

Overseas assignment report

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REPORT ON A VISIT TO INDONESIA TO
CONDUCT A REVIEW OF THE POST HARVEST
FISHERIES SECTOR

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EXECUTIVE SUMMARY

A review of post-harvest fisheries in Indonesia was undertaken for the Overseas Development Administration, by a fisheries technologist, a biologist, and an economist, during a five week visit in June and July 1988. The terms of reference were: to review post-harvest fisheries and donors' activities in the sector, and to identify a strategy for future ODA inputs.

The marine fishery is the most important in terms of value, followed by tambak aquaculture (mostly shrimps and milkfish), and the inland capture fishery. Most of the harvest is sold in the domestic market as wet fish, dried fish, and pindang (fish cooked in brine). Exports of frozen shrimp, from the tambaks and the marine fishery, are becoming increasingly important. Additionally, there are exports of wet fish on ice to Singapore.

The team considered that the greatest problem facing the sector is overfishing of the South Java Sea, resulting in operational fishing grounds being located at an ever increasing distance from the main markets on Java. This poses a challenge to resource management, both pre- and post-harvest. The former requiring resource surveys, and the latter, the identification of low-cost improvements to on-board handling, to ensure the supply of fish to Java's predominantly low income population.

A study encompassing these aspects is proposed by the EC in collaboration with France; ODNRI, in consultation with ODA HQ, will liaise with the French technical agency (ORSTOM) to determine whether complementary inputs from ODNRI would be useful.

A second area in which action is proposed is in reducing losses from insect infestation of sun-dried fish. Dried fish is an important protein source for low-income groups in Indonesia, and an area in which ODA could make an effective contribution. The use of household insecticides on drying fish in Indonesia has been widely publicised and the practice banned. The problem persists though, and the team recommends a follow-up programme to an existing project. The existing project has provided training to the staff of provincial quality control laboratories in loss assessment and reduction, including the use of a safe (and approved) insecticide--Minawet.

Financial analysis of the use of Minawet and adoption trials will be undertaken during the final stages of the existing project. Subject to satisfactory results from these, a large-scale extension project is proposed, aimed at adoption of Minawet by fish processors.

An additional element will be the provision of the necessary training and equipment in pesticide residue analysis, for the National Centre for Quality Control and Fish Processing.

LIST OF ABBREVIATIONS USED IN THE TEXT

AARD	Agency for Agricultural Research and Development
ADB	Asian Development Bank
ASEAN	Association of South East Asian Nations
DGF	Directorate General of Fisheries
EC	European Commission
FAO	United Nations Food and Agriculture Organisation
f.o.b	free on board
GOI	Government of Indonesia
GTZ	German Agency for Technical Cooperation
IPB	Institut Pertanian Bogor (Bogor Agricultural University)
ODA	Overseas Development Administration
ODNRI	Overseas Development Natural Resources Institute
ORSTOM	Institut Francais de Recherche Scientifique pour le Developpement en Cooperation
TC	Technical Co-operation
TDRI	Tropical Development and Research Institute
UNDIP	University of Diponegoro

Exchange rate: in 1988, Indonesian Rupees 3,000 was worth approximately UK£1.00.

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1. INTRODUCTION

The review was one of a series of studies of post-harvest problems in Indonesia, recommended by Nabney et al. (TDRI, 1986). The other studies were concerned with fruit and vegetable production, crop drying and vegetable oil production. During the review the team visited most of the main fish landing, marketing and processing centres on the north coast of Java (as far east as Surabaya); off-Java visits were to Ujung Pandang and Parepare (South Sulawesi), Banjarmasin (South Kalimantan), both coasts of North Sumatra, and Padang (West Sumatra). The itinerary is given as Appendix I.

1.1 Terms of Reference

The terms of reference for the review were as follows:

- i) to review the current status of fish handling, processing, marketing and distribution in Indonesia;
- ii) to review recent British aid projects in the post-harvest fisheries sector in Indonesia;
- iii) to identify and review recent and on-going post-harvest fisheries projects in Indonesia financed by the other donors; and
- iv) to recommend a strategy for ODA inputs to the post-harvest fisheries sector and to prepare project outlines to implement this strategy.

2. FISH PRODUCTION IN INDONESIA

2.1 Overview

Fish production in Indonesia can be sub-divided into six categories: the marine capture fishery, the inland open-water (capture) fishery, tambaks (brackishwater ponds), freshwater ponds, cage culture, and paddy field culture. Total production in 1985 was 2,395,600 tonnes, with a landed value of 1,472,531 million rupees (approximately £500 million). Table 1 shows the relative contributions of each category.

Table 1: Fish Production in Indonesia, 1985

	Volume tonnes	Value million rupees
Marine fishery	1,821,725	857,142
Inland Capture	269,266	217,867
Tambaks	156,367	234,889
Freshwater	84,240	97,226
Cage culture	746	1,048
Paddy	63,218	64,359

Total	2,395,562	1,472,531

Between 1980 and 1985 production volume increased by an average of 5.3 percent per annum, whilst its value at current prices grew at an average annual rate of 16.1 percent. Given an annual increase in the Agriculture Wholesale Price Index of 8.0 percent (1983-86) this suggests a small increase in unit fish values relative to other commodities. (The Consumer Price Index increased by 8.9 percent per annum between 1982 and 1985).

Readers should note that all the figures used in this chapter are official GOI statistics, unless otherwise stated. These data may understate fish landings non-uniformly; for instance, figures for Java may be more accurate than those for islands with more private landings, or thinner DGF coverage. An apparent increase in landings over time may also exaggerate the real situation, since this might partially reflect improved data collection and coverage. At the time of writing, 1985 was the most recent year for which fisheries statistics were available.

2.1.1 Marine Fish Production

In 1985 marine fish production accounted for 76 percent of fish production, with 1.8 million tonnes landed. The volume of fish landed increased by an average rate of 5.6 percent between 1970 and 1985; this rate of increase was not noticeably diminished by the trawl ban (applied progressively, but starting in 1980). By value, however, marine fish contributed only 58 percent (857,142 million rupees) to the total value of the fishery; the value (at current prices) of the marine fishery grew by an annual average rate of 15.1 per cent between 1980 and 1985. Taking into account inflation at approximately eight percent, this suggests that the growth rate mostly reflects increased volumes.

TABLE 2: Composition of Marine Catch 1985

	Volume '000 tonnes	Value R million	Unit Value R '000/kg
Tunas	232.8	131,345	0.56
Scad	180.5	63,193	0.35
Sardines/ Sardinellas	173.9	50,379	0.29
Mackerel	172.5	94,988	0.55
Anchovy	106.9	39,041	0.37
Trevallies	64.4	24,792	0.38
Shark	35.6	11,138	0.31
Snapper	25.7	13,526	0.53
Needlefish	21.8	7,331	0.34
Others	581.6	214,269	0.37

SUB-TOTAL	1,595.7	650,002	0.41 (average)

Crustaceans (shrimp)	116.7	191,062	1.64
Seaweed	63.0	2,556	0.04
Molluscs	46.3	13,522	0.29

TOTAL	1,821.7	857,142	0.47 (average)

Note Crustaceans and molluscs are shown separately because their landed weight is largely shell, and therefore not comparable with the other fish shown; seaweed is set aside because of its different nature; jellyfish is included in "others" here (catch was insignificant in 1985), but could usefully be shown separately for other years because of extreme variability in landed weight from year to year.

Table 2 provides a breakdown of the catch by species. The shrimp fishery is the most important in terms of value, with high unit values giving it a 22 percent share of total marine fishery landed value. Fish with above average unit values are tuna, red snapper, and mackerel. By volume the most important fisheries are: tuna, scad, sardine, mackerel, anchovy and shrimp.

Simon Bland, using DGF data in his assessment of Indonesia's fish stocks [1], shows that most of the marine catch is landed on North Java, South Sulawesi, and the north-east coast of Sumatra. The distribution of fishermen follows a roughly similar pattern, though the distribution of vessels is rather different--reflecting high numbers of small traditional craft in eastern Indonesian waters.

Fishing effort is difficult to quantify, but various indicators suggest effort is increasing faster than catch, i.e., catch per unit of effort is declining. At landings along the north coast of Java, fishermen explained that they now make longer trips, to reach more distant waters, to return with a full load, as Java Sea fish resources become increasingly depleted. The total number of fishing boats increased by 3.5 percent per annum between 1979 and 1985, but this figure conceals an annual increase in the number of powered vessels of 20 percent per annum, and a slight decrease in the number of non-powered vessels. However, in 1985, 70 percent of marine fishing vessels were still non-powered.

The number of full-time and "major part-time" fishermen grew by 5.9 percent over the same period, i.e., roughly the same increase as catch, and numbers of fishing gear increased by 4.8 percent. There were also some shifts in type of gear used. For instance, the proportion of marine catch caught with purse seines rose from 10 to 17 percent between 1979 and 1985; the use of shrimp nets declined with the trawl ban; and there was a large increase in seaweed collection from 1984 to 1985 (8,000 tonnes to 63,000 tonnes).

Some regional differences in fishing industry structure were apparent. Small traditional sail-powered craft were hardly seen at landings in West and Central Java, where large vessels, often with inboards, were much in evidence. Large numbers of small craft were seen, though, in East Java, and in South Sulawesi. The fishing industry in North Sumatra is also dominated by large vessels.

Any discussion of Indonesia's marine fishery must mention the status of the resource. There is a consensus that large areas of the Java Sea are now chronically over-fished, and that this situation is being compounded by the continued fishing of small fish from the inshore waters. The trawl ban is one manifestation of mounting concern over the fragility of the resource base. There

have also been suggestions that other waters off Sumatra and Kalimantan may be approaching a similar situation. The situation in eastern Indonesia is rather different, where it is generally believed that there are large unexploited fish stocks. Readers should note, however, that these comments remain conjecture until major resource surveys are undertaken. (The EC, in collaboration with France, is planning one such survey for the Java Sea--this is discussed below in Section 3.6.1).

2.1.2 Inland Openwater (Capture) Fishery

This fishery contributed 11 percent (0.3 million tonnes) to total fish production in Indonesia in 1985. Production volumes have remained approximately constant over the period 1970-1985. The value of the fishery in 1985 was 217,867 million rupees, representing 12.5 percent of the total landed value of Indonesia's fisheries. Between 1980 and 1985 the value of the fishery, at current prices, grew by 15 percent per annum. The most important fish, in terms of value and volume, are barbfish, snakeheads, and gourami.

This fishery is now under severe pressure, with recent drought, siltation and pollution all taking their toll. Kalimantan has the highest harvest (52 percent of sub-sector catch in 1985), but a recent survey predicts an imminent collapse of the fishery there [2]. The prospects for other areas are no less bleak as the effects of siltation, water diversion, pollution, insecticides and pesticides, and overfishing interact.

2.1.3 Tambaks (Brackishwater Ponds)

This fishery represents the most dynamic fish sub-sector in Indonesia, in terms of growth, structural change and product change. Given the currently buoyant world market for prawns, the imposition of the trawl ban has only accelerated Indonesia's shift into prawn culture. In 1985 35 percent of shrimp production came from the tambaks; that share is increasing each year, and in 1988 was thought to be between 50 and 60 percent.

In 1970 tambak production was 56,000 tonnes, approximately five percent of total fish landings. By 1985 it was 156,000 tonnes, still only representing six percent of total landings, but now contributing 16 percent (234.9 million rupees) to the value of total landings. The growth in volume between 1980 and 1985 was 10 percent per annum, whilst value at current prices grew by 27 percent per annum. Field interviews suggested that this trend will continue, as new tambak areas are sought and existing ponds are used more intensively.

In 1985 prawns accounted for 24 percent of sub-sector

volume, and 61 percent of sub-sector value. In terms of volume, milkfish are the most important, contributing 60 percent by weight, and 34 percent by value, to sub-sector output. Curiously, and in apparent contradiction of information gathered by the team through informal interviews, the statistics suggest that volume growth in milkfish production has been increasing at a faster rate than for prawns (12 percent per annum as compared with 10 percent). Field interviews, however, suggested that tambaks were being switched from milkfish production to prawns. It is possible that the switching is relatively recent (the team's fieldwork was undertaken in June 1988), or that more intensive production permits both scenarios to be true. It was clear that milkfish is a relatively high value fish, and therefore might be expected to play a role in tambak production for longer than, say, the lower-valued tilapia also farmed in small quantities.

One aspect of the growth in prawn culture is an apparent structural change in the tambak farming sector. Traditionally, fish or prawns were farmed extensively (low input, low output) in the tambaks by low-income groups. The income potential in producing especially export quality prawns, the premium paid for particularly large prawns, the need for timely delivery to cold storage plants, and concerns over hygiene, have led to an apparently increasing degree of vertical integration in the sector. Cold storage plants are buying up the tambaks, making capital investments, and producing prawns intensively. Whilst this assists export growth, which is of much concern to the GOI, there is an emerging debate concerning the implicit equity/efficiency issues. In most parts of Indonesia there will also be land-use trade-offs that need to be addressed if this trend continues.

In 1985 the regional distribution of the tambak output was as follows: Java, 57 percent; Sulawesi, 26 percent; Sumatra, 14 percent; and others, 3 percent.

2.1.4 Freshwater Pond Culture

Output from freshwater ponds amounted to 84,200 tonnes in 1985, representing four percent of fish landings. Output was valued at 97,226 million rupees, giving it a 7 percent share in total fish landed value. Growth in physical production was roughly 5 percent per annum, between 1980 and 1985, whilst its current value grew at 15 percent. The most important species are Common Carp, Java Barb, Nile Carp, and Mozambique Tilapia.

2.1.5 Cage Culture

Cage culture makes a very small contribution to total fish production, with an estimated 700 tonnes of fish

in 1985, valued at 1,048 million rupees. The sub-sector does not appear to be growing significantly. Common Carp is the most important species.

2.1.6 Paddy Field Culture

In 1985 fish production from paddy fields amounted to 63,200 tonnes, valued at 64,359 million rupees. That represented 3 percent of total fish landings, and four percent of total fish landed value. Physical output grew by 12 percent per annum between 1980 and 1985, whilst value at current prices grew by 15 percent, suggesting a real decline in fish unit values from this sub-sector. Common Carp and Java Barb are the most important species.

2.2 Pre-harvest Considerations for Indonesian Fisheries

Although this report focusses on post-harvest aspects of fisheries, it is appropriate to highlight some of the pre-harvest problem areas, particularly where they directly affect post-harvest activities.

2.2.1 Resource Assessment

There is clearly a need for reliable information on marine resources in Indonesia. This is most urgently true of the Java Sea where rapid resource depletion is evident. Where post-harvest recommendations aim to increase the value of the fishery, thereby raising incentives to exploit fisheries resources, reliable information on the resource base is a pre-requisite.

2.2.2 Collapse of the Inland Capture Fisheries

The ADB reports that this fishery is on the verge of collapse in Kalimantan, and approaching that point elsewhere. At the micro-level, this near-collapse may have a marked effect on income levels and protein consumption in the communities directly involved. The scale of the collapse needs to be quantified, and steps taken to slow the process and mitigate its effects.

2.2.3 Expansion of Tambak Production

There are potential conflict areas associated with the extremely rapid growth in tambak output that Indonesia has seen. One of these is already an issue--the small traditional producer being displaced by large export corporations. Their capital investments and intensive production methods are not options for the small producers with no access to credit. As this trend continues, the GOI may wish to consider ways in which

small farmers might be helped to intensify their production.

Notwithstanding the role of shrimp in generating foreign exchange, as the tambak "boom" continues there will be significant trade-offs in relation to the domestic economy. One of these is likely to be an eventual decline in milkfish production, as tambaks are switched to shrimp, and there may even be some effect on food crop production in areas where the two could compete for land. This process should be closely monitored.

2.2.4 Prawnfeed

Intensive shrimp culture in Indonesia largely depends on the import of prawnfeed. Currently Indonesia exports one of the components of this--prawn heads. As shrimp culture increases it may be possible for Indonesia to develop a local source of feed.

ODNRI would not wish to address this particular issue until related studies have been completed elsewhere (India, Bangladesh). In the meantime the ODA post-harvest fisheries adviser to the University of Diponegoro is making a preliminary study of the availability of prawn heads.

END NOTES

- [1] The Use of Surplus Production Models in Assessing the State of Indonesian Fish Stocks with an Example of a "Whole System Model" Approach to the Problems of Multi-Species, Multi-Gear Fisheries. Simon JR Bland, ODA, July 1986.
- [2] Final Report Indonesian Fisheries Economy Study, Main Text. Ministry of Agriculture, DGF and Asian Development Bank, January 1988.

3. THE MARKETING OF FISH FOR DOMESTIC CONSUMPTION

3.1 Overview

More than 95 percent of the fish landed in Indonesia is consumed domestically. Roughly 50 percent of this fish is consumed as wet fish, 35 percent is dried, 7 percent is made into "pindang" (i.e., boiled in brine), and the remainder is processed in various other ways. The wet fish category includes a small quantity of freshwater fish marketed live. These market shares vary between fisheries (for example, 70 percent of the inland capture fishery is for wet fish, and the rest is dried), and are changing over time. Note also that these proportions may overstate the importance of fresh fish, since they are based on information collected at fish landings, and exclude fish that is diverted into processing subsequently.

Live fish is the highest value market, followed by wet fish; fish will be diverted into the other lower value markets as quality deteriorates--a chain which ends with the most spoiled fish being sold as animal feed, or even fertiliser. No fish is actually wasted; losses in this context are essentially economic and nutritional. The processed product forms are ways of extending the shelf-life of the fish, and in this case do not represent a transformation into a higher value, "luxury" good.

The marketing of each of the main product forms is discussed in sections 3.2-3.5 below.

3.2 Wet Fish

3.2.1 Product Form and Handling

The very best quality marine fish will go for export on ice, where infrastructure and market channels permit. The next most lucrative market is as wet fish for the domestic market, and this takes the largest share of Indonesia's marine catch. Non-marine species generally command lower prices, with two exceptions: live freshwater fish (carp, tilapia, gurame, catfish) retails at much higher prices than any wet fish (on a par with cheaper meat forms); and milkfish, a preferred brackishwater species, may fetch higher prices than marine fish.

Amongst marine fish the higher value species include tuna, snapper, mackerel, pomfret, crustaceans and shellfish. Smaller species command lower prices, but scad, sardine and squid are popular.

On Java the highest value fish (fresh, large, preferred species) will go to hotels, restaurants, expensive supermarkets, and "up-market" retail markets in large urban centres. Lower value fish (perhaps just starting

to spoil, and small fish, such as sardine and scad) will be consumed by lower income groups in the same urban centres, and along the coasts where it is landed.

Off Java fish consumption is much higher, and given the abundance of the resource relative to the market size the so-called high value species are affordable to a larger proportion of the population, in coastal areas at least. Inland, freshwater fish plays a more important role, and again is relatively more plentiful off Java.

Catch composition and quality is markedly different at different landings, apparently reflecting proximity to good fishing grounds. At the landings visited by the team along the north coast of Java (in West Java and Central Java), a large proportion of the fish being landed was already spoiling (with belly burst, poor odour, slimy skin and little natural colour), or had been salted at sea, and would be unsuitable for sale as wet fish. Even fish destined to be sold wet was often of very poor quality, and would require extremely prompt distribution. These observations may overstate the incidence of spoilage since good quality fish is purchased immediately by large buyers, and therefore less in evidence at the landing centres (personal communication from AR Marter and IJ Clucas, based on field work undertaken in 1984/85), but spoilage is nonetheless a significant cause of economic loss to the industry.

Discussions with fishermen in West and Central Java revealed that fishing boats are now making much longer trips (often up to 30 days for the roundtrip), in order to reach fishing grounds for the large higher value species (such as tuna, mackerel, squid, snapper). Smaller vessels, going out for one or two days, can only catch very small sardine and scad. The inshore waters of this part of the Java Sea are evidently chronically over-fished. Various factors then interact to reduce the nett worth of the fishery. Small boats making short trips (hardly in evidence in this part of Java) can only catch small low-value species, which in any case spoil very rapidly because of their size. Larger vessels make longer voyages (thereby increasing costs) to catch higher value species, but in so doing return with a partially spoilt (i.e., lower value) catch.

Other factors then play their part, such as the availability or price of ice (which varies by as much as 600 percent between landings), vessel design, and fishing practices. Most of the boats the team saw being unloaded had set out with ice; some returned with none; much of the catch had been inadequately iced; some vessels carried no ice but salted the fish at sea. Some boats had insulated holds; none of those seen had refrigerated or chilled sea water systems. The team was told that no collector vessel system operates off this part of Java; the reasons for this were not clear, but may relate to

the distance from fishing grounds and the economics of operating necessarily large vessels.

The fishing industry in West and Central Java is clearly not availing itself of the operational systems needed (and available) to land good quality fish. One possible reason for this is the level of effective demand of Java's predominantly low-income population; many of the DGF personnel claimed that the Java consumer would not be able to pay the higher price associated with landing better quality fish, but it was not possible to assess the validity of this statement. There is certainly a price differential between different quality fish, and it is particularly marked at the threshold at which fish has to be diverted from the wetfish trade into processing.

Off-Java the situation is strikingly different. A high proportion of the fish that the team saw being landed (in Ujang Pandang, Banjarmasin, Belawan, Sibolga, and Padang) were large high-value species, of excellent quality (often still in rigor mortis), well-iced, and caught on short voyages (a few days, or up to two weeks off Sumatra). A collector vessel system was in operation off South Kalimantan, which picked up exclusively from Kalimantan and Sulawesi vessels (on an ad hoc but regular basis--if no collector vessel appears, fish is salted for later processing).

There appears to be an intermediate situation in East Java, with much good quality fish seen at Surabaya, that had been landed further east, or, in small quantities, on the south coast.

Most of the non-marine fish that the team saw (mainly milkfish, but also tilapia and carp) was in good condition and well packed on ice for sale at wholesale markets. A higher proportion of this fish would be sold as wet fish; some of it is farmed close to the end-market which reduces handling problems. Milkfish is a preferred species, and commands higher prices than many marine fish. When being traded alongside marine fish it was of notably superior quality. In Banjarmasin (South Kalimantan) the team noted that well-iced milkfish was being brought from East Java (by collector vessels also picking up marine catch from fishermen off Kalimantan); fish farming is apparently not possible in this part of Kalimantan because of the swamps.

The team considers that the greatest problem facing the wet fish trade is on-board handling. It was here that there was most evidence of fish being diverted into the lower value processed trade. Whilst handling downstream was not always ideal, fish did appear to be well-iced (with a little salt) from landing onwards, except when it was actually being displayed for sale. Ironically, at this point the buyer apparently wants to see the fish unencumbered by ice or appropriate storage. At landings, wholesale markets, and retail markets, fish would be

tipped out of ice boxes and displayed without ice, sometimes walked over, often in very unhygienic conditions, without "easy clean" surfaces, and in retail markets often close to chicken (and the inevitable salmonella). However, consumers appeared to be discerning and retailing is rapid, so losses did not appear to be great (though, admittedly, they would be harder to observe in this fragmented part of the marketing chain). Even if losses at this level were to be significant, the prospects for effective interventions would be less than in on-board handling.

3.2.2 Structure of the Industry

There are regional variations in industry structure, in addition to changes occurring over time.

In West Java and Central Java, the industry is dominated by large vessels--a characteristic which is in part dictated by the resource situation. The crews for these vessels are paid variously, either as wage labour, or with a percentage of the catch. Some people own large "fleets" of these boats, but no information was available on the scale of such practice.

Fish are supposed to be landed at "co-operative" landing sites and then sold by open auction, in an attempt to encourage competitive trading. In Central Java this system seems to work fairly well. Where fish is not landed within this system there is more scope for collusion to influence prices, and for control by key traders extending credit to fishermen. The team was unable to probe the extent of such practices, but Clucas et al. [1] report that considerable market power is exercised by a few large traders in West Java and East Java. The "co-operatives" play a very limited role, and do not engage in any downstream marketing activities.

Off-Java a smaller proportion of total catch is landed at the registered landings, thus avoiding payment of tax on catch, and inclusion in fisheries statistics. In South Kalimantan the team saw fish being sold directly from collector vessels to owners of small craft who would distribute to retail markets.

In North Sumatra the fishing industry is heavily integrated. On both coasts the team visited extensive private landings providing ice, salt and handling facilities. The same businesses own the large fishing boats, or extend credit, thereby obliging the boat to land its catch at that particular landing. The fish is transported to Medan, from where it can be re-packed for export to Singapore, or shipment (by road) to Jakarta, or retailed. Many of the registered landings are hardly used, or used only by artisanal fishermen landing very small quantities of fish.

Vertical integration has positive and negative aspects. The integration characteristic of wet fish marketing in North Sumatra enables efficient and prompt handling of fish for domestic and export markets. If such integration is associated with reduced total handling costs (and higher profits) this would encourage private sector investment, at the same time as improving Indonesia's competitive position in international markets. The other side to this is that new entrants may not be able to break into the chain of transactions, leaving the industry entirely under the control of large-scale operators. People providing inputs to that marketing chain (for instance, fishermen) may find themselves in a very weak bargaining position, if they have no alternative outlets. Various projects and studies have sought to address this issue in Indonesia, with co-operatives often cited as a possible solution, but to date fishing co-operatives have not become involved in any downstream marketing activity.

The market channels for wet fish are very complex, and may involve collector vessels, registered and non-registered landings, several wholesalers or brokers, in different distribution centres, and transporters. Fishermen and middlemen may have to accept poor prices for the fish, or pay high prices for inputs, where credit has been extended to them (as cash, or in kind). An example of this is a (relatively small) wholesale market for farmed fish in East Java, where the team observed 14 stands for moneylenders, apparently lending to brokers at an interest rate of 6 percent per week. (For a fuller description of market chains for wet fish in Indonesia, see Clucas et al., [1]).

3.2.3 Characteristics of Supply and Demand

Official statistics suggest that marine fish landings are increasing and that more fish is going into the wet fish trade. This seems to be in contradiction of the resource situation described above. The statistics may overstate the increase in landings (as data collection and coverage has improved) and the wet fish estimates do not take account of fish diverted into processing at later stages of the marketing chain.

The switch to large vessels operating in richer resource areas may in fact have enabled catch to be maintained, or increased a little. However, future supply of wet fish will depend on the status of the resource, on-board handling practices, and effective demand.

Population growth in Indonesia has increased demand for all fish forms, but rising incomes and urban growth have been associated with the shift towards wet fish. Income levels are stagnating at the moment, with the recession brought on by the fall in oil prices, and this will stem any shift towards more expensive food commodities. Urban

populations, however, continue to grow (especially on Java), and much of the poor quality wet fish is directed at this market. Note, though, that for low-income groups in urban areas (i.e., the majority of the population) wet fish is a luxury good, and dried fish remains an important staple.

Price trends suggest that supply has not kept pace with demand for wet fish. The eighties have seen small but real increases in marine wet fish prices [2]. Clucas et al. [1] also report higher wet fish prices in West Java (with the major Jakarta market, and competing purchases by exporters), and in rural markets (where distribution systems are less developed). In urbanised West Java fish consumption is about 11-14 kilograms per capita per year, but little over half that elsewhere in Java [3]. Rising real incomes and urbanisation are likely to continue to increase demand for wet fish, at a rate faster than any supply increase, with a consequent continuation of the upward trend in prices. Such a trend is likely to continue until such time as prices permit the necessary investment in the fishing fleet for improved on-board handling, or until there is a switch to other protein sources. At the moment, fish is the most important source of protein on Java, and policies to increase fish exports should be considered in the context of this trade-off.

3.3 Dried Fish

3.3.1 Product Form and Handling

Fish is salted and dried in Indonesia to extend its shelf-life to several months. Generally cured fish with a higher salt content has a longer shelf-life. Salt content also affects taste, and highly salted dried fish is used essentially as a flavouring agent in very small quantities.

The quality of the end product largely depends on the quality of the wet fish used. Prompt salting (preferably at sea) is important. As with wet fish, the team observed marked differences between Java and the other islands. Much of the fish seen landed in West Java and Central Java was poor material even for drying. In contrast, the dried snapper and mackerel seen in South Kalimantan was of excellent quality.

The fish is sun-dried on racks usually very near to the landing. The time needed for drying depends on the size of the fish and season (one day to two weeks), and there is an extensive range of product forms. On Java, the team saw a lot of catfish being dried, and small fish. In South Kalimantan larger fish were used, reflecting distance from Java's markets (where they would have gone into the wet fish trade). In Sumatra, "ikan bilis" is produced--anchovies first cooked in brine, then dried.

Overall, according to GOI statistics, 36 percent of the marine catch is salted and dried, and 27 percent of the inland capture fishery catch.

Substantial quantities of dried fish are lost due to insect infestation. Blow-flies lay their eggs on wet fish exposed for drying, and the emergent larvae can consume much of the fish flesh. The infestation is most serious during the wet season when drying is prolonged. Further losses can be incurred due to beetle infestation of the dried fish. The associated loss is two-fold, in weight and in quality, and processors interviewed on Java were very keen to reduce such losses. The use of household insecticides on fish in Indonesia has been widely publicised, and the practice has been banned. Field visits, however, indicated that the practice continues. This problem is discussed further in section 7.2.2.

Other problems that processors raised were to do with fermentation and bacteria, but these do not seem to be a major cause of loss. When the team did see very poor quality dried fish, further investigation revealed that it was very old and would be sold as animal feed.

3.3.2 Structure of the Industry

Market chains for dried fish are even more complex than those for wet fish, involving elaborate distribution networks, and transfer at several regional wholesale markets. Clucas et al. [1] report that the degree of concentration and vertical linkage is greater for fish originating off-Java, with the same wholesale company sometimes controlling the entire operation through to sale to urban retailers on Java. In South Kalimantan the team was told that salted fish for processing was landed directly at fishing villages, before the fresh fish was landed at the registered landing. In such cases it is possible for inter-island traders to enter into direct contracts with processors, without any open marketing. Where there are few traders, they have absolute power in dictating terms to the processors. As with all fish marketing in Indonesia, wholesalers with access to key inputs (credit, transport, market contacts) are able to exercise considerable market power.

The importance of fish processing as an employment activity for women should be stressed, because there is nothing comparable in the wet fish trade (where women are only involved in retailing and small-scale wholesaling). Virtually all of the fish drying seen by the team was supervised by women, though men were involved in the marketing.

See Clucas et al. [1] for a description of market chains for processed fish.

3.3.3 Characteristics of Supply and Demand

Fisheries statistics suggest that the total volume of fish landed is increasing over time, and that an increasing share of this catch is destined for wet fish sales. Clucas et al. [1] report a demand shift, on Java, towards wet fish and, to a lesser extent, pindang, at the expense of dried fish. However, at the landings visited by the team in West and Central Java only half, or less, of the fish being auctioned could have been sold for the wet fish trade. Most of this had been caught off Kalimantan or Sulawesi, on voyages lasting 3 to 4 weeks. There are various possible explanations of this apparent contradiction.

On the one hand, GOI statistics may overstate the shift to wet fish (see section 3.2.3), whilst on the other hand, the landings visited by the team may not be entirely representative of Java's wet fish trade. The best quality fish, particularly that landed in West Java, for the Jakarta market, may not enter the auction system. Sumatra's role in supplying Jakarta's wet fish trade may be increasing; this fish is not landed on Java, but instead is transported by road from Malacca Strait ports such as Medan.

The north coast of Java remains an important processing area, and with fishing activity increasing off Kalimantan and Sulawesi, these areas are becoming important supply sources.

There may be some decline, then, in the relative importance of dried fish, but population growth means that absolute levels of demand are at least being maintained, and may be increasing. Dried fish is consumed by low-income groups in rural and urban areas--in rural areas often reflecting a lack of alternative fish products.

It seems likely that dried fish will remain an important commodity in Indonesia, despite its currently declining market share. Certainly the quality of much of the fish now being landed on Java necessitates that it be processed. The GOI's recognition of its importance, particularly to low-income groups, is reflected in its inclusion in a group of food commodities for which the state is, in theory, empowered to intervene in marketing. In the case of dried fish, this power has never been exercised.

3.4 Pindang

3.4.1 Product Form and Handling

The term "pindang" refers to whole fish that has been cooked in brine and therefore has an extended shelf-life.

This product, in various forms, is produced in Indonesia and neighbouring countries, but is most common on Java. The product comes in many different forms, depending on variety of fish used, cooking time and method, salt concentration and packaging. The shelf-life varies from three days to several weeks, and is largely determined by salt content. Fish of the same species and of uniform size are packed, cooked and sold together.

The range of products extends from heavily salted small tuna cooked in earthenware pots for several hours, to sardine or scad, attractively packaged in small baskets, each containing 2-6 fish, which are immersed in boiling brine for a few minutes, and have a shelf-life of about three days.

Pindang "factories" occur near the main landings, and also in inland areas where firewood and labour is cheaper. Spoilage of fresh fish, occurring during marketing, may also explain the inland processing activity. Fish should, however, be of better quality than that used for drying. Physically damaged fish will break up when cooked and lacks consumer appeal.

3.4.2 Structure of the Industry

Market chains for pindang are similar to those for dried fish described in Section 3.3.2 above, with the difference that there is virtually no inter-island trade in pindang.

Processing operations seen by the team were large, but fairly low investment enterprises, employing wage labour. In certain areas particular processors dominate, and can therefore influence prices at the landing. Processors will specialise in a certain type of pindang. At Pekalongan, for instance, the team visited a large pindang operation, producing a short shelf-life product for the Surabaya market. Pindang processing, like fish drying, is an important employment activity for women.

3.4.3 Characteristics of Supply and Demand

Most production of pindang is restricted to Java, and within Java most processing occurs along the north coast. There appear to be regional variations in the product. For instance, the team only saw small fish pindang (in baskets) in Central and East Java. Central Java is the most important source of pindang for inter-province trade.

In terms of overall consumption pindang is the third most important fish form, after fresh fish and dried fish. In Central Java consumption of pindang seems to be declining slightly, as fresh fish consumption becomes more important. Elsewhere in Java there appears to be a

slight shift towards pindang at the expense of dried fish. Pindang appears to act as a relatively high quality partial substitute for fresh fish, particularly in rural areas where fresh fish is harder to obtain. (See Clucas et al. [1])

3.5 Fish Otherwise Processed

Various other products combine to account for less than ten percent of fish disposition in Indonesia. These include smoked fish, terasi (fish paste), canned fish (for the local market and for export), fish crackers, fish balls, and so on. None of these is important enough to merit particular attention here. Note though that terasi is produced in large quantities and is important as a low cost protein ingredient in Indonesian cooking.

3.6 Summary of Constraints to Domestic Fish Marketing

3.6.1 Geography of Resource versus Market

The fundamental problem facing the Indonesian fish sector today is over-fishing of the South Java Sea, resulting in the operational fishing grounds being located at an ever increasing distance from the country's main markets on Java. This means that on-board handling must be improved for wet fish, or alternative methods of preservation found. Neither strategy, however, will succeed in maintaining fish supply to Java's predominantly low-income population unless low-cost options can be found.

The Japanese aid agency recently commissioned a feasibility study to consider the establishment of cold storage plants on the outer islands, from where frozen fish could be shipped to Java. The conclusion was that such an operation would be uneconomic, presumably because the end-product would be too expensive for Javanese consumers.

There is clearly a need for comprehensive information on fishing practices in the Java Sea and how these relate to fishermen's net returns. Key technical and financial relationships need to be defined. A study addressing this would need to cover four main aspects:

- i) fishing voyage distance and duration, and how that relates to costs, vessel size/type, catch size and volume;
- ii) on-board handling (including the use of collector vessels) and how that relates to duration of voyage, spoilage rates, vessel design or modification (e.g., insulated holds), and costs;

- iii) landing prices for different types of fish, including the distinction between fish to be retailed wet (export quality, good quality domestic market, poor quality domestic market), as pindang, as dried fish, and that unfit for human consumption; and
- iv) institutional factors affecting these relationships such as credit extended to fishermen by buyers, provision of key inputs (particularly salt and ice), vessel ownership, trading practices, and access to fishing grounds.

Given the fragile state of the resource base, any such study pre-supposes more comprehensive resource data than that currently available. The resource assessment study mentioned in Section 2.1.1 (EC/France) includes a component which would address some of these issues.

3.6.2 Restrictive Marketing Practices and Supply of Credit

The GOI has encouraged fishermen and traders to form co-operatives. These co-operatives are generally supervised by government officials, and amongst other things serve as a conduit for subsidised inputs (such as fuel). It is also the responsibility of the co-operatives, at least on Java, to organise the public auctioning of fish. One of the underlying assumptions behind their establishment is that the fishermen are in a weak bargaining position relative to the buyers and processors.

Although there has been limited success with fish auctions (significantly in Central Java), the co-operatives have not been able to engage in any downstream marketing activity. Many are still very dependent on supervision by the Ministry of Co-operatives. Frequently access to inputs, and notably credit, is controlled by the buyers, who are therefore able to maintain their position of advantage over the small fishermen. Moreover, there is some conflict of interest within the co-operatives where membership comprises fishermen and buyers. If these issues could be addressed though, there is much scope for improving fishing incomes, by increasing the role played by producers' organisations in marketing activities. The provision of credit through channels not tied to fish sales would be a particularly significant step towards this process.

This area has received the attention of NGOs in Indonesia which have been involved in pilot credit schemes. ODNRI was involved in a co-operative development project [1], which is discussed in more detail in section 5.1. Additionally, the FAO, under the auspices of its regional

"Bay of Bengal Programme" is commissioning a study of fish marketing practices in North Sumatra (where production/market systems are highly integrated). Credit schemes for small producers are notoriously difficult to run, but this is an important issue that needs to be addressed in any attempt to increase fishing incomes.

3.6.3 Dried Fish Losses due to Insect Infestation

Given the prevalence of this problem, and the processors' response which has been to use highly toxic household insecticides, this is an area for urgent attention. This is developed further in section 7.2.2 below.

3.6.4 Public Institutions Serving the Sector

The fall in oil revenues has posed severe budgetary constraints for the GOI, and this problem has no immediate solution.

Whilst some measures depend on more income, there are areas in which action could be taken at very small cost. One example is in research. The team met with provincial DGF officials, representatives of the national research institutes, and university researchers. It was clear that in many areas there is very little dialogue between these groups, despite commonality of interest. Dialogue between these groups would enable much clearer identification of problems, and permit research more focussed to particular target groups.

In some places it was clear that local offices lacked sufficient funds to visit producers and processing in outlying areas. Sometimes (for example, in Kalimantan and South Sulawesi) these were the most important producing areas. The result is a poor information flow in both directions, which does nothing to promote sectoral development.

END NOTES

- [1] The Production and Marketing of Fish on a Co-operative Basis. Project QTA-23. IJ Clucas, EB Hamley, AD Marter, SJR Bland. September 1986.
- [2] Final Report Indonesian Fisheries Economy Study. Main Text. Ministry of Agriculture, DGF, and Asian Development Bank. January 1988.
- [3] Pengeluaran Untuk Konsumsi Penduduk Indonesia per Provinsi 1987. Biro Pusat Statistik, Jakarta, Indonesia.

4. THE MARKETING OF FISH AND SHRIMP FOR EXPORT

4.1 Overview

Provisional data for 1987 indicate that exports of fish and shrimp products had an f.o.b. value of US\$427 million, representing 2.5 percent of total exports. Exports of frozen shrimps were worth US\$342 million; other important products were frozen tuna (US\$26 million), fresh or chilled prawns, fresh or chilled tuna, and beche de mer. (Jellyfish exports were also significant in 1987, but the catch is extremely variable from year to year). The 1987 figures indicate rapid growth in this sector, most of which can be attributed to exports of frozen shrimp (whose value increased nearly threefold over 1986). It should be noted that the GOI is keen that such growth in exports should continue.

Each section below deals with a group of export products with common market channels. Exports are therefore discussed under the following headings: frozen shrimp, wet fish (including shrimp) on ice, frozen fish, and other products. The latter two export groups are not discussed in detail, given their relatively minor role.

4.2 Frozen Shrimp

4.2.1 Product Form and Handling

Frozen shrimp sorting and packing is carried out by so-called "cold storage plants". Shrimp are purchased from fishermen, tambak farmers, and the factories' own tambaks. Purchasing is usually at the tambak to facilitate speedy transfer from pond to factory. Most shrimp are exported "head-off" though there is some trade in good quality shrimp "head-on". Shrimps of all sizes are exported but importers pay a premium for large shrimp. Shrimp farmers are trying to switch to the preferred "black tiger" shrimp, but managers of cold storage plants complained about mixed varieties, and the extra sorting problems they create.

At the plant, shrimp are usually washed, sorted by size and variety, then packed in boxes for immediate freezing. Plants are subject to inspection by DGF officials who look for the following features: appropriate dress by employees (mouth, nose and hair covered, overalls, boots, gloves); entrance with double doors (to deter insects) and foot baths; outdoor clothing and shoes left outside processing area; well-drained easy clean surfaces; clean ceilings, walls, and light fixtures; not much direct sunlight; insect "extinguishers" and fly screens; clean toilets well away from the processing area; and waste material effectively disposed of well away from the processing area. The provincial quality control laboratories are also supposed to carry out bacteriological analysis of the end-product, though

capability and requisite funds vary between laboratories.

The team visited several cold storage plants, and found standards of hygiene to be very varied. DGF officials explained that lack of funds made it difficult to enforce recommended practices through regular inspections. Some factories, however, were extremely vigilant; most used chlorinated water, and some ran their own laboratories.

One of Indonesia's major markets, the US, has blacklisted Indonesian shrimp, because of high bacteria counts, resulting in all shipments now being checked on entry to the US. Companies exporting directly to the US then must consistently meet high standards of hygiene. Some shrimp is allegedly exported to the US via Japan, though presumably standards are still high since Japan will not wish to slur its export record.

4.2.2 Structure of the Industry

The frozen shrimp industry in Indonesia is moving towards greater vertical integration and larger scale operations. Both trends appear to be associated with significant economies of scale.

In the past, cold storage plants purchased shrimp from fishermen and tambak farmers. The trawl ban imposed since 1980 initially resulted in declining shrimp exports, but now shrimp production from tambaks has more than compensated for the loss of marine shrimps, and continues to grow. Many cold storage plants now own tambaks. In this way they assure a large proportion of their requirements. Intensive production systems permit the planned production of low cost shrimp, of preferred size and variety, with controlled harvesting and delivery so as to minimise bacteriological decay.

This move to assure the supply of high value shrimp then fuels the trend towards larger plants, which run 365 days a year, with sufficient turnover to justify their own ice plants, quality control laboratories, and so on. Many of these plants are joint ventures with Japanese firms, thereby extending vertical linkages towards the major export market.

4.2.3 Characteristics of Supply and Demand

During the eighties, world trade in shrimp has been growing steadily at about 8 percent per annum, in volume terms [1]. Europe, Japan and the USA account for 86 percent of world shrimp imports. World shrimp prices have continued to rise in real terms--about 3.6 percent per annum over the period 1977-1986 (based on FAO import data, deflated with an FAO agricultural import unit value index [2]).

This strong world demand for shrimp, and increased awareness of shrimp culture technologies, has led to an increase in farmed shrimp production. This is particularly true of Asia, where much of the land is well-suited to aquaculture, and governments are keen to support ventures that generate export earnings. This region continues to expand its shrimp culture area, and to intensify production. A levelling and subsequent falling of world prices seems likely as production from these new investments comes on-stream.

In Indonesia, the shrimp tambaks are located on Java (59 percent of production), Sulawesi (23 percent of production), and Sumatra (17 percent). Expansion of the tambak area continues. A trend towards increased development in Sumatra and Sulawesi seems likely given land pressure on Java.

The private sector has responded quickly to investment opportunities in this area. Many of the export companies visited by the team had commenced operation during the eighties, and were expanding output very rapidly. There was concern over the US blacklisting of Indonesian shrimp, but the hygiene strategy necessary to combat this is well understood. Japan is Indonesia's most important customer for shrimp (75 percent of export volume in 1986 [3]), and many of the shrimp export companies are joint ventures with Japanese corporations.

4.3 Wet fish on Ice

4.3.1 Product Form and Handling

The very best quality fish is exported on ice, if landed near Jakarta, Medan (Sumatra) or Pontianak (Kalimantan). It is air-freighted to neighbouring countries, with distribution so organised that fish landed in the evening can be in, say, a retail market in Singapore by noon the next day. Such fish will have been well-iced when caught, and is frequently the large higher value species, such as snapper, tuna and pomfret. Some shrimp is also exported through the same channels. Fish intended for export is handled very promptly and generally kept on ice throughout. It is exported in plastic lined cardboard boxes, or polythene drums, and packed well using leaves as insulating material, with ice and sometimes salt.

Export businesses are usually located around fish markets and landings, facilitating rapid handling from point of purchase.

4.3.2 Structure of the Industry

This sub-sector is reported to be extremely concentrated with just a few large firms dominating the export trade. These firms often have close links with importers in Singapore. Within Indonesia the vertical integration extends back towards the fishermen. The extreme case of this is the private landings in North Sumatra (described in Section 3.2.2). A less blatant, but similar system exists elsewhere, when exporters, or their trade contacts, own fishing fleets, or extend credit to fishing operations.

Informal interviews with fishermen and small-scale traders suggested that it is very difficult for newcomers to penetrate these closely linked export marketing chains, and for the same reason, market information is not readily available.

4.3.3 Characteristics of Supply and Demand

Most of the wet fish exports go to Singapore. Indonesia is ideally situated, with short flight times, to supply this relatively high income, growing, urban market. The f.o.b value of these exports in 1987 was US\$32 million, or US\$24 million if jellyfish is excluded.

Demand for wet fish should remain strong in Singapore, and exports from Indonesia are likely to expand, largely at the expense of the lower value domestic market.

Another potential market is Japan, which pays high prices for top quality wet fish, particularly tuna. Expansion into this market is technically feasible, given direct flights between Indonesia and Japan, and some sashimi-quality tuna has already been exported. The Japanese market, however, does demand the best quality fish, and export operations supplying that market handle fish quickly and expertly, with immediate chilling and no physical damage to the fish.

4.4 Frozen Fish

Frozen fish, particularly tuna, is exported by sea from Eastern Indonesia. The team was not able to visit any of these operations, but understand that fairly large-scale cold storage plants and factory ships process the catch of a modern shipping fleet. Most world trade in frozen tuna supplies the canning industry. Indonesia has its own fledgling canning industry, but is also well situated to supply the Thai industry.

4.5 Other products

Indonesia also exports a wide variety of other fish products in small quantities. These include canned fish, smoked fish, live fish (as fry and as ornamental fish), and even shrimp heads (for subsequent inclusion in compound feeds).

4.6 Summary of Constraints to Export Fish Marketing

4.6.1 Quality Control of Shrimp

The GOI is very concerned about the US blacklisting of Indonesia's shrimp exports. The systems are in place, however, for tighter quality control, with plant inspections by the DGF and product analysis by the provincial quality control laboratories. Follow-up measures are required to make sure that recommendations are carried out and standards maintained. Quality control laboratories need to sample export products regularly, and rigorously enforce health standards. The importance of such quality control cannot be over-emphasised, since the repercussions of negligence in this area affect the entire industry.

4.6.2 Competition in the Export Sector

The fish product export sector in Indonesia is generally characterised by a high degree of vertical integration and concentration. Given the capital investment associated with increased exploitation of fairly remote fish resources in eastern Indonesia, the same would be true of future development in this area. Although a certain amount of this is inevitable, it can inhibit new entrants, and may not always serve Indonesia's multiple development interests.

It was not possible to make a detailed investigation of margins in export businesses, but the degree of concentration and vertical linkage puts the export company (or chain of linked businesses) in a strong position relative to the fishermen. This in turn enables the extraction of super-normal profits, particularly where credit is extended, at the expense of fisherman

income. As a medium-term objective, the GOI may wish to consider ways in which producer groups could be strengthened. The provision of credit would be central to the success of any such scheme. The challenge will be to do this without discouraging private sector investment in export enterprise. Field interviews suggested that the private sector is fairly quick to respond to new commercial opportunities that arise as new areas are developed, and in as much as this helps generate foreign exchange, the GOI would not wish to inhibit this process.

Another option would be to increase (and collect) taxes on fish exports, thereby contributing to GOI revenue and GOI capability to meet its development objectives. This might seem to run contrary to the export promotion policy; however, export tax at the moment is nominal and could probably be increased without a significant effect on exporter incentives.

4.6.3 Physical Infrastructure

Increasing exports of fish products to some extent hinges on infrastructural development--particularly landings, airports, handling facilities at airports, roads, and telecommunications. This is especially true in less developed eastern Indonesia, but applies to some extent to all the islands. Road connections, for instance, are very poor between fishing ports on the south-west coast of North Sumatra, and Medan, the north-east coast town through which all trade passes.

The GOI's spending on infrastructure has had to be curtailed in line with stringency imposed by oil revenue cuts. Investment in electricity and transport/communications is still a priority, however, receiving roughly 25 percent of the development expenditure budget between 1979/80 and 1986/87 [4].

4.6.4 Institutional Support

There are other areas of institutional support where the GOI can play a role. These include extension and training, information services, legislation (e.g., relating to licensing of export businesses and enforcement of quality control) and research. Basically the structures are already in place for such support, but sometimes lack focus in their work. Policy development and the implementation of such policy would be furthered by increased dialogue between separate institutions serving the sector, and their target group.

END NOTES

- [1] FAO Yearbook Fishery Statistics--Commodities, vol. 63, 1986.
- [2] FAO Trade Yearbook, vol. 40, 1986.
- [3] Statistik Indonesia--Statistical Yearbook of Indonesia, 1986. Biro Pusat Statistik, Jakarta, Indonesia.
- [4] Indonesia, Adjustment, Growth and Sustainable Development, World Bank, May 1988.

5. BRITISH AID PROJECTS

Four British aid projects have been carried out, or are in progress, and a proposal for a new project is under consideration.

5.1 The Development of Fish Production and Marketing on a Co-operative Basis

5.1.1 Project Scope

This programme, which ran from July 1984 until September 1986, provided the Ministry of Co-operatives with the services of a Fish Technologist/Marketing Adviser, a Fisheries Co-operatives Management Adviser, and short-term inputs from an economist and a fisheries scientist. The objectives of the project were to assist the GOI to identify programmes and projects which would help in the development of Marine Fisheries Co-operatives, to make them stronger and more business-oriented in their activities. These operations would then be funded through the GOI project R-9 "The Development of Small-scale Fisheries on a Co-operative Basis".

5.1.2 Major Recommendations

The project surveyed fisheries cooperatives in the three provinces of Java, West Kalimantan, South Sulawesi, Nusa Tenggara Barat and North Sumatra. It also made a survey of the marketing of fish in the provinces covered. The team recommended that the GOI should become less involved in the management and running of Fisheries Cooperatives and should allow the units to become more self-sustaining and business-oriented. This would mean that many units which were really only administrative arms of the government would become moribund, but those units with potential would be able to become more viable given the right assistance, advice and training.

A rationalisation of numbers of cooperatives was called for and aid inputs to bring this about were recommended. A training programme specifically geared to the needs of fisheries cooperative units was suggested as part of project R-9. In addition a recommendation was made to study private sector fisheries credit in fishing villages to ascertain whether cooperatives could conceivably have a role to play in the provision of credit to their members. Proposals were also made to establish two cooperative marketing centres at Rembang and Cilacap in Central Java since at these two locations there were effective cooperative organisations which could form the basis for secondary marketing operations of benefit to the membership.

The main emphasis of these proposals was to provide technical assistance to the fisheries cooperative

movement rather than direct investment and hardware since the identified needs were for rationalisation, consolidation and manpower development. As far as is known the recommendations of the ODA team have not been followed through by the GOI.

5.2 Reduction of Post-harvest losses of Traditionally Processed Fish in Indonesia

This has been the subject of two consecutive projects, a research study from 1983 to 1986, and a technical co-operation project which is due to continue until 1989. These projects were carried out by Humberstone College, with some inputs by the Overseas Development Natural Resources Institute.

5.2.1 Insect Infestation of Sun-Drying Fish

Curing is a major, and in some areas, the only available method of fish preservation. Approximately 35% of the marine production is processed traditionally, by salting and drying, and it is predicted that fish processed in this way will continue to be a nutritionally and economically important commodity for the foreseeable future. Field investigations carried out in various parts of Indonesia have revealed that cured fish losses constitute a major problem for the fish processing industry in terms of both loss of material and financial value. Two of the main causes of losses were found to be blowfly infestation during processing and beetle infestation during storage. Some cured fish processors and retailers have consequently resorted to treating their fish with unapproved household insecticides, such as Baygon and Startox, in order to reduce insect infestation. Because of the concern about this, the use of any insecticides on fish was declared illegal in 1986. However, the use of insecticides still seems prevalent, particularly on Java. Field trials to evaluate alternative, non-hazardous methods of preventing insect infestation were carried out in West Java between 1983 and 1986. A major recommendation, resulting from this work, was that the FAO/WHO approved insecticide, pirimiphos-methyl, should be registered for use on fish in Indonesia.

The second phase of the work, a Technical Cooperation project, started in 1986. One of the major aims of this project is to provide staff of the Fish Quality Control Laboratories at several centres in Indonesia, with training in loss assessment and safe loss reduction techniques. To date, training programmes have been undertaken by Department of Fisheries staff in East Java, North Sumatra, Central Java, West Kalimantan, South Sumatra, and Lampung provinces. Similar training programmes are to be carried out in South Kalimantan, Sulawesi, and West Java, before the project is completed

in April/May 1989. The training programme conducted in each province consists of lectures and seminars on the assessment and reduction of losses of traditionally processed fish, together with practical training in survey techniques and field trials. A major emphasis of the training programme has been to provide training in the use and evaluation of pirimiphos-methyl in reducing insect infestation and losses of cured fish during processing and storage.

Pirimiphos-methyl has recently received provisional registration from the Indonesian authorities for use on fish and it is to be marketed in Indonesia under the brand name Minawet 250 IC. Minawet represents the only safe and practical remedy to the problem of insect infestation that is likely to be acceptable to commercial fish processors. The pirimiphos-methyl evaluation trials, carried out as part of the training programme in the six provinces have consistently demonstrated that pirimiphos-methyl, applied as a 0.03% dip, protects fish against blowfly infestation during processing and against Dermestes and Piophilina infestation during storage.

Delays in getting Minawet registered in Indonesia have meant that Minawet could not be recommended to fish processors until the product was registered in February 1988. Consequently the training programmes to date have been restricted to Directorate General of Fisheries staff, so that they could provide the processors with training in the use of Minawet after it had been registered. ICI plan to get Minawet on the market in the near future and are currently investigating with the Directorate General of Fisheries the most suitable method of making Minawet available to fish procesors. However, if the benefits of the ODA programme on reducing losses of cured fish in Indonesia are to be realised by fish processors and consumers, some further inputs are needed. These are discussed below (section 7.2.2).

5.3 University of Diponegoro (UNDIP), Semarang

For a number of years ODA has been providing assistance to the Faculty of Fisheries at this university. A series of fisheries specialists have helped to strengthen the faculty through curriculum development, staff training, and research support. The programme has recently been evaluated. At the beginning of 1988, a post-harvest specialist, Dr AD Matthews, was also provided, extending the ODA inputs into the post-harvest sector for the first time. It is too soon to attempt to evaluate this input.

5.4 Pindang

Pindang has been the subject of an ODNRI extra-mural grant since 1986. Little is known of the relationship between the processing conditions and product quality or

storage life. A post-graduate research student is working at UNDIP under the supervision of Dr. KDA Taylor of Humberside College. Some interesting results have been obtained but it has been difficult for Dr Taylor to provide close supervision of the work through his twice-yearly visits. During this tour it was arranged that Dr Matthews should provide day-to-day supervision, in consultation with Dr Taylor.

5.5 Brackish Water Cultivation of Shrimp

In 1987 a team led by Dr I Mackintosh considered the prospects for expanding shrimp culture in tambaks in Sumatra. A TC project was recommended, and this is still under consideration. The only post-harvest input would be to establish a small bacteriology laboratory, to monitor tambak water quality, and shrimp quality.

6. OTHER DONORS' ACTIVITIES

During the study, enquiries were made of the embassies of other donor countries, and with the offices of international agencies, concerning their activities in the fisheries sector, and particularly in the post-harvest sub-sector. For convenience these are described in alphabetical order.

6.1 Asian Development Bank

6.1.1 Marine Science Education

A US\$73 million project is concerned with assisting marine science education at five universities.

6.1.2 Fisheries Industrial Credit Programme

Under this programme, scheduled to run from 1986-1990, the ADB has provided US\$65 million to the Central Bank, for on-lending to the nationalised commercial banks. Credit is then made available to the private sector wishing to invest in fisheries. To date these have been large-scale, export-oriented activities (US\$0.5-1 million, for ventures such as shrimp cultivation and cold storage factories). No co-operatives have applied for loans, though in principle they would be eligible.

6.1.3 Agro-industries Credit Scheme

This was approved at the end of 1987, and would include fisheries operations.

6.1.4 Infrastructure Loans

ADB infrastructure loans have included: a port/cold store at Padang; fisheries vessels and equipment for Irian Jaya; a hatchery for brackish water aquaculture at Cilacap in Central Java (a follow-up project is being planned).

6.1.5 Fisheries Infrastructure Project

Under this project it is planned that 6-10 fishing ports will be selected for improvement. To date only Kendari (Sulawesi) and Sibolga (North Sumatra) have been selected.

6.1.6 Inputs into Fisheries Planning

The GOI requested the assistance of the ADB in completing

a review of the economies of the fisheries sector as an input into the planning process for Repelita V (the GOI development plan). Their conclusion was that prospects for expanding fishery output were limited, but showed promise in two areas, namely unexploited tuna stocks, and potential for aquaculture, producing for export and domestic markets. Improved information gathering, and closer co-ordination of the GOI with the private sector were also called for.

6.2 Australia

6.2.1 The ASEAN/Australian Food Handling Project

The ASEAN/Australian Food Handling Project has included regional collaboration on improved fish handling, especially the use of plastic fish boxes. These seem to have been adopted more readily in the other ASEAN countries, than in Indonesia, where there was no local manufacturer.

6.2.2 The Australian Council for International Agricultural Research

This council supports two collaborative projects on fish in Indonesia. One is concerned with the prediction and control of spoilage of fresh, cured, and dried tropical fish, and the other concerns fish drying in East Java. In both projects the leading Indonesian participant is the Research Institute for Fish Technology, part of the national research agency for Agricultural Development. The participating institutes appear to run their research programmes autonomously, without close contact.

6.3 Canada

CIDA provided the ice plant and freezer facilities for the new fish landing in Jakarta, and a request for an extension is being considered. Assistance was also provided, through ASEAN, in setting up the National Centre for Quality Control and Fish Processing in Jakarta. Aid is being provided for various non-governmental organisations, and there is some involvement in cured fish marketing.

6.4 European Commission

6.4.1 Fresh Fish Marketing

This project started in 1984, based at Bulu and Perigi in East Java (ports on the north and south coasts, with different seasonal peaks). Two fishing boats have been provided and the project is also concerned with improving fishing methods, catching, handling and marketing.

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6.4.2 Assessment of the Java Sea Pelagic Fishery

This project has been agreed in principle, and formal approval is pending, for this collaborative EC/French initiative. The counterpart agency will be the AARD. Resource assessment will form the back-bone of the study, although one component will study the off-shore pelagic fishery in the Java Sea (considering all operations between harvest and retail).

6.5 FAO

The main FAO fisheries project has been with the DGF. One aspect has been the improvement of fishing gear, and this work is now based at Semarang. A network of National Fisheries Centres has been set up, and there is a programme for information dissemination through the extension service. In each aspect there has been some involvement in fish processing.

6.6 Germany

GTZ has a small-scale fisheries project in Lombok, which includes the exploitation of novel deep water species. A processing plant was set up in Bali, and this is now being run as a commercial operation. There is a rural development project in West Sumatra, north of Padang; inputs to post-harvest fisheries include helping to develop local processing, such as the manufacture of krepok (prawn crackers).

6.7 Italy

A project on boat design and on-board handling is about to start, with work planned in Central and West Java, Sulawesi, and Nusa Tenggara.

6.8 Japan

A TC project on mariculture for shrimp in West Java has finished, and new shrimp culture project has recently started in Bali. Grant aid has been provided for two fisheries research vessels, for resource surveys, and to assist secondary school education in fisheries. In the seventies loans were provided to the GOI for the development of parastatal tuna fishing fleet, and a loan project for the development of the Jakarta fishing port was completed in 1988. A recent study considered the establishment of freezer stores off-Java, as collection points for shipment of frozen fish to Java, with the conclusion that such an operation would be uneconomic.

6.9 New Zealand

The team visited a fish marketing venture in West Sumatra which had been financed for one year by New Zealand, at its inception in 1976. The "project" now operates commercially, selling ice, and distributing fish to inland hill areas. It is understood that New Zealand has no other fisheries projects.

6.10 USA

A marine fisheries project was being planned with the AARD to be based in Ambon and Ujang Pandang. An expert from Auburn University will advise on post-harvest inputs, which are likely to cover improved drying techniques (including the use of hot air dryers).

6.11 World Bank

For some years there were no fisheries projects in Indonesia, but a new project to strengthen fisheries support services started in 1987. This has two elements: first, to restructure companies involved in fish production such as tuna cold stores in Flores, fresh and frozen tuna production in Bali, and frozen and canned tuna production in North Sulawesi; second, to improve the infrastructure for brackishwater aquaculture by small shrimp farmers by, e.g., providing suitable supplies of fresh and saline water. A natural resources project identification mission, to include fisheries, was expected for August/September 1988.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary of Problems relating to Indonesian Fisheries

Chapters 2 to 4 explored the problems relating to pre- and post-harvest fisheries in Indonesia. These are summarised below.

7.1.1 Pre-Harvest Issues

- i) there is a pressing need for resource assessment, particularly of the Java Sea;
- ii) the extent of the collapse of the inland capture fishery requires quantification, and action to slow the process and mitigate its effects;
- iii) recently increased corporate ownership of tambaks needs to be assessed in the light of implications for small producers, and food production (milkfish and possibly crops);
- iv) as shrimp culture increases, Indonesia needs to investigate local sources of prawnfeed, which is currently imported for intensive production systems.

7.1.2 Post-Harvest Issues: Domestic Markets

- i) a study of fishing and on-board handling practices in the Java Sea is needed, to enable an optimal fishing/handling strategy to be identified;
- ii) credit supply and support to producers' organisations would help improve the bargaining position of fishermen;
- iii) dried fish losses due to insect infestation, and the use of household insecticides (when safe alternatives are available) is an area of public concern that requires attention;
- iv) budgetary constraints have been imposed on all public institutions in Indonesia, but there are nonetheless areas where greater dialogue between interested parties would enable improved focus and utilisation of funds (at little or no extra cost).

7.1.3 Post-Harvest Issues: Export Markets

- i) the enforcement of quality control of shrimp exports needs tightening;

- ii) the domination of the export sector by vertically integrated businesses needs to be considered in the light of its implications for competition and fishing income, whilst retaining the foreign exchange and GOI revenue contribution of the sector;
- iii) key infrastructural requirements need to be identified, but paying particular attention to existing examples which are under-utilised;
- iv) there are areas of institutional support where more focus would permit target groups to be better served.

7.2 Recommendations

Outline recommendations are made below. These are based on the problems defined above, Indonesia's development strategy, and other donors' activities. Indonesia's development goals include increased income and employment, especially for low-income groups, higher exports, and increased availability of food for the Indonesian population.

7.2.1 Pre-Harvest Recommendations

The DDA team's brief was to consider post-harvest aspects of the Indonesia fisheries. These, however, are inextricably linked with certain pre-harvest issues, on which outline recommendations to the GOI are made below.

The GOI is urged to pursue funding of resource assessment of the marine and inland capture fishery, before undertaking activity which would put greater pressure on these resources. This is required most urgently in the Java Sea, where an EC/French initiative will assess pelagic resources (due to start in 1989).

The GOI is urged to monitor trends in tambak development and shrimp culture. Intensive farming, under corporate ownership, may have implications for traditional tambak farmers and land-use patterns. The GOI may also wish to pursue local sources of prawnfeed; ODNRI may be able to transfer experience on this topic later, after the results of other studies in the region become available.

7.2.2 Post-Harvest Recommendations: Domestic Markets

A techno-economic study of fishing and handling in the Java Sea is required so that optimal/near optimal fishing strategies may be identified. Such a study is planned as a component of the EC/French Java Sea Pelagic Resource Assessment. ODNRI will liaise with ORSTOM (the

French institute providing the technical assistance) to determine precise content of their study, and whether there is a need for any complementary inputs.

The GOI is urged to consider the role of co-operatives and other producer organisations, and ways in which credit might be channeled to these groups. The team does not propose that ODA provide inputs in this area currently. The FAO, under the auspices of the "Bay of Bengal Programme", is planning a study of marketing practices in Sumatra; the content and reaction to this study will assist in the identification of future interventions.

Dried fish losses due to insect infestation, and widespread use of household insecticides are problems requiring urgent attention. The team proposes that ODA fund a training/extension/research programme aimed at the adoption of the safe insecticide, Minawet, by fish processors, to start 1989/90, but subject to financial analysis, and adoption trials, to be incorporated into the last phase of the existing ODA/Humberside College project (1988/89). It is also proposed that the National Centre for Quality Control and Fish Processing in Jakarta be provided with the necessary equipment (a suitable gas chromatograph) and training to undertake pesticide residue analysis (for monitoring the use of Minawet, as well as other harmful insecticides).

ODA is giving assistance to pre- and post-harvest fisheries programmes at the University of Diponegoro, through the provision of two resident advisers. It is not proposed that this be extended to other institutes currently, but nonetheless the team would recommend closer contact between at least two other promising Indonesian universities and UK researchers. Such contact could involve the exchange of literature, seminars given by UK researchers when in Indonesia, and perhaps post-graduate training in the UK under the Technical Co-operation Training Programme. The team visited Hasanuddin University (South Sulawesi) and the Institut Pertanian at Bogor (IPB). The Hasanuddin fisheries department is new, and would benefit particularly from contact with the Institute of Aquaculture at Stirling. Both the Department of Fishery Production, and the Department of Fisheries Economics and Management at IPB, have submitted research proposals to ODA, concerned with improving cured fish production, and data systems (respectively). In their current form (a request for funding of local staff costs and equipment) ODA would not generally fund these. The team recommends that the departments have closer contact with Humberside College; talks can be held during the planned Humberside College visits to Indonesia 1988/89.

The team also recommends a follow-up programme for existing research on pindang. This product is becoming increasingly important in Indonesia, but the precise

relationships between type of processing, shelf-life and nutritional value are still very poorly understood. A research proposal could be drawn up by the resident post-harvest fisheries adviser at the University of Diponegoro and Dr. Taylor at Humberside who is supervising the existing research. It could be funded as an ODNRI extramural contract, (like the existing project).

7.2.3 Post-Harvest Recommendations: Export Markets

The techno-economic study of the Java Sea Fishery will have implications for export marketing, in so much as it improves handling of wet fish. Generally, though, the private sector in Indonesia seems to be responding very quickly to opportunities that arise, as new areas are opened up. The GOI's programme of infrastructural development will assist this process.

The GOI can strengthen its programme of institutional support to the sector within the existing structures. This is particularly true of quality control of export shrimp, where the mechanisms and capacity is already in place, but where strict enforcement is required.

7.3 Proposals for ODA inputs to Post-Harvest Fisheries

Project proposals relating to the recommendations in section 7.2.2 are being drawn up separately, and will contain a more detailed plan of activities.

APPENDIX I

ITINERARY

Tuesday	31 May	JRE arrives Jakarta: cured fish study up to 4 June
Thursday	2 June	AEG arrives Kuala Lumpur. Discussions with INFOFISH and ASEAN Food Handling Bureau
Sunday	5 June	GRA and AEG arrive Jakarta British Embassy, Directorate General of Fisheries Fish landings and processing in Jakarta Other Embassies
Friday	10 June	Bogor: Fisheries Faculty
Sunday	12 June	Leave Jakarta: Fish landings at Eretan and Indramayu. Arrive Cirebon: fish landing and processors
Monday	13 June	Fish landings at Gebang, Pekalongan; Arrive Semarang
Tuesday	14 June	University of Diponegoro, Semarang and Jepara
Wednesday	15 June	Semarang: fish markets and landing, prawn factories, Regional office and quality control laboratory, FAO project
Thursday	16 June	Fish landings at Tuban and Brondong; arrive Surabaya
Friday	17 June	Surabaya fish markets, Regional office, shrimp factories
Saturday	18 June	Sidoarjo fish markets, shrimp paste factory, fish smoking; Lokok fish landing; to Tretes
Sunday	19 June	Fly to Ujungpandang, South Sulawesi
Monday	20 June	Ujungpandang: Fisheries Office, Hasanuddin University, fish curing processors
Tuesday	21 June	Ujungpandang: Fish market; shrimp farmers; to Parepare shrimp factory
Wednesday	22 June	Fly to Surabaya and Banjarmasin, South Kalimantan
Thursday	23 June	Banjarmasin: Fish landing and market, Regional Fisheries Office GRA and AEG fly to Jakarta JRE: cured fish study * (to 25th)
Friday	24 June	GRA and AEG Jakarta: other donors
Saturday	25 June	GRA and AEG Jakarta fish market AEG: Statistics Bureau
Sunday	26 June	Fly to Medan
Monday	27 June	Medan: Fish markets, Regional Fisheries Office; Betawan fish landings

Tuesday	28 June	Drive to Sibolga: fish landing
Wednesday	29 June	Drive to Sorkam and Barus: fish landings. Then to Parapat
Thursday	30 June	To Medan
Friday	1 July	Fly to Padang
Saturday	2 July	Padang: Fish markets, fish marketing project, bagan landing, fish harbour, Regional Fisheries Office
Sunday	3 July	To Jakarta: JRE to Bandar Lampung: cured fish project * (to 5 July)
Monday	4 July	GRA and AEG: Other Embassies; reporting session with Post-harvest Forum
Tuesday	5 July	GRA: report writing, other Embassies AEG: To IFB, Department of Fisheries Economics and Management; and DGF Extension Dept.
Wednesday	6 July	GRA and JRE to UK AEG: To Madras: discussion concerning Bay of Bengal Programme *

* to be reported separately

APPENDIX 2

PEOPLE MET DURING THE REVIEW

British Embassy, Jakarta	(Mr Barry Hefferon (Mr Steve Persighetti	Aid Secretary
British Council, Jakarta	(Mr Allan Jones (Miss Caroline Warrior	Director, Education Development Unit
Directorate-General of Fisheries Jl Harsono R M No 3 Building B	(Maj Gen R Soeprapto (Dr Martono (((Director General Director, Fisheries Enterprises & Processing Department
Ragunan-Pasar Minggu Jakarta Selatan	(Dr Josephine Wiryante (Ir Budi Rahardjo (Mr Su'ud Elfandi (((Mr I Made Putna ((Mr H Panjaitan	Directorate of Planning Director, Fisheries Infrastructure Develop- ment Chief, Sub-Directorate of Fisheries Resources Directorate of Extension
EEC Delegation PO Box 55 JKPDS Jakarta 10220	M Andre Chalmin	Economic Counsellor
Asian Development Bank PO Box 99 JKSA Jakarta 10110	Mr Remigio D Torres	Senior Project Economist
German Embassy Jln M H Thamrin No 1 Jakarta 10350	Dr Gert Hauerstein	Counsellor (Sci & Technol)
Area Development Project (GTZ) PO Box 146 Padang, W Sumatra	Dr Speidel	Project Manager
Italian Embassy 45 Jln Diponegoro Jakarta	Mr Riccardo Manara	1st Secretary Commercial
FAO PO Box 2338 Jakarta	Mr Nicholas Hughes	Programme Officer
Japanese Embassy Jln M H Thamrin 24 Jakarta	Mr Atsushi Loki	First Secretary
World Bank Lippo Building Jln Rasuna Said Jakarta	Mr Sinha	

National Centre for Quality Control & Fish Processing Jln Muara Baru Ujung Jakarta Utara 14440	Dr Sunarya Mr Surono	Director
Australian Embassy ADAB, Bank Niaga Bldg Jln Thamrin 55 Jakarta	Dr John Nation Ms Bronwyn Robbins	First Secretary ACIAR Liaison Officer
Agency for Agricultural Research & Development PO Box 50 Palmerah Jakarta Pusat	Dr Endang Sriherwati	Director
ICI Pesticides Indonesia PO Box 2158 Jakarta 10001 ICI Agrochemicals Fernhurst Haslemere	Ir Jo W Lemmens Ir S M L Tambunan Mr Joe O Luterbacher	Director Development Manager Far East & Pacific Region
Canadian Embassy Wisma Metropolitan Jln Thamrin, Jakarta	Miss Sari	Aid Assistant
USAID Jln Medan Merdeka Selatan S Jakarta 10110	Mr Saud Mohamed	
IPB (Agricultural Inst Bogor) Faculty of Fisheries	Dr Rudy Nitibaskara Dr Rudy Suwandi Dr Sahat MH Simandjuntak	Head, Post-harvest Dept Post-harvest Dept Dept of Fisheries Economics & Management
IPB Faculty of Agri Technology Kampus IPB Darmaga PO Box 61, Bogor	Prof F G Winarno Prof Soewarno T Soekarto	
Ministry of Agriculture Gedung A Lantai VI Jl Harsono R M No 3 Ragunan Pasar Minggu Jakarta Selatan	Ir Suharyo Husein Dr Ferial Sirath Mr Risman	Acting Head, Bureau of Foreign Co-operation (Bureau of Foreign (Co-operation
Fish Quality Control Laboratory Cirebon	Mr Benny	Head
Diponegoro University Jl Imam Bardjo SHI Semarang	Prof Moeljono S Trastotenojo Ir Joetata Hadihardaja Prof Sapardi Dr Lachmuddin Ms Ratna Ibrahim Dr M Smith Dr A D Matthews	Rector Vice-Rector Head, Fisheries TCO TCO
Provincial Fishery Service Jl Imam Bonjol 134 Semarang, Central Jarva	Ir Sukotjo Adisukresno	Chief

Fish Quality Control Laboratory, Semarang	Mrs Asnaini	Head
Fishing Technology Development Centre PO Box 218 Semarang	Ir Achmad Farid Mr R Mayne Mr Sokojo	Director FAO Expert
Central Java Marine Products Co (P T CEJAMP) PO Box 108 Kaligawe Semarang	Ir Sulchin	Director
P T Seafer Intermaco Semarang	Mr Amir Subianto	Production Manager
Department of Fisheries Brondong, East Java	Mr Asiful Zahid	Fishery Officer
Provincial Fishery Service Jl A Yani 152B Surabaya, East Java	Ir Soetikno Ir Harjoto Ir Harijanto	Chief Head Marketing & Pro- cessing
P T Mina Mas Utama Jl Ke Muncil Karoseri Gedangan Sidoarjo Surabaya, East Java	Ir Turto Gerdiman	Manager
P T Surya Alam Tunggal Surabaya, East Java	Mr Rachmat Gunawan	Director
Provincial Fishery Service Ujungpandang, S Sulawesi	Dr Abdul Munif Kadir Dr M Arifin Ir Husni M Barani Ir Natsir Suleiman Ir Rahmat	Chief Deputy Chief Fisheries Officer Head, Quality Control La
Faculty of Animal Sciences Hasanuddin University Kampus UNHAS Tamalanrea Jl Perintis Kemerdekaan Ujungpandang, S Sulawesi	Ir Arsyudin Salam Ir Makmur H Syam Ir Helmi A Koto Ir Nandi Kuswandi S	Fisheries Dept Social Economics Agri Eng Dept Food Sci & Tech Dept
P T Sipu Nutiara Indah Parapare, S Sulawesi	Mr Tony Mr Masnari B	Director Manager
Provincial Fishery Service Banjarbaru, S Kalimantan	Mr Wasuni	Fisheries Officer
Provincial Fishery Service Medan, N Sumatra	Mr Boedi Soesila Mr Siregar Mr Rudy Sihombing Mr Silalahi	Chief
Fishery Office Sibolga, N Sumatra	Mr Sitorius	Fishery Officer

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