



# Compliance to HACCP and Competitiveness of Oman Fish Processing ☆

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## Abstract

Exports of fish products are very important for the Sultanate of Oman to diversify sources of income and achieve higher standards of living to fishermen. In the past government regulations and support were sufficient to reach markets such as the European Union and the United States. During the last decade, however, there has been more focus on the application of more stringent quality regulations according to international norms namely Hazard Analysis Critical Control Point (HACCP). This paper investigates the perception and compliance of Oman fish companies to HACCP and consequences for corporate success and competitiveness. The paper provides an overview of international and national fish market regulations and the development of seafood regulations in Oman. It also develops an empirical framework to investigate empirically the relation between the adoption of international quality control procedures and success in export markets using an export penetration index. The paper findings show that up to 1998, Oman fish quality regulations differ in scope and objectives from HACCP. For instance, there is no requirement of plant-level quality management system equivalent to HACCP. Also, Oman regulations were based on regular inspections by government agents whereas HACCP is a system-based approach aiming at reducing repeated inspections. Empirical results support the hypothesis put forward; variables reflecting on the quality of fish products, that is, HACCP and sanitation were found to be positively correlated to the export index. © 2001 Elsevier Science Inc. All rights reserved.

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## **1. Introduction**

Fishing has provided sustenance to a majority of the Omani population for many centuries. Today, more than 26,000 people are directly employed in the fisheries sector and total landings are almost 120 thousand metric tons, a 24% increase from 1985. In addition to meeting domestic demand, Oman exported 31% of its total catch in 1997 at a total value of (OR) 27,137 million. Fish exports represent the second largest export item after oil exports. Fish is exported to some 30 countries with the main importing countries being the United Arab Emirates, Saudi Arabia, Jordan, Spain, France, Italy, Lebanon, and Qatar.

Since 1997, Oman, like other developing countries, has experienced periodic difficulties with exports to the European Union (EU) because of the apparent lack of quality control measures. The Ministry of Agriculture and Fisheries has addressed these problems by sponsoring research on food safety and quality control, training programs for fish processing companies as well as inspection visits to assess quality and safety at fish processing facilities. The Ministry has developed hygiene and quality regulations and taken several measures to improve landing conditions and handling of fish to assure the quality of the marine products harvested in Oman.

Quality regulations for export products, such as seafood, have been adopted by many developing countries to enhance national exports. Although these regulations enhance exports by assuring the safety of the products, processing companies have responded by delaying private implementation of internationally accepted quality control programs anticipating further government subsidies. The outcome of such a delay was very costly to Oman. In July 1998 the threatened ban on Omani fish exports to the EU was considered one of the biggest challenges that the Omani fisheries sector had recently faced. Although the ban had been lifted about one year later, its effects may persist for some time.

This paper examines the adoption of quality control measures [Hazard Analysis Critical Control Point (HACCP)] in the fisheries industry in Oman. Emphasis will be placed on HACCP as a tool to improve export performance and to regain and expand higher value fish export markets in the EU and the U.S.A. The objectives of this paper are threefold:

1. To provide an overview of the state of international and national fish market arrangements with emphasis on Oman;
2. To link the adoption of and attitudes toward internationally recognized quality control procedures (HACCP) to export performance; and
3. To draw implications about the impact of HACCP on corporate success and competitiveness of the fisheries sector in Oman.

## **2. International and national fish market arrangements**

Quality control and assurance systems in the food sector is one form of market institution intended to produce safe food and reduce the risk of food-borne illnesses. The common forms of quality assurance systems are (Holleran et al, 1999):

1. Private voluntary international standards: International standards, such as ISO 9000 standards intend to ensure the conformance of products to agreed specifications by careful documentation of production processes and practices. International standards may require third party certification, which mitigates some of the hazards and costs of exchange by guaranteeing the consistency of the production process.
2. National assurance systems: Most national assurance systems are established by national governments to assure consumers that the products of a nation are produced in a prescribed manner. This category represents legal standards, which are often mandatory. The FDA regulations in the US and the 1990 Food Safety Act in the UK are examples of national assurance systems.
3. Proprietary quality systems: Proprietary quality assurance systems specify retailers' unique safety and quality requirements. In the U.K., Sainsbury's, Tesco, and other large retailers maintain private quality assurance systems usually based upon the ISO set of standards to ensure that their suppliers consistently meet product specifications. Such systems reduce inspections and audit activities considerably while assuring the quality of products.
4. Trade associations may formulate consensus standards, which are, in turn, required by its members. The recently developed food hygiene standards developed by the British Retail Consortium is an example.

The role played by the Food and Agriculture Organization (FAO) food standards and the FAO Codex Alimentarius Commission aims to coordinate all food standards program and ensures fair practices in the food trade. The Codex is composed of food standards, codes of practice, guidelines, recommendations, and other legal texts to be used in international commerce. FAO and Codex have adopted HACCP as a basis for food safety management. HACCP is a preventive system based on identifying hazards and controlling risks at specific points of the processing chain. HACCP is being accepted worldwide and is becoming a requirement in international trade as an effective means of ensuring food quality and safety.

### *2.1. Regional regulations*

Regional regulations also play an important role to assure national products as well as imported products. The EU issues regulations that lay down conditions for products produced within the Union and also for fish imported from third countries. To approve imports from a third country, "inspections may be carried out on the spot (where fish is processed) by experts from the Commission and the Member States." (OJ-EU, 1991).

These EU regulations require information on: (1) the legislation of the exporting country; (2) the organization of the competent authority and its inspection services; (3) the actual health conditions during the production, storage and dispatch of fishery products; and (4) the assurance, which a third party can give, on the compliance with the standards in the EU. The EU directives require the HACCP approach as a basis for food safety (93/43/EEC).

To comply with the requirements of export markets, such as the EU market, developing

countries' national governments have developed quality assurance systems to sustain their exports. This approach is very common in developing countries, where firm-specific quality assurance systems are not well developed or implemented. In many developing countries the practice as well as the attitude is that inspection and quality certification of fish for export are the responsibility of the government (Sierra, 1991). This system works on the basis of memorandum of understanding signed between the relevant government bodies in importing countries and exporting countries. Fish processors, approved under the signed memorandum of understanding, will enjoy a "preferred status" that considerably simplifies sampling and testing procedures in the importing countries (Sierra, 1991).

## *2.2. Oman quality assurance programs*

In Oman, the quality of fish has been the focus of the national fisheries development plan. Early efforts concentrated on modernization of the sector through acquisition of better equipment and aimed at the improvement of distribution networks and the marketing system as a whole. Quality of exported fish, mainly to neighboring countries, was assured by refrigerated transportation in boxes approved by the Government, and by quality control by the border inspection when fish was transported to the largest export market, the United Arab Emirates (Hock, 1998).

The development of seafood processing and quality control in the Sultanate of Oman can be summarized as follows (Al Barwani, 1996):

- In the early 1970s, the Government constructed and operated fish processing plants in major communities to diversify the sources of income. These processing complexes were equipped with cold storage and ice plant facilities to preserve the quality of fish.
- In the mid-1980s, these public facilities were privatized. Fish exports increased to traditional markets (GCC) as well as to Europe, Asia and North America. At this stage, however, quality control was not a major concern.
- In the 1990s, driven by the expansion of fish exports and the increased attention to quality and food safety, the Sultanate has put greater emphasis on quality control to ensure continuous acceptance for its products in international markets. The Ministry of Agriculture and Fisheries (MAF) subsequently established a Quality Control Section (QCS) to develop quality control measures for processing plants exporting to international markets. This effort resulted in the current Quality Control Act for seafood exports issued first in 1997 (QCA).

The QCA, developed in collaboration with experts from the United States (Slavin et al., 1993), aimed at enhancing Oman fish exports by laying down general procedures and standards for export plants. The QCA covers hygienic regulations for plants and their personnel, including buildings, equipment, transporting, labeling, inspection and sample testing. Finally, it sets specifications for fresh and frozen fish for exports. The QCS enforces these regulations through on-site inspections. Fish processing companies complying with these regulations obtain a quality control number allowing them to export fish.

There are at least two main differences between the Omani QCA system and HACCP:

Table 1

The percentage value of fish exports by major regions<sup>a</sup>

Year	GCC	Europe	U.S.A.	Other
1995	33	22.5	3	41
1996	27	22.3	3	47.5
1997	19.7	23.2	4.42	54
1998	54.5	19.75	0.08	25.7
1999	59.7	1	0.3	39

<sup>a</sup> In 1998 and 1999 the percentage export quantities is reported.*Sources:* Statistical Year-Book Ministry of Commerce, 1998 and Ministry of Agriculture and Fisheries, 2000.

1. Different scopes and objectives. QCA is directed mainly to processing plants. It aims at enhancing Oman fisheries exports through the assurance of high quality fish products. In other words it is a support policy to facilitate the entry of Oman products into international markets in the absence of plant-level quality management systems. HACCP on the other hand covers a wider range of activities including processors, importers, exporters, factory freezer trawlers and some distributors. It aims at preventing seafood-borne illnesses among consumers locally and abroad and it is the responsibility of individual companies to implement.
2. An inspection based approach versus a system-based approach. The QCA is enforced through regular inspections carried out by QCS agents. Although the QCA does not specify the number or rate of inspections, it is expected that inspections should be carried out two to four times per year. Inspections are based on a sanitation compliance checklist, which includes building constructions, equipment and transportation facilities, general hygienic conditions, and samples' preparation and handling. The checklist is filled in and a quality rating is assigned. All records of the inspections are kept at the QCS.

HACCP, as defined by Griffin (1996) "requires companies to examine their systems carefully, identify hazards to the product's safety during every step, find control points where hazards can be averted or corrected, and document the entire system for every batch of seafood processed." There are at least two features that characterize a HACCP plan. First, it deals with the whole system: from receiving of raw material, to the delivery of final products. Second, it requires the documentation of the processes. Documentation is required for liability suits. Although FDA regulations do not require certification of the HACCP system "if any problem arise, an investigation will show if the (HACCP) plan is working by the documentation required under HACCP" (Griffin, 1996).

The QCA has helped many companies upgrading their sanitary and hygiene conditions but not to the level required under a HACCP system. The discrepancy between the two systems, as described above, has resulted in severe costs to the fish industry in Oman. The total value of Oman fish exports to the EU has averaged OMR 5.5 Million, that is, U.S. \$ 14.3 Million, between 1995 through 1997 (OCCI, 1999). Unless other markets were identified, this amount would be sold at drastically lower prices (Table 1).

### 3. Attitudes toward HACCP and export performance

The implementation of an HACCP-based quality system is likely to confer a significant competitive edge to fish export companies. The perishable nature of the raw material and the products advocate for an effective quality assurance system. As a result, an HACCP system would increase competitiveness with regard to competing supply chains that might be of national importance (Ziggers, 1998). Competitiveness means the ability of a firm to maintain and increase market share over a sustained period of time. Business growth in general depends on the ability to expand a market. Factors affecting export performance can be grouped into factors external and internal to firms (Aaby and Slator, 1989). Management and firm characteristics as well as export market-strategy are considered as factors internal to firms. Export performance has been typically measured using indicators such as export sales, export sales growth, export profits and export intensity (Baldauf et al., 2000).

Oman has exported seafood products to over 30 countries in the Gulf region (GCC), Europe, U.S.A., and other (Table 1). Exports to the EU amount to 23% of total exports over the period 1995 through 1997, which shows the importance of this market capturing a relatively high share of Oman's exports. In 1999, following the 1998 EU ban on Oman fish exports, this percentage fell down to 1%, which is indeed a dramatic decrease.

Table 2 shows the status of HACCP implementation in Oman. It appears that except two companies all interviewed fish companies are exporting to one or more EU member country. The ratio of exports to EU to total production varies from 30 to 100% for individual companies before the EU ban. Table 2 also shows that most companies have a strong interest in implementing an HACCP system to maintain their market share in European markets. Most of these companies have contacted a consultant to examine their plant-layouts and to design an HACCP plan. As a result, most companies have made minor or major changes to their plants. In some cases, plants have been fully reconstructed to meet EU sanitation directives. These observations reflect on the relationship between the desire to maintain and increase market shares and the interest in HACCP.

#### 3.1. Theoretical approach

This section develops a framework that links the adoption of quality control based on HACCP to competitiveness in international markets and investigates measurable determinants of quality assurance and competitiveness. We assume a given firm  $i$  that produces an output  $y$ , which could be decomposed into two proportions. One proportion,  $y_1$  having good quality intended to be exported to countries requiring high quality and sanitation procedures; and a second proportion  $y_2$  with lower quality intended to be marketed in countries with lower standards. Let this implicit function be as follows:

$$y(y_1, y_2, q_1, q_2, x, k) = 0, \quad (1)$$

where  $q_1$  and  $q_2$  refer to the quality of product  $y_1$  and  $y_2$ , respectively,  $x$  is a vector of variable inputs and  $k$  is fixed inputs.

The corresponding cost function, assumed to be determined jointly by the rate of outputs and quality attributes of each category, is defined as:

Table 2

Exports to EU and U.S.A. (% of total production) and status of HACCP implementation (1997)

Plant	Exports to EU & USA (%)	HACCP Plan <sup>1</sup>					
		Interest	Documentation	Training	Consultant	Underway	Sanitation
1	100	1	0	1	1	1	–
2	80	0	0	0	0	0	–
3	80	1	0	1 <sup>a</sup>	0	0	–
4	25	1	1	1	1	1	–
5	25	1	1	1	1	1	++
6	75	0	1 <sup>b</sup>	1 <sup>a</sup>	0	0	–
7	0	0	0	0	0	0	+
8	40	1	0	0	1	0	++
9	58	1	0	1	1	1	+
10	30	1	0	0	1	0	++
11	35	1	1	1	1	1	+
12	31	0	0	0	0	0	+
13	0	0	0	0	0	0	+
14	70	1	1 <sup>c</sup>	1 <sup>c</sup>	1 <sup>c</sup>	1	++
15	100	1	1 <sup>c</sup>	1 <sup>c</sup>	1 <sup>b</sup>	1	++
16	60	1	1 <sup>c</sup>	1 <sup>c</sup>	1 <sup>b</sup>	1	++

<sup>1</sup> Variables under HACCP plan are defined as binary with 1 if company has responded positively to the question and 0 otherwise.

<sup>a</sup> Training organized for free by the Ministry of Agriculture and Fisheries.

<sup>b</sup> The company has its own quality system.

<sup>c</sup> Started March 1999, this is, after the EU ban.

– Minor modifications to meet sanitation requirements.

+ Needs major modifications to meet sanitation requirements.

++ Needs reconstruction of the plant.

$$c(q_1, q_2, y_1, y_2, w, k) = 0 \quad (2)$$

the profit function defined by (1) and (2) is given as follows:

$$\text{Max}_{y_1, y_2} \pi = p_1 y_1 + p_2 y_2 - c(q_1, q_2, y_1, y_2, w, k) \quad (3)$$

This specification assumes also that the prices are function of the quality attributes,  $p = f(q)$ . By taking the first-order conditions of (3) we can derive the firm's supply for  $y_i$  as function of quality attributes, inputs prices  $w$ , and fixed inputs  $k$ :

$$y_i = f(q_1, w_i, k) \quad (4)$$

Eq. (4) is the basis for the analysis of exports and competitiveness of Omani fisheries. The dependent variable  $y_i$  is the quantity of the product sold in market  $i$ , which represents the proportion of total production sold in that specific market (i.e., market share). The quality of the product is represented by the adoption of quality assurance and safety system, to be designated by HACCP system in this study. HACCP will be defined by a number of binary variables that show the commitment of the firm to the implementation of HACCP. These variables may include documentation, training, records, procedures, sanitation conditions, and so forth.

Export models as indicated by (4) could be estimated as market share equations to explain export behavior. This kind of models was used by Martins (1993), who derived market share equations from a double stage CES utility function where products are differentiated based on the country of origin. Such approach requires time series data on different countries to estimate market shares and then estimate the equations. These data are not available in Oman. Moreover, Oman is a small country so an approach based on product differentiation across firms would be more appropriate. We consider market shares based on market penetration performance and use cross-section data over a sample of fish processing companies in Oman.

An export penetration index (EPI) defined by Featherstone and Uhm (1993) is as follows:

$$EPI = X/Y, \quad (5)$$

Where, X is the total export and Y is the total production. In this paper we define an index similar to the above definition but that reflects the quality of exported goods. For this purpose we consider the EU and the United States as markets with high level of quality requirements. Then, the above index would be modified as follows:

$$EPI = (X_{US} + X_{EU})/Y, \quad (6)$$

This index reflects export performance of a firm compared to other firms in the same industry. Firms that export more to markets such as the U.S.A. or the EU would achieve higher value of exports and make more profits. This index reflects also the quality of exports and the relevance of quality control and sanitation measures.

### 3.2. *Estimation and empirical results*

The empirical model to be estimated is as follows:

$$EPI = f(\text{HACCP}, \text{Sanitation}, \text{Labor}, \text{capital}) \quad (7)$$

Data were collected through a questionnaire and site visits to fish processing companies in Oman. We interviewed 16 companies, which represents about 85% of the total number of fish processing companies available at the time of the study. The questionnaire is composed of three sections. The first section concerned general information on the company: labor, freezing capacity, storage capacity, average processing per day, ice plant, management, main products and, destination. Section two describes production and exports to different markets (regional, EU, U.S.A., and other). The last section gauged to the implementation of HACCP and sanitation measures.

These data were used to derive an export penetration index as defined by Eq. (6). A scale variable (0 to 3) of the status of HACCP was calculated by adding three binary variables (1 if the company has responded positively and zero otherwise): participated in HACCP training, implemented HACCP documentation, and employed a HACCP consultant. Labor was approximated by the number of employees. Labor could be used as a proxy for the size of the company. In the literature, the size has been found both positively and negatively



Table 3  
Results of the OLS model<sup>1</sup>

Variable	OLS model	
	Parameter	t-statistics
Intercept	0.436	3.48 <sup>a</sup>
Labor	−0.018	−2.93 <sup>a</sup>
Capital	0.0003	0.69
HACCP	0.149	2.57 <sup>a</sup>
SANIT1	0.593	3.80 <sup>a</sup>
R <sup>2</sup> (Adj R <sup>2</sup> )	0.63 (0.48)	

<sup>1</sup> The dependent variable is the percentage of exports to EU and U.S.A.

<sup>a</sup> Parameter significantly different from zero to 5%.

<sup>b</sup> Parameter significantly different from zero at 12%.

associated with export performance (Baldauf et al., 2000). Capital was defined by investments in freezing and storage capacity. Finally, the variable *sanitation* was defined by dummy variables: SANIT1 takes 1 if the plant required minor modification to meet EU sanitation requirement and 0 otherwise; SANIT2 is defined in a similar way when the company required major modifications and reconstruction. Only the first dummy is included in the estimation to avoid singularity problems in the estimation.

A linear model was estimated by the OLS method, where export is a continuous variable that takes values between 0 and 1. The results are presented in Table 3.

The model performed well in accordance with the hypotheses of the paper. In presence of qualitative variables, an adjusted  $R^2 = 0.48$  is quite reasonable. The labor and capital variables were found to have very little and a rather negative impact (in the case of labor) on export performance. This shows that smaller companies have performed relatively better in terms of exports to Europe and to the United States. This fact may also imply that companies have over invested in freezing and storage capacity. Variables, which reflect on the quality of fish products, that is, HACCP and SANIT1 were found to be positively correlated to the export index.

As defined above, HACCP will be high (maximum of 3) for companies, which have invested more in training, consulting and documentation. On the contrary, HACCP would be equal to zero for companies that have not invested in any of these areas. Minor modifications refer to situations where the plant-layout is acceptable but the level of sanitation needs more attention to meet the requirement of customers. Major modifications are required when the general layout is not acceptable, which effects the cleanness of the plant and products. The results indicate that companies that implemented HACCP (or closer) have performed well in terms of exports to Europe and to the United States. In a similar way, companies that need only minor modifications to meet sanitary requirements are found to have higher percentage of exports to EU and U.S.A.

#### 4. Conclusions

This paper investigated the perception and compliance of Oman fish companies to HACCP and consequences for corporate success and competitiveness. The paper tests

empirically the relation between the adoption of international quality and safety procedures (HACCP) and success in export markets by constructing an index of export penetration. The paper findings show that up to 1998, Oman fish quality regulations differ in scope and objectives from HACCP. For instance, there is no requirement of plant-level quality management system equivalent to HACCP. Also, Oman regulations were based on regular inspections by government agents whereas HACCP is a system-based approach aiming at reducing repeated inspections. Empirical results support the hypothesis put forward; variables reflecting on the quality of fish products, that is, HACCP and sanitation were found to be positively correlated to the export index. The results also show that companies have a strong interest in implementing HACCP system to maintain or regain their competitive position in the European markets.

The Ministry of Agriculture and Fisheries has started an awareness campaign to implement HACCP in early 1990s. Companies were allowed to export based on quality control inspections carried out by the Ministry. Although the purpose of the Ministry was to encourage companies to implement HACCP, most companies have been waiting for more government assistance, such as training, consultants, and even funding to make the necessary modifications to their plants and processes. Market shares have been gained through the years and reflect a well-established relationship between Oman suppliers and European customers. Currently Oman fish products are facing tighter competition from other Asian countries' seafood products and there is a fear that Oman's share be captured by other countries' exports.

The cost to upgrade companies to the level of HACCP depends mainly on the level of modifications needed to meet sanitation requirements. Three categories have been identified: (1) companies with minor modifications; (2) companies that require important modifications; and (3) companies requiring full reconstruction. To these modification the costs of consultants, training, and documentation have to be added. Given the cost burden to upgrade these companies it is expected that the number of companies will substantially decrease, and therefore, lead to higher concentration in the fish processing sector of Oman.

More generally, this study emphasized the need for HACCP as a tool to compete in international markets, namely higher-value export markets in the European Union and the United States. Results show that companies, which have implemented HACCP have performed better than the others. The adoption of HACCP is spreading around the world. It has become a requirement in the EU and the U.S.A. since 1997. So, upgrading Omani fisheries companies to meet internationally accepted procedures is a challenge to both agribusiness managers and to government institutions. In fact, the need to promote seafood exports has been a goal of national strategies to diversify national income sources. For this reason it is expected that the fisheries industry will enjoy more support to face these recent challenges. The implications of the application of quality and safety regulations for the domestic market are not obvious, though, at least in the short run, as in most developing countries.

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