compliance with technical measures, Mozambique can capture and maintain a significant share of the world's market of fishery products, by supplying more quantities. Frozen shrimps and prawns (tiger shrimp) shall be in the frontline of such strategy.

The installation of fish inspection laboratory in Mozambique has, however, some critical factors where its viability is dependent upon: the availability of firms which will prefer domestic laboratorial services and the harmonization of HACCP procedures and their acceptance in world major importing markets; occurrence or outbreak of fish diseases which will impact the total production and exportation; and the drop in prices in international markets, which could disincentive firms.

The risk of occurrence of these critical factors seems to be low due to existence of huge conscience about the need to harmonize rules and technical procedures in good-faith, and the fact that national food safety measures is increasingly based on international standards, guidelines and recommendations adopted by international organizations, like the *Codex Alimentarius*, implementation of sound environmental standards for fish mode of production, and the increased demand for fish and fishery products in the world.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

SUMMARY OF THE DISSERTATION

The purpose of research is to answer two questions: (1) what are the determinants of exports of fishery products from Mozambique, and (2) what are the costs and the benefits of complying with importer's technical regulations, standards, and measures. The questions raised are founded in recent literature which highlights the importance of technical measures to trade in the export and import of agro-food products. In fact, recent evidences emphasizes that technical standards and sanitary and phytosanitary standards designed to safeguard food safety, human, animal and plant health and life are acting as substantial obstacles to exports of fish and fish products. Therefore, apart from prices and consumer's incomes, agro-food products are highly sensitive to the degree of compliance to consumers' technical regulations and standards. The importance of these standards can be seen in Panisello and Quantick (2001:172) who say: "*HACCP is becoming the exchange currency* (…) *used by importing and exporting countries to facilitate the trade of food products*".

The dissertation starts, in the Chapter 2, by providing a general picture on the role of the technical measures to trade of world fishery industry, highlighting the concepts of "product", "production and processing", and "labeling and marketing" standards. From the world data, aquaculture production is underlined as the mode of production that is increasing the world supply, and especially, the trade fluxes from developing to developed countries. A general lesson from that chapter is that captures should be reduced (not necessarily stopped), while environmental-friendly aquaculture should be promoted. That is why the chapter indicates that technological advances in fisheries science, higher incomes, health and sanitary consciences as well as the population structure, combined with lower or zero tariffs on imports, is pushing importing countries' governments to improve their means to control [imports] of agro-food. This is done by applying and enforcing stringent technical standards and regulations, which is affecting, particularly, fishery products. Its perishability nature and the wide evidences of fishery as being vehicle for food-borne illnesses are among the main reasons for the application of such stringent regulations and standards (Martinez et al. 2007).

In the Chapter 3, Mozambique is analyzed. The dissertation assumes that the country has deficit in applying technical standards, taking as evidences the successive findings of failures to meet the EU legislations on food safety (data from others important markets were not found). The reasons for that are complex, but include the economic model chosen after the independence, long economic stagnation and backwardness created by the civil war, lack of supportive infrastructure and equipment, and deficient control of the domestic refuse and sewage facilities. This suggests that additional effort, to enforce the existing rules, institutions and laws shall be done. The chapter points out that 11 tariff line of fishery products are exported consistently, offering potential alternatives for product diversification, and through it, to market diversification. In this point, the dissertation criticizes and joins its voice to those who critics the fishing agreements, arguing that they lead to underinvestment infrastructures for compliance to technical measures, and they endangers the fishery resources, due to their “extractive” nature.

In the Chapter 4, the dissertation tests the significance of sanitary and environmental indicators to the exports of fishery products from Mozambique. An export demand equation under the assumption of imperfect substitute goods was taken, using the quantity of shrimps and prawns, frozen, as the dependent variable. The results points out that the export demand model for shrimps and prawns exported from Mozambique performs better with Spain and Portugal, the two main partners. In most of the cases, the fixed effect methodology performed better than the pooled least square since it corrected the majority of the wrong signals detected in the pooled least square and the t-statistics, by lowering the significance of these variables. Although the sanitary and environmental indicators are significant with some trading partners, the number of products being rejected, destroyed or deviated to others markets is increasing, as well as the number of mandatory quantity of samples to be tested at laboratories.

The Chapter 5 uses two products (frozen shrimps and prawns and dried fish), two equations (export demand and supply) and one technical indicator (costs for carrying laboratory analysis). The results for dried fish performed poorly, which suggests that more assessments are needed. As for the shrimps and prawns, the instruments performed well, taking the F-statistic results. The comparison indicates the relevance of shrimps and prawns as the engine of exports for fisheries products in Mozambique and because of that, fishery products in general are sensitive to the economic profile of the trading partners, namely Spain and Portugal, and not sensitive to others partners, even for the largest importers of dried fish.

The Chapter 6 revises the costs for compliance faced by different developing fishing countries. In general, smaller and more vulnerable countries appear as more dependent on foreign aid, while relatively great economies tend to support their own compliance activities. The chapter also indicates that the empirical data suggests that costs for compliance are far below the benefits.

In Chapter 7, the estimates of the NPV and the BCR provided results close to these reported by others researchers (Swann et al. 1996; Jaffee et al. 2005; Manarungsan et al. 2005; Niang 2005; UNCTAD 2007). For the Mozambican case and as for the costs of laboratory set-up and recurrent sanitary and chemical tests, the NPV represent is 643,071 and the BCR is 3. This means that Mozambique can set up fishery laboratory and sustain its strategy conducive to increase its world's production share, by supplying more quantities of aquaculture products, especially frozen shrimps and prawns.

CONCLUSIONS AND MAIN RESULTS

From the chapters, sub-chapters and all material provided here, this dissertation concludes that beside prices and income, technical measures (sanitary and environmental aspects):

(1) Are affecting the demand of exports of fishery products, from Mozambique, especially, frozen shrimps and prawns exported to EU – in fact, the importance of sanitary and environmental factors in the trade of agro-food products had been reported by several authors, like WHO and FAO (2005);

(2) From the worldwide trend and exporting successful developing countries, increasing-production strategy should be based on increase of aquaculture and a gradual decrease of captures;

(3) Export-promoting strategy should be based on increase of quantities (produced and exported) and of quality (compliant to sound technical, health and environmental standards), than on prices.

(4) The benefits of complying with technical measures, represented by export values are higher than the costs, represented by the costs of laboratorial analysis in the Maputo Fish Inspection Laboratory. This conclusion is consistent with studies done in others countries (Swann et al. 1996; Jaffee et al. 2005; Manarungsan et al. 2005; Niang 2005; UNCTAD 2007). The magnitude of the share of the costs to the export value is also close to that was reported by Manarungsan et al. (2005) for the Thai fishery industry;

(5) Above all: if the laboratorial costs of compliance are negligible, then problems of compliance should be found in errors of delivering the products, as for instance, the rupture of the cold chain. Therefore, the investment on the technical compliance structure shall be directed to upgrade the freezing equipments, storage and modern vessels.

The implication of all the dissertation results together – elasticities for income and price, sanitary and environmental conditions of fishery products, including the *CLA* as an IV and the positive NPV in a proposal for laboratory setup – is that there is opportunity to expand the production and exportation of fishery products, enlarge the number of the species traded. Taking the fluxes of ODA available in the fishery portfolio, modern vessels with installed capacity to process and carryout basic tests are an option.

RECOMMENDATIONS

For Policy Makers and Fishing Industry

Projections for prices of fishery products point a slight increase in the next years: this imply that fishery exporters from Mozambique shall be more proactive in changing and adapting their production, labeling and marketing standards, to take advantage of the price "premium" of the successful compliant exporters. This implies:

a) That the Government shall reduce domestic taxes and taxes on supply or imports of intermediate inputs for production, processing and labeling, to keep the cost of production at a competitive level. Since aquaculture production depends heavily on fishmeal, others fishing actors can appear in the market, to supply the fishmeal needed. For wider economic impact in Mozambique, small and medium sized firms, including artisanal firms, shall be mobilized to take this opportunity, since feedfish are, on average, small pelagic fish, which can be easily produced by familiar and cooperatives actors;

b) As for labeling and marketing standards, Mozambique need to approve and enforce a compulsory domestic regulation which will be supportive to exporting firms (and also domestic consumers) requiring producing firms to provide elements needed for traceability about the exact nature and characteristics of the product, properties, composition, quantity, durability, origin or provenance, method of manufacture or production, and so on;

c) To compensate the reduced governmental revenues (generated due to reduced taxes on domestic and imported intermediate inputs), taxes can be raised on environmentally unfriendly companies, products, and practices.

Providing support and incentives to the firms, such as fiscal arrangements in the acquisition of vessels with capacity to operate in high and deep sea and Mozambican EEZ can be an alternative towards the increase of quantities supplied, at the expense of diminishing the captures along the coastal areas. This policy option has the following advantages:

a) Vessels with capacity to operate in high-sea will explore valuable fishery resources that, otherwise, cannot be accessed and commercialized. The figures on Mozambican exports are concentrated on shrimps and prawns and some species of fish, because, as shown in the Chapter 3, the domestic firms have no capacity to reach high and deep sea species, like tuna, deep-sea octopods, or deep-sea squids. This can contribute to the diversification products exported;

b) Fishery species caught in deep-sea are less linked to health and sanitary problems on humans because the high salinity there and considerable distance from land-based sources of pollution make such kind of species less likely to be suspected of infection by microbes. Moreover, the reduction of captures along coastal areas by industrial firms would have a positive impact on local and fishing communities;

c) An appropriate fiscal arrangement for this is to subsidize the production at the high sea. Instead of fuel subsidy (which have negative environmental consequences), production could be encouraged by reducing or returning the VAT (value added tax) paid by this group of operators. This option can affect the international competitiveness from reduced costs of production, and might induce fishery firms to gain markets to others African competitors;

d) Others sources of revenues that balance the reduction of captures along the coastal areas, the promotion of aquaculture, and the promotion of high sea captures includes to restrict the fishing effort by taxing additional unit of time on the extra days of fishing, vessels with old engine or equipments or fishing gears.

Investments on modern vessels, processing and storage facilities is a step to be done, for marine captures. To that end, the surplus coming from exports shall be reinvested.

a) The government can incentive that long run target by lowering the interest rate that commercial banks capture from funding this process, especially on energy-efficient and environmentally-friendly vessels or equipments. In fact, energy-efficient vessels can be used to carry out the high and deep sea fishing;

b) Processing plants layout must be designed to be compatible with HACCP implementation, minimizing as possible the frequency and time necessary for handling, facilitate cleaning, inspection and maintence (Panisello and Quantick 2001:171);

c) Grants and others payments can be provided to local communities to decommissioning their vessel's capacity and/or improve their storage facilities.

Considering the demand elasticity of income (from the Chapter 4), increased quantities supplied imply more incomes, and, thus, additional governmental revenues, and more jobs created. Since the activities related to the increase of fishery output (either captures or aquaculture production) tend to be labor intensive of low skill labor, this can provide enormous benefits.

At long run, the private sector shall be able to setup fishery processing plants in Mozambique, to increase the value added, diversify products and markets, and be resilient to sanitary and environmental problems, since most of them are correlated with low processed fishery products. In fact, the more added values on fishery products, easier become to control the HACCP since the critical points are reduced.

For Researchers and Academia

Throughout the dissertation several issues were raised which deserves a more depth investigation and data analysis. For instance

(1) It is necessary to understand the issue of persistent fluxes of exports vs. the non-persistent lines of exports. This offers the possibility of understand the sustainability of exports;

(2) The income elasticity for dried fish is not coherent with the reality of low income countries such as South Africa, Malawi, Zimbabwe and Zambia. Other issue is related to the real dimension of the trade captured by the official data among these countries;

(3) More studies to compare the demand-side sensitivity on technical measures to trade on all tariff lines of fishery products exported by Mozambique are needed;

(4) More studies, preferentially, at the firm level studies, to complement, reaffirm or reject the findings of the NPV and BCR should be carried out. This implies a creation of a comprehensive database on plant level costs of production, data before and after a specific regulation, structure of costs, wages, etc.

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Annex 1: List of Fishery Products Covered under this Dissertation at HS-6 digit: 1992 Edition

Persistent Exported Products

030219	Fresh or chilled salmonidae (excl. trout "Salmo trutta, Oncorhynchus mykiss, Oncorhynchus clarki, Oncorhynchus aguabonita, Oncorhynchus gilae, Oncorhynchus apache and Oncorhynchus chrysogaster", Pacific salmon "Oncorhynchus nerka, Oncorhynchus gorbuscha, Oncorhynchus keta, Oncorhynchus tschawytscha, Oncorhynchus kisutch, Oncorhynchus masou and Oncorhynchus rhodurus", Atlantic salmon "Salmo salar" and Danube salmon "Hucho hucho")
030379	Frozen freshwater and saltwater fish (excl. salmonidae, flat fish, tunas, skipjack or stripe-bellied bonito, herrings, cod, sardines, sardinella, brisling or sprats, haddock, coalfish, mackerel, dogfish and other sharks, eels, sea bass and hake)
030559	Dried fish, salted, not smoked (excl. cod and other fillets)
030611	Frozen rock lobster and other sea crawfish "Palinurus spp.", "Panulirus spp." and "Jasus spp.", whether in shell or not, incl. rock lobster and other sea crawfish in shell, cooked by steaming or by boiling in water
030613	Frozen shrimps and prawns, whether in shell or not, incl. shrimps and prawns in shell, cooked by steaming or by boiling in water
030614	Frozen crabs, whether in shell or not, incl. crabs in shell, cooked by steaming or by boiling in water
030619	Frozen crustaceans, fit for human consumption, whether in shell or not, incl. crustaceans in shell, cooked beforehand by steaming or by boiling in water (excl. rock lobster and other sea crawfish, lobsters, shrimps, prawns and crabs); frozen flours, meals, and pellets of crustaceans, fit for human consumption
030623	Shrimps and prawns, whether in shell or not, live, dried, salted or in brine, incl. shrimps and prawns in shell, cooked by steaming or by boiling in water
030729	Scallops, incl. queen scallops, of the genera Pecten, Chlamys or Placopecten, frozen, dried, salted or in brine, with or without shell
030741	Live, fresh or chilled cuttle fish "Sepia officinalis, Rossia macrosoma, Sepiola spp." and squid "Ommastrephes spp., Loligo spp., Nototodarus spp., Sepioteuthis spp.", with or without shell
030799	Molluscs, fit for human consumption, whether in shell or not, frozen, dried, salted or in brine, incl. sea urchins, sea cucumbers and other aquatic invertebrates (other than crustaceans); flours, meals and pellets of aquatic invertebrates (other than crustaceans), fit for human consumption (excl. chilled, and oysters, scallops, queen scallops, mussels, cuttlefish, squids, octopus and snails other than sea snails)

Others Exported Products

030110	Live ornamental fish
030192	Live eels "Anguilla spp."
030211	Fresh or chilled trout "Salmo trutta, Oncorhynchus mykiss, Oncorhynchus clarki, Oncorhynchus aguabonita, Oncorhynchus gilae, Oncorhynchus apache and Oncorhynchus chrysogaster"
030212	Fresh or chilled Pacific salmon "Oncorhynchus nerka, Oncorhynchus gorbuscha, Oncorhynchus keta, Oncorhynchus tschawytscha, Oncorhynchus kisutch, Oncorhynchus masou and Oncorhynchus rhodurus", Atlantic salmon "Salmo salar" and Danube salmon "Hucho hucho"
030223	Fresh or chilled sole "Solea spp."
030229	Fresh or chilled flat fish "Pleuronectidae, Bothidae, Cynoglossidae, Soleidae, Scophthalmidae and Catharidae" (excl. halibut "Reinhardtius hippoglossoides, Hippoglossus hippoglossus and Hippoglossus stenolepsis", plaice "Pleuronectes platessa" and sole "Solea spp.")
030232	Fresh or chilled yellowfin tunas "Thunnus albacares"
030234	Fresh or chilled bigeye tunas "Thunnus obesus"
030239	Fresh or chilled tunas (excl. albacore or long-finned tunas "Thunnus alalunga" and yellowfin tunas "Thunnus albacares")
030250	Fresh or chilled cod "gadus morhua, gadus ogac, gadus macrocephalus"
030261	Fresh or chilled sardines "Sardina pilchardus, Sardinops spp.", sardinella "Sardinella spp.", brisling or sprats "Sprattus sprattus"
030262	Fresh or chilled haddock "Melanogrammus aeglefinus"
030263	Fresh or chilled coalfish "Pollachius virens"
030269	Fresh or chilled freshwater and saltwater fish (excl. salmonidae, flat fish, tunas, skipjack or stripe-bellied bonito, herrings, cod, sardines, sardinella, brisling or sprats, haddock, coalfish, mackerel, sharks and eels)
030270	Fresh or chilled fish livers and roes
030329	Frozen salmonidae (excl. Pacific salmon, Atlantic salmon, Danube salmon and trout)
030339	Frozen flat fish "Pleuronectidae, Bothidae, Cynoglossidae, Soleidae, Scophthalmidae und Citharidae" (excl. halibut, plaice and sole)
030341	Frozen albacore or longfinned tunas "Thunnus alalunga"
030342	Frozen yellowfin tunas "Thunnus albacares"
030344	Frozen bigeye tunas "Thunnus obesus"

030345	Frozen bluefin tunas "Thunnus thynnus"
030349	Frozen tunas of the genus Thunnus (excl. albacore or longfinned and yellowfin)
030350	Frozen herrings "Clupea harengus, Clupea pallasii"
030351	Frozen herrings "Clupea harengus, Clupea pallasii"
030374	Frozen mackerel "Scomber scombrus, Scomber australasicus, Scomber japonicus"
030375	Frozen dogfish and other sharks
030378	Frozen hake "Merluccius spp., Urophycis spp."
030380	Frozen fish livers and roes
030410	Fresh or chilled fillets and other fish meat, whether or not minced
030420	Frozen fish fillets
030429	Frozen fish fillets (excl. swordfish and toothfish)
030490	Frozen fish meat, whether or not minced (excl. fillets)
030510	Flours, meals and pellets of fish, fit for human consumption
030520	Fish livers and roes, dried, smoked, salted or in brine
030569	Fish, salted or in brine only (excl. herrings, cod, anchovies and fillets in general)
030612	Frozen lobsters "Homarus spp.", whether in shell or not, incl. lobsters in shell, cooked by steaming or by boiling in water
030621	Rock lobster and other sea crawfish "Palinurus spp., Panulirus spp. and Jasus spp.", whether in shell or not, live, dried, salted or in brine, incl. in shell, cooked by steaming or by boiling in water
030622	Lobsters "Homarus spp.", whether in shell or not, live, dried, salted or in brine, incl. lobsters in shell, cooked by steaming or by boiling in water
030624	Crabs, whether in shell or not, live, dried, salted or in brine, incl. crabs in shell, cooked by steaming or by boiling in water
030629	Crustaceans, fit for human consumption, whether in shell or not, live, fresh, chilled, dried, salted or in brine, incl. crustaceans in shell, cooked beforehand by steaming or by boiling in water (excl. rock lobster and other sea crawfish, lobsters, shrimps, prawns and crabs); flours, meals and pellets of crustaceans, fit for human consumption
030731	Live, fresh or chilled mussels "Mytilus spp., Perna spp.", with or without shell
030749	Cuttle fish "Sepia officinalis, Rossia macrosoma, Sepiola spp." and squid "Ommastrephes spp., Loligo spp., Nototodarus spp., Sepioteuthis spp.", frozen,

	dried, salted or in brine, with or without shell
030751	Live, fresh or chilled octopus "Octopus spp.", with or without shell
030759	Octopus "Octopus spp.", frozen, dried, salted or in brine, with or without shell

Annex 2: Methodology for Estimating the Costs for Laboratorial Analysis (1990-2014)

	A		B		C		D	
	Quantities Exported, Tons		**Quantities Exported, kgs**		**Quantities Exported, per Month**		**Cost Laborat. Analysis, per unit**	
Years	**Fish, dried**	**Shrimps, frozen**	**Fish, dried**	**Shrimps, frozen**	**Fish, dried**	**Shrimps, frozen**	**Fish, dried**	**Shrimps, frozen**
1990	-	4,122.50	-	4,122,504.00	-	343,542.00	-	28.03
1991	-	7,073.16	-	7,073,162.00	-	589,430.17	-	31.82
1992	-	6,558.84	-	6,558,841.00	-	546,570.08	-	29.91
1993	-	6,393.30	-	6,393,307.00	-	532,775.58	-	30.19
1994	-	8,470.00	-	8,470,000.00	-	705,833.33	-	35.85
1995	-	6,830.00	-	6,830,000.00	-	569,166.67	-	34.86
1996	-	10,137.00	-	10,137,000.00	-	844,750.00	-	33.86
1997	-	6,845.00	-	6,845,000.00	-	570,416.67	-	33.10
1998	-	8,140.00	-	8,140,000.00	-	678,333.33	-	32.60
1999	-	7,507.00	-	7,507,000.00	-	625,583.33	-	31.89
2000	2,150.00	6,511.00	2,150,000.00	6,511,000.00	179,166.67	542,583.33	20.77	30.85
2001	1,357.00	5,968.00	1,357,000.00	5,968,000.00	113,083.33	497,333.33	20.20	30.00
2002	1,859.00	8,151.00	1,859,000.00	8,151,000.00	154,916.67	679,250.00	19.89	29.54
2003	2,694.00	5,760.00	2,694,000.00	5,760,000.00	224,500.00	480,000.00	19.45	28.88
2004	5,093.00	5,548.00	5,093,000.00	5,548,000.00	424,416.67	462,333.33	18.94	28.13
2005	3,354.00	6,386.00	3,354,000.00	6,386,000.00	279,500.00	532,166.67	18.32	27.20
2006	599.00	14,066.00	599,000.00	14,066,000.00	49,916.67	1,172,166.67	17.75	26.35
2007	1,800.00	9,618.00	1,800,000.00	9,618,000.00	150,000.00	801,500.00	17.25	25.62
2008	370.00	9,379.00	370,000.00	9,379,000.00	30,833.33	781,583.33	16.62	24.68
2009	490.00	8,019.00	490,000.00	8,019,000.00	40,833.33	668,250.00	16.68	24.76
2010	589.00	8,908.00	589,000.00	8,908,000.00	49,083.33	742,333.33	16.41	24.37
2011	567.00	5,283.84	567,000.00	5,283,844.00	47,250.00	440,320.33	18.83	25.03
2012	902.73	830.76	902,729.00	830,765.00	75,225.42	69,230.42	17.01	27.76

2013	712.01	2,270.52	712,007.00	2,270,525.00	59,333.92	189,210.42	19.63	29.54
2014	801.84	3,222.48	801,839.00	3,222,478.00	66,819.92	268,539.83	18.96	28.56

	E		F		G	H	I	
	Qty. of Fish Necessary for test, Once (unit)		One-firm Yearly Laboratorial Costs		GDP growth	No. Firms, Total	No. Firms per species for products	
Years	Fish, dried	Shrimps, frozen	Fish, dried	Shrimps, frozen	Mozambique	Mozambique	Fish, dried	Shrimps, frozen
1990	-	12	-	367.92	30.81	22	-	22
1991	-	12	-	419.87	30.99	24	-	24
1992	-	12	-	378.05	31.37	26	-	26
1993	-	12	-	399.62	31.78	25	-	25
1994	-	12	-	430.20	32.16	27	-	27
1995	-	12	-	418.35	33.03	27	-	27
1996	-	12	-	406.35	35.48	29	-	29
1997	-	12	-	397.23	39.11	32	-	19
1998	-	12	-	391.14	43.33	36	-	29
1999	-	12	-	382.69	46.84	39	-	31
2000	10	12	249.30	370.24	47.35	39	10	29
2001	10	12	242.40	360.00	52.99	44	8	36
2002	10	12	238.65	354.44	57.66	48	9	39
2003	10	12	233.36	346.58	61.13	51	16	35
2004	10	12	227.26	337.51	65.95	55	26	29
2005	10	12	219.81	326.45	72.26	60	21	39
2006	10	12	212.94	316.25	76.83	64	3	61
2007	10	12	207.04	307.49	82.43	68	11	57
2008	10	12	199.39	296.12	88.05	73	3	70
2009	10	12	200.10	297.18	93.63	78	4	74

2010	10	12	196.87	292.38	100.00	83	5	78
2011	10	12	289.67	309.83	107.72	87	9	78
2012	10	12	281.69	376.64	112.42	98	14	84
2013	10	12	273.61	376.33	118.04	102	13	89
2014	10	12	267.47	398.73	121.08	109	17	92

Source: Author

Annex 3.1: Japanese Total Imports of Shrimps and Prawns (in Tons) from the World and from Mozambique (1990-2014)

Years	Imports from the World	Imports from Mozambique
1990	283,448.06	1,237.38
1991	284,493.33	1,354.63
1992	272,760.79	1,153.09
1993	300,489.25	1,479.25
1994	302,975.43	1,636.25
1995	292,909.92	1,887.00
1996	288,762.63	1,744.06
1997	267,246.96	2,151.13
1998	238,906.11	1,675.19
1999	247,313.93	1,694.44
2000	246,627.29	1,782.59
2001	245,048.47	1,998.00
2002	248,868.35	1,653.63
2003	233,195.33	1,259.69
2004	241,442.75	1,027.50
2005	232,434.77	1,334.57
2006	229,948.06	1,216.59
2007	207,243.33	323.31
2008	196,626.19	200.40
2009	197,573.83	238.01
2010	205,344.68	59.21
2011	205,216.29	97.87
2012	200,501.83	130.39
2013	187,280.36	217.45
2014	162,298.17	193.24

The structure of the Japanese imports of shrimps and prawns from the World and from Mozambique is presented in the left side data, with time-series of 25 years, from 1990 up to 2014.

Imports from the World: the linear slope returns: y=305,829–5,005.50x with a R-squared of 0.89. Departing from 305,829 tons, Japan is reducing, yearly, imports of shrimps and prawns, from the World, at an average rate of 5,005 tons.

Imports from Mozambique: the linear slope returns: y=2,064–73.40x with a R-squared of 0.59. Japan is decreasing its imports of shrimps and prawns from Mozambique at an average rate of 73.40 tons every year, in the recent 25 years.

Data Source: UN-COMTRADE

Annex 3.2: Italian Total Imports of Shrimps and Prawns (in Tons) from the World and from Mozambique (1990-2014)

Years	Imports from the World	Imports from Mozambique
1990	24,765.99	198.26
1991	25,091.73	201.68
1992	24,962.01	205.53
1993	24,873.87	199.58
1994	23,552.84	204.62
1995	24,088.41	263.12
1996	29,379.41	141.61
1997	24,971.89	272.50
1998	35,271.33	377.56
1999	33,413.22	251.09
2000	37,999.65	293.39
2001	45,043.39	247.80
2002	40,350.56	130.55
2003	45,628.02	176.98
2004	46,633.38	90.22
2005	52,059.62	9.84
2006	62,783.06	37.20
2007	65,466.19	83.65
2008	59,430.87	25.38
2009	61,683.55	34.39
2010	63,982.37	20.16
2011	64,967.00	20.16
2012	58,067.24	51.09
2013	57,295.33	19.80
2014	63,218.71	9.84

The structure of the Italian imports of shrimps and prawns from the World and from Mozambique is presented in the left side data, with time-series of 25 years, from 1990 up to 2014.

Imports from the World: the linear slope returns: y=22,867+2,229x with a R-squared of 0.86. Italy is increasing its imports of shrimps and prawns from the World at an average of 2,229 tons per year, in the last 25 years.

Imports from Mozambique: differently from what happens at the World level, imports from Mozambique are decreasing yearly, as the linear slopes shows: y=299.68–15.29x with a R-squared of 0.68.

These data suggests that, as for shrimps and prawns, Italy is paying attention to substitute products from Ecuador, Indonesia and others countries.

Data Source: EUROSTAT, UN-COMTRADE

Annex 4: Continuation of Equation 5.7

Then, replacing the equation 5.7, into the structural equation 5.1 – for the quantity of exports demanded – to substitute the log*PRI* the results are:

(5.8) $\log QTY_{Di,t} = \pi_{10} + \pi_{11}(\Omega_{30} + \Omega_{31}\log CAP_t + \Omega_{32}\log WAG_t + \Omega_{33}\log CLA_t + \Omega_{34}\log PSU_{i,t} + \Omega_{35}\log YIM_{i,t} + v_{3i,t}) + \pi_{12}\log PSU_{i,t} + \pi_{13}\log YIM_{i,t} + v_{1i,t}$

(5.9) $\log QTY_{Di,t} = [\pi_{10} + (\pi_{11}\Omega_{30})] + (\pi_{11}\Omega_{31})\log CAP_t + (\pi_{11}\Omega_{32})\log WAG_t + (\pi_{11}\Omega_{33})\log CLA_t + (\pi_{11}\Omega_{34})\log PSU_{i,t} + (\pi_{11}\Omega_{35})\log YIM_{i,t} + (\pi_{11}v_{3i,t}) + \pi_{12}\log PSU_{i,t} + \pi_{13}\log YIM_{i,t} + v_{1i,t}$

(5.10) $\log QTY_{Di,t} = [\pi_{10} + (\pi_{11}\Omega_{30})] + (\pi_{11}\Omega_{31})\log CAP_t + (\pi_{11}\Omega_{32})\log WAG_t + (\pi_{11}\Omega_{33})\log CLA_t + (\pi_{11}\Omega_{34} + \pi_{12})\log PSU_{i,t} + (\pi_{11}\Omega_{35} + \pi_{13})\log YIM_{i,t} + (\pi_{11}v_{3i,t} + v_{1i,t})$

(5.11) $\log QTY_{Di,t} = \beta_{40} + \beta_{41}\log CAP_t + \beta_{42}\log WAG_t + \beta_{43}\log CLA_t + \beta_{44}\log PSU_{i,t} + \beta_{45}\log YIM_{i,t} + v_{4i,t}$

Where β's are the parameters of the first stage equation for the log*QTY*.

Assuming the right-hand variables are uncorrelated with the residuals and also are uncorrelated with exogenous variables, they are estimated by OLS and their basic assumptions. In small samples case, the overall test of the model significance is based on the *F*-test and the *p*-values and interval estimates are based on the *t*-distribution.

From the reduced forms – equations 5.8 and 5.11 – the right signs of the first-stage parameters are the following:

	log*CAP*	log*WAG*	log*CLA*	log*PSU*	log*YIM*
log*PRI*	$\Omega_{31}>0$	$\Omega_{32}<0$	$\Omega_{33}<0$	$\Omega_{34}<0$	$\Omega_{35}<0$
log*QTY*	$\beta_{41}<0$	$\beta_{42}>0$	$\beta_{43}>0$	$\beta_{44}>0$	$\beta_{45}>0$

Annex 5: Questionnaire of the Competent Authority – INIP Mozambique

This survey is intended solely to collect data about the process of compliance to the technical measures to trade, including sanitary measures. The data to be collected will be used solely for academic purposes and/or for academic publications.

Fishery Inspection and Certification

From the list below, what products exported by Mozambique have been inspected more frequently by INIP? (On a scale of 0 – never inspected – to 10 – inspected every time – check the products and frequency, with data from 2011):

Frozen shrimp	0	1	2	3	4	5	6	7	8	9	10
Fresh shrimp	0	1	2	3	4	5	6	7	8	9	10
Frozen fish	0	1	2	3	4	5	6	7	8	9	10
Fresh fish	0	1	2	3	4	5	6	7	8	9	10
Dried fish	0	1	2	3	4	5	6	7	8	9	10
Others	0	1	2	3	4	5	6	7	8	9	10

On a scale of 0 – no requirement – to 10 – very strict requirement – report your perception about the level of rigor in the inspection of fish products for exports, as requested by the following counties or markets:

Europ. Union	0	1	2	3	4	5	6	7	8	9	10
USA	0	1	2	3	4	5	6	7	8	9	10
Japan	0	1	2	3	4	5	6	7	8	9	10
South Africa	0	1	2	3	4	5	6	7	8	9	10
Zimbabwe	0	1	2	3	4	5	6	7	8	9	10
Malawi	0	1	2	3	4	5	6	7	8	9	10

Costs of Compliance to Technical and Sanitary Measures in Trade

The countries that import fishery have updated their standards on health, food additives and others food safety issues. Two examples are the European Union Commission Decision (EC) No. 466/2001 of 8 March 2001 laying down the Maximum Levels for Certain Contaminants in Foodstuffs, and the Notification No. 513, of 31 March 2000, of the Japanese Ministry of Agriculture, Forestry and Fisheries, laying dawn the Patterns of Quality of Labeling for Processed Food.

On maximum levels for certain contaminants in food commodities required by the EU, for instance, what kind of costs the INIP and fishing industry incurred, since 2000? (Check the alternatives)

☐ Formation and training of technicians

☐ Establishing laboratories for chemical and sanitary analysis

☐ Improving the process of production and processing of products

☐ Other types of costs. What: ____

In recent years (2002 and 2012), Mozambique had installed and or rehabilitated fishing and inspecting laboratories, and is on the way to receive accreditation by the appropriate bodies. What are the costs? (Please specify the currency):

	2001-2011	2012-~
Construction of laboratories		
Equipment		
Accreditation		
Others (specify)		

What was the average cost, per unit inspected, upon installation of the laboratories?

Product	Laboratory 2001-2011	Laboratory 2012-~
Frozen shrimp		
Fresh shrimp		
Frozen fish		
Fresh fish		
Dried fish		

How many laboratory tests did the INIP, on annual average, since the installation of laboratories?

Product	Laboratory 2001-2011	Laboratory 2012-~
Frozen shrimp		
Fresh shrimp		
Frozen fish		
Fresh fish		
Dried fish		

On average, what are the annual numbers of tests by type of fish?

Product	Laboratory 2001-2011	Laboratory 2012-~
Frozen shrimp		
Fresh shrimp		
Frozen fish		

Fresh fish		
Dried fish		

What kind of tests did/does the INIP? (List the technical details of laboratorial tests)

Product	Laboratory 2001-2011	Laboratory 2012-~
Frozen shrimp		
Fresh shrimp		
Frozen fish		
Fresh fish		
Dried fish		

About the Benefits of Compliance with Technical and Sanitary Measures

In general, what kind of benefits is the fishing industry getting, when they inspect the products for exports (tick the appropriate options)

☐ Export to more markets

☐ Larger quantities exported

☐ Increased unit price in foreign markets

☐ Minor rejection of products at the importer's borders

☐ More investments

☐ Other. What: ____

Annex 5: Benefit Cost Analysis for a Laboratory in Mozambique

Assumptions		**Summary of the Results**	
Discount Rate	5.00%	PVB (in USD)	3,000,000.00
Appraisal Period	30 Years	PVC (in USD)	1,000,000.00
Project Whole Life Costs (in USD)	8,000,000.00	Capital Costs (in USD)	1,107,320.00
		Benefit Cost Ratio	3.00
		Net Present Value (in USD)	643,071