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DEVELOPMENT OF MARINE BASED INDUSTRIES IN EASTERN INDONESIA

543

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UNIDO Project No. INS/85/015

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EXECUTIVE SUMMARY

Study Process

1. The field work for this project was carried out in January, February, June and July of 1987.

2. Members of the consultant team visited all fish landing and market places in Sulawesi Selatan, major landing places and towns in Sulawesi Tenggara, landing places and markets in Ambon, Maluku and fish canning places in Bali.

3. Members of the consultant team discussed all aspects of this study with government officials in all places visited and presented a summary of the major findings of this report to representatives of BAPPEDA/BAPPENAS Perindustrian and Perikanan in Sulawesi Selatan and Jakarta in July, 1987.

4. This report has incorporated the comments and suggestions made by Perindustrian officials in July, 1987.

Findings and Conclusions

5. Although the potential fishery resources (sustainable fishery yields) in Eastern Indonesia are unknown, there is no evidence yet of either economic or biological over-fishing of large pelagic species. However, the harvest of marine shrimp has already reached the maximum sustainable yield (MSY) and the harvest of inshore demersal species approaches the MSY. There would seem to be adequate resources for further development and processing only of pelagic species.

6. Infrastructural support and the availability of managerial skill are essential components of any industry development strategy. These components are not available equally in all regions of the study area.

7. Sulawesi Selatan, particulary Ujung Pandang, but also Watampone and Pare Pare, has the full complement of infrastructural requirements. There is an adequate level of supporting industrial infrastructure, small-scale managerial ability and skilled personnel available in Sulawesi Selatan to support further marine resource and agriculture based industrial development.

8. At this time there is insufficient infrastructural support available in Sulawesi Tenggara or Maluku to support such industrial development. While this could become available over the next few years, transportation complications would remain as problems for these more isolated regions.

9. Small-scale industries, manageable at the local scale, are more likely to be successful than large-scale industries, particularly at their outset. Large-scale ventures would require outside knowledgeable managers and skilled personnel and, because of the greater amount of capital involved and marketing and distribution required, present much greater risks.

10. Within Sulawesi Selatan, Pare-Pare offers a good potential location for a fish-canning plant and an associated fish-meal plant to process "waste" fish from the canning plant.

Pare-Pare is recommended for the following reasons:

- o proximity to (but outside of) Ujung Pandang;
- o planned port development;
- o availability of land, water and labour;
- o location with respect to skipjack availability and proximity to the relatively untapped potential resources of Makassar Straight; and
- o away from areas of heavy artisinal fishing.

11. To ensure that adequate skipjack were available for canning, a network of collection depots (5 initial depots) would be constructed at selected key landing areas along the NW Coast and East Coast of Salawesi Selatan. Fish would be brought to these depots by fishermen and transported from there to the canning plant by truck. Fish would also be collected by a collection vessel operating from Pare Pare north to off Mamuju, collecting from bagan and villages en route. Frozen skipjack would be drawn from time to time from places such as Kendari, Ambon and Bau Bau (where it is proposed to build a small cold store) and so on.

12. The collection depots would be equipped with a concrete pad, clean water, fish storage containers (200 kg. & 500 kg.), ice making equipment, an insulated chill room where skipjack would be stored on ice (for up to 5 days) for the canning plant, and a separate insulated store for fresh fish for the local market. At a later date, the collection depots would be expanded to include boat maintenance and fuel supply, lockers for fishermen, and a boat ramp and repair facility.

13. The facilities proposed for the collection depots would assist the local marketing and distribution of fish and the standard of living of artisanal fishermen.

14. Another significant industrial opportunity for immediate to short-term consideration would be to assist the Djajanti group to investigate the operational requirements of, and to increase the amount of fish available to, their 100 ton per day capacity fish meal plant located in the Aru Island group (Arafura Sea).

15. There are a number of institutional and private sources of potential funding for projects of the types identified. Profitability (and scale of operations) will be the key determinants. Further, the Asian Development Bank approved loans of $65 million to Indonesia in 1986 for fish storage, processing and marketing.

Financial Analysis

16. The financial analysis for the proposed projects showed the following:

		NPV (18%)	IRR (%)	PayBack
o	Tuna Cannery	$US 8.2M	81	2.3 yrs
o	Fishmeal Plant	($US 0.6M)	(9)	n/a
o	Cannery plus Fishmeal Plant	$US 7.6M	67	2.8 yrs
o	Ice Manufacture	$US 0.5M	62	2.2 yrs
o	Ice Dispensing and Insulated Storage	$US 0.3M	75	1.9 yrs

The project internal rates of return are rather high but sensitivity analysis of the effect of cost increases or revenue decreases showed that the internal rates of retu. . would remain healthy. The major costs are largely capital costs, which have been determined fairly accurately, but revenue is a function of managerial ability. Nevertheless, with revenue reductions of 40 per cent, the following internal rates of return could be achieved.

o	Tuna Cannery	25%
o	Ice Manufacture	43%
o	Ice Dispensing	52%

17. It would be financially worthwhile to implement the cannery alone (with ice manufacture and dispensing) or the cannery and the fishmeal plant combined. At these internal rates of return, private investors may be interested to invest and should be approached. However, it should be noted that management and marketing would be major determinants of success.

Conclusion

The four projects identified here would, together, provide a profitable, integrated system for the collection and canning of tuna and the distribution of fish among local markets within Sulawesi Selatan.

TABLE OF CONTENTS

TABLE OF CONTENTS
(cont'd)

LIST OF APPENDICES

2.0 INTRODUCTION

2.1 CONTEXT OF STUDY IN INDONESIA'S DEVELOPMENT PLANNING

Departmen Perindustrian prepared the National Industrial Development Outline. Background to this outline included the following comments:

i) Some structural problems in the manufacturing sector remain to be remedied. These include:

- o inadequate structural depth;
- o dependence on imports;
- o need to improve the distribution of industrial development projects, quality and competitiveness;
- o the need to escalate the development of industrial exports.

ii) Strengths which can be harnessed to support the development of national industries, include:

- o natural resource endowments including marine resources;
- o manpower;
- o the strength of the domestic market.

iii) The stage of development already achieved and the level of economic growth in the countries which constitute Indonesia's export markets, as well as sources of technology and foreign investment.

The National Industrial Development Outline includes the Six-Point Industrial Development Programme. Points which bear on fisheries development include:

<u>Point One:</u> Development must deepen the industrial structure linked with other economic sectors including the processing of marine resources. Development projects must take due account of their economic feasibility, including factors of economic scale, choice of technology, and the viability of existing markets, both domestic and overseas.

<u>Point Three:</u> The development of a strong and reliable small-scale industry sector and the growth of small-scale industries engenders greater community participation; it is therefore a vehicle to make the community politically, socially and mentally ready to accept the great changes that will be effected as a result of the industrialization process.

The principal step in the early stage of small-scale industries development is to deal with the marketing problems, to be followed by extension services on the various aspects of business relating specifically to entrepreneurship and management, capital and the quality of products.

Point Four: Development of export industries must be further intensified, so that industrial products can make a real contribution in the expansion of non-oil exports.

The industrial export drive may be approached in two ways:

i) development of industries, with a clear comparative advantage, as export industries; and

ii) development of industries, which were initially based on import substitution, into exporting industries.

Indonesia's export drive will place great reliance on products of the following categories of industries:

- Multifarious industries (mainly agro-based, forest-based, plantation-based industries, minerals processing industries and industries which are labour intensive). Exports by these industries are expected to spur economic growth.

  It is this category of industries that will be given priority for development once they have a steady overseas market. Most of them (about 95%) would be private firms.

- Basic chemical industries.

- Engineering industries.

- Small-scale industries. (Within this category, crafts in particular have favorable development prospects with the assistance of trading firms).

Point Six: Continuous efforts to raise manpower quality, which involves development of entrepreneurs as well as professionals for top and middle management, specialists and skilled labour.

To assist the achievement of the objectives under the National Industrial Development Outline, R.I. Law No.5/1984 was promulgated to provide a sound and constitutional basis for the regulation and sustained development of the manufacturing sector.

Pursuant to Article 1 of the above law, domestic industries are, as a matter of policy, classified into three categories:

Category I: Basic industries comprising basic metals, engineering industries, electronics, and basic chemicals.

Category II: Downstream and multifarious industries.

Category III: Small-scale industries

Each category has its specific characteristics in terms of:

- o size of investment;
- o technology employed;
- o mission to be fulfilled, whether to underpin economic growth or to foster equitable distribution;
- o employment of labour.

Indonesia's export performance will rely mainly on multifarious industrial products, which possess comparative advantage. Development of marine resource processing, industries falls within this category.

A number of actions have been, and will be required to be, taken to improve performance in the harvest and processing of marine resources. Some of these actions include:

- o raising the efficiency and completeness of domestic industries by, among other things, liberalizing port and customs handling, simplifying licensing procedures, and lowering interest rates;
- o improving capacity utilization;
- o assessing the requirements for technical and financial restructuring of industrial firms and expansion of existing, or development of new, industries;
- o quality maintenance;
- o tariff rates designed to encourage exports and protect "vulnerable" industries;
- o increased efficiency through such measures as modernization, quality improvement and capital restructuring.

Part of the overall development strategy which has a direct bearing on the processing of marine resources, is to diversify exports away from reliance on oil exports. Increased harvesting and processing of fisheries and other natural resources could potentially generate increased employment within Indonesia and enhance the balance of payments situation.

REPELITA IV

Development strategies as applied at the national and regional levels include reference to Policy Guidelines which state that the development of agriculture, covering food crops, fisheries, animal husbandry, farming and forestry should be increased through integrated, harmonious and widespread intensification, extensification, diversification and rehabilitation, while conserving natural resources and maintaining environmental stability.

Fishery Development

Fishery development under REPELITA IV is directed generally toward the following objectives:

(a) to attain better income and better living for the small fishermen and fishfarmers and extend employment opportunities;

(b) to improve the productivity of fishermen and fishfarmers and at the same time increase the total fish production;

(c) to increase fish consumption, particularly among the low-income population groups;

(d) to increase exports and decrease imports of fishery products; and

(e) to have better control on the utilization and management of fishery resources.

DGF targets for national fish production, consumption and exports for 1988 are summarized in Exhibit 1 and compared with actual 1981 levels. The Exhibit shows clearly the emphasis placed on increasing fish production particularly via aquaculture and marine capture and consumption.

EXHIBIT 1: FISH PRODUCTION AND CONSUMPTION PERFORMANCE AND TARGETS, 1981 - 1988

(ooo's mt)	1981 Actual	1988 Targets	% Change
Total Fish Production	1,914	2,932	52.2
Marine	1,408	2,174	54.4
Inland Capture	265	353	33.2
Aquaculture	241	405	68.0
Domestic Consumption	1,853	2,739	47.8
Total kg Per Capita	12.3	15.7	27.6

Source: DGF

To support the intensification, extensification, diversification and rehabilitation, fishery marketing facilities, infrastructure for fishery port facilities and irrigation facilities for fishponds will be increased. The intensification is intended to achieve optimum productivity without neglecting the fishery resources. The extensification is intended to speed up fish hauling along the coast, off shore and in high-potential seas. The diversification of coastal fishery business is to be accomplished through gradual modernization of fishing equipment developed cooperatively with fisherman in connection with the development of coastal villages.

Guidance of fish marketing will be directed toward improving the type and quality of fish produced and toward improving the facilities and infrastructures for marketing. This guidance is also to be directed toward improving the marketing system and management that supports production activities; and, toward improving the market information system.

To improve the capability of fishermen, guidance and training in skills needed to use new fishing equipment will be intensified and improved. Marketing will be improved. The construction and renovation of fishery infrastructure, such as ports, piers, places for fish auctions and public sales, and clean water supplies will be continued and completed. The private sector is encouraged to build other supporting infrastructures such as ice factories, refrigerators and product processing units.

Considering that marine products are commodities that spoil easily, fishermen will also be given guidance on storage and ways to adjust to the type and quality of fish products required by the market. The role of big companies in processing and marketing products of traditional fishermen will be improved through "the core company system".

Processing Industry for Agriculture and Fishery Products

The processing industry for agriculture and fishery products includes industries related closely to the agricultural sector such as: the canning of fish, meat, vegetables, fruits and other products.

The goal of developing the food-canning industry is to increase product quality and diversify products according to consumers' tastes. The location of industrial plants depends on developments in the agriculture, animal husbandry, and fishery sectors such as the fish-canning industry in Central Kalimantan, North Sulawesi, South Sulawesi, Bali and Maluku.

The policies established to encourage the development of the canning industry are to limit the import of agricultural products, and support the development of a tin plate industry and other packaging materials. The procedure by which to obtain permits for investment will be simplified, quality and standardization will be improved and people will be encouraged to consume domestic products.

South and South-East Sulawesi Regional Development Direction

Priority for development in South and South-East Sulawesi within REPELITA IV will be given to the economic sector, with an emphasis on the agricultural development.

Industrial development is directed toward industries for processing agricultural and marine products. In the marine industry sector, the development of the marine fishery, fresh water fishery and fishponding industry will be continued. Particularly important will be the canning of fish, meat, fruit and other foods. Production capability, marketing and management of the marine industry is to be emphasised.

Thus, this study, to assess the potential and feasibility of fisheries resource processing in East Indonesia is entirely consistent with national and regional development policy and priorities.

Government Constraints

Presently, the Government has few incentives to offer investors in the commercial fishing industry. Perhaps the best incentives fall within the loans from the ADB and the World Bank under which the Government provides funds to state owned banks for lending to the fisheries sector at rates of interest 3 to 4 points lower than commercial lending rates.

The Government's stated desire to create the growth of the commercial fisheries and related industrial development is not well reflected in the very restrictive fishery laws, particularly the tuna and skipjack fisheries. Foreign Investment Rules (01.1.03-FISHERIES dated 1985) provide that vessels equipped with Purse Seine are only allowed to operate in the waters of the Indonesia Exclusive Economic Zone (EEZ). This is based on laws promulgated by the Director General of Fisheries (DGF) to protect fishing grounds used by small-scale fishermen. The restriction applies to all purse seiners whether or not totally owned by Indonesian nationals or joint venture enterprises.

This means that all archipelagic waters are closed to purse seining including the tuna and skipjack waters of the Banda, Flores, Ceram and Maluku seas. However, this area could easily support a fleet of 60 modern tuna purse seine vessels fishing beyond the 12 mile offshore line so as not to disturb the very limited number of small scale fishermen in the region (UNIDO, 1985).

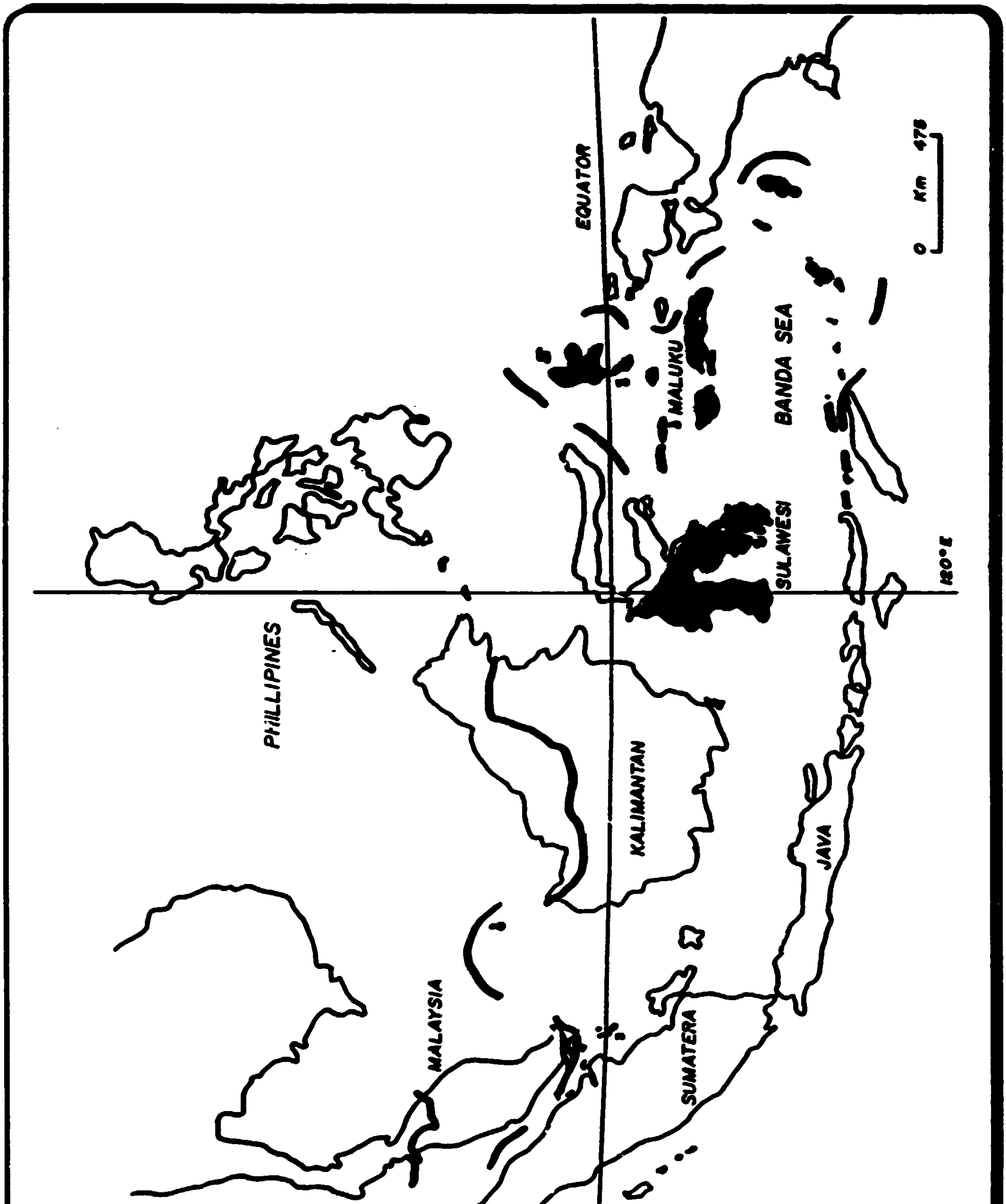
2.2 INTRODUCTION TO STUDY AREA

Indonesia is an archipelagic nation of over 13,000 islands, which including the sea within the exclusive economic zone, covers an area of 5.8 million sq. km. The land makes up only about one third of this. With a population of 160 million growing at about 2.2 per cent per annum, it is the world's fifth most populous nation. However, two-thirds of the population, or more than 100 million people, are concentrated on the inner islands of Java, Bali and Lombok, which account for only 7 percent of the land area of the country.

Fisheries, considered to be a major potential contributor to the diversification of the local and export economies, are thought to have under exploited potential in Eastern Indonesia.

The location of the study area, essentially the Banda Sea and its periphery, is shown on Exhibit 2. The area lies to the East of Java and the Island of Borneo; it extends eastward to Irian Jaya. The area lies between approximately 118° and 135° East longitude and between 2° and 12° South latitude.

EXHIBIT 2: LOCATION MAP



The region is marked by its equatorial monsoon climate, with a November to March wet season on the West Coast and April to November on the East.

South Sulawesi can be divided topographically into the Western, Southern & Eastern Coastal strip of under 100 metres and the central mountains of over 1,000 metres elevation. Rivers are relatively short and carry heavy loads in suspension. Swampy, brackish water areas extend along much of the coast, particularly in South Sulawesi.

The province of South Sulawesi, with a population of about 7,000,000 people is more densely settled, particularly along the littoral plains, than either Southeast Sulawesi or Maluku. These are settled sparsely.

There are few large towns. Ujung Pandang, a population of over 700,000 people, is the largest centre in Indonesia east of Surabaya. Few other towns in the study area have populations over [illegible]0,000 people.

Most towns and villages are located along the coastal strip. Settlements are connected by poor roads. Inter- and intra-provincial transportation by road or sea is both costly and rudimentary. For example, by sea there is no inter-island reefer service and passenger carrying coastal vessels are often poorly equipped and extremely over-loaded.

The locations of major places visited in Sulawesi as part of the field work and discussed in the text are shown on Exhibit 3. Members of the team also visited Maluku.

2.3 TERMS OF REFERENCE

The Terms of Reference are summarized below:

Objective of the Study

The immediate objective of the project is to recommend a pattern of industrial investment through provision of resource based opportunity studies for marine industries with special emphasis on export market and regional industrial development of two selected regions, namely Moluku and South Sulawesi.

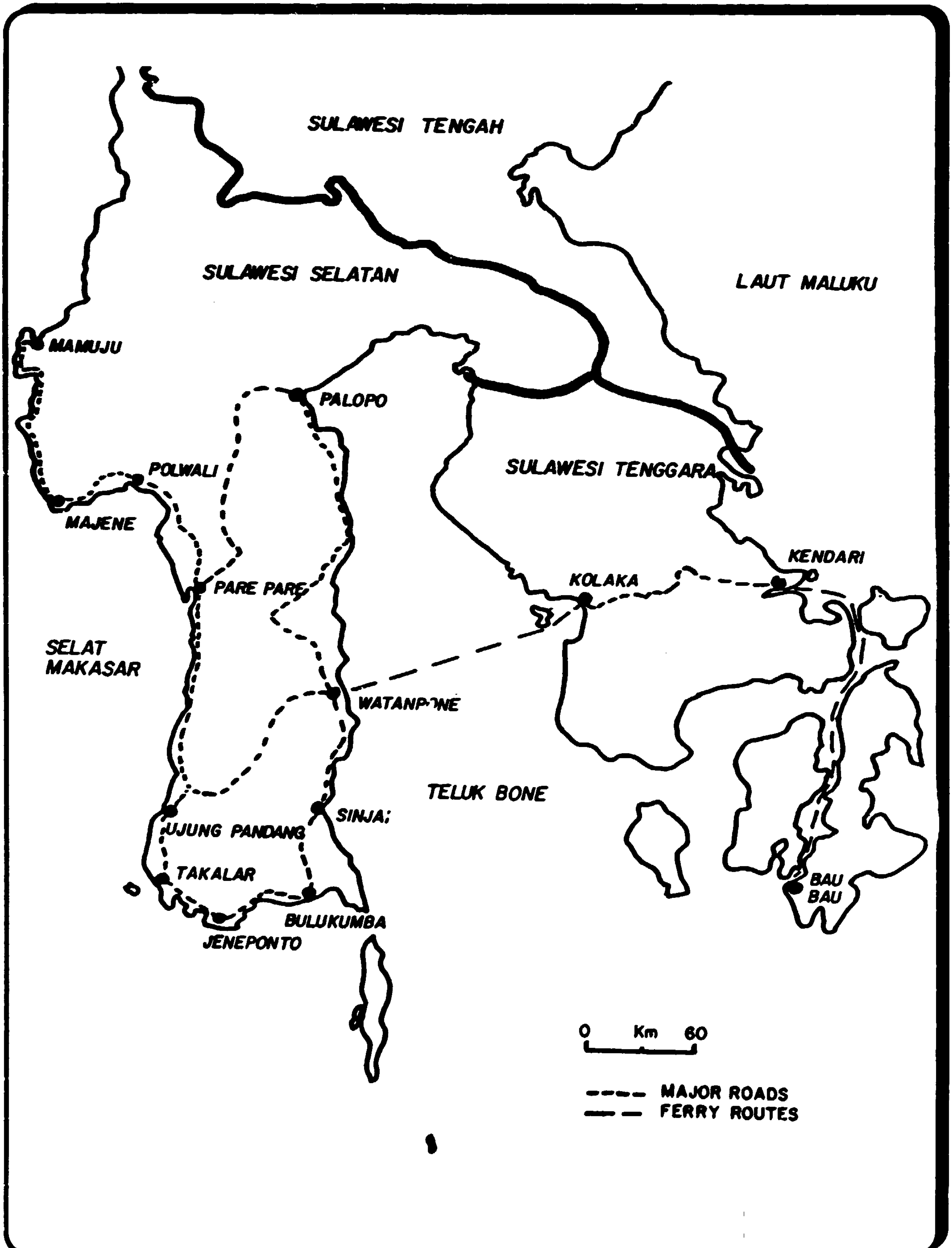
The marine based industries referred to will be based on skipjack/tuna, shrimp/prawn, mackerel, seaweed, crabs, cuttle fish, lobster, and others.

Scope and Main Activities

Detailed analysis is to be carried out on all the following aspects and incorporated into the report.

1. Analyze existing data as to the availability of marine resources and their economic exploitation/recovery.

EXHIBIT 3: SULAWESI SELATAN AND TENGGARA



2. Assess the general situation of available fishery vessels and trend of fish catches.

3. Identify specific products for processing and utilizing the marine resources.

4. Analyze current fisheries production.

5. Estimate market potential (5-10 years) for those products identified for the domestic Indonesian market and for export.

6. Survey proven technologies currently available for economically processing these marine resources into marketable products and recommend the most appropriate technology.

7. Assess the availability of suitable, required technological skills to support the processing.

8. Identify possible industrial plants and supporting industrial investments such as cold storage.

9. Identify the most likely opportunities, locations, technologies and plant sizes for the economic utilization of marine resources (initial focus to be on technologies appropriate to Indonesian conditions).

10. Assess trade and tariff policies and regulations governing foreign investment, foreign exchange policies, taxation and relevant investment incentives provided by the Government of Indonesia.

11. Investigate industries presently based on marine resources, their structure and growth, capital employed and manpower engaged, future plans and prospects.

12. Identify possible financial resources for investment in the identified industries.

13. Prepare project profiles for the industries recommended, identifying major benefits and costs, reflecting existing and potential markets, and including technical and financial details to enable potential Indonesian or foreign investors to make a preliminary assessment.

14. Recommend the manpower/skill development needed to support the suggested investment programme.

2.4 PEOPLE INTERVIEWED

Many people in government and the private sector, both in Indonesia and overseas, were interviewed and provided valuable assistance. While it is not possible to recall the name of every person who assisted, the names of key people are listed in Appendix A.

2.5 THE REPORT

This report is concerned primarily with the potential processing of marine fishery and seaweed resources. These include shrimp, tuna and other pelagic fish species (surface feeders), demersal fish species (sub-surface feeders), cephalopds (squid and octopus, etc.) and seaweed (mostly Eucheuma and Gracilaria species). Scientific and Indonesian, as well as English, common names are given for major fish species as part of Appendix B.

Each major marine resource is discussed in a separate Chapter.

For the potential projects identified, we are concerned principally with markets:

- o export canned tuna;
- o export frozen shrimp;
- o domestic fishmeal;
- o domestic fresh and frozen fish.

3.0 INDONESIA'S FISHERY

3.1 ROLE OF FISHERIES

The role of fisheries in the national economy is small yet significant. Fisheries is a major source of employment, engaging about 3 million people or 5 per cent of the labour force, but labour productivity is low, producing only 1.6 per cent of GDP in 1981.

Fish plays a central role in the Indonesian diet, providing 62 per cent of all animal protein supplies, with per capita consumption of about 13.2 kg in 1984. While per capita supplies have been growing recently at an annual rate of about 1.5 per cent, the relatively low level of fish consumption in Indonesia reflects the low capture rates, largely by artisinal means, and the country's relatively low level of personal income. But, with an average income elasticity of demand for all fish products of 0.8 (1.0 for fresh fish, 0.6 for dried fish) consumer preference for fish is as strong in Indonesia as elsewhere in Southeast Asia (McElroy, 1987).

While the potential for expansion of the fisheries sector is thought to be large, initial emphasis on the handling, processing and marketing of fish promises to provide more immediate benefits than the expansion of catching effort. This report examines the marine resource base, identifies possibilities for processing and assesses the feasibility and viability of implementing several identified projects to expand fish and seaweed processing and to improve fish handling and distribution.

During the decade from 1973 to 1983, marine fisheries production increased by nearly 600,000 tons or 67 per cent (from 889 to 1487 thousand tonnes). The growth in total fisheries production was a healthy 4.5 per cent per annum compared with the population growth of about 2.3 per cent per annum during the same period.

Increased landings from marine fisheries is mainly attributed to an expansion of the fishing fleet, in particular, smaller vessels, and to the successful implementation of vessel motorization programs during the later plan periods. The fishing fleet increased by 36,387 vessels or 14.7 per cent, from a total of 248,113 vessels in 1978 to 284,500 in 1982. The number of motorized vessels increased from 25,992 vessels in 1978 to 58,500 in 1982 and 61,800 in 1984, averaging 22.8 per cent increase per annum during the period (see Appendix C).

Exhibit 4 shows the steady growth in total marine fish landings and the landings of skipjack from 1.2 m to 1.5 m tonnes and from 51,800 to 80,700 tonnes respectively over the period 1980 to 1984.

Indonesia's current fish production comprises a large number of fish species but, because of the nature of all tropical fisheries, relatively modest tonnages of each species (see Appendix C and Exhibit 8).

3.2 TYPES OF FISHERY

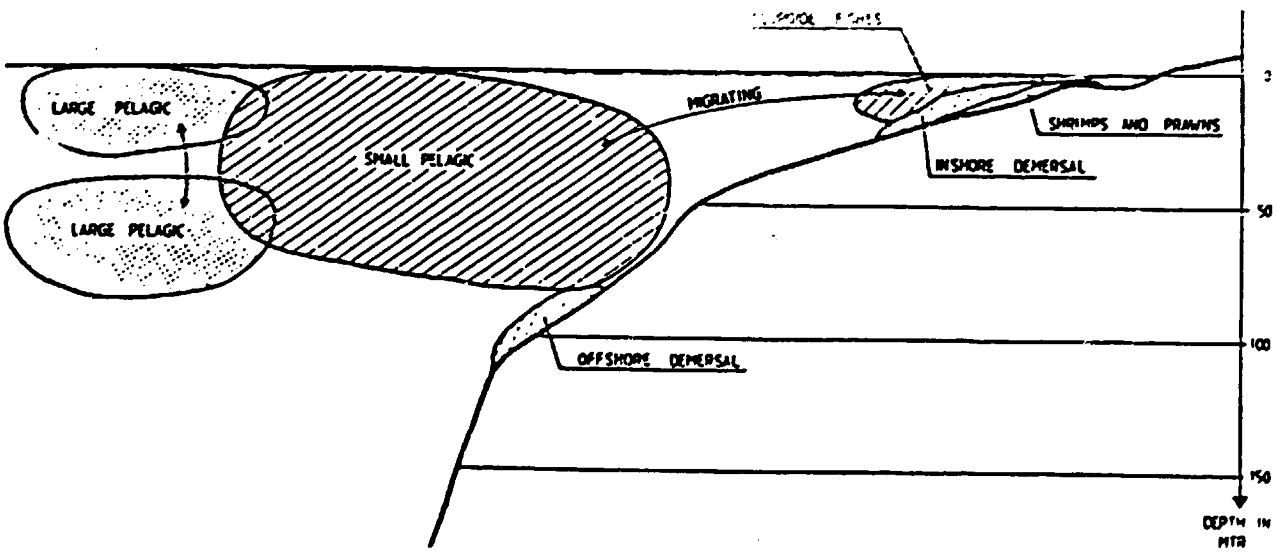
The major fish production comes from pelagic and semi-pelagic species which constitute about 60 per cent of the landings . Demersal fish species and shrimps make up approximately 40 per cent of landings. Basic definitions of the different types of fish groupings (pelagic, demersal, etc.) are illustrated in Exhibit 5.

Demersal fishes are especially concentrated on the continental shelf, close to shore, in depths varying down to about 40 m and along the edge of the continental shelf

EXHIBIT 4: MARINE FISHERIES PRODUCTION BY SUBSECTOR'S 1980 - 1984

	(tons)				
	1980	1981	1982	1983	1984
Marine fishes	1,218,167	1,206,983	1,326.447	1,467,824	1,529,553
Tuna	20,898	25,239	28,080	26,088	30,697
Skipjack	51,818	57,430	61,577	76,790	80,658
Other	103,927	118,620	74,615	112,317	71,896
Total	1,394,810	1,408,272	1,490,719	1,682,019	1,712,804

EXHIBIT 5: GENERAL DISTRIBUTION OF THE FISH FAUNA ON AND OFF INDONESIA'S CONTINENTAL SHELF



in depths varying from around 70m to 120 m. The demersal fish fauna varies according to the nature of the bottom and the sea temperature. Snappers and similar types of fish have a preference for harder bottom while croakers, grunters and catfish prefer softer bottom, and shrimps soft muddy bottom.

The pelagic fishes are very often found off, and along the edge of, the continental shelf. Smaller pelagic fishes migrate inshore onto the shelf in the spawning season and are often accessible to catching when close inshore.

The broad continental shelf in the Java Sea and off Irian Jaya, with rather extensive river systems and a large influx of fresh water, favours shrimp production and is the dominant fishing ground for the shrimp fishing vessels. This area also favours concentration of small pelagic and demersal fish.

The continental shelf off Sulawesi and all the eastern islands is much narrower, has less river run off, and the bottom conditions are generally harder. These waters have a high primary production and are rich in both bottom dwellers on the continental shelf and pelagic fish feeding on the high primary production which is favored with upwelling and intricate current systems helping to increase production (ADB, 1985).

3.3 THE MARINE RESOURCE BASE OF EAST INDONESIA

Marine Physiography

The Banda Sea, the main focus of the marine area under study, is continuous with the SW Pacific Ocean via the Maluku Sea. The Banda Sea is connected on its East with the Arafura Sea, adjacent to the West Coast of Irian Jaya; on its south it adjoins the Timor Sea, to the north of Australia, and on its west it connects with the Flores Sea. An area of importance to this study is the Makassar Strait, between the island of Borneo and along the Western coast of Sulawesi. The Makassar Strait connects the Flores and Java seas with the Sulawesi Sea to the north of Sulawesi. Exhibit 6 shows the location of seas in the study area.

Bathymetrically, the Banda Sea is an extremely deep basin, deeper than the other seas of the Indonesian archipelago, with sea depths in some parts exceeding 5 kilometres. To the southwest, the Flores Sea includes a deep basin with similar depths and there are substantial deep areas in the centre of the Makassar Strait.

The areas of continental shelf are very limited. These lie principally towards Irian Jaya, east of Kep Aru, and along the littoral of Sulawesi Selatan and Tenggara, particularly off Ujung Pandang. Along most coast-lines in the study area, the continental shelf forms only a narrow strip 5 to 10 kilometres in width. This factor has important implications to the fishery resource.

The study area has a typical equatorial climate with marked wet seasons. From November to March, the northwest monsoon prevails; from May to September, the southeast monsoon is dominant. During these periods the high pressure centre is quite stationary; winds tend to blow fairly consistently and in one direction for the four to five months of the monsoon. This is the case particularly over the sea.

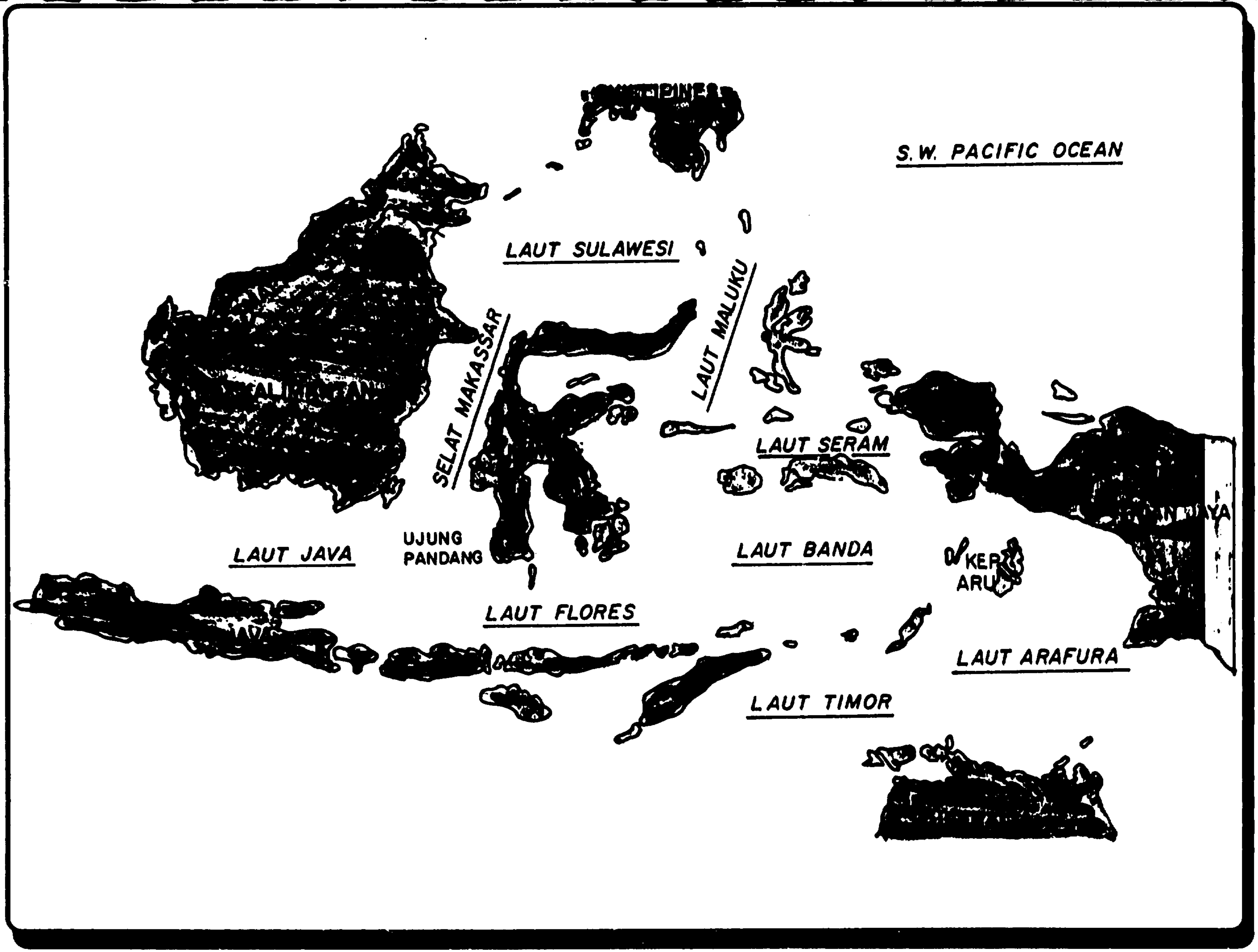


EXHIBIT 6: LOCATION OF SEAS

Because the Banda Sea and adjacent marine areas lie directly on the axis of both the northwest and southeast monsoons they comprise an area conducive to strong air and sea circulation, a result of the constancy of the winds, even if their force is rather weak (Wyrtki, 1961). The winds affect sea surface conditions for several months and the strength and direction of flow of the ocean currents throughout the study area. Both the availability of fish and the ability of fishermen to put to sea safely are affected severely. During the most severe period of the monsoon, fishermen to the windward side rarely fish while those in the lee remain unaffected.

The project area is influenced, virtually year round, by the South Equatorial current which flows southeast from the Pacific Ocean, through the Sulawesi Sea, and south through the Makassar Strait. There is an exchange of sea water with the southern Philippines Sea and thus with the Pacific Ocean. During the northwest monsoon, waters from the Flores Sea enter the Banda Sea where they are forced to submerge. During August, currents from the Arafura Sea are reinforced by the SE Monsoon so strengthening the flow of water into the Banda Sea. The pattern of ocean currents is illustrated as part of Appendix D.

The Arafura Sea and the eastern parts of the Banda Sea are important regions of upwelling which reaches a peak in July, with net upwelling occurring from the beginning of May until the middle of September during which the area is considered to be one of the most productive fishing areas in the region (Haskoning, 1983).

The reversal of the main current regime twice a year changes the location of eddy structures, areas of micro upwellings and areas of divergence and convergence. Similarly, regions of local productivity may shift, for example, they may alternate from one side of an island to the other side as currents change their direction.

These characteristics have important consequences for the interpretation of the results of exploratory fishing surveys and assessments of artisinal fishing activities.

Fisheries Resources of East Indonesia

The great depths in most of the study region and the large variation in wind direction have important implications for potential fisheries investment. Because of the relatively small continental shelf area in the study region, demersal fisheries (e.g., for species such as breams, snappers and lobsters) will not have a large potential. Several studies (e.g. Watts and Watson, 1983) report that existing demersal resources are fully, if not over, exploited. Thus, future fisheries development must come from expanded pelagic fisheries, either coastal or offshore.

Development of pelagic fisheries will range from the expansion of traditional fisheries, or those not requiring large capital investments, such as pole-and-line fishing, using locally constructed vessels, to the purchase of costly offshore boats, capable of following their target stocks throughout the region. Either of these possibilities should enable offshore fisheries to be developed without competition with artisinal fishermen for available fish resources.

Because of the large seasonal variation in the weather caused by the reversal in the direction of the monsoons, large seasonal variation in the availability of particular fish stocks is apparent. This may directly affect decisions regarding capacity of fish plants to be constructed. For example, it may be necessary to build a plant with an annual capacity of 20,000 tonnes per year in order to produce 10,000 tonnes/year of product if supply of raw product were limited to six or seven months of the year. Alternatively, fish could be brought in from further afield or stored in fish storage facilities, in order to enable the plant to operate for the entire year.

Pelagic stocks tend to show greater variation in annual abundance and in their regional availability than demersal stocks. Variation in regional and annual availability is particularly true for species such as yellowfin and bigeye tuna whose migratory ranges are large. Investment decisions regarding plant capacity based on resource availability in one year may over-estimate the average catches available (if the base data were obtained in a year of unusually high stock abundance).

Exhibit 7, from Watts & Watson (1983) shows the location of major fishing grounds around the island of Sulawesi.

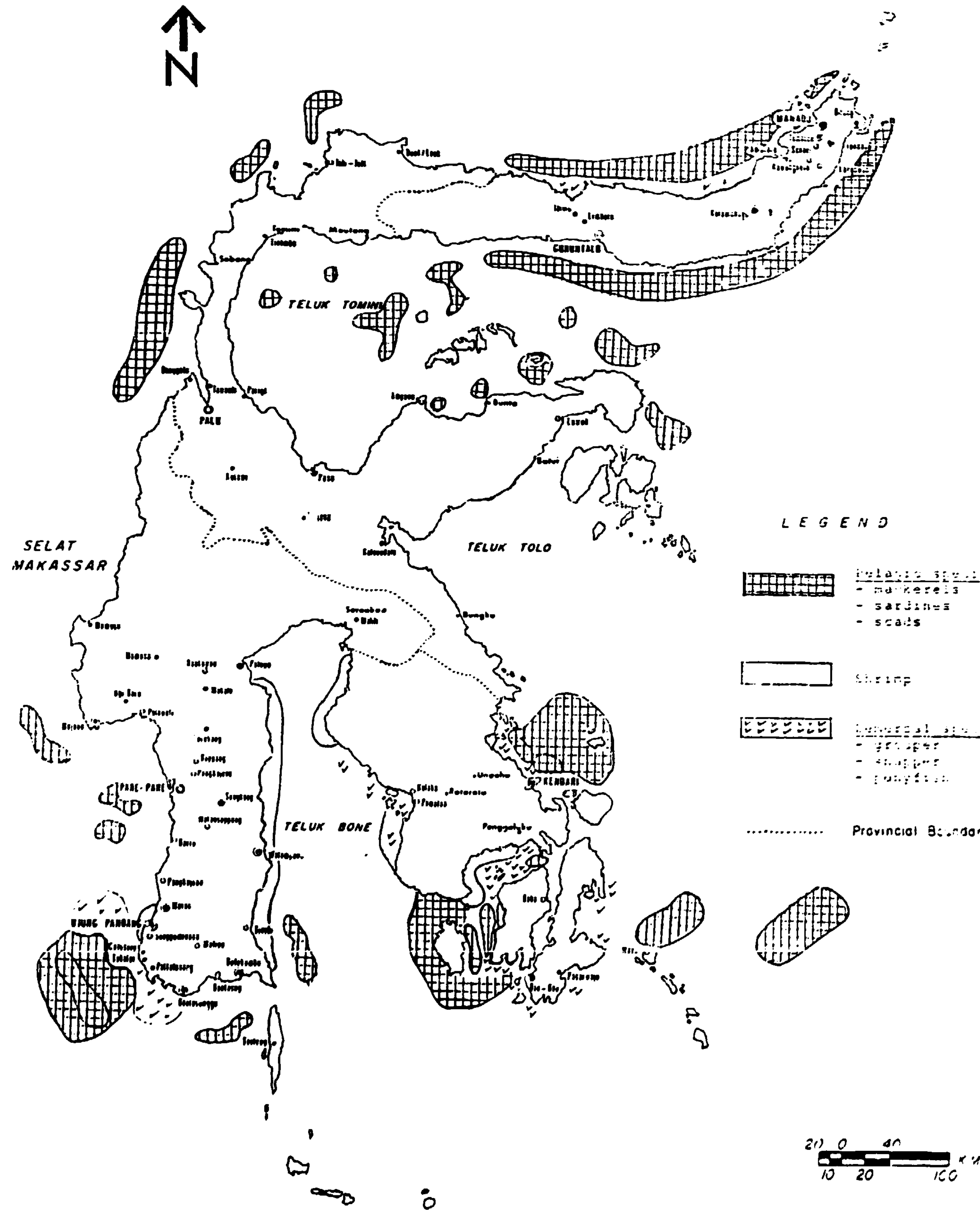
There are a number of indications that fish stocks, at least for demersal and small pelagic species, may be less than often quoted in Indonesia. South Sulawesi's marine fisheries landings rank third in the nation but levels of exploitation are approaching or have reached MSY, and there is evidence suggesting that some fishermen have responded to reduced landings by using explosives and other destructive fishing techniques. The most important coral reef fishery in Indonesia, which lies off Ujung Pandang is heavily fished, if not overfished, and to an unknown extent has been damaged by explosives (USAID, 1985 and field inspection 1987).

Appendix E from USAID (1985) shows that demersal and small pelagic fish stocks may be overfished along the South coast of Sulawesi and around Maluku. Further, demersal fish and shrimp are fully exploited in the Arafura Sea (also confirmed by fishing company data gathered in the field in 1987).

No accurate information on marine fish stocks around Sulawesi exists (also see USAID, 1985) although many bio-acoustic and species specific surveys have been carried out around the island. Preliminary estimates from an INFIDEP survey indicate that the pelagic fish range, in standing biomass, from 5 mt to 50 mt per square nautical mile. Many of the demersal fish stocks (e.g. ponyfish, groupers, snappers) are already fully exploited and the narrow continental shelf around most of Sulawesi greatly limits the potential for increasing their catches (Watts and Watson, 1983).

Although full and, in some areas, over-exploitation of demersal fish resources is occurring, almost nothing is known about the biology of the species involved. Pelagic fish stocks (estimated to be about 46% to 63% of potential Indonesian production) normally remain unexploited until demersal stocks are depleted. However, while small pelagic and demersal fish stocks may be threatened, there would seem to be abundant resources of large pelagic species (for example, tuna and skipjack).

EXHIBIT 7: MARINE FISHING-GROUND LOCATIONS AROUND SULAWESI



SOURCES : FISHERIES SURVEYS, DINAS PERIKANAN, FISHERMEN, OBSERVATIONS.

The Banda Sea, Northern Makassar Strait and the seas around Maluku would seem to provide a rich year-round fishing ground for tuna and skipjack but UNIDO (1985) warns that "...although there is a resident stock of skipjack and tuna in the area a large share of the fish captured each year are from stocks that are migrating widely throughout Eastern Indonesia and the Pacific. As such, it is not meaningful to estimate the exploitable potential of skipjack and tuna for the project area independent of the rest of Eastern Indonesia."

Generally, tropical marine ecosystems combine high diversity with low individual species productivity and vulnerability to overfishing. There are many species but low populations of each species. Exhibit 8 shows the 1984 catch in tons by province in East Indonesia. Of the 40 species named, only 11 species yielded more than 5,000 tons in 1984 in South Sulawesi; Maluku and Irian Jaya showed only 5 species where the catch was over 5,000 tons. The most important fish species are illustrated in Appendix C.

When it is realized that these low tonnages were spread over numerous landing places, it can be seen that very few species are suitable for commercial processing. Considering the market even fewer species are worthy of detailed investigation. Only prawns, the tunas and perhaps the sardines would be available in sufficient quantities to justify industrial processing.

The availability of prawn and tuna resources are discussed in more detail in the following sections.

Export of Fish from East Indonesia

Appendix F includes data and graphs showing the export of fish products from East Indonesia over the period 1981 to 1985. The DGF data show that South Sulawesi, Maluka and Irian Jaya have consistently been able to export large quantities of fish products, particularly prawns, fish roe and tuna.

EXHIBIT 8: MARINE FISH PRODUCTION BY SPECIES AND PROVINCE, 1984

Fish Species/tons	Bali & NTT	Sel. Sulawesi	Maluku & I.J.
Total	**129,156**	**236,805**	**110,221**
Pony Fish	2,743	7,646	225
Sea Catfish	1,277	1,086	97
Lizardfish	49	310	294
Goat Fishes	386	835	666
Grunters	313	1,584	350
Red Snappers	1,177	3,284	2,212
Groupers	974	1,972	936
Emperors	1,445	4,947	3,272
Giant Seaperch	1,224	1,201	1,820
Threadfin	496	2,276	527
Yellowtails	621	1,381	1,756
Croakers	94	1,219	296
Sharks	1,949	2,790	624
Rays	797	1,[illegible]04	331
Pomfret	327	1004	513
Barracudas	401	1,750	1,105
Scads	9,314	17,980	4,473
Trevallies	1,715	6,716	5,407
Jacks	1,399	3,396	2,328
Hard-tail Scad	70	1,856	1,133
Queen Fishes	180	106	470
Rainbow Runner	36	1,380	272
Flying Fishes	982	8,727	2,002
Mullets	780	4,049	1,336
Threadfins	42	254	199
Needle Fishes	4,311	2,434	9,357
Anchovies	10,927	25,791	3,402
Rainbow Sardine	309	4,335	816
Fringes Sardine	12,582	30,203	2,750
Indian Sardine	37,069	9,106	1,616
Wolf Herrings	346	338	85
Chinese Herring	69	736	119
Ind Mackerels	3,492	14,910	3,350
Indo Kingmackerels	107	798	764
Narrow Kingmackerels	1,772	3,347	1,341
Cutlass Fishes	911	953	20
Tunas	2,289	8,580	8,315
Skipjack Tuna	5,237	21,513	31,228
East Little Tuna	14,972	8,469	5,578
Other Fishes	5,979	25,139	8,836
Crabs and Lobsters	58	3,328	57
Prawns & Shrimp	274	7,296	8,029
Squid	2,099	1,529	185
Other Molluscs	195	212	1,774

Source: DGF, Fisheries Statistics of Indonesia, 1984

4.0 FISHERY RESOURCES OF EAST INDONESIA: SHRIMP, TUNA AND SKIPJACK, OTHER FISH, CEPHALOPODS AND SEAWEED

4.1 MARINE SHRIMP

Shrimp have been caught in relatively large volumes in the waters around Sulawesi and Maluku for some time, particularly by Japanese/Indonesian joint operations set up in the nineteen sixties. However, there is evidence that maximum yields for the marine shrimp fishery are being reached and that future expansion in shrimp production will have to rely on aquaculture. Although there are technical problems to be overcome in order to achieve very intensive production from shrimp culture, Sulawesi has large areas of Tambak which offer considerable potential fairly immediately for extensive, low yield aquaculture.

Shrimp are generally found wherever river water enters the sea and where there is a suitable bottom type. A number of commercially valuable shrimp species can be found throughout the study area (see below) but they are unevenly distributed. The major shrimp fishing grounds are in the Arafura Sea (off the west coast of Irian Jaya) and around Aru Island. Minor grounds occur in the Gulf of Bone and along the south coast of Sulawesi Seletan. Other important shrimp resources occur on the east coast of Kalimantan, across the Makassar Straits from Sulawesi.

EXHIBIT 9: MAJOR SPECIES OF SHRIMP CAUGHT IN STUDY AREA

Zoological Name	Common Name[1]
Penaeus merguensis	banana
P. indicus	white/Indian banana
P. monodon	tiger
P. semisulcatus	king
Parapenaeopsis spp.	rainbow
Metapenaeus monoceros	endeavour

Penaeid shrimp generally spawn at sea; their postlarvae migrate into brackish water areas, river mouths, and mangrove swamps. The shrimp subsequently migrate offshore during their adolescent phase. Unar and Naamin (1986) found that there are many spawning activity peaks within a year for P. merguinsis, P. semisulcatus, and Metapenaeus ensis though some spawning occurs at all times.

The marked variation in the catch rates of shrimp that occurs between seasons indicates that, like the juveniles, the adults undertake migrations so that their availability to capture is not always the same. Arafura Sea catches are reported to

1 No exact conventions exist for the common names. Yamamoto (1982) reports that Penaeus semisulacats and P. monodon are referred to as tiger shrimp; P. merquensis as white shrimp; and Metapenaeus monoceros as endeavour shrimp.

be best in February-March for P. merguensis and September-October for P. monodon (Haskoning, 1983). Yamamoto (1980) reported the best catches in Irian Jaya to be from October to January with the lowest catch rates during June and July; he found a positive correlation between catch rates and size of shrimp caught. Unar and Naamin (1986) reported best catch rates to occur during the rainy season off Irian Jaya, (i.e., August-September, and November-December). Greatest river runoff occurs at this time.

As in all shrimp fisheries, a large by-catch of fish is caught during fishing operations (up to 90 per cent of the catch can be non-shrimp species). Unar and Naamin (1986) report fish by-catch rates to vary from 3.6 to 8.5 tonnes/trawler/day in the Arafura Sea. Dominant fish species in the East Indonesian by-catch are Harpodon nehereus, Stromateus spp., Sciaenidae, Scomberomorus spp., Batodeii, Arrus spp., Trichiurus spp., sharks, Lutjanidae, Snappers, Serranidae and crabs.

Past and Potential Catches

Exhibit 10 shows catches of marine shrimp in the study area from 1975 to 1984. The apparent drop in catch from Maluku and Irian Jaya from over 10,000 tonnes in 1979 to 8,000 tonnes in 1984 is not explainable on the basis of available information. Either over-fishing or reduced fishing effort could be the cause; other explanations are possible.

Other "informal" estimates of shrimp catches for different parts of the study area are not comprehensive or detailed. For example, Hanna (1974) noted that Maluku exported 2,614 tonnes of shrimp in 1972, but gave no indication as to whether this export was shrimp tails or whole shrimp; Dwiponggo (1982) noted that, 3,622 tonnes of shrimp were, on average, produced annually from 1975 to 1979 from the south coast of Sulawesi.

Based on an estimate of the virgin shrimp biomass of 36,000 tonnes, the DGF (1983) estimated the shrimp MSY for Maluku and Irian Jaya at 18,000 tonnes/year.

EXHIBIT 10: MARINE SHRIMP CATCH EASTERN INDONESIA, 1975-1984

(ooo's tonnes)

REGION	1975	1976	1977	1978	1979	1984
East Kalimantan	4.3	4.9	5.7	7.8	10.8	-
South Sulawesi	2.5	3.3	4.0	5.2	5.1	7.3
North Sulawesi	0.2	0.1	0.1	-	0.1	0.2
Maluku and Irian Jaya	9.3	8.9	8.8	9.0	10.1	8.0

Sources: 1. Unar and Naamin, 1986
2. SPI, 1986

The estimate of 18,000 tonnes/year MSY has been repeated by subsequent authors, e.g., Bailey et al. (1986) and Soesanto (1985). Bailey et al. note that the Irian Jaya resource was expected to be fully exploited by 1994. Unar (1973) provides an estimate of the standing stock size in the Arafura Sea, derived from the catch results of a survey vessel in 1969. He estimated the shrimp stock to be 4,207 to 5,355 tonnes (647 to 834 kg/sq. mile). None of the available estimates of the marine shrimp catch potential are based on sound population dynamics principles. Watts and Watson (1983) cite a potential shrimp production of 6,000 tonnes/year for Sulawesi Selatan, 1981 production was 5,400 tonnes.

At present, the important industrial fisheries for shrimp are located near the western coast of Irian Jaya, at Bintuni, Kaimana, Merauke, Aru, Irian and Yamote. Of these areas, Irian and Aru have increased in importance over the last five years while those of Merauke and Yomate have declined in both the relative and absolute amount of landings that have been taken.

One fishing company operating eight boats in this area (PT Nusantara Fishery), reported an annual catch rate of 238 kg/day. Total catch for their eight boats was 543.2 tonnes or 67.8 tonnes/vessel. This is considered to be an acceptable catch rate by international standards. PT Nusantara Fishery operates six 150 GRT vessels, one 190 GRT vessel and one 270 GRT vessel. The catch composition in 1986 was approximately 30% tiger shrimp and 70% white shrimp. A second company, PT Mina Kartika, operates a shrimp fleet of 13 trawlers and two collector vessles in the eastern part of the study area.

There was considerable variation in Mina Kartika's 1986 monthly catch rate, from a low of 176.3 kg/day in January to 412.0 kg/day in September; greatest fishing effort was extended in April (a fleet average of 27.9 days/month), least in March and December (a fleet average of 21.5 days/month). Exhibit 11 shows that, while the total catch by this company over the period 1977 - 1986 has been relatively stable, the catch rate in 1986 of 238 tonnes/day is below the 10 year average, and the general trend in catch rate over this period has been one of decline.

EXHIBIT 11: CATCH DATA FROM ONE FISHING COMPANY

Year	Total Catch (t)	Catch/Day (kg)
1977	435	310
1978	465	280
1979	547	339
1980	467	308
1981	424	278
1982	569	259
1983	605	298
1984	438	201
1985	460	197
1986	543	238

Source: Field, 1987

The catch data above indicate clearly that any further increase in effort can be expected to result in lower catch per unit effort by the individual fishing vessels.

Recent published catch data show that there is little chance of substantial increases in the harvests of marine penaied shrimp from the study area. Because of declines in catch rates, it may be possible to obtain further, rather minor, increases in total yields, but only with substantial increases in fishing effort. It is probable that existing effort in the industrial fishery in the Arafura Sea already exceeds that necessary to maximize returns from the fishery. Thus, increasing effort may result in diminishing financial and economic returns. A contemporary and comprehensive bio-economic analysis of the shrimp fisheries in the Irian Jaya-Maluku region is soon to be available from ICLARM (D. Pauley, pers. comm.). The results of this study should assist with the making of future shrimp fishing investment decisions.

Conclusion About Marine Shrimp Resource

The level of shrimp harvesting from marine sources in Eastern Indonesia is at or near the maximum sustainable yield. Marine shrimp are being successfully exported via Indonesian or Japanese/Indonesian joint venture companies which grade and package shrimp for particular markets. Therefore, there is little opportunity for further expansion or processing of marine shrimp. However, there is considerably greater potential for the processing and marketing of aquaculture shrimp raised in tambaks. While aquaculture products are outside of the terms of reference for this study, it is felt that the potential here is sufficiently significant to warrant analysis in order to determine potential processing requirements.

4.2 TUNA AND SKIPJACK

Tuna and skipjack are large bodied pelagic fishes. The common and scientific names of these and other large bodied pelagic fishes found in the study area are listed in Appendix G.

The Indonesian archipelago is believed to be an important nursery ground for several species of large tuna (yellowfin, big-eye and albacore) and skipjack. This is because of the high rainfall in the area and the nutrient inflow carried by water runoff from the land and from the upwelling of seawater (Yonemori et al., 1985).

Skipjack and tuna, considered to be relatively abundant in the Banda Sea, form the basis of an important fishery in Indonesia. Yellowfin are particularly valuable on the Japanese market for Suishi.

Skillman (1980) reported that more than 80% of the large tuna caught were yellowfin. SCS (1979) reported that in 1979, 67% of the tuna landings were yellowfin, 26% big-eye tuna, and 7% albacore. However, identification of the different species present in the catch may still be a problem (Haskoning, 1983). Frigate and bullet mackerel are difficult to distinguish and they are also confused with eastern little tuna.[2] Similarly, there are difficulties in distinguishing between

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[2] In some provinces, catches of frigate and bullet mackerel (Auxis spp.) and small tonggol (Thunnus tonggol) are included in the landings data for Eastern little tuna.

yellowfin and bigeye in the size range in which they are generally encountered in the catch.
The knowledge of stock structure and status which is required for the management of these resources remains incomprehensive and inaccurate (Yonemori et al., 1985). There is no doubt that skipjack can make large migrations with movements throughout the southwest Pacific (Sibert 1986). Yellowfin are known to undertake migrations over even longer distances. Because of its location, adjacent to the Western Pacific and leading to the Indian Ocean, tuna stocks pass freely through the Banda Sea region.

While some stocks may be local and spawn in the area of the Banda Sea, most of the catch comes from populations which move about Eastern Indonesia and the west Pacific (UNIDO, 1984). Suhendrata et al. (1986) showed from a tagging study of skipjack and yellowfin in the Northern Banda Sea that some tuna moved south, but more migrated eastward with recaptures in eastern Papua New Guinea. Fish tagged east of the Philippines have been recovered in the northern Banda Sea region. Data on the migration of yellowfin tuna in the Western Pacific are not as extensive as for skipjack. Tagged yellowfin in the Eastern Pacific show the same diffuse movement as has been observed for skipjack with apparently seasonal migrations (Sibert, 1986).

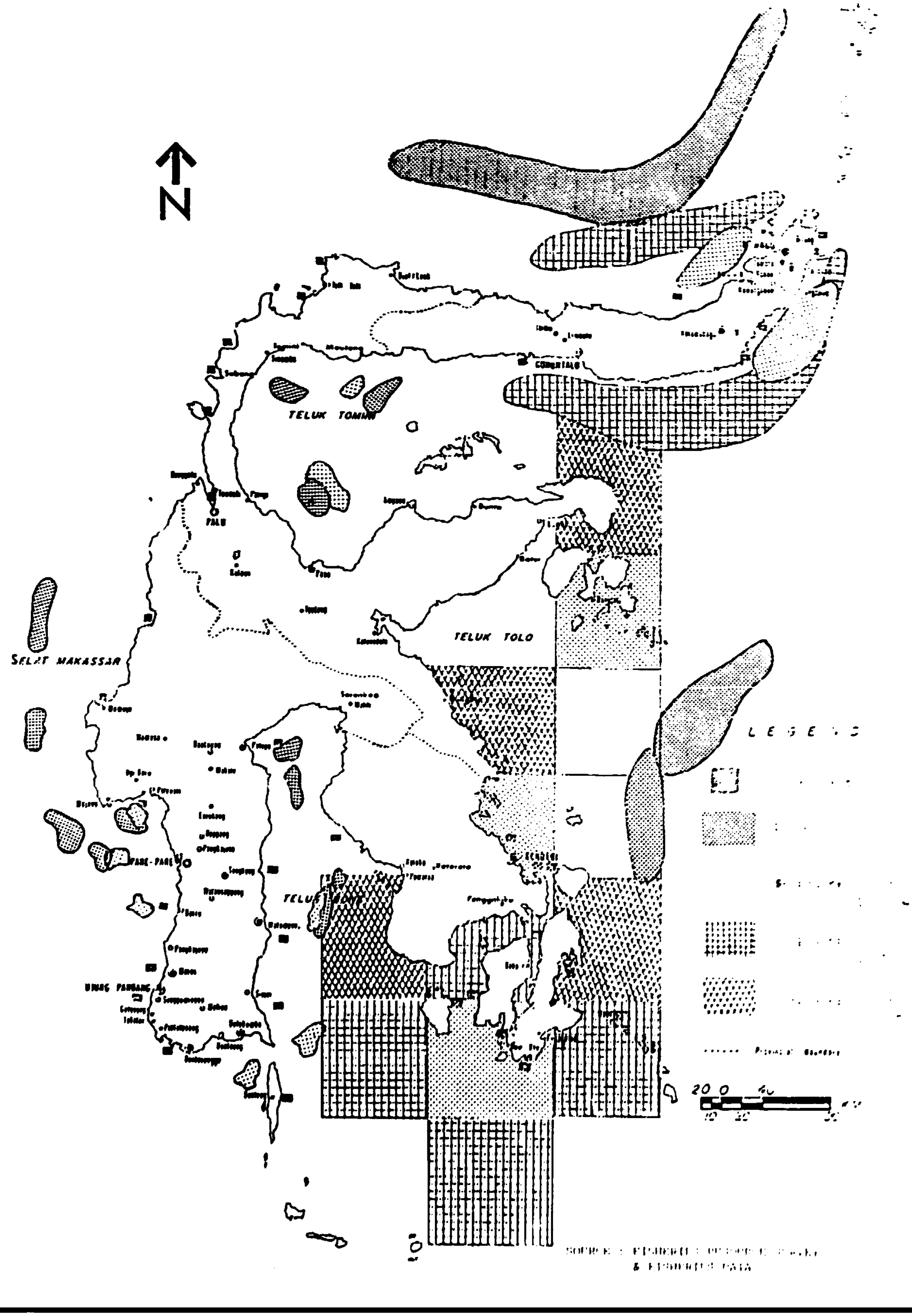
Skipjack in the study area are usually caught in surface waters close to the coast. Yellowfin, and the other large tuna, are taken in areas of deep oceanic water.

Development of the fisheries for skipjack and tuna is not been well distributed throughout the study area, especially in the case of skipjack; its exploitation has been concentrated either in areas of high population density or in the vicinity of processing plants built for export purposes. For example, 70% of the production of skipjack in Eastern Indonesia comes from Sulawesi and of this 64% comes from Sulawesi Selatan (ADIS, 1984). Dwiponggo (1982) describes the pelagic resources about Sulawesi Selatan as "already highly exploited"; the ADB (1983) claims that catches of pelagics, at least for Sulawesi Selatan, are at, or above, their level of sustainable yields. However, Watts and Watson (1983) found that the nature of fishing seasons and the migratory patterns of the pelagic species made it very difficult to obtain reliable data on the status of these stocks.

Preliminary estimates indicate that the pelagic stocks are widely dispersed, in densities of roughly 5 - 50 tonnes/square nautical mile, but with marked regional concentrations. For example, Wilimovsky et al. (1978) found that 35% of the South Sulawesi tuna catch came from the Gulf of Majene. Other key tuna and skipjack fishing areas include Telok Bone, and the area off the South and Southeast of Sulawesi Tenggara (see Exhibit 12).

Estimates of the maximum sustainable yield (MSY) per unit area have been calculated for Indonesian waters, both in the archipelagic waters and the extended economic zone (EEZ) (DGF, 1983). Various authors have tabulated possible catches, apparently derived from these estimates (see Tables 1 and 2 of Appendix G). The ADB (1983) noted that there appeared to be excellent potential for further exploitation of skipjack and tuna in a number of areas, within and outside Indonesian archipelagic waters, and that abundant skipjack stocks were available off the north and south coast of Irian Jaya, around the province of Maluku and in the

EXHIBIT 12: SKIPJACK, TUNA AND LIVE-BAIT FISHING GROUNDS



waters surrounding Sulawesi. However, the ADB also noted that precise determination "of the potential fish resources" in Indonesian waters is difficult to make, that estimates vary, and that only a limited amount of research has been conducted to assess the magnitude of the potential. Despite these caveats, production of tuna and tuna-like fish from the study region has been increasing (IPTP, 1986). See Exhibit 13.

EXHIBIT 13: CATCH STATISTICS OF TUNA AND TUNA LIKE FISHES

(000's tonnes)

Year	Tuna	Skipjack	Tuna-Like Fishes
1976	8.0	23.3	42.1
1977	10.9	26.4	47.2
1978	10.6	29.4	46.1
1979	14.7	36.3	57.8
1980	17.6	44.2	61.6
1981	21.9	50.9	70.3
1982	24.3	49.7	83.2
1983	20.2	64.3	80.4
1984	26.5	70.2	79.0

Source: DGF, Fisheries Statistics of Indonesia, 1976-1984

4.3 SKIPJACK

Skipjack are significantly smaller than yellowfin and not in such demand for canning purposes or international markets because their flesh is darker and consumer preference is for light meat. However, there has always beeen a market for skipjack in Japan.

The Fishery

Skipjack (Katsuwonus pelamis) are harvested commercially by two principal methods: purse seine and pole-and-line, called "funai" in Indonesia. Pole-and-line fishing, first introduced into Indonesia by the Japanese in 1910, relies on skipjack being sighted. This is often assisted by the presence of seabirds feeding on small fish forced to the surface by the predator skipjack.

A second way by which skipjack are caught is by trolling (Unar 1981). This can be done from a wooden canoe (or proa), from which one or several lines are towed, using brightly coloured artificial lines.

Further, In the Makassar Straits, around Maluku and in the waters off North Sulawesi, rafts (or "rompong") anchored in water depths of 500m to 2000m are used as fish attracting devices. Skipjack and other fish are caught around the raft by trolling, handlining or with gill nets.

Nearly 11,000 Japanese pole-and-line fishing vessels, which were mostly large boats displacing over 250 GT, operated in Indonesian waters including the EEZ, and caught over 60,000 tonnes of skipjack in 1974. After 1974 their numbers declined and purse-seiners came to take an increasing amount of the skipjack catch. Japanese purse seiners caught over 26,000 tonnes of skipjack in 1979 and over 14,000 tonnes in the first four months of 1980 (Ayodha, 1983); he suggests that South Korean and Taiwanese fishermen may have caught an equivalent amount in the same year. Fishermen from the Philippines, Thailand and the U.S. have also fished skipjack in Indonesian waters but no data on their catch success is available (Bailey et al. 1985).

Pole-and-Line Fishing

The direction of the Monsoon is an important factor in controlling fishing. During the northwest monsoon, operations are best on the southeast, lee sides, of the islands. During the southeast monsoon, fishing operations are best undertaken on the northwest sides of the islands. Thus, in areas subject to the monsoon influence, the supply of product to shore based facilities can be disrupted or complicated by the need for storage facilities or to obtain supplies from further afield.

The three skipjack producing districts of Sulawesi Tenggara are Kendari, Baubau and Kolaka. Many skipjack are bought from local fishermen in BauBau by a collector vessel which delivers the product to the freezing plant in Kendari. When the collector boat is not "on station" in Bau Bau, any skipjack that are caught are sold through the local auction/public market system.

The skipjack fishery about the coast of Sulawesi Selatan is seasonal, progressing from Pare-Pare in the Makassar Straits, during the dry season (southeast monsoon) to Bone in the Gulf of Bone during the wet season (northwest monsoon). However, some skipjack are landed in all regions throughout the year using a variety of gears other than pole-and-line. For example, Dwiponggo (1982) notes that, on average, only 50% of the catch of larger pelagic fishes was caught by pole-and-line in Sulawesi Selatan during the period 1975-1979, while 65% of the pelagics catch were skipjack.

The Maluku Islands are the main tuna producing area in Indonesia and the region where pole-and-line fishing was introduced to the country. Vessels are based in Ambon and Ternate. The main fishery takes place about Ternate Island and Tidore, and between these islands and Halmahera. The best fishing occurs from March until June and September-October though large variations occur from year to year (Marcille et al., 1984). Although, skipjack have been fished about Ambon for many years, because of bait fish shortages in the vicinity, fishing activities have been extended to the northwest coast of Seram Island.

Catch Statistics and Potential

Summary statistical reports rarely identify the species composition of catches, also, catch statistics are often aggregated for an unknown number of fishing areas. The Indonesian catch of skipjack and eastern little tuna for the years 1978-1984 are shown below. Landings during this period have continued to increase steadily.

Landings for eastern little tuna, which have always exceeded the landings for skipjack, peaked in 1982 and declined slightly in 1983 and 1984, the last years for which data are available.
Catches of skipjack by province in the study area have, in all but one case, increased consistently. The exception is for Irian Jaya, where a decline in catch occured between 1978 and 1979.

EXHIBIT 14: INDONESIAN CATCH OF SKIPJACK AND EASTERN LITTLE TUNA, 1978-84

(000's tonnes)

Year	Skipjack	Eastern Little Tuna
1978	33.5	55.2
1979	42.8	66.6
1980	51.8	76.8
1981	57.4	87.7
1982	61.6	106.0
1983	76.8	103.9
1984	80.7	103.2

Source: DGF,

EXHIBIT 15: CATCH OF SKIPJACK BY PROVINCE, 1975 - 1984

(tonnes)

	1975	1976	1977	1978	1979	1984
Sulawesi S & SE	6.0	4.9	6.9	7.0	9.7	21.5
Sulawesi N & NE	4.7	7.3	5.5	5.6	8.5	18.5
Maluku	9.2	7.6	8.7	8.7	10.0	18.1
Irian Jaya	0.3	1.6	2.3	5.5	4.1	13.1

Source: Marcille et al., (1984); SPI. (1986).

A quantitative estimate of the catch potential of skip[illegible] n the study area requires knowledge, not only of the amount of fish landings, b[illegible] so of the amount of fishing effort involved. Such calculations invoke assumptions about the way the fishery operates. These and other such necessary assumptions can be held only weakly in the case of pelagic fisheries for the survey area. Further, fishery models used to estimate potential yields usually assume that the catch (and effort) data apply to a single stock or stock system. From these few comments it is apparent that present estimates of MSY can be only very general or indicative. The sustainability of any particular the catch rate will depend on:

- the extent to which the exploited resources comprise local stocks;
- normal annual and seasonal variability in stock abundance and availability; and
- the catches by other fishing operations on the same stocks, either in the same area or elsewhere in the geographic range of the stocks' movement.

Exhibit 16 shows catch and effort data for pole-and-line vessels operated by state-owned enterprises in Ambon. The data show large variations in the catch-per-unit effort (CPUE) that bear no relation to the amount of fishing effort. If stocks were primarily local, one would expect that as fishing effort increased, catch-per-unit effort would decrease. If catches depended on migratory stocks, then catch per unit effort would vary in relation to the abundance of the migratory populations.

The data for Ambon and the North Sulawesi show a large degree of variation which appears to be unrelated to the amount of fishing effort and suggests that the number of fish in the region varies year by year because of changes in the migratory behaviour of skipjack. Other more detailed information, is presented in Appendix G (Table 3).

EXHIBIT 16: CATCH OF SKIPJACK BY STATE ENTERPRISE VESSELS

Year	Ambon			North Sulawesi		
	Catch (tonnes)	Effort Days	Kg/ Day	Catch (tonnes)	Effort Days	Kg/ Day
1967	-	-	-	1284	2240	530
1968	473	1131	418	1397	2142	652
1969	450	1011	445	1912	1795	842
1970	658	1022	643	1578	1706	925
1971	773	962	804	1326	1766	751
1972	1067	1014	1052	598	1523	392
1973	944	1258	750	502	1134	442
1974	616	985	626	657	1356	484
1975	546	834	655	617	1163	530
1976	683	848	805	281	819	343
1977	501	748	670	339	451	751
1978	944	1390	679	271	457	570

Source: SCS, 1979.

4.4 BAIT FISHERIES

Because the pole-and-line technique of skipjack fishing requires the use of small bait fishes to "chum" the skipjack (attract and excite them) so that they can be caught by artificial lure, adequate supplies of bait fish are essential to the success of skipjack pole-and-line fishing but localized shortages of baitfish have been reported (USAID, 1985). It seems to be the common experience that the constraint to skipjack pole-and-line fishing is more usually a shortage of baitfish rather than the availability of skipjack. (See, for example, Watts and Watson; 1983; Haskoning 1983). Further, over-fishing of bait fish will affect the abundance of skipjack which consume "baitfish" as one of their major food items.

Any small fish that skipjack will eat can be used as bait fish, the main species being anchovies and Sardinella spp but the juveniles of any schooling species may be used. Appendix G includes table 4 listing fish species that have been used for bait fish. The most important genus is Stolephorus, followed by Rastrelliger and Sardinella species.

The composition of bait fish catches varies with season, depending on migration and spawning patterns, e.g. the oil sardine has a spawning peak (and availability) during February/March and October/November in the Ambon region at the time of the change in direction of the monsoons. Seasonal availability of the same species may vary from one region to another. For example, Kawakami (1976) reports that Stolephorus were "in season" from March to November in Staring Bay (Sulawesi Tenggara), from May to October in Kolaka but available year round at Kendari, Buton and Tomari Bay.

Gafa (1986) found variations in the mortality rates of bait fish once caught. Rastrelliger spp. and Decapterus spp. survived for at least 24 hours, Caesio coerulareus, about 24 hours; Sardinella fimbriata and Stolephoris commersonii for about 20 hours and Stolephorus indices for about 16 hours. The best bait fish have low mortality rates of capture.

Bait Fish Capture and Catch Rates

Because bait fish are usually most abundant in shallow bays and littoral areas where informal riparian rights are asserted by local fishermen, most bait fish are caught by locals and then sold to the pole-and-line vessel operators. In some cases the bait fishermen (e.g., about Baubau) act as co-adventures with the pole-and-line fishermen and take a share of the revenue (10%-25%) of the skipjack vessel's catch.

Baitfish are caught by nocturnal light attraction together with lift nets, ringnets and beach seines. Also, the pole-and-line vessels themselves may catch bait fish at night. This technique involves suspending a light over the side of the boat and a square box shape net beneath the light. The fish are transferred to bait holding boxes on the vessels. Local fishermen use a similar technique, either on boats or platforms set in waters up to 15 m deep. Their gear is referred to as stationary or floating "bagan apung", or simply "bagan". The live bait fishery that supports the pole-and-line fishery is well developed throughout the study area. (See the Figure and Table 5 of Appendix G).

Bait fish catch rates depend on season, region and the number of catching operations. However, there seem to be clear, if undocumented, indications that bait fish can be over-fished and that this happens at sites where there is a large number of bagan in operation. For example, there are over 50 stationery bagan in the Kendari Harbor alone. Several studies have concluded that decentralization of pole-and-line fishing may be necessary to ensure better utilization of baitfish resources.

Bait fish consumption by pole-and-line skipjack vessels is given by Kawakami (1976) in Table 6 of Appendix G. The data shows that the catch rate is approximately 10 kg of skipjack caught for each kg of bait fish used. Kawakami reported that for one vessel in 1970, 6,770 kg of bait fish (2,462 buckets) was used to capture 103 tonnes of skipjack (an estimated catch to bait ratio of 1 to 15.2). This ratio varied by season from a low of 1:1.8 in July (an exceptional month) to 1:26 in January. The second lowest month was October with a ratio of bait fish to skipjack caught of 1:10.2. Other data (e.g., IPTP, 1985/86), suggests bait/skipjack ratios in the order of 1:14.

Relatively little has been documented about the potential number of pole-and-line vessels which may be supplied with available bait fish despite rather extensive surveys such as that described by Gafar (1986) or Subari (1983). Haskoning (1983) believes that the limited availability of bait fish is affecting pole-and-line fishing in Ambon and Ternate and a shortage of baitfish in the Kendari area was reported to the field mission.

Proper management of the bait fish resource is essential to the success of present and future pole-and-line fishing for skipjack. Future management initiatives can be in two directions:

- o the biological management of the bait fish species and/or;
- o better utilization of captured bait fish.

The first action would not be simple, particularly given the large number of species involved and the possibility of multispecies interactions, but improvements to the utilization of bait fish could be implemented fairly quickly. One action would be to improve bait fish survival once caught by introducing measures such as on-board water circulation pumps or aerators, or installation of lamps within the bait tanks so that the bait fish could see to avoid damaging themselves by swimming into the tank walls. A solution to these problems may require government involvement in a baitfish management program and some form of regulation in the case of baitfish storage methods to ensure that a potentially scarce resource was not misused.

4.5 LARGE TUNA

As noted previously, a variety of species of Scombridae comprise the "Tuna" category in Indonesia. Of these, yellowfin is by far the most important. Marcille et al. (1984) indicated that over the period 1973 - 1981, an average of 62.2% of the "tuna" catch was yellowfin, 18.5% bigeye and 5.6% albacore. Yellowfin are fast growing voracious feeder reaching more than a metre in length whose distribution in tropical waters is bounded by the 23°C isotherm (Bardach and Matsuda 1980);

however, their high oxygen demand bars them from low-oxygen sea water, even when it is within their thermal range.

Yellowfin stocks in the Pacific form three reasonably distinct population groups, Western, Central, and Eastern. Yellowfin can easily move 20-30 km a day and tagging studies show that they move readily over distances of more than a thousand kilometres. The two other most frequent species of large tuna, bigeye and southern albacore, have similar life histories and often no distinction is made between yellowfin and bigeye in tuna fishing operations. Hence, catches of the latter species become included with yellowfin in the landings statistics (Sibert, 1986).

Although yellowfin (and bigeye) are caught by purse seine in the Pacific, Indian and Atlantic Oceans, the main gear used in the study region is longline. Such gear was first used by the Japanese in Western Indonesian waters as early as 1954 (Pusat, 1983). In longlining, a horizontal line is deployed to which glass floats and flagged bamboo poles are attached. Branch lines are hung from the main line and frozen squid or small pelagic fish are normally used as bait. As many as 2000 hooks per set may be used on a main line which can extend more than 75 miles (Hojgaard, 1983).

A major expansion of tuna longlining began in Bali, Indonesia in 1973, when a fleet of ex-Japanese vessels of 111 to 300 GRT started operations (White and Yesaki, 1982). These vessels used 300 baskets of 5 hook gear and operated from 100 to 600 miles seawards, in the Indian Ocean and in the Banda Sea (Skillman, 1980). The average weight of the yellowfin and bigeye tuna caught was 32-37 kg. Another operation was begun by C.V. Daya Guna Samudera, fishing in the Banda Sea and, Maluku Seas; and about Irian Jaya. This company, which operated 20 ex-Korean longliners, caught tuna of average weight of over 50 kg/fish (Haskoning, 1983).

IPTP (1985) listed the following companies as using longline gear in East Indonesia in 1985.

COMPANY	NUMBER OF VESSELS
P.T. Perikanan Samodra Besar	20
P.T. Sabur Mina	6
Daya Guna Samudra	6
Kartika Mina Samudra	2
Five other companies of one each	5

Sibert (1986) notes that for yellowfin, the total catch at high levels of effort tends to be no greater than at moderate levels of effort. The average hooking rate falls to between 1 and 2 fish per 100 hooks as fishing effort is increased. Bahar (1985) notes that bigeye have a tendency to live in deeper water which requires conventional longline gear to be modified and found the hook rate in the Banda Sea to vary from 0.4 to 5.8 fish/100 hooks depending on hook depth and number of branch lines per basket; another recent study (Rahanjo, 1985) showed catch rates of 1.8 per 100 hooks. (Also see Table 7 of Appendix G).

Yellowfin are also taken by handlining about rompongs anchored in deep water. Such fishing is undertaken around the North of Sulawesi and in the Makassar Straits. (Merta, 1984) found that of a catch taken in November, all but one of 145 tuna caught were yellowfin, one bigeye being the exception. These fish, caught above the thermocline (which was at a depth of 75 m), had weights ranging from 7 to 57 kg with a mean of 33.0 kg; age ranged from 2 to 6 years. According to Laevastu and Hela (1970), bigeye are more frequent in the thermocline layer, while albacore are more frequent below the thermocline.

Past Catches and Potential

Catch data for yellowfin are even more aggregated than for skipjack. The fishery statistics for Indonesia list catches only for "tuna" with no species breakdown. Exhibit 17 shows the landings of "tuna" from the provinces in the study area in 1984 and for Indonesia and the Western Pacific as a whole for the period 1978-84. East Indonesia accounted for approximately 78 per cent of the total Indonesian catch in 1984.

A further area where exploratory fishing for large tuna has been undertaken is the Makassar Straits. Nasution, Merta and Arifudin (1986) describe the results of tuna catches from around rompongs set off the coast of Mamuju. During the period, February - September 1983, Pt. Perikanan Samudera Besar collected 526 tons of tuna from rompongs in this area. Of the catch 20.6% was bigeye, 18.6% albaocore, and 7.2% southern bluefin. Minor catches of white marlin, black marlin and stripe marlin were also taken. It is unknown if this fishery has been continued other than on an artisanal basis.

Suhendrata and Bahar (1986), who reviewed the results of long-line surveys, conducted by Perikanan Samodra Besar from 1967 to 1981, state that the hook rate indicates the most important fishing grounds for yellowfin tuna to be the Sulawesi Sea, Halmahera to Irian Jaya, SW Sumatra, the Indian Ocean region off Java, Bali and Nusa Tenggara and the Banda Sea. However, no data on the actual tuna production from these areas is given.

EXHIBIT 17: TUNA PRODUCTION 1977-84

(000's tonnes)

Year	Total Indonesia	% Change	West Pacific	% Change
a) Indonesia and West Pacific (1977 - 1984)				
1977	-	-	10.9	-
1978	13.4	-	10.6	-2.4
1979	17.9	33.5	14.7	38.3
1980	20.9	16.8	17.6	16.5
1981	25.2	20.8	21.9	19.8
1982	28.1	11.3	24.3	11.2
1983	26.1	-7.1	20.2	-17.0
1984	30.7	14.9	-	-

a) Eastern Indonesia (1984)	Production
Sulawesi Selatan	6.8
Sulawesi Tenggara	1.8
Sulawesi Utara	6.6
Sulawesi Tengah	0.4
Maluku	5.5
Irian Jaya	2.8
Total East Indonesia	23.9

Source: SPI (1984); IPTP (1985).

Estimating the sustainable catch for wide ranging species such as yellowfin or bigeye, which pass through several sovereign jurisdictions and fishing areas, is fraught with hazard. Bardach and Matsuda (1980), who feel that the best indicators as to sustainable yields of a fish population come from fishery statistics, note that data from the Japanese longline fishery (covering nearly the entire range of this species) indicate that an increase in fishing intensity would "lead to damage to the stock" and soon depress yields. They note that the total catch has not increased despite an increase in the number of hooks fished. Yellowfin are considered to be fully exploited, with potential for only minor increase in the central Pacific region (Suzuki et al., 1978). FAO/IBRD (1973) reached a similar conclusion, noting that catch rates were between 1 and 2.9 fish per 100 hooks. The FAO/IBRD concluded: "It is doubtful whether longlining operations from Indonesian bases will continue to be successful" and noted that Japanese longliners had stopped fishing in the Banda Sea and left for better grounds.

4.6 TUNA AND SKIPJACK RESOURCE AND LOCAL AVAILABILITY

Insufficient information exists to enable rigorous evaluation of existing estimates of potential sustainabie yields of pelagic fishes. Such information is difficult to collect and requires ongoing analysis. The parameters that determine the annual sustainable yields often vary from year to year providing further uncertainty. The Directorate General of Fisheries recognizes that their initial estimates of potential yield (DGF, 1983) are highly uncertain, probably too high and require careful review. However, accurate (and difficult to get) estimates of sustainable yields are not essential for expansion of the fishing industry as long as this expansion occurs in a phased or incremental fashion that is monitored carefully. This requires that collection of accurate catch and effort statistics occur during any expansion of fisheries together with timely analysis of the data. After a significant expansion of fishing effort, say a 20% increase in fishing effort, a limit on further expansion of fishing effort would be set (i.e., the number of vessels permitted in the fishing industry would be limited), until the impact on the catch-per-unit-effort and on total landings had been determined. Such an assessment would take at least one to two years.

There is probably no problem with "over fishing" of pelagic fishes, at least on a regional basis, for the present time but high local fishing intensities can be expected to depress catch rates. Haskoning (1983) repeats the conclusions of the South Pacific Commission study that a further extension of skipjack fishing would be sustainable in Indonesian waters. There is a general consensus that skipjack resources will sustain increased landings. However, bait fish availability may be limited. Furthermore, it must be stressed that any increase in catch, particularly from areas where skipjack are already exploited, will be accompanied by a reduction in the catch per unit of effort. If the fishing costs are a significant fraction of total costs, then the increased (marginal) revenue from any expanded fishing operations may not exceed the additional costs from the increased fishing effort.

The case for expanding fishing effort on yellowfin operations is less clear. Marcille et al. (1984) caution that yellowfin may be fully exploited. Also, purse seine fisheries for skipjack often have a bycatch of juvenile yellowfin. Thus, the introduction of, or expansion of, purse seining for skipjack could result in a reduction of yellowfin catches by longliners.

On a Western Pacific basis there are suggestions that total catches may not be increased much further even with a substantial increase in fishing effort. Such information supports a conservative or risk averse development policy whereby any expansion in fishing effort is done in an incremental, and preferably, reversible manner. In this case, for example, until the resource has confidently been proven, vessels should be chartered and not bought.

For both skipjack and the large tunas, attention must be paid to other fisheries developments in other areas of the Western Pacific. For many of the small countries in this area, expansion of tuna fisheries is one of their few economic development options. Thus, competition, for resource and for markets, is likely to increase in the near future.

Local Availability

Exhibit 18 shows tuna, skipjack, tongkol, shrimp and total fish landings by Kabupaten in Sulawesi Selatan during 1985. Of the 24,000 tonnes of tuna and skipjack landed, 19,200 tonnes came in at six locations: Palopo, Bone, Bulukumba, Pare-Pare, Polmas and Majene. The major landing areas are Palopo and Bone, to the north of the East Coast with a total of 9,600 tonnes of tuna and skipjack between them and Majene, Polmas, Pare-Pare on the West Coast, with a total of 8,700 tonnes.

EXHIBIT 18: SULSEL FISH LANDINGS BY DISTRICT (KABUPATEN) IN 1985

(000's tonnes)

KAB	Total[1]	Tongkol[3]	Shrimp	Tuna	Skipjack[2]	Tuna & Skipjack	Av. Price in Rp/Kg Skipjack	Av. Price in Rp/Kg Tuna
Luwu (Palopo)	27.5	2.8	0.3	---	2.9	2.9	1024	---
Wajo	4.8	---	0.3	---	0.1	0.1	---	---
Bone	26.1	0.5	0.5	2.7	4.0	6.7	710	681
Sinjai	12.3	0.1	---	---	0.2	0.2	---	---
Bulukumba	9.0	0.5	0.4	0.2	1.7	1.9	859	765
Selayar	4.3	---	---	---	---	---	---	---
Bantaeng	9.1	---	---	---	0.8	0.8	---	---
Jeneponto	8.4	---	0.2	---	0.1	0.1	---	---
Takalar	14.1	---	0.4	---	---	---	---	---
U.Pandang	10.9	0.3	0.2	---	---	---	---	---
Maros	12.6	---	1.5	---	---	---	---	---
Pangkep	10.8	---	2.2	---	0.9	0.9	1106	---
Barru	15.4	0.5	0.3	0.4	0.5	0.9	828	735
Pare-Pare	8.1	1.2	---	0.1	1.8	1.9	873	---
Pinrang	7.6	0.4	1.9	0.5	0.5	1.0	1104	1112
Polmas	14.5	2.3	0.5	2.2	2.1	4.3	549	535
Majene	6.5	1.3	---	0.5	1.0	1.5	999	948
Mamuju	4.7	0.2	---	0.4	0.3	0.7	560	478
Total[4]	206.7	10.0	8.5	6.9	17.2	24.1	826	1232

Source: Sulsel, Dinas Perikanan Propinsi Dati I, (DP I) Laporan Statistik 1985

1. Seafish only
2. Cakalang
3. Frigate Mackerel
4. All Places

Exhibit 19 shows that the seasonal distribution of the tuna and skipjack catch is relatively even with no marked low season. This is because the monsoon affects only one coast at a time. With major landings coming in on each coast, the seasonal effect is evened out. This has profound effects on the possibility of skipjack and tuna processing. The eveness of production, season to season, of tongkol, shrimp and squid should also be noted.

In addition to the landing data presented in Exhibit 18, there is evidence that catch levels are potentially much higher in Mamuju (700 tonnes in 1985). The company, PT Perikanan Samodra Besar (Persero), operated a skipjack collection vessel picking up skipjack and tuna from 41 rompong off Mamuju for eleven months during 1983. The amount of fish collected varied month to month, the main catching months being May to September (297 tonnes) in contrast to the other 6 months (97 tonnes).

From the data, it would seem that from one to four tonnes per day would be collectible except during December and January. Further, it should be noted that the fishermen have requested the collection service to be re-introduced and that catches usually increase when a market is provided.

Analysis of skipjack landings from pole-and-line boats in Bau Bau reveals a slightly different seasonal pattern of landings with July to December being the busiest months in 1986 (DP I, Sulawesi Tenggara). Data show that a total of nearly 500 tons of skipjack were landed during 1985 and 1986. There is potential for further growth in landings at Bau Bau.

Finally, the landings of skipjack in Kendari, principally by the PT Perken fleet of 33 pole-and-line vessels, provide a concentrated source of raw material. The 2,100 tonnes landed in 1985 had grown to 2,900 tonnes in 1986 (DP I, Sultra). Further, it should be noted that, as PT Perken has increased the size of its pole-and-line fleet, catch rates have not declined. There would appear to be further potential available to the fleet as it becomes gradually expanded.

EXHIBIT 19: SULSEL SEASONAL DISTRIBUTION OF FISH CATCH, 1985

Quarter	Skipjack	Tuna	Tongkol	Shrimp[1]	Squid
			(000's tonnes)		
1	3.8	1.7	2.4	1.9	0.3
2.	4.4	1.3	2.2	2.0	0.2
3.	3.8	1.5	2.5	1.6	0.2
4.	5.3	2.4	2.9	2.5	0.6
Total	17.2	6.9	10.0	8.1	1.3

Source: Sulsel, Dinas Perikanan Prop. D.I, Laporan Statistik, 1985
Note: (1) 72% white shrimp, 7% tiger shrimp, 21% other. Lobster total 7.6 tonnes.

4.7 DEMERSAL FISHES

As for demersal fisheries in other tropical regions of the Indo-Pacific, the fish fauna in the study region is characterized by the large number of species that are exploited and the absence of any one predominant species.

The shrimp fishery in Maluku-Irian Jaya catches large quantities of demersal fish as a bycatch comprising 80-95% of the total catch. Most of the bycatch, is discarded once the more valuable shrimp have been separated.

Exhibit 20 lists recorded catches of some demersal fishes in four of the provinces in the study region. It should be noted that fish taken as a bycatch and then discarded, are unlikely to be included in any official landings figures. Some of these species, particularly the Carangidae, are also taken in pelagic fisheries. On the basis of the 1984 landings statistics, scads (Decapterus spp.) were the major species caught in South and Southeast Sulawesi with carangids being the main species landed in Maluku and Irian Jaya. Of the four provinces, 1984 landings in Sulawesi Seltan exceeded those in the other three provinces combined.

The high value species, (i.e., the Lutjanidae, Serranidae and Lethrinidae) represented 12.2% of the catch in Sulawesi Selatan, 27.0% in Sulawesi Tenggara, 20.0% in Maluku and 8.8% in Irian Jaya.

For many of the species, catches may come from a number of substocks or separate stocks within a province, e.g. demersal stocks in the Gulf of Bone may be reproductively isolated to those on the continental shelf off Ujung Pandang. While the stocks of one particular species may be fully exploited in one provincial or regional area they may be under exploited in another. Detailed knowledge of the relative state of exploitation in the different regions does not exist and a major ongoing program would be necessary to obtain it. It is within this context that opinions regarding the potential for increasing landings of demersal species in the study area must be appraised.

The majority of reports that review the fish resources of the region, (e.g., Bailey et al, 1985), consider the exploratory fishing on which the estimates in DGF (1983) are based to have "provided only limited data for preliminary resource analysis or economic assessments." These authors conclude that there is very little potential for further expansion of the demersal fishery and Watts and Watson (1983) believe that the state of the catches from the demersal resources was approaching full exploitation. In support of this, they note that despite an increase in the mechanization of the fleet from 4% to 21% mechanized over the period 1976 to 1981, the average increase in productivity per boat was only 7.4%, (from 5.4 tonnes/boat/yr to 5.8 tonnes/boat/yr). Watts and Watson noted that FAO estimated the MSY for these fishes at 35,000 tonnes and that this had probably been reached already. In the case of Northern Sulawesi they noted that the shelf area in that region is not extensive and that, therefore, the demersal resources must be quite limited. There is no evidence to the contrary.

EXHIBIT 20: DEMERSAL FISH PRODUCTION BY SPECIES AND PROVINCE WITHIN STUDY AREA, 1984

(tonnes)

	Sulsel	Sultra	Maluku	I. Jaya
Leiognathedal	7039	607	163	62
Ariidae	1014	72	58	39
Upeneus spp.	716	119	586	80
Domadasys spp.	1380	204	308	42
Lutjanidae	2334	950	2069	143
Serraridae	912	1060	898	38
Lethrinus spp.	3677	1270	3167	105
Lates calcarifer	778	423	1440	380
Nemipterus spp.	2014	262	496	31
Calsio	843	538	1712	44
Sciaenidae	1189	30	10	286
Sharks	2697	96	473	151
Rays	1343	61	234	97
Pampus argenteus	749	7	303	10
Sphyraena spp.*	751	999	1056	49
Pecapteries* spp.	15646	2334	4220	253
Selar spp.*	6004	712	5088	319
Selaroides spp.*	1951	1445	1966	362
Megalaspis cordyla*	1691	165	1122	11
Mugil spp.*	3356	693	1029	307
Other species	869	87	1125	138
Total	5697€	12134	27523	3254
% Of Four Provinces	57.0	12.2	27.6	3.3

Source: SPI, 1986

Note: *Also taken in pelagic fisheries

The wide disparity between the DGF (1983) estimates and those of FAO for the demersal resources in the study region has also been noted by ADB (1983). Further, it is recognized within the Directorate General of Fisheries, Jakarta, that the earlier estimates which were unavoidably based on meager field information, should be recalculated using the more recent catch effort data that has become available.

For the reasons given above, future developments of the study area's demersal fisheries are more likely to be achieved by increasing the value of the present catch (through such value-adding activities as better catch handling, reduced post-harvest losses, improved marketing, utilization of bycatch species presently discarded, or by new forms of processing) than by further fisheries expansion.

4.8 CEPHALOPODS

Among the species mentioned specifically in the terms of reference for this study are lobster and squid. At present little is known about the fisheries potential for these species; in the first case because the resource appears to be meager, and in the second case, because special exploratory fishing surveys are needed to determine whether an exploitable squid resource exists in the study region.

Squid

No estimates have been made of the squid resources in the study region, but the absence of a directed squid fishery suggests that it is unlikely that large squid resources exist. Surveys of squid resources have been carried out in waters adjacent to Lombok (Soselisa et al., 1986) and Alas Strait (Marzuki and Sujastani, 1986). Four species were found: Loligo edulis, L. devaucelli, L. tagoi, and Sepioteuthis leassoniana. The first of these was the most common. Production in the Lambok area (1974-1983) was reported at 13,753 tonnes/year.

The production of squid, cuttlefish and octopus is shown for the study area in Exhibit 21. Sulawesi Selatan dominates the landings of squid. Landings of cuttlefish and octopus are highest in Maluku and Irian Jaya respectively. The accuracy of information about this resource is poor. Comments on the possible existence of unexploited squid resources in the study area can only be speculative and should not provide the basis for planning of a possible fishery. The landings statistics for Sulawesi Selatan suggest that catches can be increased in other regions of the study area. However, even if there were a sizable resource, profitable catch rates may not be obtained, for example, if the population density were low, catch rates may not be financially viable.

EXHIBIT 21: LANDINGS OF SOME CEPHALOPODS IN THE STUDY AREA, 1984

	(tonnes)		
	Squid	Cuttlefish	Octopus
Sulawesi Selatan	1296	68	3
Sulawesi Tenggara	233	-	-
Sulawesi Utara	451	9	1
Sulawesi Tengah	98	11	-
Maluku	141	105	9
Irian Jaya	44	27	33
Total	2263	119	46

Source: SPI, 1986

Possibly, the only way to determine whether a financially viable fishery for squid can be developed in the study area would be to undertake a well planned exploratory survey over a full year (to allow for the seasonal variations) at a cost in the order of $500,000 to $750,000.

Octopus

Octopi are bottom dwellers. It is possible that landings of this species may be increased in areas of demersal fisheries. However, the potential increase in landings is likely to be much less than that for squid or cuttlefish. The probable stock size is unlikely to support a significant export fishery.

Lobster and Crab

A variety of lobster and crab species are found in Indonesian waters. However, in terms of total fishery, the landings of lobsters are incidental. There are few areas of suitable habitat - rocky reefs and moderately shallow-bottomed sandy areas. Because of the high value of lobster and the readily available domestic and export markets, it would be surprising if substantial new stocks were discovered. The present minor level of production supplies local hotels and restaurants with any excess of landings being flown to markets in Jakarta on an irregular consignment basis.

According to published statistics, large quantities of swimming crab (Portunus spp.) are landed in Sulawesi Selatan (over 3,200 tonnes in 1984, SPI, 1986). These were frequently seen on sale in city and village markets. No information exists on the size or productivity of this resource.

4.9 FLYING FISH

Several species of surface feeding fishes are the object of fisheries in the study area. The most important of these, flying fish, occur in four genera: Paraexcoetus, Evolantia, Excoetus, and Cypsilurus (Owiponggo et al.,1983). It is the last of these which is the most important with three species contributing to the fishery: Cypsilurus oxycephalus, C. altipennis, and C. spilopterus in Sulawesi Selatan and Tenggara.

The well established flying fish fishery is rather unusual in that it is an artisanal fishery directed to the capture of gravid female fish for their eggs, which form a valuable export item. The flying fish are caught either in Pakkajal (floating traps, as they are in other tropical areas, e.g., the Caribbean) or with gill nets. While flying fish are caught by fisheries in most coastal areas, especially along the Makassar Straits, the major fishery is apparently located in Gaelsong, just south of Ujung Pandang.

Exhibit 22 lists catches of flying fishes and needle fishes (Tyulosurus spp. and Hemirhamphus spp.) in the study area (for 1984) where more than two thirds of the catch was landed in Sulawesi Selatan. For the needlefish, nearly 60% of the total landings occurred in Maluku.

EXHIBIT 22: LANDINGS OF FLYING AND NEEDLE FISHES IN THE STUDY AREA, 1984

(tonnes)

	Flying Fishes	% Total	Needle Fishes	% Total
Sulawesi Selatan	8,512	67.4	1,378	9.2
Sulawesi Tenggara	215	1.7	1,056	7.0
Sulawesi Utara	1,797	14.2	2,205	14.7
Sulawesi Tengah	96	0.8	1,034	6.9
Maluku	1,978	15.7	8,822	58.7
Irian Jaya	24	0.2	535	3.6
Total	**12,622**	-	**15,030**	-

Source: SPI, 1986

Dwippongo et al. (1983) have fitted a surplus production model to catch and effort data for the fishery in Sulawesi Selatan. Depending on the assumptions used in fitting the model, they estimate the MSY to be 12,290 to 15,686 tonnes. On the basis of these estimates, a moderate increase in catch should not cause biological harm to the stock. Catches in Sulawesi Selatan exceeded 14,300 tonnes in 1976 but effort and catch declined thereafter until 1980.

Because this fishery is directed to one species for a particular export market, it could benefit from a specific cost-benefit analysis of the consequences of different levels of fishing effort. A marketing study could determine whether processing activities would be possible and profitable.

4.10 OTHER PELAGIC FISHES

Several other pelagic fish species are important for local consumption but these do not occur in large quantities and would not be suitable for industrial processing except perhaps for freezing. Also, along the West Coast of Sulawesi Selatan, particularly north of Barru, shark are caught and shark liver-oil extracted. Quantities of key species caught in 1984 are shown in Appendix G (Table 8).

4.11 SEAWEED

Seaweeds have been used for food in many parts of the world, including Indonesia, for many centuries, both for direct consumption and after processing in a variety of ways. In Indonesia, several species of seaweed are consumed directly. For example in Java Asparagopsis sandfordiana is prepared by soaking in water and then cooking with meat; in Bali Hypnea cervicornis is prepared with palm sugar and grated coconut as a sweet jelly. In many areas, Gracilaria is eaten raw in salads. Also Indonesians eat seaweed boiled as a vegetable, mixed with various spices, cooked with coconut milk, for thickening soup, puddings and sweetened jellies, and for medicinal purposes (Soegiarto, 1977).

Although direct consumption of seaweed is important in local areas, the scope of this report is restricted to "industrial uses". These consist of uses involving processing of seaweed to extract their phycocolloids - either agar or carrageenans. Both of these phycocolloids can be extracted from seaweeds that grow, and are cultured, in Indonesia.

The present marketing focus of Indonesian seaweed producers and exporters is to supply raw product, (i.e., dried seaweed or partially processed seaweed), to foreign processors. This appears to have been a sound commercial policy at this stage in the development of the Indonesian seaweed industry.

The demand for phycocolloids in Indonesia should continue to grow as the Indonesian economy matures and expands. Requirements for thickness and gelling agents by the food industry in Indonesia should increase as consumption of processed foods increases. Expanding national sanitation programs for monitoring the safety of water and food for public health requirements will require increased supplies of pharmaceutical grade agar for bacteriological assaying. Requirements for phycocolloids for industrial applications will also increase as the Indonesian economy becomes progressively more industrialized. For these reasons, enterprises engaged in the seaweed industry in Indonesia could profitably monitor the financial feasibility of domestic production of phyco-colloids, not only for export markets but also for domestic consumption. Bailey et al (1985) note that Indonesia imported 350 tonnes of agar in 1983 valued at $530,000 (US).

Various red and brown seaweeds are used for extraction of four primary phycocolloids:

- agar, from red seaweeds (Rhodophyta);
- alginates, from brown seaweeds (Phaeophyta);
- carrageenan from red seaweeds; and
- furcellaran, from red seaweeds (found in the North Atlantic).

Phycocolloids are large molecular weight non-crystalline polysaccharides that dissolve in water to form viscous solutions. They are used to thicken aqueous solutions to form gels, to form water-soluble, oil-repellant films, and to act as stabilizers when mixed with other products; they are used widely in many different food and non-food applications.

Agar

Agars are complex, water soluble, low sulfate polysaccharides. Two types of agar are produced, one from the Gelidium genera and one from the Gracilaria genera. The gel-strength varies according to the species used. Manufacturers may use a mixture of seaweeds to obtain the gel strength they desire. Agar is principally used in foods and is widely used as a thickening agent, e.g. for jams and soups. Because agar jellies are stable up to 35°C they can be used for applications where gelatin, the most commonly used food thickener, is unsuitable. In Japan, which is a major consumer of agar, more than 60% of the agar is used as a food additive, or as agar jelly, made from a 1 to 12% aqueous solution of agar. Agar is used in canned meats and pet foods, though for this application it is being increasingly replaced by carrageenan.

Agar, in a more highly refined form, has a unique application as a bacteriological culture medium. Bacteriological agar are generally non-ionic with melting temperatures greater than 85°C and gelling temperatures of 35 to 39°C. Such high quality agar can only be made from a limited number of red seaweeds, notably Gelidium and Pterocladia (ADB/FAO 1983) Demand for bacteriological-grade agar is expected to remain strong as requirements for quality testing and health certification increases with expanded implementation of national health regulations and increasing health laboratory activities and because the seaweeds used to produce bacteriological-grade agar are in short supply. Supplies may become restricted in the future (ADB/ FAO 1983).

Carrageenan

There are three main forms of carrageenan which vary in their ability to thicken solutions and form gels. The proportions of the three forms present in the plant vary among different species of seaweeds. Two forms of carrageenan, the Lambda and Kappa types, are obtained from the varieties of seaweeds grown in Indonesia. Each type can be derived from a separate species complex within the genus Eucheuma. The two gels have very different properties and differ from the carrageenans obtained from other species of Rhodophyta. Kappa carrageenans, derived from the species referred to as E. cottonii, form warm-water soluble, brittle, rigid gels. Lambda carrageenans, derived from species referred to as E. spinosum form syrup-like gels that thicken without becoming rigid (Doty, 1977).

Kappa carrageenan, when used for gelling, has uses in low calorie jellies and desserts. They can be used as a fat stabilizing, thickening and suspending agent for pet foods, and for emulsion stabilization in non dairy puddings, artificial whipped toppings and synthetic milk. In dairy applications, they are used as a thickening and gelling agent in custards and flans and as an emulsion stabilizer in whipped cream. They are also used as suspension agents in milk products such as chocolate beverages, egg-nogs, etc.

Non dietary uses of carrageenan include suspension and activity stabilization of liquid antibiotics, for slip and bodying in lotions and creams, foam stabilization, thickening and gelling in shampoos and toothpaste, and as a coating and bodying agents in cough preparations and salves (Hansen et al, 1981).

There has been a consistent increase in the number of uses of phycocolloids, particularly carrageenan. World demand is expected to grow steadily (ADB/FAO 1983). Further, as the Indonesian economy matures and diversifies, domestic demand for these products, as for agar, can be ex^ected to grow rapidly.

4.12 SEAWEED PRODUCTION IN INDONESIA

Seaweed for phycocolloid production is obtained by harvesting "wild" populations and from mariculture; until recently the entire crop was obtained from plants growing wild. The most recently available figures show that total Indonesian seaweed production ranged from 3,156 tonnes (dried weight) in 1973 to 8,426 tonnes in 1975. Most production originated in Maluku (72.1% - 96.4% of the total, depending on the year). Production in Sulawesi was relatively minor, under three per cent of the total.

Mubarak (1960) reports that in general, the Indonesian seaweed potential is exploited without regard to the management necessary to ensure sustained harvests, particularly for those seaweeds used in the production of carrageenan. He also reports that the agarophytes have not been developed to their full potential because of "unfavorable market structures".

Although no recent data are available, mariculture of seaweeds in Indonesia for phycocolloid extraction has been expanding rapidly in the last few years (Neish, FMC, Phillipines, pers. comm.) This has been the case particularly for Eucheuma, grown for the production of carrageenans. As a consequence, demand for Eucheuma obtained from wild stocks can be expected to diminish.

Relative to mariculture of carrageenophytes, production of agarophytes, based primarily on the culture of Gracilaria, is still in a developmental stage. However, at the time of the field visit to Sulawesi, it was apparent that the elements necessary for the successful commercial mariculture of this species are being put into place and rapid expansion may be imminent.

There is one important difference between the mariculture of Eucheuma and Gracilaria. Eucheuma only grows in the open sea in shallow bays, Gracilaria can be grown in brackish water ponds.

Bali, which is not in a monsoonal area, is an important location for the production of Eucheuma because production can occur in the open sea year round. In Maluku or Sulawesi, the alternate east and west monsoons mean that production in any one area will be high for only one half of the year. The occurrence of typhoons in the more easterly areas also means that complete loss of all production (plants, securing ropes or rafts, etc.) will occur from time to time, further diminishing the attraction of open ocean maricultural activities in the Sulawesi - Maluku area. For these reasons and because of the successful development of Eucheuma production in the Bali region, the high growth rates obtained there, and its imminent introduction to other islands nearby (e.g. Sumba Island), it is unlikely that mariculture of Eucheuma would be competitive in the Sulawesi - Maluku region.

In contrast, because Gracilaria is raised in ponds (tambak) and because Sulawesi is the area of greatest tambak development in Indonesia, Gracilaria production can be expected to become important in that province.

Production of Eucheuma

Eucheuma has been harvested in Maluku and, to a lesser extent, Sulawesi, for some time. Most of the production is exported by traders based in Ujung Pandang.

Few site specific descriptions of wild Eucheuma harvesting are available. One, is that by Trono (1980) who visited sites in the Manui Island chain, approximately 45 miles NE of Kendari, Sulawesi Tengarra, where seaweed gathering was the primary activity of approximately 60 families living on Samaringa Island. In late 1950's families harvested about one tonne/week in season. The natural stocks have since been considerably reduced; in 1980, the total harvest was down to 10 tonnes. As in the Philippines, the harvesters have been severely affected by fluctuations in the price paid for Eucheuma.

Trono (1980) described three sites where he believed mariculture of Eucheuma could be successful:

- o The Northern tip of Bakuku Reef (northeast of the Island of Kokoila);
- o The Southwest portion of Taka Belantang reef; and
- o The Southwest portion of the Pangajarang Atoll.

These sites are all in the Manui Island chain. Trono concluded that the potential for Eucheuma farming was great because of the high production, the "almost unlimited space" and the importance of Eucheuma was well understood by the local people. However, past experience shows that occurrence of satisfactory growing conditions alone will not guarantee the success of such activities.

Despite trials, commercially viable mariculture of Eucheuma in the Sulawesi region has not yet been achieved. Mubarak (1980) reported that of a number of cultivation attempts undertaken at different sites within Indonesia prior to 1980, cultivation about Samaringa Island, Central Sulawesi was the most successful. Growth trials were undertaken from July 1975 to the end of 1977 by the Marine Fisheries Research Institute which concluded that the culture of seaweed around Samaringa Island would be quite profitable if it was conducted by the local community. However, a private firm "Pectin Enterprises", which had sponsored the research in 1977, withdrew because of insufficient profitability.

All government sponsored Eucheuma cultivation trials have used raft culture in which the plants are suspended in seawater; future cultivation trials planned by public agencies also plan to concentrate on this technique. The other technique used in mariculture of Eucheuma is a sea-bottom technique. Detailed descriptions of sea-culture techniques of Eucheuma are given by Doty (1973), Doty and Maxwell (1975) and Hansel et al (1981); small pieces of Eucheuma are tied to nylon ropes that are pegged along parallel lines on the sea floor. Crops are harvested approximately every two months depending on growth rates. This technique is often referred to as "open sea culture" (Rabanal and Trono, 1983). Thus, for the production of significant quantities Eucheuma suitable reef areas are necessary where wave action is not strong enough to tear the crop from the anchoring ropes. Water clarity must be sufficient and current flow should be as high as possible without actually damaging the plant (Neish, FMC, Philippines, pers.comm).

It is of particular relevance that the major amount of the Eucheuma produced in the Philippines, and now in Indonesia, is produced this way and not by raft culture. Doty and Alvarey (1975) and Hollenbeck (pers. comm.) note that when growth rates are excessive because of highly conducive environmental conditions, as occurs in raft culture, premature senescence occurs and the plant dies. Doty and Alvarez sound a salutary note of caution that "several have felt they have solved all problems through laboratory or field experiments of duration too brief to show more than the initial (growth) spurt."

Several concerns need to be investigated before any further investment in mariculture of Eucheuma in the Sulawesi or Maluku is considered. Culture of Eucheuma is rapidly expanding in the Bali and Sumba Island regions of Indonesia. It is reported that excellent growth rates are being obtained, and yields are nearly four times greater than those obtained in the southern Philippines. This production appears possible on a year-round basis. Further, in Bali it is possible to cultivate the seaweed in areas very convenient to the growers. This reduces costs and adds to the attraction of raising seaweed as a source of livelihood. For all of the above reasons, Eucheuma mariculture in Sulawesi and Maluku is not considered to be competitively viable. This is in direct contrast to the opportunities for expanded Gracilaria production.

Production of Gracilaria

The extensive area of Sulawesi tambak makes possible the development of large scale Gracilaria production without the need for large capital expenditures. Thus, if Gracilaria mariculture proves to be commercially viable, production could expand very rapidly.

Improvements in the gel yield (which is not necessarily the same as the biomass yield) may be obtained by selective growing of different Gracilaria strains. At present, one producer in Sulawesi is using a strain of Gracilaria verucosa. Other species of Gracilaria, native to Indonesia, include G. echinoides and G. gigas though exact taxonomic identification of particular Gracilaria species can be difficult (Hollenbeck, pers comm.)

Taiwan has successfully developed pond culture of Gracilaria. There, the net yield (probably dry weight) is 8 tons/ha/yr (Smith, in press). For comparison, similar yields have been obtained in Sulawesi and 40 tons dried seaweed/ ha/yr have been obtained in New Zealand (Hollings, 1985).

During the period 1973-1983, production of cultured Gracilaria in Taiwan increased from 5,060 tons to 9,698 tons, and in value from $55/ton to $993/ton. (Smith, in press) However, much of this production may have been for direct human consumption and so direct comparisons may not be meaningful. Although Smith in his citations is not explicit, these revenues would appear to be for dried weights. The Taiwanese costs and earnings figures tabulated by Smith, are the only financial analyses of pond produced Gracilaria that are available. They will not apply directly to Sulawesi, where several of the costs cited for Taiwanese production e.g. weeding and fertilizer, are not incurred. Smith reports that Gracilaria production in Taiwan has been found to be more profitable than milkfish culture, the traditional pond culture activity.

Costs and potential earnings associated with Gracilaria production in Sulawesi Selatan are not available for several reasons. However, it is claimed that by growing Gracilaria instead of rice, farmers can double their monthly income from Rp 15,000 to Rp 30,000.

Although mariculture of Gracilaria has been the primary objective of groups in Sulawesi they recognize that seaweed polyculture with shrimp will be a preferable activity. Informal reports indicate that Gracilaria and shrimp polyculture involves no sacrifice of yields of Gracilaria; rather yields of both the shrimp and the seaweed are improved. It has been suggested that shrimp remove epiphytes from the fronds of the Gracilaria and enhance nutrient levels in the tambak ponds. The Gracilaria, for its part, appears to "condition" the pond water, at least by assisting in oxygenation and in providing a habitat for the shrimp. There is little doubt that shrimp / Gracilaria polyculture is practical and will be undertaken in the future as the ability to market Gracilaria improves.

Events in Taiwan give some indication of what may be expected in Sulawesi. In Taiwan in 1973, 64% of the area used for growing Gracilaria was in a monoculture system but by 1983 all brackish water ponds were devoted to shrimp/Gracilaria polyculture. Smith (in press) reports that these farming activities resulted in an "extremely high rate of return o: initial capital investment." Although the field mission did not locate any such polyculture activities in Sulawesi, polycultural practices can be expected to develop.

Few restrictions on mariculture of Gracilaria were apparent in Sulawesi Selatan. Extensive tambak areas seem to be available and not involved in active cultivation. Private companies, active in Sulawesi/Selatan, are able to provide seed material, working capital, production advice and act as buyers, or marketing agents, of Gracilaria for the tambak farmers. Almost all commercial organizations that were contacted indicated that availability of capital for funding was not a constraint on development of projects which were financially viable. The main problem to be resolved in the expansion of agarophyte production is a satisfactory development of market linkages sufficiently remunerative to the producers.

Gracilaria producers in Sulawesi/Selatan have two marketing options:

- o to sell the dried weed, or partially treated product, to foreign producers, or

- o to process the product.

The success of processing, an optimal long-term objective, will depend on the rate at which a sufficient level of Gracilaria production can be achieved, the installation of processing facilities and the acquisition of the expertise required to process the dried Gracilaria. Also, satisfactory marketing arrangements must be established. Acquiring the process technology and expertise may best be achieved through foreign assistance, for example, with either a joint venture, a licencing arrangement, or direct purchase of the necessary technical knowledge, aided, possibly, through a consultation or technical assistance arrangement.

Conclusion About Seaweed Resource

The potential for tambak aquaculture of Gracilaria in Sulawesi Selatan is very significant. Already the area planted to Gracilaria has been expanding steadily. A small secondary processing plant commenced operating in Marros in 1986. There is potential for other secondary processing facilities and even tertiary processing at a later date. However, aquaculture production of seaweed is beyond the scope of this assignment.

5.0 THE PRESENT SITUATION AND POTENTIAL OPPORTUNITIES

5.1 FISH LANDING SITES

Of the fish landing sites inspected, only a few have basic facilities to assist with the unloading of fish and the servicing of boats. Basic infrastructure for the artisanal landing areas is almost totally lacking. Most sites do not have a jetty or boat ramp for use by the fishermen, nor do most sites have a water supply, workshops, boat ramps, supply of ice or electrical power supply.

With few exceptions, in the larger towns, the landing sites are located on a sand or gravel beach with no facilities. Landing places were generally unused. In all of South Sulawesi only four communities had fish landing places in use: Sinjai, Bulukumba, Palapo and Ujung Pandang. Fish are unloaded manually using baskets and carried to buyers or vendors at the local market. Some of the buyers take the fish, usually in metal lined wooden boxes, and transport it via trucks and motorcycles for sale in other population centers.

Although there are small ice making facilities located in various communities in Sulawesi and Maluku, many of these plants (of 1 to 6 tons per hour capacity) are underutilized. Fisherman and fish traders generally do not use ice. Fishing activity is lower and fish spoilage is higher than warranted due to the lack of, or shortage of, ice and its improper usage. Fish spoilage occurs, also, because of the lack of insulated storage rooms.

Fishermen experience delays resulting from repair work done to vessels in the absence of slipways or boat ramps; most repairs are done on the beach. Some fishermen carry their outboard motors home for security reasons. Time is lost in obtaining fuel because fuel is not stored at the landing site.

5.2 DOMESTIC FISH MARKETING AND DISTRIBUTION

Facilities

Several fish markets were inspected. Methods of handling, displaying and selling the fish were, for the most part, primitive and unsanitary. Many of the markets had only dirt floors where fish was displayed directly on the ground. Only a few markets were equipped with concrete isles and drainage facilities. Cutting boards were either non-existent or badly worn. In the latter case, usually wooden and ripe for the collection and retention of bacteria. No provisions were available for clean water or wash-down of stall areas and very few markets had elevated display/cutting surfaces.

Fish auction places, which provide centralized collection points for the selling of fish, collection of fish landing statistics and the collection of municipal taxes are managed by municipal governments. Consequently, there is no uniform auction, recording or taxation system. Further, many auction places have no weigh scales and others do not weigh and tax small catches. Hence, there may be a significant under-estimate of actual landings in the fisheries statistics.

Municipal fish markets are generally in very poor condition and generally have no water or electricity, no garbage disposal facilities, are poorly drained, and lack ice or insulated storage facilities. The unsanitary conditions contribute to rapid deterioration of freshly-landed fish.

Other factors which combine to reduce fish quality include:

- o non-use of ice by many fishing vessels;
- o high cost of preserving and transporting fresh/frozen fish within the existing infrastructure network;
- o improper ice use, packing and insulation methods during fish transport; and
- o general lack of any fresh fish preservation at most retail markets.

Available facilities are less than adequate to provide for proper handling, preservation and market distribution of the large volume of fish traded in the domestic market. Post-harvest loss of fish throughout the country is considered to be substantial.

The present distribution of ice plants, cold stores, freezing plants and refrigerated transport facilities is inadequate to stimulate improved fish handling methods or the distribution of fresh/frozen fish to urban markets, particularly in Java. Nearly all of the large volume of fish currently transported to supply-deficit Java is in cured form (salted, dried, smoked, etc.). Refrigerated fish facilities around the country are utilized primarily for export products ADB, (1984).

Fish handling

Fish dealers sometimes bring or purchase blocks of ice at fish landing sites for their own packing requirements. However, ice when used, is often not used correctly, for example it is insufficiently crushed and thus does not have its desired cooling effect. Similarly, fish transport containers are seldom equipped with sufficient insulation and are commonly ill-designed for the usually long trips from fish landing sites to markets. Retail market vendors generally do not use ice to preserve fish on display, so cultivating the belief commonly held among consumers in Asia that fish displayed on ice is "old" stock requiring ice because it was left over from the previous day.

The existing domestic fish market in Indonesia is characterized by a very large number of very small traders working with limited capital and often no fixed assets. Trading arrangements between traders in the market are usually informal and often ad hoc. (UNDP/FAO 1986)

Market co-ordination between stages in the fish marketing chain is usually lacking. Several issues arise which have a major bearing on the quality and reliability of supply and prices received. Issues include:

- o lack of market and price information;

- o short shelf-life of products;
- o low volumes of fish traded, and, hence;

- o exacerbated difficulty/cost of inter-regional trading in fish.

Consumption

The key factors affecting domestic demand for fish are a combination of: population, per capita income, price of fish (domestic and export), price of fish substitutes, and tastes and preferences. Information on most of these variables is not available and previous economic analyses have assumed average figures. Projections are, however, available on population growth. Indonesia's population is expected to grow at an annual rate of 2.2% to an estimated 183 million people by 1990. Over the same period, per capita income is expected to grow at a rate of 0.8 per cent.

Recent estimates of per capita monthly expenditures indicate that fish is a more important commodity than meat, particularly for low income Indonesians. Although it is uncertain what the economic outlook for total per capita income will be during the rest of the 1980's, it is safe to assume that slight improvements in real personal income will occur. Expenditure elasticities indicate that income increases will lead directly to the increased consumption of fish. The ADB (1984) expects per capita demand for fish to increase at an average rate of 5.47 per cent annually to the mid nineties.

The annual per capita consumption of fish & fishery products was estimated by the DGF to be 12.8 kg in 1982. Fish production would have to increase by about 2.3 per cent annually just to keep pace with the population growth; this would mean a potential demand for fish of about 2.1 million tons by 1990 and at least 2.8 million tons by the year 2,000 at the current level of per capita consumption of fish and fish products. However, the expected growth in disposable income, would suggest a higher demand for fish. The average per capita monthly expenditure on fish was about Rp 710 in 1981, but the highest per capita monthly expenditure on fish was made by the higher income groups (Rp 30,000 - Rp 40,000 monthly income) ADB (1985). Thus, as incomes rise, fish consumption can be expected to increase though the income effects on fish demand are not clear.

For these reasons, the per capita consumption of fish and fishery products has been conservatively projected to reach an average of 18.0 kg per capita per annum in about 1990. Nationally, this would imply a total consumption of about 2.9 million metric tons in that year. Even at an annual increase in per capita income of only 2 per cent, domestic demand for fish would reach 2.5 million mt by 1990. Failure to augment domestic fish supply to meet expected demand requirements will almost certainly lead to an increase in real prices of fish, affecting low income groups severely (ADB, 1984). If this were to come from domestic sources, a number of issues must be addressed, for example, improvements to marketing and distribution effort and support for increasing production and to make the produce available to consumers.

5.3 DOMESTIC TRADE IN FISH

The major components of Indonesia inter-island trade involve the 'export' of fish and fish products from Sumatera Selatan, Kalimantan, South Sulawesi and Bali-Nusa Tenggara to Java. These 'flows' have developed due to the demand on Java and the costs of transporting fish which make it commercially impossible for Java to 'import' fresh fish from provinces further away.

Big price differences from one region to another are observable for nearly all fisheries products. This points to the inadequacy of the present marketing system and the need for a well conceived investment program with increased emphasis on private sector involvement and Government support, (ADB, 1985).

The size of Java's population and the relatively low level of Japanese fish consumption suggests considerable market potential. Opening of the Java market to fishermen from areas where resources are abundant relative to local demand would increase employment and income opportunities in producing areas, expand utilization of available resources, and increase the supply of high quality protein to consumers on Java.

Both fresh and salted, dry fish enters Java from Sumatera and Kalimantan. Small quantities of dried fish are shipped to Java from Nusa Tenggara Barat. It appears that shipments of fish from South Salawesi to Java have declined over the past decade. However, the full extent of inter-provincial trade in fisheries products remains unknown. Further, no evidence of significant shipments of fish from Maluku to Java exists despite the considerable potential for such trade (USAID, 1985)

In examining the feasibility of encouraging development of inter-island fish trade, it was discovered that a small number of wholesalers exert control over domestic marketing of fresh and dried fish on Java by controlling distribution of fisheries products from the point of supply to the retail outlet. Potential competitors, including government sponsored cooperatives and private traders, have been forced out of the Java market by price manipulation, limiting the access to auctions, and even the threat of violence (USAID, 1985).

The marketing system is dominated by a network of intermediaries who collect and assemble marketable quantities of demand-specific products. Past actions suggest that wholesalers will attempt to frustrate the creation of new trading patterns outside of areas where long-established relationships with local buyers provide them with a high degree of control.

The potential problems to be faced in developing inter-island fish trade are enormous, but so are the opportunities for improving employment and real incomes.

The proportion of the catch destined for marketing as fresh or processed fish varies depending on physical location fo. the landing points in relation to consumer markets. For example, a variable but generally high proportion of the catch landed outside of Java is processed before it enters the marketing and distribution system, while on Java the bulk of the catch is sold as fresh or fresh-iced product.

Conditions affecting supply and demand for fresh and processed fish on Java differ markedly from those elsewhere in Indonesia due to the presence of numerous large urban centers and greater population densities, even in rural areas surrounding small scale fishing communities. Moreover, there exists on Java a relatively well developed road system which facilitates the rapid shipment of fresh iced fish from major fishing ports to Jakarta, Surabaya, or other urban centers of demand.

Where road systems are not well developed, for example in Sulawesi and Maluku, communities depend in most cases on fishermen from the immediate area for supplies of fresh fish. The absence of roads or their poor condition inhibits the rapid transport of highly perishable fish between more isolated fishing communities and coastal or inland population centers.

Post harvest-handling and marketing presents severe constraints to Sulawesi and Maluku fishermen. There are inadequate outlets for production and local markets are subject to extreme fluctuations in supply and price (Watts and Watson, 1983). Most fishermen say that they could catch more fish if they had somewhere to sell it.

Constraints to the marketing of production from traditional fishermen include long distances to market for non-motorized boats, low volume and irregular supplies, absence of ice or cold storage facilities, lack of knowledge about efficient fish processing and poorly-maintained, overcrowded municipal markets. Improvement in the handling, marketing and distribution of fish would be one of the most effective ways to assist traditional fishermen.

South Sulawesi has both the highest production and average fish price of the four Sulawesi provinces, which suggests an unsatisfied internal market demand. Conversely, Southeast Sulawesi has the lowest average fish price as a result of insufficient market outlets for excess production, and has a poorly developed fishery (Watts and Watson, 1983).

Intra-provincial distribution of fish is normally carried on without ice or cold storage. Even so, where road communications are good, as in South Sulawesi, fish may be transported the same day up to 150 km from the landing place by motorcycle. One reason for the limited use of ice is its price (50 Rp/kg), this, across most of Sulawesi, often combined with low fish prices, makes the use of ice uneconomic for most traditional fishermen. Inter-island trade is mainly for salt-dried fish and nonexportable grades of frozen skipjack and tuna from Ujung Pandang and Kendari.

Currently, fishermen have little market information on which to base production and marketing decisions. Artisanal fishermen are dependent on wholesalers for setting prices and they do not know what the value of their product is. Increased availability of market information might improve the operational and pricing efficiency in the market place. Better market information would assist fishermen when negotiating a "fair" price for their product through fish marketing cooperatives. Similarly, tambak producers could benefit through better market information on which to base decisions about when to drain their ponds and harvest their product to achieve optimal sales revenue.

5.4 FISH PROCESSING AND STORAGE

The present distribution of ice plants, cold stores, freezing plants and refrigerated transport facilities is inadequate to stimulate improved fish handling methods or the distribution of fresh/frozen fish to urban markets, particularly in Java. Nearly all of the fish transported to supply-deficit Java is in cured form (salted, dried, smoked, etc.). Refrigeration facilities around the country, as well as much of the fish, are utilized primarily for export products. An improvement and expansion of these facilities will be required to stimulate changes in present fish handling distribution practices as well as to cope with future production growth and expanding export opportunities (ADB, 1984).

Within the study area freezing and cold storage facilities are located only in Ujung Pandang, Kendari and Ambon. Another, located in Ternate, is believed to be closed due to financial and managerial problems.

A government edict requires companies which construct fish processing/packaging facilities to also construct cold storage rooms. As a result, there is an excess capacity of cold storage rooms over the entire study area. Many of the cold rooms that were inspected were either completely empty or filled to less than half capacity. Estimates of utilization factors varied from 20% to 50% of installed capacity. Cold storage facilities in the study area are listed in Exhibit 46.

Of the cold storages inspected, with the exceptions of two skipjack and tuna fishing companies, all were being used for storing frozen shrimp. Temperatures of storage varied from site to site but were generally adequately maintained in the range -10°C to -20°C. Cold stores were generally well managed. Operation of entry doors, provision of air curtains and ante-rooms were according to good practice. Product was being stored away from walls and ceilings and good packaging practices were being followed. In some cases, frozen product was conveyed into the cold room through hatch doors. This concept reduces the influx of warm moist air into the cold storage, thus reducing product deterioration and refrigeration load (due to fluctuating temperature).

A small public cold storage (20 tonnes) located in one of the public fish markets in Ujung Pandang (Rajawali market) had been inoperable for several years due to lack of maintenance and spare parts.

EXHIBIT 23: COLD STORAGE FACILITIES IN EAST INDONESIA, 1987

Company	Commenced	Product	Capacity [1] Freezing(t/hr)	Cold Store(t)
Sulawesi Selatan				
Dataran Bosawa	1984	shrimp	4.0	140
PT Serdid	1970	shrimp	7.5	350
Bonecom	1968	shrimp	2.5	230
PT Marco Makasar	1979	shrimp, fish	10.0	300
CV Sentosa Trading	1981	shrimp	1.6	100
PT Mitra Kartika Sejati	1975	shrimp	7.0	140
Sulawesi Tenggara				
PT Dharma Samudra	1982	fish	20.0	200
PT Perken	1979	skipjack, shrimp	18.0	1,000
PT Mina Fajar Raharja		shrimp	n/a	n/a
Maluku				
PT Nusantara Fishery	1970	shrimp	1.0	100
PT Maprodin	1968	shrimp, fish	45.0	50
Perum. Perikanan	1976	skipjack	26.0	1,000
East Indonesian	1974	skipjack	n/a	400
PT Mina Kartika	1973	shrimp, fish	n/a	100
PT Daya Guna Samudra	n/a	n/a	n/a	n/a
Irian Jaya				
PT West Indonesia	1970	shrimp	n/a	100
PT Dwi Bina Utama	1975	shrimp	n/a	100
PT Usaha Mina	1973	skipjack	50.0	1,300
PT Alfa Kurnia Fish	1973	shrimp, fish	n/a	100
PT IMPD	1970	shrimp	4-5	100
PT Minapura Maya	1985		1.0	20

Sources: DGF, Kumpulan Inventarisas: Unit Pengoloahan Hasil Perikanan di Indonesia, 1985/86 and Field, 1987.

Note: 1) The DGF has indicated here and elsewhere, and field visits confirmed, a large proportion of used cold store capacity.

Ice making facilities are located within most of the cold storage plants in Ujung Pandang. There is an ice plant with one processor in Kendari but, with the exception of Kolaka, commercial ice making equipment is virtually non-existent. Small scale ice making is carried out in some of the villages using home freezers.

All ice making equipment inspected in Ujung Pandang, Kolaka and Kendari produced block ice where the water is frozen inside molds immersed in refrigerated brine solution. One flake ice machine was inspected at a fishing village near Pare Pare. This machine had been inoperable for some time due to lack of parts and administrative problems.

Fish freezing facilities exist only in Ujung Pandang and Kendari with cold storage companies. These, generally of the contact or plate freezer type, are used primarily for freezing shrimp for export. The installed capacity is about adequate for the existing production. A few blast freezers were also inspected.

Some fish processing: de-veining, heading, grading, packing and freezing of shrimp is being carried out on shore by several companies in Ujung Pandang and in Kendari. Very little other industrial processing is done within the study area but small-scale salting, drying and smoking is carried out in most fishing districts.

Very little processing is carried out in Ambon. Since shrimp trawling is still permitted in the Arafuru Sea, freezer trawlers are used. Shrimps are de-headed, graded and packaged, at sea, ready for export.

One company in Ambon operates freezer vessels and cold storage capable of storing tuna at -50°C for the Sushimi market.

5.5 LICENSING AND TRADE REGULATION

A number of licenses are required by companies which wish to establish in the field of marine product processing and trade. The required procedures and types of licenses are outlined in Appendix H-1 along with the trade regulations which apply to marine product processing and trading companies (Appendix H-2). Examples of applicable import tariffs are shown in (Appendix H-3).

The interaction of regulatory policies, which affect the export, import, licensing taxation and restriction of trade in marine products, is illustrated below in Exhibit 47. The entries in the matrix refer to the sections described in Appendix H.

5.6 FISHING VESSEL CONSTRUCTION

Almost all fishing vessels in the study area are built with wood at local beaches and slipways, particularly for the artisianal fishery. Vessel construction is of major regional and local significance, particularly in several coastal communities specializing in this activity. There are few, modern/efficient fishing vessels and the private and public sector fishing companies that were visited have a requirement for more vessels in order to increase fish harvests. One company plans to build fibre-glass fishing vessels (for its own use) in the near future.

EXHIBIT 24: INDONESIA REGULATION OF TRADE IN MARINE PRODUCTS AND MARINE INDUSTRY INPUTS (1987)

	TRADE REGULA-TION (1)	TARIFF POLICIES (2)	FOREIGN INVEST-MENT (3)	FOREIGN EXCHANGE (4)	TAXATION (5)
EXPORT PRODUCTS (a)	1.a	n/a	3.a	4.a	n/a
IMPORT PRODUCTS (b)	1.b	2.b	3.b	4.b	n/a
IMPORT INDUSTRY INPUTS (c)	1.c	2.c	3.c	4.c	n/a
TAXATION (d)	n/a	n/a	3.d	n/a	5.d
RESTRICTION (e)	n/a	n/a	n/a	4.e	n/a
LICENSES (f)	1.f	n/a	3.f	n/a	n/a

Note: For example, column 1, row a, (1.a), means that trade in export products is regulated (see Appendix H for details).

Present Vessel Building Activities

Wooden boats are built at a number of sites in the study area, particularly in Sulawesi Selatan, but the single most important centre for new vessel construction is at Tanarlemo, east of Bulukumba. At the time of the mission's visit, 86 hulls were under construction ranging in length from 4 to 50 metres (LOA). Details of vessel characteristics are given below. An equipped, open decked seiner with an 18 to 20 hp diesel motor and carrying a crew of 15, cost about Rp's 9 million in early 1987 (engine Rp 2 m, net Rp 5 m, boat Rp 2m).

All types of vessels, cargo boats and fishing vessels, built at this site follow the traditional style, with a rounded hull, particularly athwartships, but also running up to the bow.

EXHIBIT 25: CHARACTERISTICS OF SOME VESSELS UNDER CONSTRUCTION IN TANARLEMO, SULAWESI

LOA (m)	Beam (m)	Depth (m)	GRT	Engine (hp)	Cost (Rp.m.) (1)
50	12	4	300	150 (2)	60
15	3.4	-	20	22	-
16	4	1.75	20	22	4
30	9	4	250	150	40

Note: (1) Cost in millions of rupiah not including engine.
(2) Sails also.

Vessels are constructed with ironwood keels and skegs, with the hull and superstructure built with a local hardwood - Vittex spp. This wood is reported to have a life of about 20 years but quality wood is sometimes difficult to obtain at reasonable prices (ADB, 1983). There was no sign of any use of power tools to assist construction, even some planks were sawn by hand. Construction techniques tended to be opportunistic in respect to use of wood, particularly for ribs, whose position when fitted tended to be dictated more by their shape than by a design requirement for rib spacing. Planks were primarily fixed by pegs, but galvanized iron bolts were also being used.

The ADB (1983) noted 26 that yards in Indonesia built steel-hulled vessels and a large number of smaller yards produce wooden vessels. Of the yards building in steel, 14 can build vessels larger than 200 GT, and 3 can build vessels larger than 10,000 GT. Most of the experience of these yards is in building coastal freighters and work boats. The ADB commented that substantial technical assistance would be insert exhibit 46 required to build quality steel-hulled fishing vessels, particularly if the vessels were to be used in offshore fisheries.

Skipjack pole-and-line vessels up to 100 GT have been built at Semarang and Surabaya. Yards in Jakarta and Ujung Pandang are reported to have had experience in building with glass-reinforced plastic, and such a yard is under construction by Pt. Perkin in Kendari. Within the study area, boat building and repair facilities are located in Ujung Pandang, Bulukumba, and Kendari. Motor repair facilities are available in Ujung Pandang, Bitung, and Kendari.

Although shipyard repair and service facilities are located at major ports throughout the country delays in repairs have been frequent and costly because of overload of service facilities. The ADB (1983) felt that there should be opportunities for further investment in this sector.

Recommendations of Previous Consultancies

It has been concluded consistently by previous studies that the traditional vessel designs (the basis of the artisanal fishing fleet) are deficient in a number of operational characteristics and wasteful of materials. Vessel handling, safety and efficiency could be enhanced by adopting improved vessel designs. However, there may be market resistance to adopting new designs, particularly through private sector initiative alone.

Several past projects have attempted to improve vessel design and construction. The FAO (1985) found that it was not possible to find people who had both the theoretical knowledge of boat construction methods and the practical skills necessary to build boats. The FAO claimed that boat builders had no idea of the basic principles of framing, planking, caulking, selecting and utilizing the properties of fine timbers, or ensuring their longevity. In support of this contention, many derelict boats, 5 to 10 years of age, were found with sound wood, but with irreparable damage to their seams.

In a subsequent FAO study, Coackley (1986) came to the following conclusions regarding vessel construction in Indonesia:

- craftsmanship is high but technical appreciation is low;
- wood is becoming difficult to locate and is always used unseasoned (consequently planks are unstable and leak frequently);
- large variations in caulking techniques occur (again there are leakage problems);
- boatbuilding is undertaken with an attitude of low first cost (and low quality of vessel construction); and
- vessel designs favour a keel with no rocker, the stem leaving the fore end at a sharp angle giving a hollow forefoot, and all edge fastened planked vessels are framed after planking by using natural crooks or knees with their change of direction at the keel and not at the chine, (this results in dished hulls with slack bilges and little stability until well loaded).

Coackley (1986) noted that there is a copying of styles passed down or seen elsewhere without a technical appreciation of why shapes of structural members should be so. He noted that the high degree of craftsmanship evident was rendered less effective by poor tools and no understanding of the basic principles of naval architecture. The common construction deficiencies listed by Coackley in boatbuilding practices were echoed by an expatriate naval architect stationed in

Surabaya (Mr. Peter Ellerich), Thus, it is apparent that vessel design deficiencies are not simply limited to one region.

A fisheries development in Gora constructed a basic vessel, of 14 metres LOA, waterline length 12.5 m, and beam 4.8 m. The vessel capable of 8 knots, had a 220 HP Perkins engine, derated to 110 h.p. This vessel design would have a hold capacity of 22 to 25 m^3 which, after insulation, would be 19 m^3, sufficient to enable 3.5 tonnes of fish, boxed in ice, or up to 10 tonnes in bulk to be carried. Deck equipment included a net roller. The estimated cost was Rp 35 to 40 million. This vessel development program was sponsored by a European aid agency with vessel design assistance from Australia (Ellerich, pers. comm.).

Potential Development of Vessel Construction

Two ways to develop the local vessel construction industry include:

a) upgrading and expanding the present vessel construction activities, and/or

b) developing new shipyards that use 'modern' techniques and work in steel or fiberglass.

Further development of present expertise (to supplement existing entrepreneurial and artisianal skills) may contribute more social and economic benefits to communities than 'modern' industrial activity that tends to concentrate in urban centres. To be effective, such a program should meet a number of development objectives:

- encourage economic development outside of urban centres;
- encourage and upgrade the existing skilled and motivated work force;
- introduce vessel designs that are an evolutionary development of existing boats (this is important as fishermen are slow to adopt radically new designs or techniques); and
- produce competitively priced boats by adopting efficient construction techniques and vessel designs.

Many of the elements of such a development programme could be included more appropriately in a socio-economic development program rather than an industrial development program because so many of the program elements would be difficult to implement or audit in a normal commercial manner. For example, implementation of new techniques or designs may depend on persuasion or example.

5.7 POTENTIAL OPPORTUNITIES

Seven opportunities are identified below for the improvement of marine resource handling, processing and distribution. These opportunities would be linked together within a development framework designed to facilitate gradual implementation over a three to five year period.

Following this chapter, the processing of the resources and the feasibility of implementing the suggested projects is discussed in depth.

a) LANDING SITES

The majority of fish landings in Indonesia are made by small-scale, artisinal fishermen. Therefore, improvements in the artisinal fishery would affect significant increases in fish landings and the quality and distribution of fish for local consumption.

Improved facilities and infrastructure are needed urgently at most of the fish landing sites if fisheries development is to be a government priority.

Provision of jetties would make loading and unloading easier. Installation of ice making and ice storage equipment would reduce losses, facilitate wider marketing and distribution, improve quality and improve fishing productivity (the fishermen would be able to take longer fishing trips). Further, if internal transportation were improved, for example improving East-West roads, it would be possible for the West coast of Sulawesi, when in Monsoon to be served with fish from the East coast, and vice versa.

The provision of on-site fuel storage and water supply would mean less time in getting ready for a fishing trip. Most of the artisinal fishermen maintain their own boat motor and fishing gear. Fishermen's facilities such as engine and gear lockers and workshops with proper tools, would enable fishermen to store gear and maintain motors on site. A boat ramp or slipway would make possible an increase in productivity in the maintenance and repair of boat hulls. With proper facilities near moorings, more time would be available for fishing.

Local Markets

All retail markets can be improved in one way or another. The primary objective would be to improve fish handling methods in order to reduce fish spoilage. Arrangements should include properly constructed fish stalls using impervious surface-finishing material (such as ceramic tiles) and with floors sloped to drains. Display/cutting tables should be elevated: A supply of potable water to clean the fish and hose down the stalls is very important; also, clean ice should be available.

The recommended improvements to fish landing sites and the retail markets, would be relatively inexpensive. Improvements to storage and distribution could be expected to be higher in cost. The benefits, though difficult to quantify, would include improved quality, potentially more evenly distributed prices throughout the year, provision of fish to wider geographic areas, increased demand for fish and improved diet.

b) ICE MAKING

There is widespread need for more ice in most of the areas visited. Observations were made of fish being stored, sold and transported without ice. Fish quality was often poor. The proper use of ice would extend the shelf life of all fish and fish-products several-fold. Also, ice used properly enables the potential size of the distribution network to be extended geographically. Over time, the increased quality and reduced losses through spoilage would enhance the viability and profitability of the fisheries sector.

Small ice machines could be located at each major fish landing site. Ice would be used potentially on fishing boats, for on-site storage, in fish markets and when fish is transported. There is a growing awareness, among fishermen, of the benefits to be obtained from ice usage.

Small ice machines could be located at each major fish landing site. Ice making capacity would be determined by expected usage by the boats, for on site storage, fish markets and when being transported.

c) STORAGE AND DISTRIBUTION

Improvements, needed in the storage and distribution systems, would relate closely to landing site and market improvements. The establishment of chill rooms (insulated rooms) at each landing site and the use of insulated boxes for transporting/storing fish and ice would reduce losses, improve quality and lengthen shelf life (thereby increasing the potential distances for transporting the fish).

Some organized, scheduled routing of insulated trucks would assist the fishermen in disposing of their catch. Improvements in roads are needed in some areas (such as the road from Majene to Mamuju in South Sulawesi and from Kendari to Kolaka in Southeast Sulawesi).

d) CANNING OF TUNA

The skipjack and tuna industry in Indonesia appears to be controlled by the Japanese markets and Japanese technology. Pending the completion of the market analysis, there may be an opportunity for a cannery. Pare Pare was investigated for potential sites for an integrated fish processing plant. Suitable sites are available in Pare Pare. Pare Pare is not only near to the resource but also has most of the necessary infrastructure.

The port development proposed for Pare Pare (to be funded by the ADB) would provide an ideal location. However, steps should be taken immediately to ensure that space is made available for a potential canning plant.

Alternatively, another area just South of Pare Pare may be suitable. Preliminary investigations have been carried out for a 10 tonnes/8 hour unfrozen skipjack/tuna cannery and a 20 tonnes/8 hour frozen skipjack/tuna cannery. Equipment layouts and cost estimates of each plant are being prepared.

e) FISHMEAL PRODUCTION

There is currently a strong and growing demand for fishmeal in Indonesia. In addition to the relatively stable demand for fishmeal in the poultry and livestock feed industry, new demand is building rapidly to supply the requirements of tambak "farmers" who feed shrimp on pelletized food containing a high proportion of fish meal. A relatively new industry is beginning to produce the required pellets. These pelletizing plants use large quantities of fish meal, most of which is currently imported from South American countries (Peru, Chile, Argentina and Brazil).

A fishmeal plant could utilize the by-product offal generated by the proposed cannery. Although fishmeal plants can be purchased with a capacity as low as 200 kg/hour, a plant of capacity of at least 500 kg/hour would be preferable in order to obtain a good quality product. A fishmeal plant of 500 kg/hour capacity would correspond roughly with the offal generated from a 10 tonnes/8 hour canning plant. Further, additional raw fish resources may be available as by-products from the shark-liver oil extraction activities practiced along the coast North and South of Pare Pare.

f) SHRIMP PROCESSING

Chapter 4.0 indicated that marine shrimp harvest levels were at or near the MSY. Thus, there is very little opportunity for expanded processing of marine shrimp. Further, current processing facilities are underutilized.

There is, however, potential to produce more shrimp in Sulawesi tambak than are currently harvested from all of the seas of Eastern Indonesia. Should this production potential be realized, further processing facilities would be required, particularly in areas of tambak concentration which are away from the centres where current shrimp processing facilities are located.

The study team is of the view that tambak shrimp aquaculture is of relevance to this study but unfortunately such considerations are outside of the terms of reference.

g) SEAWEED PROCESSING

The consulting team observed a growing interest in the primary and secondary processing of two species of seaweed - Gracilaria and Eucheuma. These seaweed plants are ultimately processed to produce agar and carrageenin respectively. Although there appears to be considerable potential for Eucheuma production in the sea off Bali and NTT, there is very large potential for Gracilaria production in the tambak of Sulawesi Selatan. The industry in Sulawesi is in its infancy but there is increasing private sector interest in Gracilaria production and processing.

Production, processing and market development would be undertaken best by the commercial enterprises involved in Gracilaria production. However, current enterprises, though energetic and progressive, have not yet reached a stage where they could make a strong marketing thrust. The optimal development of this industry could involve an initial stage in which efforts were concentrated on production, with the economic benefits of secondary and tertiary processing delayed until the position of Sulawesi as a supplier of material has been established firmly.

The study team is of the view that there is considerable potential for the expansion of Gracilaria production in Sulawesi tambak and for the expansion of Gracilaria processing. However, further consideration of these possibilities lie outside of the terms of reference.

5.8 MARKETS FOR POTENTIAL PRODUCTS

For the potential projects identified, we are concerned principally with five markets:

- o export canned tuna
- o export frozen shrimp
- o export seaweed and seaweed products (not covered by Terms of Reference)
- o local fishmeal
- o local fresh fish

Separate sections are set out in Chapter 7.0 below on each of these markets. Before presenting them however, several general market and marketing factors are discussed.

6.0 WORLD MARKET FOR SHRIMP, TUNA AND FISHMEAL

6.1 WORLD SHRIMP MARKET

Supply and Demand

> "Prospects in the international market in the 1980's appear to be bright for frozen shrimp, which has traditionally dominated Indonesia's seafood exports. Recent developments in the international shrimp market have confirmed a strong world demand and attractive prices for frozen shrimp till 1990..." (ADB, 1984).

Shrimp is one of the most important products entering world fisheries trade (20% of global trade in fish products). Demand remains strong and has kept pace with the World production increase of 72% from 1.08 million mt in 1970 to 1.86 million mt in 1985.

The three major shrimp markets, Japan, USA and Europe, together absorb about 50% of the total world production.

Tropical marine shrimp, the focus of this report, are the principal species entering world trade channels and represent the major part of the shrimp market in Japan, USA and Southern Europe. Coldwater shrimp are preferred in Northern Europe and, hence, are a major factor in the European market. Freshwater species are of only minor importance in world trade.

Shrimp are harvested principally by fishermen but a small, increasing percentage of world production is cultured. The World catch of shrimp in 1985 was 1.86 million mt, live weight; of this amount, probably less than 0.1 million mt was produced in culture operations. The remainder was caught by fishermen, principally by trawling, with smaller quantities taken by canoes, traps, weirs and other fishing gear.

Shrimp culture, now a commercial reality, is showing rapid growth in some countries of Latin America and the Indo-Pacific region. Further, any future growth in supply of tropical shrimp must come from culture operations, since boat catches are not expected to show any substantial increase.

Shrimp is marketed principally in frozen form. Smaller quantities are traded live, fresh, canned and dried. The primary product form is raw headless with the shell on. Other forms include whole with the head on, and peeled, both raw and cooked.

The World supply of shrimp increased rapidly in the seventies, from 1.08 million mt in 1970 to 1.62 million mt by 1977. Catches remained relatively stable until 1981, when they began to increase (see Exhibit 26). There are no separate statistics for aquaculture production included in the total world catch shown below, but it is thought unlikely that shrimp farming accounts for more than 7% of total world supply at this time. However, the increase in world production since 1982 is probably due chiefly to the rapid expansion of tropical aquaculture projects especially in Latin-America and the Indo-Pacific region. Also, it has been partially due to heavy catches of coldwater shrimp by Norway and other North Atlantic countries.

EXHIBIT 26: WORLD CATCH OF SHRIMP, 1970 - 1985

(million mt, live weight)							
1970	1975	1980	1981	1982	1983	1984	1985
1.08	1.31	1.65	1.63	1.70	1.76	1.81	1.86

Source: FAO, Fish Data, October 1986

The strong trend of increasing production of tropical cultured species is likely to continue. Coldwater species, on the other hand, grow much more slowly than tropical shrimp and have in the past been the subject of rapid build-up in catches followed by equally rapid decline. The North Atlantic stocks may now be at maximum levels of exploitation; catches in Norway dropped sharply in 1986.

Preliminary figures published by the FAO for catches of shrimp in 1984 by major producing countries are shown in Exhibit 27.

EXHIBIT 27: SHRIMP PRODUCTION BY MAJOR PRODUCING COUNTRIES, 1984

Country	Production (000's mt, live weight)	Share of World Catch (%)
India	207.3	11.2
China[1]	207.1	11.2
Thailand	175.0	9.4
USA	136.0	7.3
Indonesia	127.0	6.6
Norway	83.6	4.5
Mexico	76.1	4.1
Malaysia	70.1	3.8
Brazil	63.3	3.4

Source: FAO, Infofish, Marketing Digest, 3/86.

1 The statistics for China provide no individual figures for Taiwan, whose production would place it among the top 10 producing nations.

Imports of shrimp by principal market countries increased an average of 55% in volume (332,000 mt to 513,000 mt) and 199 % in value (US $1.45 m to $3.19 m) during the period 1976 to 1984 (Exhibit 28).

EXHIBIT 28: IMPORTS OF SHRIMP BY MAJOR MARKETS, 1984

Country	Quantity (000's mt)	Value (US $ m)	Quantity Change 1976 - 84 (%)
Japan	169	1,272	37
USA	137	1,119	39
Hong Kong	23	117	55
France	24	98	53
Canada	14	93	88
United Kingdom	18	79	174
Denmark	29	69	193
Italy	13	58	176
Spain	13	55	59

Source: FAO, Yearbook of fishery statistics, volume 59

Japan and the USA, the dominant import markets in 1984, accounted for 60% of all imports by volume and 75% in value. Since 1984, both countries have exceeded their previous year's imports in each successive year, thus maintaining their dominant positions. The volume and value of shrimp exports by principal exporting countries were, in 1984, as set out in Exhibit 29.

EXHIBIT 29: EXPORTS OF SHRIMP BY MAJOR SUPPLIER, 1984

Country	Quantity (000's mt)	Value (US$ m)	Quantity Change 1976 - 84 (%)
Mexico	34	402	10
India	55	289	15
Indonesia	28	194	(8)
Ecuador	20	151	1073
Australia	15	142	149
Thailand	19	119	27
China[1]	16	119	56
Hong Kong	15	118	21
Brazil	12	92	n/a

Source: FAO, Yearbook of fishery statistics, volume 59

Note: ([1]) Estimated; these statistics include those for Taiwan. Taiwan's exports would place it amongst the top 10 exporting countries.

Amongst the major exporting countries, production growth occurred chiefly in those with resources of coldwater shrimp (Denmark) and in countries involved with shrimp culture (Ecuador, Bangladesh, Philippines).

6.2 MAJOR MARKET COUNTRIES FOR SHRIMP

A. United States

Domestic landings in Gulf of Mexico and South Atlantic ports totalled 91,000 mt (headless weight) in 1986. This was 6% higher than 1985 and 15% above the average for the period 1981 - 1985. It was the highest catch recorded for this fishery. Lower fuel costs, reasonably good export prices and relatively good abundance of shrimp made 1986 a good year for many vessel operators.

Total imports in 1986 were 11% higher than in the previous year and 46% higher than in 1982. The annual import volume has increased for seven consecutive years. Significant was the increase in imports from Ecuador of 44% over the year 1985 to 1986. Imports from China increased by 203% over the same period.

In regard to types of product, shell-on shrimp continued to dominate, accounting for 65% of imports in both 1985 and in 1986. Imports of cooked and peeled tropical shrimp increased in 1986 as supplies of this product from cold water fisheries declined.

EXHIBIT 30: USA - IMPORTS OF SHRIMP, 1984 - 1986

(ooo's mt, product weight)

a) by leading export countries

Country	1984	1985	1986
Mexico	37.0	30.7	33.8
Ecuador	21.2	20.0	28.2
Taiwan	8.3	13.5	15.7
India	10.5	10.9	11.1
Thailand	8.3	11.1	11.0
Panama	7.4	9.0	9.9
China	1.5	3.1	9.4
Brazil	9.0	11.5	9.0

b) by product types

Product Type	1984	1985	1986
Shell-on	102.6	105.7	119.1
Peeled	46.8	49.8	55.5
Canned	6.2	7.8	7.2
Breaded	0.1	0.3	0.1

Source: USA, National Marine Fisheries Service

It is reported that increasing quantities of shell-on shrimp are being imported in individually quick frozen (IQF) form for sale by supermarket chains.
USA imports from Indonesia accounted for only 0.6% of the total USA shrimp imports in 1985. With only few exceptions, Indonesian exporters have been blacklisted by the US Food and Drug Administration (USFDA). While the USFDA normally inspects imports of shrimp at random and infrequently, the shipments of blacklisted exporters are automatically detained and inspected until USFDA becomes satisfied that quality is being maintained at the appropriate standard.

Record imports, combined with record landings in the Gulf of Mexico and the South Atlantic fishery, indicated that US consumption in 1986 reached the highest levels ever recorded. Apparent consumption in 1986 was 10% higher than the previous year and 28% higher than in 1983.

EXHIBIT 31: USA - APPARENT SHRIMP CONSUMPTION, 1984 - 1986

(ooo's mt, product weight)

Origin	1984	1985	1986
Domestic landings	79.1	85.6	91.0
Imports	155.7	163.6	181.9
Inventory adjustments	4.0	0.2	0.7
Apparent consumption (total)	**238.8**	**249.4**	**273.6**

Source: USA, National Marine Fisheries Service

Shrimp prices in the USA tend to rise and fall with the general upturns and downturns in the economy over a three to three-and-a-half year cycle.

Price fluctuations in the US market can be seen best by looking at data for Ecuadorian white shrimp as this is the product traded most consistently throughout the year (see Appendix H).

There is no organized shrimp market or marketing exchange in the US, and no set mechanism for the determination of prices. The overall supply of each size appears to be the major factor in determining prices for that size. Although the long term movement of prices for all sizes is generally in the same direction, prices in the short-term will vary for individual sizes.

An increasing flow of cultured shrimp, grown all year round in Ecuador and other tropical countries, has tended to counter the fluctuations in supply from the seasonal capture fisheries. As a result, prices appear to have fluctuated less in recent years; especially prices for the medium sizes which form the major part of Ecuador's production.

Black tiger shrimp, a major export from Indonesia, have recently begun to penetrate the US market. Black tigers are usually priced below other species owing to consumer resistance to their appearance.

B. Japan

Japanese domestic shrimp landings normally account for about one-quarter of total Japanese supply. Shrimp imports, which account for three-quarters of the supply were, in 1986, 16% higher than the previous year and 41% higher than in 1982.

EXHIBIT 32: JAPAN IMPORTS OF SHRIMP BY LEADING EXPORTERS, 1984 -1986

(ooo's mt, product weight)

Country	1984	1985	1986	% 1986
Taiwan 'Province'	16.5	21.8	37.8	17.8
India	38.5	36.2	36.7	17.2
Indonesia	24.1	24.4	27.7	13.0
China	10.3	10.7	18.7	8.8
Greenland	2.6	6.2	9.5	4.5
Australia	10.2	10.5	9.5	4.5
Vietnam	5.1	7.0	9.4	4.4
Thailand	6.7	7.4	8.9	4.2
Philippines	5.1	6.0	8.4	3.9
Bangladesh	5.9	7.4	7.3	3.4
Total	**169.1**	**182.9**	**212.8**	**100.0**

Source: Japan, Marine Products Importers Association

Indonesia is a major supplier of shrimp to Japan, accounting for 13% of Japan's 1986 imports, only slightly behind Taiwan and India. India, for many years the leading exporter to the Japanese market, has recently been challenged by Taiwan. Imports from Taiwan in 1986 were 73% higher than the previous year and 130% higher than 1984. Also, substantial increases in 1986 exports to this market, in relation to 1985, were achieved by China (75%), the Philippines (40%) and Vietnam (34%). The increase in production in Taiwan, China and the Philippines can be ascribed chiefly to cultured shrimp.

Since Japan liberalized its shrimp imports in 1961, purchases from overseas have increased almost every year. The strength of the Japanese yen in relation to the US dollar, the currency in which shrimp is normally traded world-wide, has undoubtedly contributed to Japan's strong import performance in 1986 but rising per capita incomes probably played a role also.

Consumption of shrimp in Japan reached a record level in 1986, when cultivated (farm-raised) shrimp, especially black tigers from Taiwan and white shrimp from China continued to expand their share of the market. Consumption of imported coldwater shrimp declined.

As for the USA, there is no organized shrimp market or marketing exchange in Japan. Market activity is at its peak in the last quarter of the year and prices tend to rise during that period. Other high points are April-May and July-August.

Black tiger shrimp, particularly important in this report, is a relatively new species in the Japanese market but imports have increased very rapidly in recent years, achieving an increasingly large share of the market. Often priced below competing species, black tiger shrimp has been able to substitute for other, long-established, species and now has nation-wide distribution.

The principal exporters of black tigers to Japan are Taiwan, Philippines, India and Bangladesh, as well as Indonesia. Taiwanese exports have increased rapidly, so that Taiwan must be considered the price leader and can be expected to hold prices down in order to sell its increasing volume of exports. Wholesale prices for black tiger shrimp are shown in Appendix I for the period 1984-86 .

C. Europe

Coldwater shrimp, a major factor in the European market, is mostly supplied from countries in the North Atlantic, particularly four principal suppliers: Norway, Greenland, Iceland and Germany.

EXHIBIT 33: NORTH ATLANTIC COLDWATER SHRIMP CATCH, 1984 - 1986

	(000's mt, live weight)	
Country	1984	1985
Norway	84.1	n/a
Greenland	41.5	52.4
Iceland	24.4	24.9
Germany (FR)	12.0	17.7

Source: FAO, Fishdata

Imports of shrimp by European countries from all sources were, in 1985, 17% higher than they had been in the previous year.

EXHIBIT 34: EUROPE - IMPORTS OF CHILLED AND FROZEN SHRIMP, 1984 - 1985

	(000's mt)	
Country	1984	1985
Denmark	38.2	48.2
United Kingdom	32.9	36.4
France	26.7	32.6
Italy	12.9	14.5
Norway	6.6	13.6
Sweden	13.3	13.5
The Netherlands	9.4	12.4
Spain	12.7	9.7
Belux	7.9	9.4
Germany (FR)	6.6	5.0
Total (of 14 countries)	**169.7**	**198.2**

Source: Datafish, Marketing Digest, June, 1986

It should be noted that several of these countries, such as Denmark and Norway, are also major exporters or re-exporters of shrimp. Imports are classified by product form in Exhibit 35. Imports of shell-on coldwater species in 1985 were nearly 29% higher than the previous year; cooked and peeled shrimp imports were over 12% higher. In contrast, imports of shell-on warmwater shrimp were only slightly higher (2%).

EXHIBIT 35: EUROPE IMPORTS OF CHILLED AND FROZEN SHRIMP BY PRODUCT FORM, 1984 - 1985

Classification	1984	1985	% Change
	(ooo's mt)		
Shell-on, coldwater	78.8	101.4	28.6
Shell-on, warmwater	52.0	53.0	1.9
Cooked and peeled (cold and warmwater)	38.9	53.0	12.3

Source: FAO, Infofish, Marketing Digest, June, 1986

Consumption and Prices

With a total consumption of around 200,000 mt (FAO, Infofish, Marketing Digest), Europe follows Japan and the USA as the third largest market for shrimp.

Up to 1984, tropical shrimp had been increasingly accepted in the European market. This trend changed as a result of increased availability of coldwater shrimp at favourable price levels and did not need to be paid for in US currency (which was strengthening in relation to European currencies at that time). The deaths in the Netherlands in 1984, caused by food poisoning which was ascribed to tropical shrimp, also had a negative effect on the shrimp trade in general and on the reputation of tropical cooked and peeled shrimp in particular.

The European market cannot generally compete in paying prices which Japanese and US importers can pay. Further, there is no established market for black tiger shrimp in Europe, although small quantities have been imported.

6.3 SHRIMP MARKET PROSPECTS

World production from capture fisheries has probably stabilized and no growth can be expected. In contrast, it is expected that growth in the production of cultured shrimp will continue, especially in Latin America and the Indo-Pacific region, and that imports of cultured shrimp from these areas will be the principal source of future supply to satisfy expected future higher demand in the major markets.

There will doubtless be the usual fluctuations in supply of shrimp from capture fisheries according to the availability of shrimp in the fishing grounds. Cultured shrimp will tend to provide a more even flow into the markets, but as culture production expands, growth in the total supply of shrimp is expected to hold down prices, especially for the sizes produced by the shrimp farmers. It is expected that, despite the usual cyclical price fluctuations, the overall trend will show only slight increases in constant terms.

The relative strength of demand in the three major markets can be expected to be affected by changes in exchange rates, especially the relation of the Japanese to the US currency, economic conditions, and the level of disposable income.

The biggest problem facing shrimp exporting companies is the shortage of raw shrimp supplies. With greater raw material, processing cost go down, especially the costs attributable to fixed equipment, due to the greater utilization of plant facilities. Currently, most shrimp exporters are operating at only between 10 to 30 percent capacity.

In an effort to make up this shortage of shrimp raw material, emphasis has been placed on aquaculture produced shrimp. However, tambak shrimp tend to have a slight off-color, due to water quality. This causes prices to be slightly lower for this product. Also, recent records indicate that contamination is higher for shrimp from tambaks resulting in rejection of the product at the market.

Indonesia's shrimp industry is currently dominated by the Japanese with a vertically integrated distribution system between the collector and processor and the Japanese importing company, all of which are closely tied financially. The market is risky with narrow channels and prices are distorted. Proper grading, weighing and handling of shrimp is required to improve profitability but at the moment, many processing firms are doing only basic cleaning and packaging before export to Japan (USAID, 1985).

6.4 WORLD FRESH AND FROZEN TUNA MARKET

"Frozen and canned skipjack/tuna accounted for at least 8 per cent of the total value of Indonesia's fishery product exports during 1982. Export of these products has expanded rapidly in recent years despite the downward trend in international prices which began in 1981 and the historically low prices which persist to-date. However, the altered world market, particularly for frozen and canned skipjack, and to a lesser extent for frozen and canned large tuna, has set off a fundamental change in the global distribution of the skipjack/tuna canning activities from the high-cost market countries such as US and France to areas close to skipjack/tuna resources with low production costs."

The World tuna catch increased 88% over the 15 years 1970 to 1984, from 1.1 million mt to 2.1 million mt. Skipjack and yellowfin were, by far, the most important species caught, in terms of volume over the past 15 years (Exhibit 36). Also, the catch of these two species has increased at the greatest rates.

EXHIBIT 36: WORLD CATCHES OF TUNA BY TYPE 1970 - 84

(000's mt, live weight)

Specie:	1970	1975	1980	1982	1984	% Change
Yellowfin	362	516	535	545	599	65.5
Bigeye	121	196	216	211	190	57.0
Bluefin	84	72	80	91	73	(13.1)
Skipjack	391	563	780	760	1050	168.5
Albacore	159	182	185	204	186	17.0
Total	**1118**	**1530**	**1796**	**1811**	**2099**	**87.7**

Source: Infofish

Tuna is caught mainly by fishing vessels using purse seine, longline and pole-and line-fishing gear.

For many years Japan has been the largest producer of tuna but, as for the USA, its share of world production has declined over the past decade and a half. Whereas Japan was responsible for 45% of the world catch 1970, by 1984 its share had declined to 38%. Over the same period, the USA's share of the world catch declined from 19% to 13%.

With the introduction of 200 mile Exclusive Economic Zones (EEZ), other countries have developed and expanded their tuna fleets. For example, Indonesia's tuna catch increased from 21,000 metric tonnes in 1970 to 115,000 metric tonnes in 1984; a growth of 448 percent, the highest rate of growth among the top seven tuna producing countries. Several other developing countries achieved large increases in their tuna catches over the same period (also see Appendix I).

Whole round tuna, chiefly frozen, is traded World-wide. With the exception of certain special uses in Japan (for example, sushi) most of the tuna shipped in this form is sold to canneries. Japan and the Republic of Korea are the leading exporters of fresh and frozen tuna and the USA, Japan, Thailand and Italy the major importers (see Exhibit 37).

US imports of fresh and frozen tuna have declined 32% in the period 1980-84, due principally to the closing of all major canneries in the continental USA. In contrast, imports by Thailand are showing rapid growth to supply the increasing raw material requirements of the rapidly expanding canning industry in that country.

EXHIBIT 37: EXPORTS AND IMPORTS OF FRESH AND FROZEN TUNA, 1980 - 84

(000's mt)

	1980	1981	1982	1983	1984
a) Exports by Principal Producers					
Japan	91	46	41	56	89
Korea	118	107	81	188	86
France	17	23	37	46	37
Solomon Islands	22	24	15	28	33
Mexico	n/a	22	15	12	32

b) Imports by Major Importer

	1980	1981	1982	1983	1984
USA	269	274	222	199	183
Japan	92	101	127	142	111
Thailand[1]	n/a	n/a	n/a	26	110
Italy	77	71	77	74	83
Ivory Coast	14	15	25	28	26

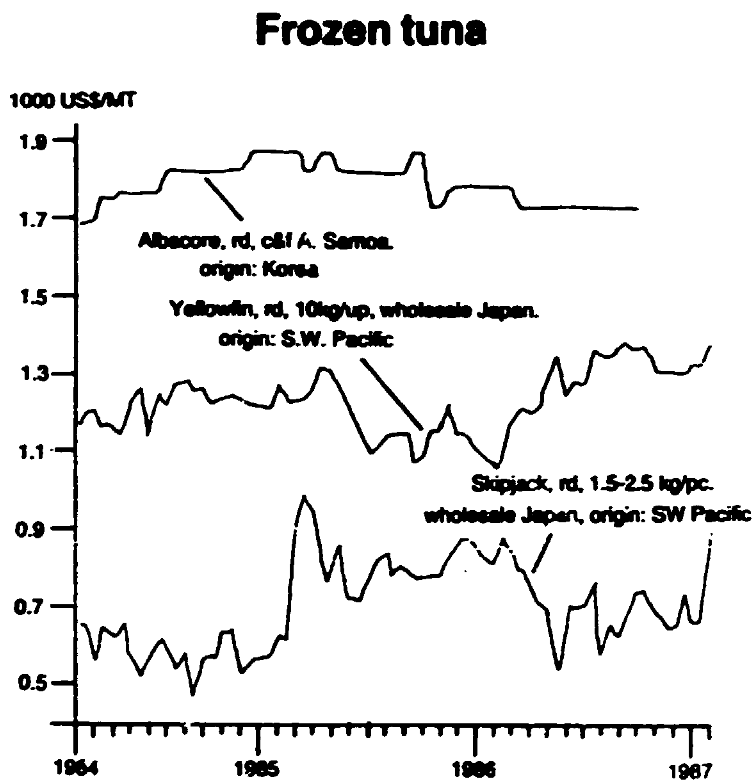
Source: Infofish

Note: (1) Estimate

The prices paid for fresh and frozen tuna and skipjack have fluctuated along with the level of trade in this commodity. Exhibit 38 below illustrates these fluctuations by showing the wholesale prices paid for frozen skipjack in Japan for the three years 1984 to 1986. The implications of the price level to the proposed tuna canning project are that prices paid for raw material should be in line with those paid not only at landing sites but also by competitive purchasers seeking tuna for freezing. (Note, ignoring this factor was one cause for the demise of SAFCO's canning plant in Bitung).

Exhibit 38 shows that frozen skipjack sold wholesale in Japan for US$ 600 to US$ 800 (cif) per mt. These prices relate to those paid to PT Perken of Kendari during 1985 and 1986, when the export price from Kendari ranged, for the most part, between US$ 500 and US$ 600 (cif) per mt.

EXHIBIT 38: REPRESENTATIVE WHOLESALE PRICES FOR FROZEN TUNA 1984 - 86



Sources: a) FAO, Infofish Marketing Digest, No. 2/87

6.5 PRODUCTION AND TRADE OF CANNED TUNA

The principal producers of canned tuna are the USA, Japan, Italy and Thailand which, together, accounted for over 66% of World production in 1984. However, it should be noted that Thailand was only a minor producer in 1980 and whereas the other three countries produced 71% of the World total in 1980, their share was down to 59% in 1984.

EXHIBIT 39: CANNED TUNA PRODUCTION BY MAJOR PRODUCING COUNTRIES, 1980 - 84

(mt, product weight)

	1980	1981	1982	1983	1984	1985
USA	275	287	246	268	275	259
Japan	95	111	113	117	124	114
Italy	48	49	48	52	59	n/a
Thailand[1]	--	8	15	28	59	n/a
France[2]	14	19	25	30	68	85
Total	**588**	**678**	**637**	**690**	**777**	**n/a**

Source: Infofish
Note: (1) Estimated by Infofish
(2) US, International Trade Commission.

The Thai industry's estimates of production (cited by the US International Trade Commission) are somewhat at variance with those of Infofish but, whichever figure is accepted, Thai production increased by over 6 times in the period 1980-85. Further, by 1984, Thailand had become the leading exporter of canned tuna (see Exhibit 37). Thailand's exports increased in 1985 to 77,000 mt (US, ITC), equivalent to 31% more than the 59,000 mt exported the previous year.

EXHIBIT 40: EXPORTS OF CANNED TUNA BY MAJOR EXPORTING NATION, 1980 - 84

(000's mt)

	1980	1981	1982	1983	1984
Thailand[1]	--	8	15	28	59
Japan	38	35	36	37	46
Philippines	11	18	19	24	23
Ivory Coast	18	17	19	24	23

Source: Infofish

Note: (1) Estimate

World tuna trade continues to expand; imports increased 59 per cent between 1980 and 1984. The USA not only retains the biggest importer of canned tuna but also increased its share of world tuna imports from 29% in 1980 to 40% in 1984. Growth has also been shown by UK (118%), Canada (33%), France (32%) and Federal Republic of Germany (27%). During 1985, US imports increased still further to 97,000 mt (US, ITC), 31% higher than in the previous year.

EXHIBIT 41: IMPORTS OF CANNED TUNA BY MAJOR IMPORTING NATION, 1980 - 84

	(000's mt)					
	1980	1981	1982	1983	1984	% of 1984 World Imports
USA	29	32	40	55	74	40
France	25	28	30	34	33	18
UK	11	19	13	18	24	13
Germany (FR)	15	14	15	16	19	10
Canada	9	10	7	11	12	7
World Total	**116**	**125**	**127**	**157**	**184**	**100**

Source: infofish

Supply and Demand

A. The US Market

The USA accounts for one-third of the total World total tuna market, over half of the World market for canned tuna and dominates international trade in canning-quality tuna (King, 1986).

Canned tuna is available to the US market from three sources: imported raw fresh and/or frozen tuna packed in the USA; domestic landings packed in the USA; and imported canned tuna.

Domestic landings packed in the USA have remained relatively stable, while canned tuna produced from imported raw material has declined. More and more, the USA imports canned tuna; this has increased by 234% from 29,000 mt in 1980 to 97,000 mt in 1985 (US, ITC).

The principal suppliers of canned tuna (virtually all packed in water) are Thailand, Philippines, Japan and Taiwan. Imports from Thailand accounted for 57% by quantity and 53% by value of the total tuna imports in 1985 (Exhibit 39). Canned tuna from Indonesia accounted for only a small share of US imports (0.6% by volume and value in 1985).

EXHIBIT 42: US IMPORTS OF CANNED TUNA

a) by principal sources, 1985

	Quantity (000's lbs)	Value ($US 000's)	Unit Value ($US per lb)
Thailand	122,666	111,852	0.91
Philippines	30,797	25,930	0.84
Japan	23,703	28,142	1.19
Taiwan	23,472	29,801	1.27

b) from Indonesia, 1980-85

1980	0	0	--
1981	146	209	1.43
1982	595	699	1.18
1983	2,634	2,679	1.02
1984	2,222	2,102	0.95
1985	1,388	1,186	0.85

Source: US, ITC

Canned tuna imports are subject to quota. For canned tuna not packed in oil imports are subject to 6% duty until the annual quota has been reached. Imports after the quota are subject to 12.5% duty. The quota is based on the previous year's US canned tuna production.

Consumption and Prices

Canned tuna, which has for some time formed the largest segment of the canned seafood consumed in the US, increased its share of per capita consumption of all canned seafood from about 56% to 63% over the period 1970 to 1985. The importance of canned tuna in the US seafood market can be seen by the large share of the total seafood of that market that canned tuna occupies (20% to 24%).

EXHIBIT 43: US ANNUAL PER CAPITA CONSUMPTION OF CANNED TUNA AND OTHER SEAFOOD 1970-1985

(lbs)

	Canned Tuna	All Canned Seafood	Tuna % All Canned
1970	2.5	4.5	55.6
1975	2.9	4.3	67.4
1980	2.9	4.5	64.4
1985	3.3	5.2	63.4

Source: Fisheries of the United States, 1985

Processors and wholesalers sell to retail and institutional buyers. Canned tuna is sold chiefly at retail outlets for consumption at home, most commonly in 6.5 oz. cans. There is also a small but growing institutional market, in which restaurants, hotels, schools, prisons and others use primarily 4 lb cans. The institutional market has increased its share from about 10% in 1975 to about 14% in 1984 (King, 1986).

Products destined for the retail trade are sold under private labels, supermarket house brands or labels which are widely advertized. The large US tuna companies tend to reserve the highest quality products for their nationally advertized labels, for which they charge higher prices to cover the cost of advertizing and the maintenance of brand preference.

Retail prices usually reflect the level of wholesale prices, as well as the discounts and promotional allowances offered by producers and the retailers' decisions regarding profit margins and the use of shelf space. US retail prices increased sharply during the inflationary period 1978 to 1981 (Exhibit 44). This, combined with a downturn in the economy after 1980, and low beef and poultry prices, caused a significant drop in the sales ofcanned tuna. Consumption (Exhibit 45) recovered when US processors, having negotiated lower fish prices, were able to reduce their selling prices and supplies of low cost canned imports become available.

The principal periods of demand during the year are Lent (March-April) when some consumers eat more fish for religious reasons and in the summer (July-August) when consumers on vacation prefer the convenience of prepared foods. The seasonal pattern of demand is reflected in wholesale and retail price trends, with more promotional discounts offered in the autumn and winter and fewer discounts offered in the spring and summer.

Factors Affecting Demand

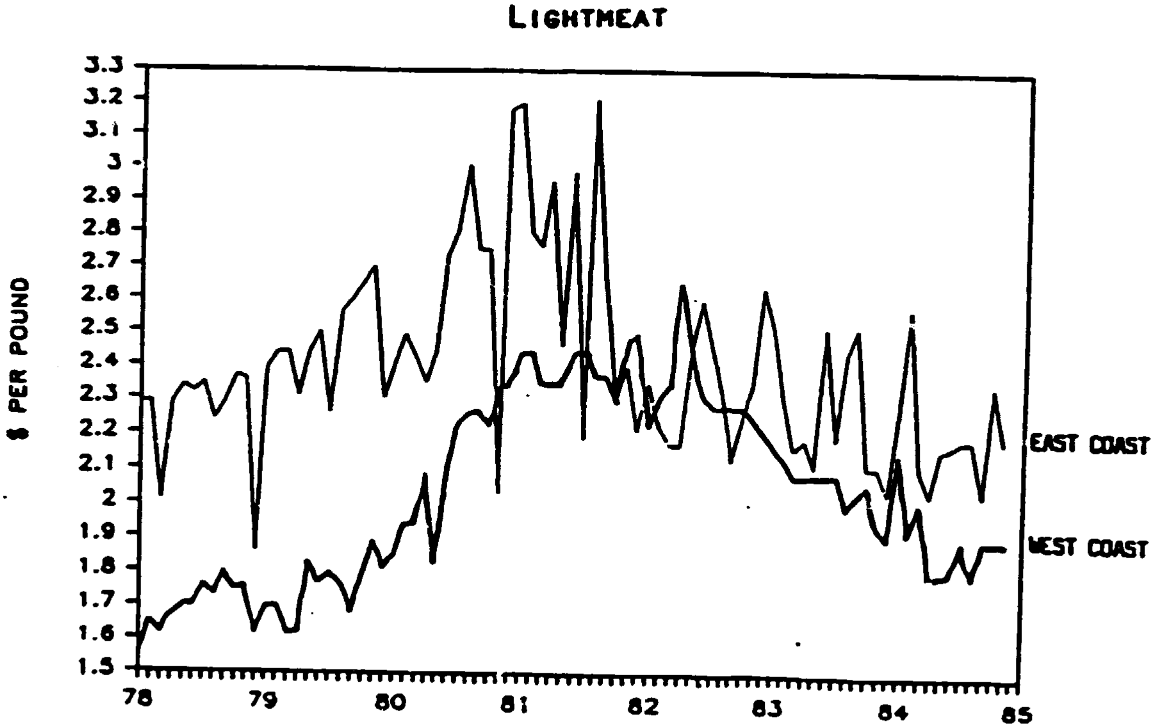
US demand for canned tuna is influenced chiefly by changes in disposable household income, canned tuna prices and the prices of substitute products, such as beef and poultry. Statistical tests (King, 1986) indicate that disposable income is a more important factor influencing tuna demand than either the price of tuna or substitute.

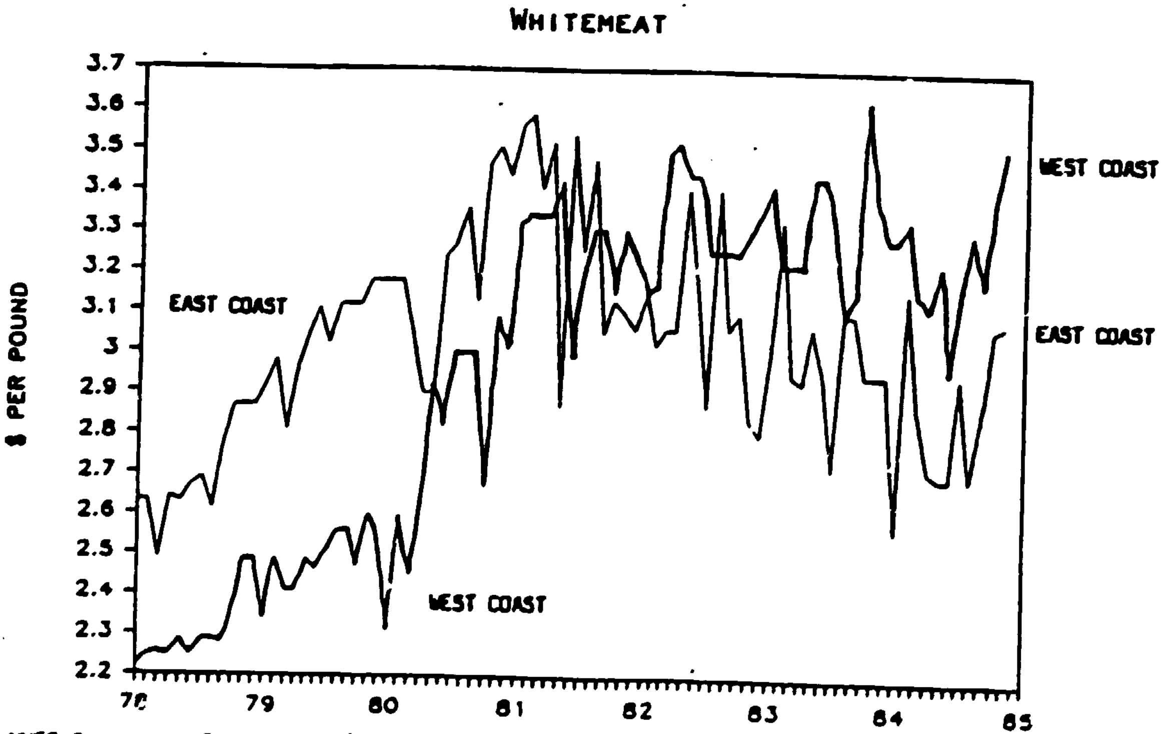
Tuna demand does not respond much to small price changes but there may be a price threshold above which people switch their buying to tuna substitutes. When canned light meat tuna was priced near US$1.00 per can (in the early 1980s), the decline in demand was more abrupt than would have been expected in the light of the historical relationships between prices and demand. The elasticity of demand in the US market, excluding the threshhold impact, has been summarized by King, (1986) as follows:

- Response to Tuna Price Changes: A 1.0% decline in retail tuna prices results in a 0.2% increase in the amount of canned tuna sold.

- Response to Substitute Price Changes: A 1.0% decline in the prices of meat and poultry substitutes for tuna results in a 0.3% decline in the amount of canned tuna sold.

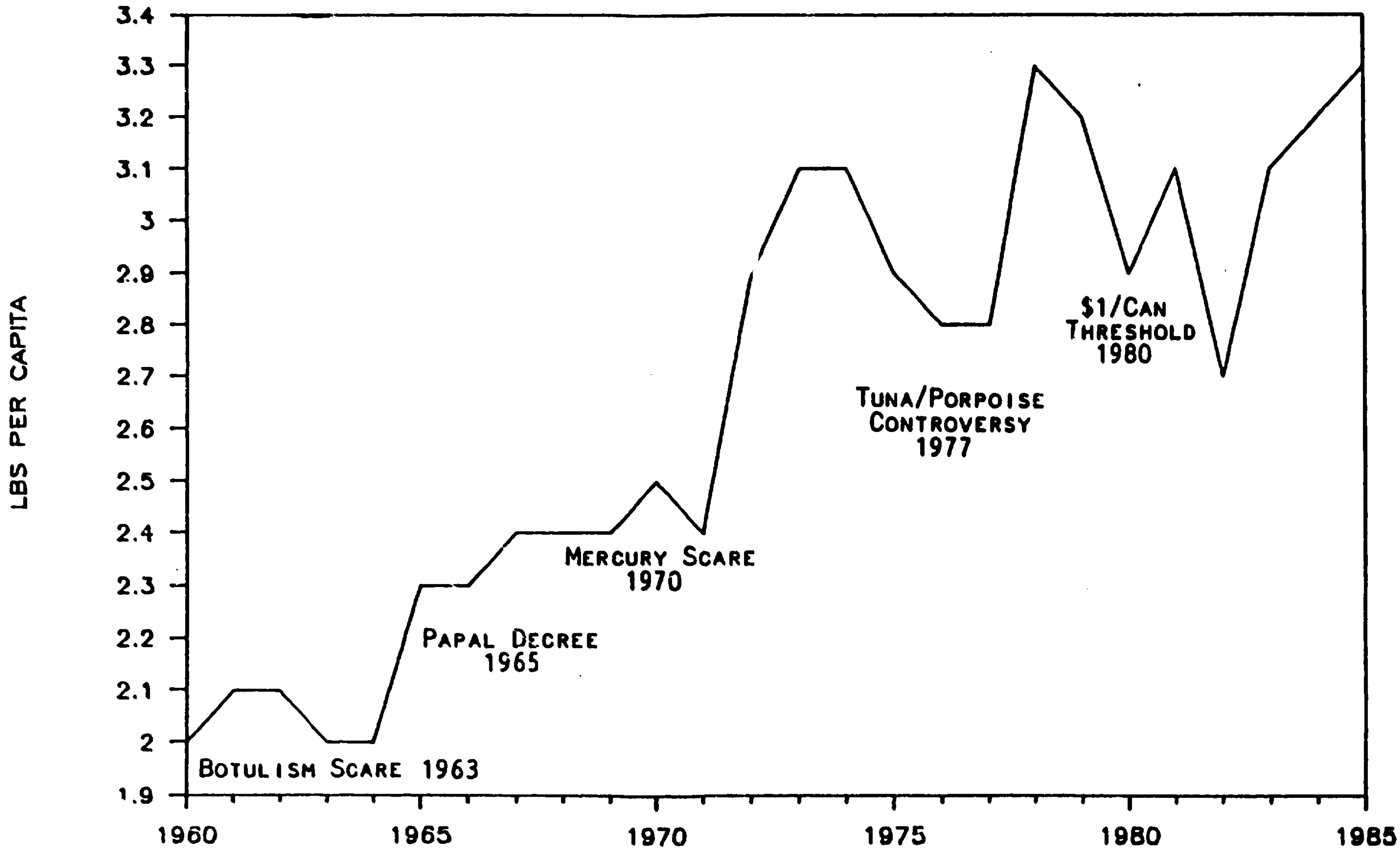
EXHIBIT 44: U.S. RETAIL TUNA PRICES, 1978 - 85





SOURCE: NMFS OPERATION PRICEWATCH (DISCONTINUED 12/85)

EXHIBIT 45: U.S. PER CAPITA CONSUMPTION OF CANNED TUNA



SOURCE: NMFS, E R G PACIFIC, INC.

o <u>Response to Changes in Threshold Income</u>: A 1.0% decline in disposable household income results in a 1.0% decline in the amount of canned tuna sold.

Although overall demand for canned tuna is apparently not very responsive to price changes, the demand for a specific brand may be. Consumer brand allegiance is not strong. Hence, changes in the price of an individual brand may have a significant effect on the sales of that brand.

B. The Japanese Market

Japan is a major producer, consumer and exporter of canned tuna but Japan's imports of canned tuna are very small; 1985 imports were only about 1,000 mt (equivalent to 1% of total consumption).

The possibility that Indonesia would be able to export canned tuna in any volume to this market must be considered remote for the foreseeable future.

C. The European Market

The European market, the second largest consumer of canned tuna, consists of a group of countries, whose production and consumption levels vary widely. Some European countries (Belgium, Luxembourg, Greece, France, Italy, Portugal and Spain) are considered to be mature markets, which have long been accustomed to consume canned tuna. The UK, Federal Republic of Germany, Ireland and the Netherlands are new markets which are expanding as consumers develop a taste for canned tuna.

Supply and Demand

The principal European producers of canned tuna are France, Spain and Italy. However, these countries do not supply sufficient quantities to satisfy the market Hence, substantial volumes of canned tuna are imported. Europe, estimated to absorb almost 50% of world imports, imported over 10 million standard cases (97,000 mt to 101,900 mt) in 1984 and 1985 (see Exhibit 46).

France, the UK and Germany between them accounted for 75% of the 1984 total imports of canned tuna to Europe, their consumption grew by 56% between 1982 and 1984. Consumption growth in several small countries has been similarly high.

There is little doubt that Thailand is the principal overseas supplier to the European market. Other important suppliers include the Philippines, Ivory Coast, Japan, Mauritius, Taiwan and Senegal.

The conventional import duty rate of 24% applies to canned tuna entering EEC countries from many overseas suppliers. However, canned tuna entering under the Generalized System of Preferences (GSP) pays no import duty. Groups of countries which are beneficiaries of the GSP are African, Caribbean or Pacific countries signatory to the Lamé convention; British Commonwealth countries those countries which are considered least developed among the developing countries and certain mediterranean countries.

France, the largest market for canned tuna in Europe, consumed about 7 million cases in 1985. It is thought that growth in consumption will continue, but at a slower rate than presently. There is probably little scope for overseas importers in view of the close connections with canneries in the Ivory Coast and Senegal, which have duty free access.

Consumption in the UK consists entirely of imports, Thailand and Japan being the major suppliers. Canned tuna has sold at prices which have enabled it to take market share from canned salmon, long a traditional item of consumption in the UK. The tuna market is dominated by 2 premium brands, John West and Princes.

EXHIBIT 46: EUROPEAN IMPORTS OF CANNED TUNA, 1982-85

(000's standard cases)[1]

	1982	**1983**	**1984**	**1985**
France	3,140	3,575	3,421	3,898
UK	1,400	1,850	2,530	2,504
German	569	1,695	2,011	n/a
Switzerland[2]	400	450	485	n/a
Bleu	427	506	523	n/a
Italy	265	353	371	n/a
Sweden	247	262	287	n/a
Austria[2]	220	230	250	n/a
Denmark	131	181	229	237
The Netherlands	149	147	228	n/a
Finland	128	162	147	199
Greece	86	76	81	n/a
Ireland	16	25	33	n/a
Norway	30	34	32	n/a
Total	**7,208**	**9,546**	**10,630**	

Source: Infofish

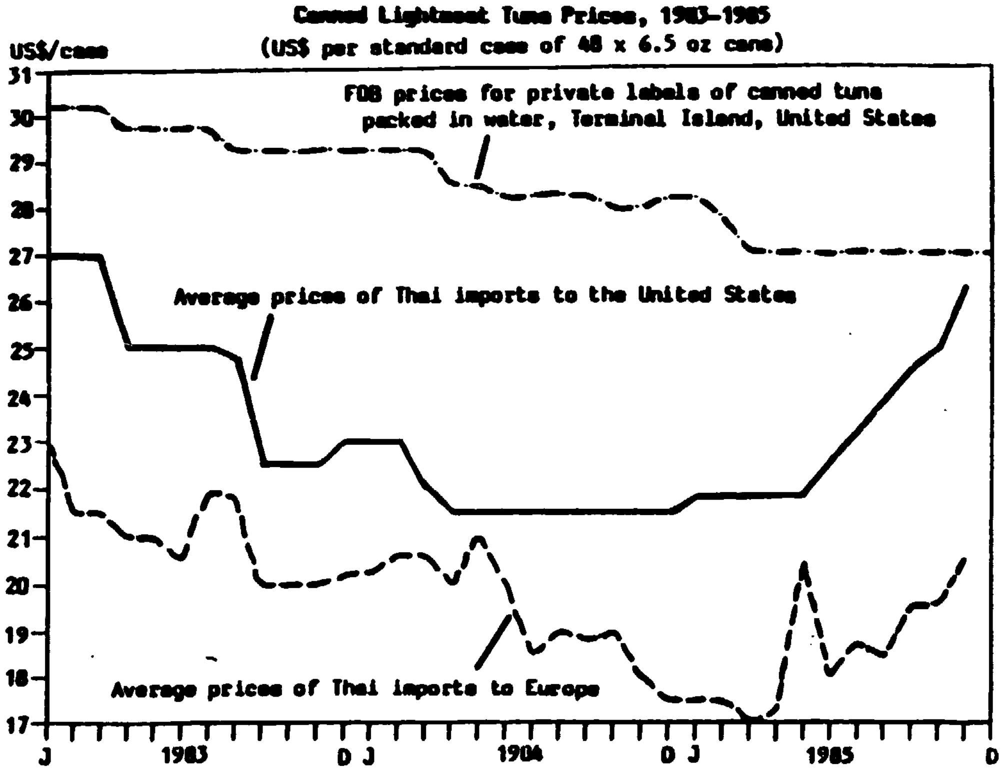
Note: (1) One case contains 48 cans of 6.5 ozs each (312 ozs per case).
(2) Estimates.

Trade in canned tuna in the Federal Republic of Germany is more price dependent than in either France or the UK. Over 30 per cent of German consumption of tuna is in the form of tuna dressing. Major suppliers include Thailand, Philippines and Taiwan.

Growth in consumption is likely to continue in the European market but cannot be expected to be as rapid as it has been in recent years. Further, it is apparent that Europeans do not pay prices as high as those paid by US buyers (Exhibit 47).

EXHIBIT 47: CANNED TUNA PRICES PER CASE IN THE U.S. AND EUROPE, 1983 - 86

a. Tuna Packed in Water ($US cif Europe and the US)



b. Tuna Packed in Oil and Brine ($US cif in Europe)

		Oil		Brine	
		Thailand	Indonesia	Thailand	Indonesia
1983	Feb	22.5	N/A	22.5	23.0
	July	22.0	23.0	21.0	22.0
1984	Feb	20.3	21.5	N/A	20.5
	July	20.0	21.0	20.0	21.0
1985	Feb	17.5	19.8	18.3	18.8
	July	22.1	21.9	18.6	20.9
1986	Feb	21.9	21.1	19.0	21.1
	July	22.1	-	-	21.1
1987	Feb	-	22.7	-	21.7

Source: FAO, Infofish Trade News, Nos. 1/83 to 1/87.

The prices for Thai and Indonesian canned tuna (c.i.f. Europe) trended slightly downwards from 1983, reaching a low in the first half of 1985. Since then they have strengthened, but at the end of 1986 were still 10% to 15% lower than they had been at the beginning of 1983 (see Appendix G, Table 9).

__Indonesian Exports of Canned Tuna__

Indonesian exports of canned tuna by major destination countries are shown in Exhibit 48. The prime importing country in 1985, the Netherlands, can be expected to remain a key market for Indonesian canned tuna because of company linkages between Bali Raya, PT Mantrust and Dutch marketing outlets. The exhibit shows that the 2,200 tonnes of canned tuna exported in 1984 was worth $4.4 million, an average price of about $2,000 per tonne; this had dropped to an average price of $1,238 per tonne in 1985.

EXHIBIT 48: INDONESIA EXPORTS OF CANNED TUNA, 1984 - 85

Destination	mt.	$US	mt.	$US (000's)	(000's)
Singapore		64	72	174	196
Australia		348	558	13	28
USA		1,107	2,221	446	803
Britain		293	723	402	975
Netherlands	187	384		735	165
Other	201	448		46	81
Total	**2,200**	**4,406**		**1,816**	**2,248**

Source: Indonesia, Bureau of Statistics

6.6 PROSPECTS FOR CANNED TUNA

Although US domestic production of canned tuna in 1985 still supplied a significant share of the US market, imports have more than doubled in the past four years, their market share increasing from 9% in 1976 to 28% in 1985. The market for imported canned tuna in Europe showed a major increase (about 57%) between 1982 and 1985.

The World tuna industry has been in a depressed state during the current decade, with low prices prevailing for both frozen and canned products. This has caused an international restructuring of the industry.

High labour costs, combined with relatively low prices for their product, has led to the closing of all the major tuna canneries in continental USA. There has been a rapid increase in canned production in SE Asia, based on the use of productive, low-cost labour. Thai exports of lightmeat canned tuna to the USA increased from 6 million lbs in 1980 to 122 million lbs in 1985.

Export markets have expanded as a result of the closing of the major canneries in mainland USA and of increased demand in Europe. Hence, there are opportunities for additional investment in processing facilities in the developing world. The viability of such processing facilities will depend on the extent to which they can be competitive with the new and aggressive canners in SE Asia, especially those in Thailand.

Lower fuel prices will tend to hold down production costs but no substantial improvement in market prices is expected in the near term. However, continued growth in consumption can be forecast as incomes in consuming countries rise. The rate of growth will depend largely on the extent to which canned tuna can continue to be produced at a cost which makes the product increasingly attractive to consumers in the market countries.

Thailand, which imports frozen tuna from Indonesia, is able to sell its canned tuna at very low prices but at consistently high quality (Infofish, 1985). The fast growth of Thai canned tuna production and export, which had been difficult to forecast, led to a shortage of raw material supply and increasing imports of frozen skipjack and bonito because Thai resources haven't been sufficient. Of some 60,000 tons of raw material processed in the tuna canneries in 1983, 35,000 tons had to be imported while the rest came from domestic production (Infofish, Marketing Digest No. 1/85). About 83,000 tons of skipjack and bonito were imported in 1985; in the first half of 1986 imports had increased to an annual level of around 97,000 tons.

While Thailand currently enjoys a favourable production cost structure this may not continue as incomes rise in Thailand, as Indonesia and other suppliers of frozen tuna process more in their own countries and if the US moves to protect its own industry.

For these and other reasons, there is an opportunity for Indonesia to expand its production of canned tuna and indications that this is beginning to occur in the study region. For example it is understood that:

- Bali Raya in Denpassar intend to expand their tuna plant capacity from 35 tonnes per day at present to 100 tonnes per day by 1989;
- SAFCo'S plant in Bitung has been wholly acquired by the ASTRA Group with plans for renewed production;
- PT Bonecom plans to build a small (8 ton per shift) plant in Jakarta to utilize their frozen skipjack from Kendari.

For planning purposes, and from all of the above price data, an expected price for skipjack and tuna packed in brine in the order of $US 22.00 per case (cif) would be appropriate at this time.

6.7 FISHMEAL

Fishmeal may be manufactured from raw fish or fish waste of good quality. While it is envisaged that a fish meal plant would operate alongside a canning plant other sources of raw materials would include the by-catch from the shrimp fishing, shark bodies after the extraction of the liver for liver oil, and flying fish bodies after the extraction of eggs.

Fishmeal Supply and Demand

Fishmeal, a high protein feed for animals, has higher value than its competitors, chiefly vegetable protein meal, because of its excellent balance of amino acids, its vitamin B content, and the unidentified growth factor (UGF). These elements make it an important component of the diets of simple-stomached animals, especially in in their early stages of growth.

Fishmeal has a small, but important, role in the world market for animal feed accounting for about 5% of the world protein meal market (ADB/FAO, 1983).

World production increased from 2.1 million mt in 1960 to 5.5 million mt in 1970. From 1972 to 1980 production fluctuated between 4 and 5 million mt, with no clear trend up or down but, since 1981, production has again increased and in 1984 reached 5.9 million mt. The trend continued in 1985 and 1986, with substantial increases in Peruvian production.

EXHIBIT 49: FISH MEAL WORLD PRODUCTION (1960 - 1984)

(tonnes millions)

Year	World Production
1960	2.1
1970	5.5
1980	5.0
1982	5.4
1983	5.2
1984	5.9

Source: FAO, Yearbook of Fishery Statistics.

Production is determined primarily by the abundance of available resources. This fluctuates from year to year, partly for natural reasons and partly as a result of periodic overfishing, which creates the need for subsequent lower catches to permit the stocks of fish to recover.

Japan is the largest producer of fishmeal, followed by Chile, the USSR and Peru. Japan is also an importer. The USSR and the USA play only minor roles in world fishmeal trade.

EXHIBIT 59: FISHMEAL PRODUCTION BY PRODUCING COUNTRIES, 1984-86

(tonnes millions)

Country	1984	1985	1986
Japan	1.3	n/a	n/a
Chile	1.0	1.1	1.3
USSR	0.7	n/a	n/a
Peru	0.5	0.6	1.0
USA	0.4	0.3	0.3

Source: FAO, Yearbook of Fishery Statistics; and Globefish.

The World market for fishmeal is characterized by a small number of exporting nations serving the import requirements of a large number of consuming countries. Europe and Japan are the greatest concentrations of demand.

The seven leading exporting countries--Chile, Peru, Denmark, Norway, Iceland, Japan and Thailand accounted for 78% of world exports (2.6 million mt) in 1984. This represented 45% of total world production. The principal importing countries are the Federal Republic of Germany, the United Kingdom, Japan, Taiwan and other European and Pacific countries.

Indonesia's trade in fishmeal accounted for a small part of the World market. Of 4,500 mt of fishmeal produced in Indonesia in 1984, 2,517 mt was exported, equivalent to 0.1% of world exports. In the same year, Indonesia imported 45,333 mt, 2% of world imports, with a value of US$24.7 million.

Fishmeal usage depends on the strength of demand for the feeds of which fishmeal is an ingredient and on the degree to which it may be replaced by competing products, particularly soybean.

The lack of growth in supplies of fishmeal (relative unavailability) has caused a reduction in fishmeal's share of the World market for high protein feeds, despite the large expansion in the overall market for animal feeds over the past 2 decades. The USA, a major producer of vegetable protein feeds, has tended to use less fishmeal. Europe, on the other hand, produces relatively little vegetable protein feed, the prices for which are high. Furthermore, European farmers appear to place a high value on the effect of the UGF and often use a certain minimum amount of fishmeal, even when the cost does not justify it. Japanese consumption of fishmeal is high because of the large and growing demand for meat and poultry.

6.8 TRENDS IN FISHMEAL MARKET AND PRICES

Fishmeal prices have fluctuated over the past two decades, chiefly in response to the variations in production levels, but the overall trend in prices has been very flat, particularly in constant dollar terms.

EXHIBIT 51: VALUE OF WORLD IMPORTS OF FISHMEAL

($ US per tonne, cif, Hamburg)

Year	Value
1970	180
1972	179
1974	410
1976	341
1978	445
1980	506
1982	416
1984	432

Fishmeal is only a small part of the World market for animal feedstuffs; soybean meal is the major competitor. The price ratio between fishmeal and soybean meal has trended upward (ADB/FAO, 1983) during the period 1960-80, as a result of lack of growth in fishmeal production at the same time as the production of other protein meals has increased. However, the ratio has rarely stayed over 2.0 for any period of time because of the substitutibility of soybean meal for fishmeal. Hence, because soybean meal is the dominant element in the animal feed market and fishmeal has a ceiling in the fishmeal to soybean meal price ratio, fishmeal prices tend to vary in a relatively close relationship to soybean meal prices (Exhibit 52).

High prices were at least partly the result of poor catches off the west coast of South America caused by the presence of warm surface water (El Nino). In 1984 and 1985 prices, declined under the pressure of good production, but recovered to some extent in 1986 (see Exhibit 52).

Indonesian Fishmeal Imports

Indonesia's imports of fishmeal in 1984 and 1985 are shown below in Exhibit 5.3 The increase in fishmeal imports from 1984 to 1985 follows a trend indicating increasing demand for this product for poultry feed and shrimp feed in Indonesia. The marked drop in fishmeal prices from 1984 to 1985 should be noted. From the data above, it would be appropriate to say that imported fishmeal costs about $US 350 to $US 550 per metric tonne in Indonesia ($US 450 has been used for planning purposes).

EXHIBIT 52: SOYBEAN MEAL AND FISHMEAL PRICES (1980 - 1985)

($US per ton)

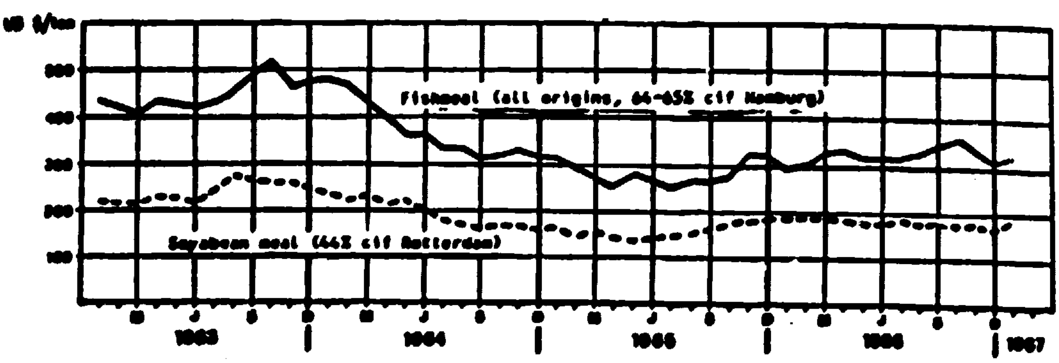
a) 1980 - 1984 (Prices cif, Rotterdam)

	Soybean Meal		Fishmeal		Ratio
	current	constant[1]	current	constant[1]	soy/fish
1980	262	250	506	483	1.93
1981	253	240	519	492	2.05
1982	219	211	416	401	1.90
1983	230	235	450	460	1.96
1984	197	198	432	434	2.19
Sample average					2.01

Source: World Bank, 1986

[1] constant 1985 dollars

b) 1983 - 1987 (prices cif, Hamburg and Rotterdam)



Sources: Oil World
GLOBEFISH AN 11702

EXHIBIT 53: INDONESIA IMPORTS OF FISHMEAL

Origin	1984			1985		
	Tonnes (000's)	$U.S. (000's)	$U.S. per Tonne	Tonnes (000's)	$U.S. (000's)	$U.S. per Tonne
Thailand	10.9	6,181	576.06	19.3	8,062	417.20
USA	1.0	522	522.00	0.5	191	382.00
Chile	5.9	3,115	527.97	14.2	5,770	406.33
Peru	22.8	12,624	553.68	11.6	4,264	367.59
Other	1.3	880	676.92	2.3	7,060	306.96
Total	**41.9**	**20,322**	---	**47.8**	**25,337**	---

Market Outlook

World fishmeal production remained essentially stable, although fluctuating within a range of 4.0 to 5.0 million mt from 1972 to 1983. Although production increased to 1986, it may may be adversely affected again in 1987 by warm water currently present off the west coast of South America.

Production from resources currently exploited is expected to continue to fluctuate in the future but little or no overall growth is envisaged. There exists the possibility of major expansion by the exploitation of new stocks (mesopelagic fish and Antarctic krill) but it is not expected that this will take place to any major extent in the foreseeable future.

The market in which fishmeal competes is expected to continue to expand, although at a lower rate than in the past two decades.

World production of all oilseed meals is projected to increase from 113 million mt in 1982 to 168 million mt in 1995; soybean meal production is expected to increase from 76 million mt (67.3%) in 1982 to 123 million mt (73.2%) in 1995 (World Bank, 1984). The overall rate of increase in the World consumption of oil seed meals is expected to slow down to an increase of only just over 3% over the period 1985-1995, as compared to 5% in the 1970-1982 period. The slower growth in consumption reflects the near market saturation in industrial countries.

Consumption is expected to grow faster in centrally planned and developing countries where modern poultry farming has been increasingly introduced and where the share of world imports of meals increased from 4% in the mid-1960s to 17% in 1982; it is projected to reach 21% by 1995.

For these reasons, soybean meal prices are expected to remain at relatively low levels in real terms (Exhibit 54). Constant dollar prices for 44% protein soybean meal are projected to decrease from US$157 per tonne in 1985 to US$153 in 1987. Prices are then expected to recover to US$166 per tonne by 1990 and decline again to US$154 per tonne by 2,000; well below the prices of the period 1980-83.

The prices of individual meals are determined by the interaction of supplies of and demand for the products in international markets. The extent to which fishmeal prices move with the overall level of prices for all meals depends on the ease with which it can be replaced by other meals. Short-term price movements also reflect changes in weather conditions, inventories, exchange rates and the prices of substitutes.

Prices for fishmeal can be expected to follow those of soybean meal quite closely. Our predictions for fishmeal are based therefore on those mentioned in the previous section for soybean meal, and it is assumed that fishmeal prices will fluctuate proportionately with soybean meal prices.

EXHIBIT 54: SOYBEAN MEAL AND FISHMEAL PRICE PROJECTIONS, 1986-2000

	$US per mt		
Year	**Soybean Meal**[1]		**Fishmeal**[2]
Actual	$ Current	Constant $1985	$ Current
1984	197	198	432
1985	157	157	n/a
Projected			
1986	180	159	320
1987	170	153	308
1988	194	164	330
1989	197	165	332
1990	201	166	334
1995	227	158	318
2000	262	154	310

Source: World Bank, 1986.

[1]. Soybean meal prices for meal of 44% protein; cif, Rotterdam
[2]. Fishmeal prices are average value of world imports, cif, Rotterdamu

In making the projections we have assumed a fishmeal to soybean meal price ratio of 2.01, the simple average over the period 1980-84 (See Exhibit 52). However, it should be noted that the ratio has been less than 2.0 since 1984.

The predicted prices are averaged. Wide swings in the short term fishmeal market have been characteristic and can be expected to recur, especially when abnormal weather conditions affect the oilseed crop or the availability of fish resources. However, it can be seen that fishmeal prices are expected to fluctuate and to end the century 28% below their 1984 level (in constant dollar terms).

7.0 THE PROJECT PLAN

7.1 INTRODUCTION

It should be noted that all of the following has been discussed fully at the provincial and Kabupaten level with officials from BAPPEDA, Perikanan and Perindustrian, with representatives of KADIN and the private sector and with Pusat officials of Perikanan and Perindustrian.

While it is not possible to be accurate about the ultimate size of the maximum sustainable yield, because a full resource survey has not been conducted in the study area, there is every indication that additional yields, particularly of larger pelagic fishes would be possible by expanding the fishing effort. Current landings indicate that the supply of fish raw material is, and can be expected to remain, available to support modest processing industries.

Within a framework of staged development, beginning initially in Sulawesi Selatan and then subsequently in Sulawesi Tenggara, a number of industrial project opportunities have been identified.

The identified opportunities would process resources harvested from the Banda and Maluku seas, the Makassar straits and the aquaculture production of shrimp and seaweed (rumput laut...Gracilaria spp) from tambak, located mostly in Sulawesi Selatan but also, to a lesser extent, in Sulawesi Tenggara.

As the initial processing industries become established and successful, further and diversified expansion would be possible in the future.

Obviously, a number of difficulties must be overcome if the harvesting, collection, processing, storage, marketing, and distribution of processed fish and fish products is to operate smoothly. However, the seriousness of these difficulties and the dedication required to overcome them does not seem to be appreciated fully among decision makers. Improved management at all levels and stages in the harvest to market sequence would possibly be the most urgent requirement.

Accounts of badly maintained vessels and plant under-capitalization, under-utilized capacity and bankruptcy are common. For example, PT Cakrawala and PT East Indonesia Fishery in Maluku were reported recently to have gone bankrupt (Jakarta Post, 10.2.87) and, although well endowed with plant and vessels, many state run fishing companies are not well managed, for example, PT Perikanan Samudra Besar (Jakarta Post, 28.1.86).

7.2 ELEMENTS OF THE PLAN

Chapter 5.0 identified seven opportunities for expanded processing and improvement in the handling of marine based resources:

- o Landing Sites and Local Markets
- o Ice Making
- o Storage and Distribution
- o Canning of Tuna

- o Fishmeal Production
- o Shrimp Processing
- o Seaweed Processing

Two of these opportunities, shrimp processing and seaweed processing, lie outside of the Terms of Reference in so far as the processing of seaweed and additional shrimp would be based on aquaculture production. The remaining five opportunities introduced below are expanded on in the remainder of this report.

The first three of the projects would be linked together functionally and geographically. Improvements to landing sites and local markets, ice making facilities, and storage and distribution would enhance, not only the quality and availability of fish for local consumption but also the quality and supply of ('tuna' includes skipjack and larger tuna) for processing.

Canning of 'tuna' and fishmeal production would be linked together. The fishmeal plant would primarily handle waste offal from the canning plant. The two processing facilities would, therefore, be adjacent and linked in the process chain.

7.3 CANNING OF 'TUNA' AND FISHMEAL PRODUCTION

The size of a potential 'tuna' canning plant would vary according to three major factors:

- o the market for canned 'tuna'
- o the availability of 'tuna' in sufficient volume and price
- o the ability of management to operate the plant and market the product

Throughout this report it is suggested that a moderately sized plant has a better chance of success than a large plant. If a moderately sized plant became successful, expansion would be possible at a later date. Plant designs proposed in this report have built into them the possibility of being expanded in the future.

Of the 'tuna' delivered to a canning plant, approximately 60 per cent by weight becomes canned. The remaining 40 per cent is 'waste' in the form of offal from those fish which became processed and a small percentage of spoiled fish unsuitable for processing. the 'waste' fish must be disposed of. There would be a cost associated with such disposal. For planning purposes, the cost of dumping 'waste' fish is estimated to be $ US 25 per mt to cover the cost of a truck, fuel, labour and any dumping charges.

However, an alternative to simply dumping the 'waste' is to process it into fishmeal. The 'waste', essentially of negative value (equal to the cost of dumping), would be processed to fishmeal in a plant adjacent to the canning plant. The same plant could process other clean unwanted fish such as fish waste, sharkbodies after liver oil extraction, flying fish bodies after egg extraction, physically damaged but fresh fish and other unsold clean fish from the market.

7.4 LANDING SITES, MARKETS, ICE, STORAGE AND DISTRIBUTION

In order to be able to obtain sufficient 'tuna' to supply a canning plant, it would be necessary to collect 'tuna' from a wide area or introduce a fleet of purse seiners to serve the canning plant's needs. From the experience and record elsewhere in Indonesia, for example, Maluku, fleets of locally operated purse seiners have been neither maintained nor managed well. Failures have been frequent. The alternative of contracting with foreign purse seiners would be valid but is not recommended at this time.

It is proposed that 'tuna' be supplied by local fishermen landing their catch at specified landing places where ice and fish storage facilities and, later, boat repair and supply facilities, would be located. These facilities would be available also for use by fishermen and traders dealing in the local market place.

A depot would be available for the storage of 'tuna' on ice in an insulated storage facility supplied directly with crushed ice. An adjacent insulated storage facility would be available for local usage. Ice would be produced at the site in the same building and be made available initially free of charge to fishermen who supply a specified minimum amount of 'tuna' to the canning plant. Ice would be sold to other users.

Clean water would be provided. Boat repair and supply facilities would be constructed at a later date, along with a boat ramp, as fishermen become accustomed to supplying the canning plant with 'tuna'.

Fish markets in the same towns in which the depots were located would be upgraded by the provision of clean water, drainage facilities and insulated storage facilities.

'Tuna' for canning would be picked up from the depots at periodic intervals, probably every two or three days, by company truck or, in the case of 'tuna' collected off Mamuju and along the coast between there and Majene (see Exhibit 3) by collection vessel operated by the canning company.

Facilities Proposed Ultimately for Typical Fish Landing Site with Ice Facilities

A typical fish landing site is shown on a drawing included in the inside pocket of the back cover of this report. It includes the following:

- 5m x 60m jetty;
- access road;
- 10m x 20m boat ramp;
- fishermen's lockers;
- elevated water storage;
- 10 tonnes/day ice machine;
- 30 tonnes ice storage;
- fuel storage and metering facilities;
- 10 tonnes insulated fish storage;
- workshops

7.5 AVAILABILITY OF 'TUNA' AND LOCAL PRICES

Two basic options are available for obtaining skipjack for processing:

- o company ownership of boats with crews paid either on a profit sharing or fixed salary basis, and
- o purchase of fish from independently owned fishing boats.

Company ownership of boats is not recommended at this stage. However, it is noted that UNIDO (1985) recommended the acquisition of 5 purse seiners of 400 gt capacity to support a proposed cannery in Ujung Pandang. Boats and skilled fishermen are already operating in the region. It is the view of the consulting team that the resource would be better utilized by purchasing fish from independent boat owners and/or fishermen. This approach would also keep overall investment lower and reduce management requirements.

Fish purchase on a contract, or posted price basis, is recommended. Under this scheme the company would establish fixed prices for the various grades of fish and boat owners would sell, and the company buy, their total catch at these posted prices. The company would provide ice free of charge and also, over time as the collection depots become fully operational, offer other services such as fueling facilities, ordering of spares, etc., to build up loyalty among fish suppliers. Costs of these other services would be deducted from the catch proceeds.

There is evidence that local boat owners/fishermen would welcome the opportunity to contract on this basis. For example, the experimental collection of skipjack from bagan off Mamuju in 1985/86 showed that fishermen were very happy to receive a stable, though relatively low, price for their catch of skipjack (see Section 4.6). Further, it should be noted, from previous experience, that when an expanded market for fish has been created (for example, a canning factory has been established) the landings of required fish have increased.

Another chance to level out the production of skipjack and tuna is by contracting foreign vessels. One example of contracting foreign vessels is provided by PT Bali Raya, an enterprise belonging to the PT Manstrust Group, which has contracted US vessels to increase and level out the catch.

An alternative and complementary system would be to have a fleet of owner-operated pole-and-line boats supplying fish under contract. Such a system is operated by PT Perken in Kendari. PT Perken's fleet of 30-35 boats supplied approximately 2,800 mt of Cakalang in 1986. While a similar arrangement could work well for the proposed plant it is thought better to initially leave the catching of fish to fishermen using traditional methods and gradually improve on these methods as the canning plant becomes established and such issues as a stable market, use of ice, reliability of supply and so on, become accepted.

'Tuna' for processing in the proposed fish canning plant can be expected to come from three sources:

- o diversion from existing landings;
- o from increased landings;

- o from cold stores currently located in Kendari, Ambon and as proposed in Bau-Bau (and possibly from Bitung).

Exhibit 55 (based on Exhibit 18) shows the volume of landings of 'tuna' (Cakalang and Big tuna) at each of the main landing points in Sulawesi Selatan and as available in frozen form from PT Perken in Kendari. Exhibit 55 shows landings of 'tuna' for 1985 as follows:

- o the coastal strip, Pangkep to Mamuju - 10,300 tonnes;
- o Palopo - 2,900 tonnes;
- o Watampone - 6,700 tonnes;
- o the Southern coast - 2,700 tonnes; and
- o potentially, in frozen form, from Kendari - 2,500 tonnes.

With a stable and constant market, all of these landings can be expected to increase. There can be expected to be available a minimum of 3,000 tonnes in the first year of operation beginning in 1989 and rising quickly thereafter. For planning proposes, a raw material input of 8,000 tonnes is expected by 1991, rising further to over 10,000 tonnes by 1994.

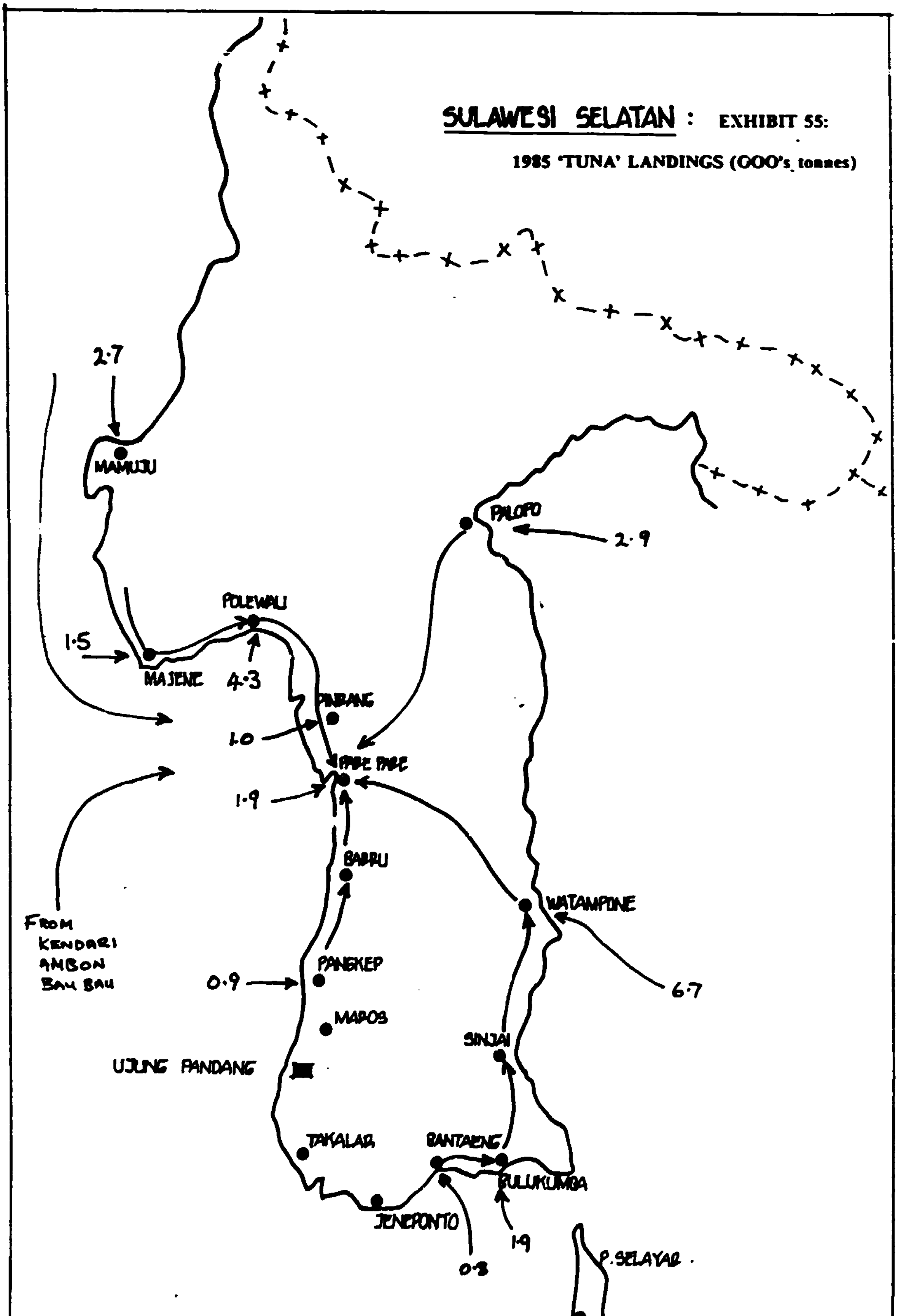
Prices paid for Cakalang in the retail markets of various towns visited in 1987 as part of the field work, are shown in Exhibit 56. Prices in Sulawesi Selatan ranged from a low of 450 Rp's per kg to a high of 1100 Rp's per kg, depending upon season. Markups between fishermen and the retail selling price were observed in the order of 100 to 250 Rp's per kg. Recognizing that market price stability and a constant source of demand provides suppliers with financial security, an estimated price for Cakalang raw material in the range of 400 Rp's to 800 Rp's per kg would seem appropriate. PT Perken, in Kendari, was paying 350-450 Rp's per kg in 1986 for Cakalang suitable for freezing.

For planning purposes, a price of 600 Rp's per kg of Cakalang (skipjack) has been used. This amounts to approximately $US 380 per mt.

EXHIBIT 56: CAKALANG (SKIPJACK) PRICES 1986/87

Market	(Rp's/Kg) Skipjack
Jakarta	2000-2550
Kendari	650-900
Kolaka	550-750
Bone	800-1050
Sinjai	500-700
U. Pandang	800-1100
Majene	700-950
Mamujui	450-650

DP. II, Interviews and Field, 1987



SULAWESI SELATAN : EXHIBIT 55:
1985 'TUNA' LANDINGS (OOO's tonnes)
2·7
MAMUJU
PALOPO
2·9
POLEWALI
1·5
MAJENE
4·3
PINRANG
1·0
PARE PARE
1·9
BARRU
WATAMPONE
FROM
KENDARI
AMBON
BAU BAU
PANGKEP
0·9
6·7
MAROS
SINJAI
UJUNG PANDANG
TAKALAR
BANTAENG
BULUKUMBA
JENEPONTO
1·9
0·8
P. SELAYAR
Source: Propinsi Sulsel, Dinas Perikanan J, 1986

7.6 LOCAL FISH PRICES AND THE POSSIBILITY OF INTRA AND INTER-ISLAND DISTRIBUTION

The provision of ice at collection depots and the provision of insulated storage facilities for market fish, as well as 'tuna' for canning, will provide opportunities for the quality of fish in the market and the daily diet to be improved. Post harvest losses will be reduced from day-to-day and season to season. Additionally, opportunities will expand for the transfer of fresh fish on ice from village to village, particularly in insulated containers, in response to price differentials.

Exhibit 57 shows fish prices for selected types of fish in Sulawesi Selatan by representative month in 1986. The exhibit shows, for example, that in January, the price of Tongkol in Pare Pare was Rp's 1275 per kg whereas in Polmas (near Palapo) the price was Rp's 1300 per kg and Rp's 1200 in Watampone (Bone). A second example, for Tembang, shows that the prices in Pare Pare, Polmas and Bone were, in September, Rp's750/Kg, Rp's 860/Kg and Rp's 650/Kg respectively.

Considering these two types of fish and the three locations, the price differential would be as shown below.

Price Differentials (Rp's per Kg)

	a) Tongkol	b) Tembang
Pare Pare/Polmas	155 (PP->P)	110 (PP->P)
Pare Pare/Bone	75 (B-->PP)	100 (B-->PP)
Polmas/Bone	230 (B-->P)	190 (B-->P)

The transport cost of moving fish in 200 Kg lots from town to town is shown on Exhibit 58. The cost of transport among the three centres: Pare Pare, Polmas and Bone would be as follows:

Transport Cost (Rp's per Kg)

PP-->P	30.1
B-->PP	21.5
B-->P	51.6 *

* It would be less than this by direct route.

Thus, at the transport costs quoted and the price differentials reported, trade in fish between towns should be profitable. Further, margins would in many cases be sufficient to warrant the purchase of ice and use of insulated containers.

EXHIBIT 57: SULSEL FISH PRICES BY REPRESENTATIVE MONTH: 1986

(Rp's per Kg)

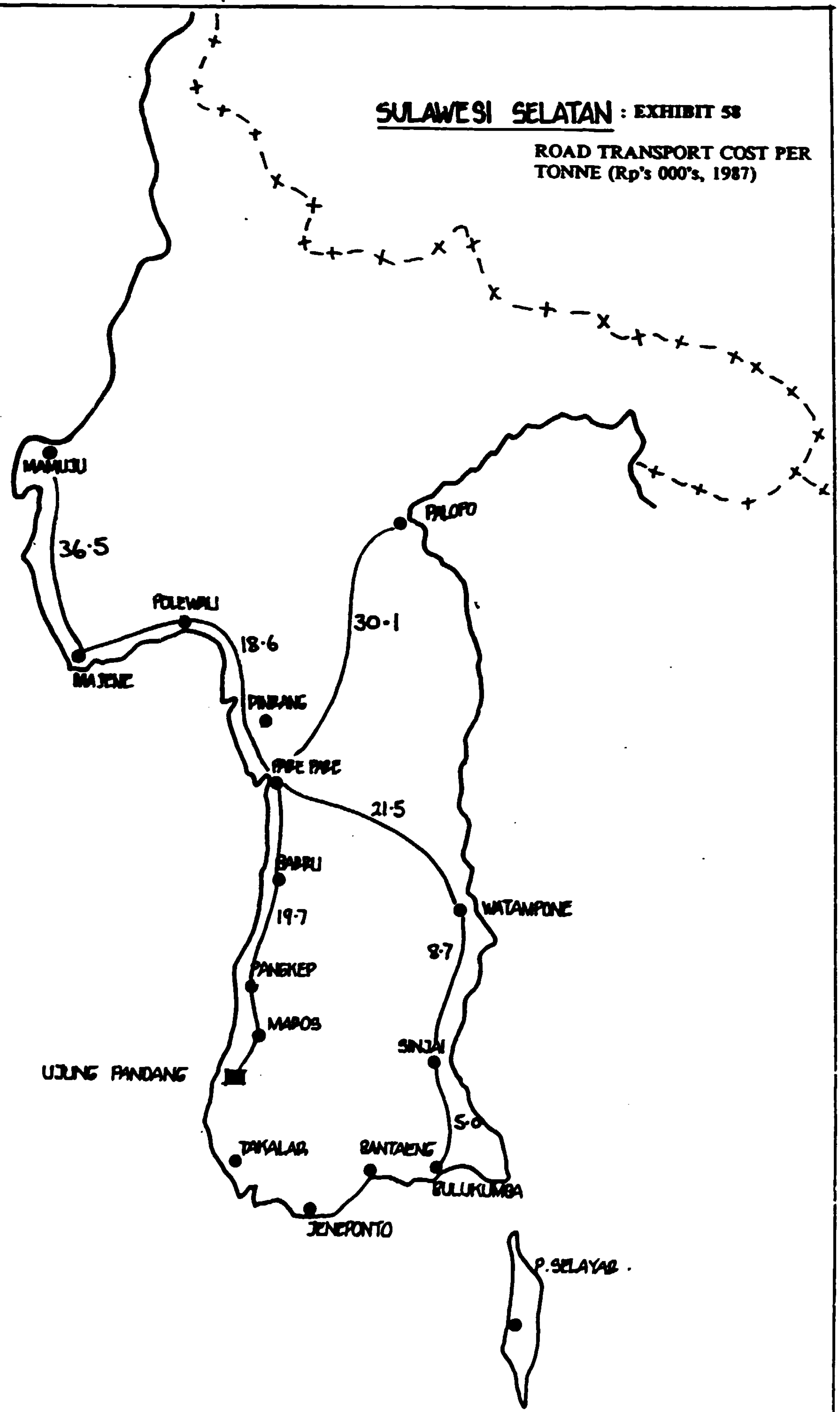
		Jan	March	May	July	Sept	Nov
PARE PARE	Tongkol[1]	1275	1300	1200	1175	1100	1225
	Tenggiri[2]	1100	950	1050	1125	1075	1225
	Tembang[3]	965	---	1000	325	750	600
	Selar[4]	120.	---	1050	---	1050	---
	Bandeng[5]	1300	1275	1200	875	1175	1300
POLMAS	Tongkol	1430	1350	1450	1350	1375	1400
	Tenggiri	1210	1200	1250	1175	1200	1050
	Tembang	960	850	900	900	860	850
	Salar	1050	900	1050	1050	1000	950
	Bandeng	1150	1150	1100	1000	1050	1150
BONE	Tongkol	1200	1300	1200	1200	1200	---
	Tenggiri	900	900	950	1100	1000	---
	Tembang	650	700	650	650	650	---
	Selar	850	900	900	950	900	---
	Bandeng	1000	1100	1100	900	950	---
BULU-KUMBA	Tongkol	1300	1350	1350	1500	1600	1600
	Tenggiri	1100	1200	1200	1330	1250	1500
	Tembang	800	700	650	700	500	500
	Selar	850	850	800	800	700	700
	Bandeng	1800	2000	1900	1700	1500	1600

Source: Sulsel, DP I, Files

Notes: (1) Frigate Mackerel or Eastern Little Tuna, (2) Spanish Macerel, (3) Sardine, (4) Scad, (5) Milk Fish

SULAWESI SELATAN : EXHIBIT 58

ROAD TRANSPORT COST PER TONNE (Rp's 000's, 1987)



SOURCE : QUOTE by TRANSPORT COMPANY, July, 1987 (See Appendix K)

7.7 CANNERY LOCATION AND SITE SELECTION

Site investigations were confined to the Sulawesi and Maluku regions of Eastern Indonesia because these regions are in the heart of the skipjack and tuna resource areas.

Ambon, Kendari, Mamuju, Ujung Pandang and Pare Pare were all considered as potential locations for a cannery. Ambon was quickly ruled out because of the lack of land and supportive infrastructure and the high cost of transit associated with cans and the canned product. The consulting team was advised that is was forbidden to construct any kind of industrial plant in the Ambon Gulf area.

Exhibit 59 shows the locations considered for a potential canning factory and the criteria used to select the preferred location. While all locations that were considered could be deemed to have sufficient 'tuna' available, other criteria, particularly the availability of land, labour, managerial skills and support infrastructure, point to potential, suitable locations within East Indonesia only in Ujung Pandang or Pare Pare at this time.

Further, considering the potential positive impact and linkages within the regional economy, the most beneficial locations in terms of future other related developments (for example, fruit canning, sauce manufacture, label printing and so on) place Ujung Pandang or Pare Pare clearly ahead of the other locations considered. Finally, the cost of land in Ujung Pandang and its unavailability near the sea (a harbour location was ruled out by BAPPEDA) and only modest local landings of 'tuna' leads to the conclusion that Pare Pare would be the preferred location.

An area of about 2 Hectares is recommended for the canning factory, fish meal plant, to allow for future expansion, parking areas, and so on.

The site should have several key characteristics. Ideally, the site should:

- be accessible from the sea,
- be close to road transportation,
- have an adequate water supply,
- be close to an adequate supply of labour,
- allow competitive accessibility to the product markets,
- have access to goc : communication facilities,
- have access to banking/financial institutions, and
- be close to service firms for repair and maintenance of equipment.

EXHIBIT 59: TUNA CANNING PLANT LOCATION SELECTION

	Criteria Considered						
Locations Considered	Available "Tuna"	Water & Elect.	Available Land	Labour & Management	Transp. In & Out	Infrast. Support	Devt. Impact
Ambon	●	○	--	--	--	○	--
Kendari	●	○	●	--	○	○	--
Bone	●	●	●	--	--	--	○
Mamuju	●	○	●	--	--	--	--
U. Pandang	○	●	○	●	●	●	●
Pare Pare	●	●	●	●	●	●	●

Good conditions	●
Acceptable conditions	○
Poor conditions and prospects	--

Ujung Pandang has all of these necessary facilities and characteristics. Any site between there and Pare Pare would be close enough to Ujung Pandang to enable usage of the latter's servicing, financial and communication facilities.

Sites were inspected at Pare Pare, Binangae, Bojo and Warangae (see Exhibit 60). The first choice for a site is within the new port development area at Pare Pare. Unfortunately, BAPPEDA indicated that there is insufficient space at that location. The other three sites that were considered are located on the coast just south of Pare Pare.

The sites at Binangae and Warangae would require recurrent maintenance dredging to provide sufficient draft to allow direct berthing of a proposed collector vessel and coastal reefers. The site at Bojo would be suitable.

The Bojo site has a well sheltered harbour with naturally occurring water depths of up to 16m at low tide (field measurement). The site would be immediately adjacent to the main Noth/South highway. Water and electrical power is available nearby. The capacity and quality of the existing wells would seem to be sufficient for water supply but it is expected that water purification by chlorination would be required.

Bojo is a small village located approximately 6 km south of Pare Pare. It is also the site of a cold storage and processing plant (under construction) for frog legs and shrimp. Adequate skilled and unskilled labour is available in Pare Pare.

The proposed network of collection depots is shown on Exhibit 61. Fresh 'Tuna' (mostly Cakalang, or Skipjack), would be transported to Pare Pare by truck from Palopo, Watompone, Bulukumba and Majene, Polewali and Pinrang. A collection vessel would collect from Bagan off Mamuju and from villages along the coast between Mamuju and Majene. Additional supplies of frozen skipjack could be obtained periodically from Kendari, Bau Bau and Ambon.

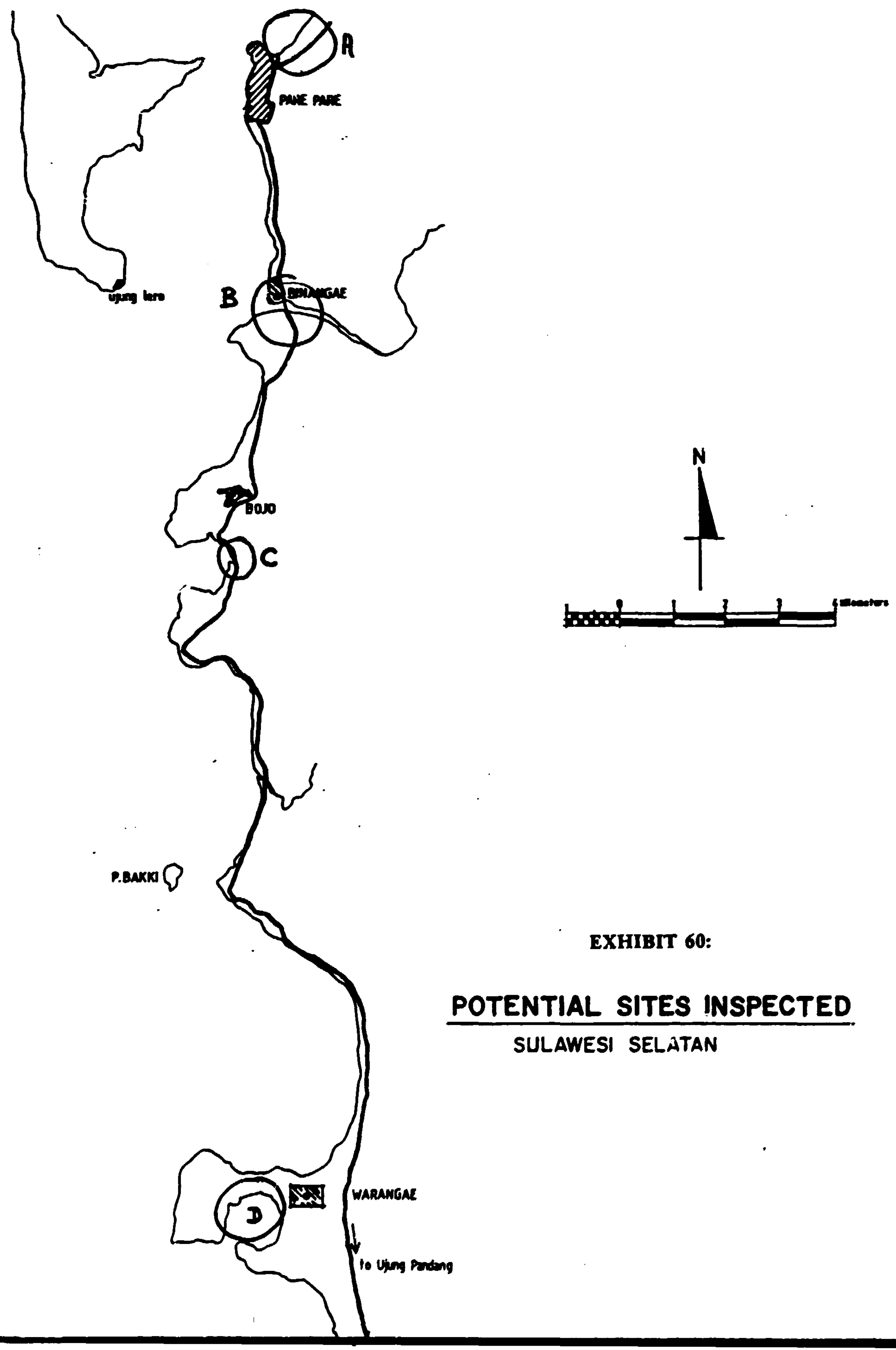
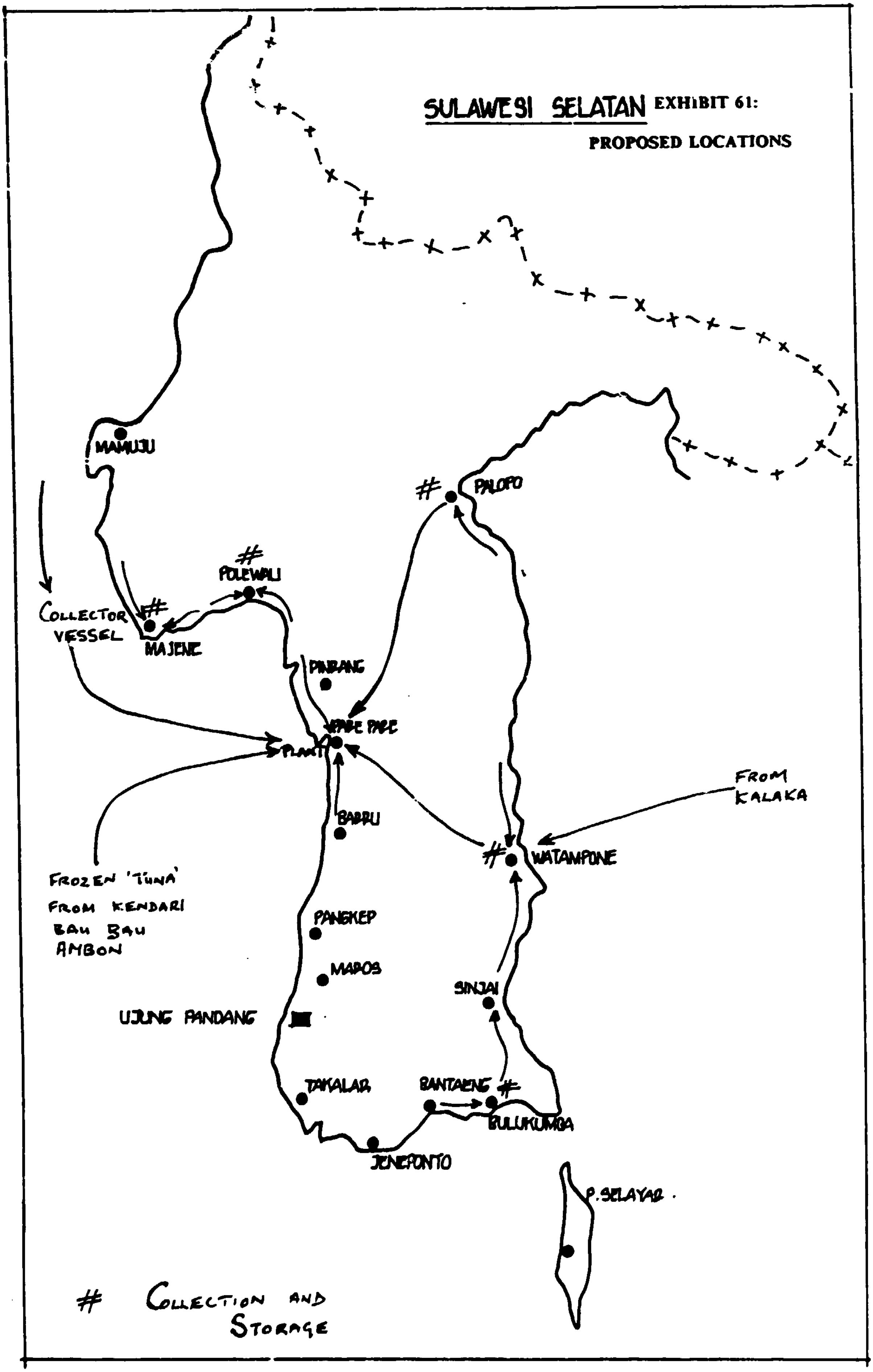


EXHIBIT 60:

POTENTIAL SITES INSPECTED

SULAWESI SELATAN


SULAWESI SELATAN
EXHIBIT 61:
PROPOSED LOCATIONS
MAMUJU
PALOPO
POLEWALI
COLLECTOR VESSEL
MAJENE
PINRANG
PARE PARE
PLANT
FROM KALAKA
BARRU
WATAMPONE
FROZEN 'TUNA' FROM KENDARI BAU BAU AMBON
PANGKEP
MAROS
SINJAI
UJUNG PANDANG
TAKALAR
BANTAENG
BULUKUMBA
JENEPONTO
P. SELAYAR
COLLECTION AND STORAGE

7.8 PROJECT PLAN SUMMARY AND SCHEDULE

The major features of the proposed project are summarized below:

Stage 1:

a) "Tuna Canning Plant"

- o Location: Desa Bojo in Kabupaten Barru near Pare Pare;
- o Capacity: 20 tonnes raw fish per 8 hours shift of which about 12-13 tonnes would be available for canning and 7-8 tonnes as fish "waste";
- o Other Facilities: 500 tonnes cold store at plant for holding "tuna"; 20 tonnes per day ice making capability (ice for canning plant and to distribute to fishermen, etc.).

Note: The canning plant will be designed so that future expansion would be easy to implement.

b) Fishmeal Plant (attached to Canner)

- o Capacity: 30 tonnes per 24 hours;

c) Fish Storage and Collection Network

- o Facilities:
  - step 1: ice making, chill room;
  - step 2: addition of ramp and repair facilities and storage/fuel;
  - step 3: addition of jetty.

(These facilities, particularly the chill room and ice, will also support and make possible improved local and regional marketing of fresh fish).

- o Locations (initial):
  - Majene;
  - Polewali;
  - Watampone;
  - Palopo;
  - Bulukumba.

Note: Capacity will be smaller at Bulukumba; all units will be designed for subsequent expansion).

- o Location (subsequent):
  - Kolaka.

d) Supporting Requirements

- o Insulated containers of two sizes 200 Kg and 500 KG for collection and storage of fish on ice.

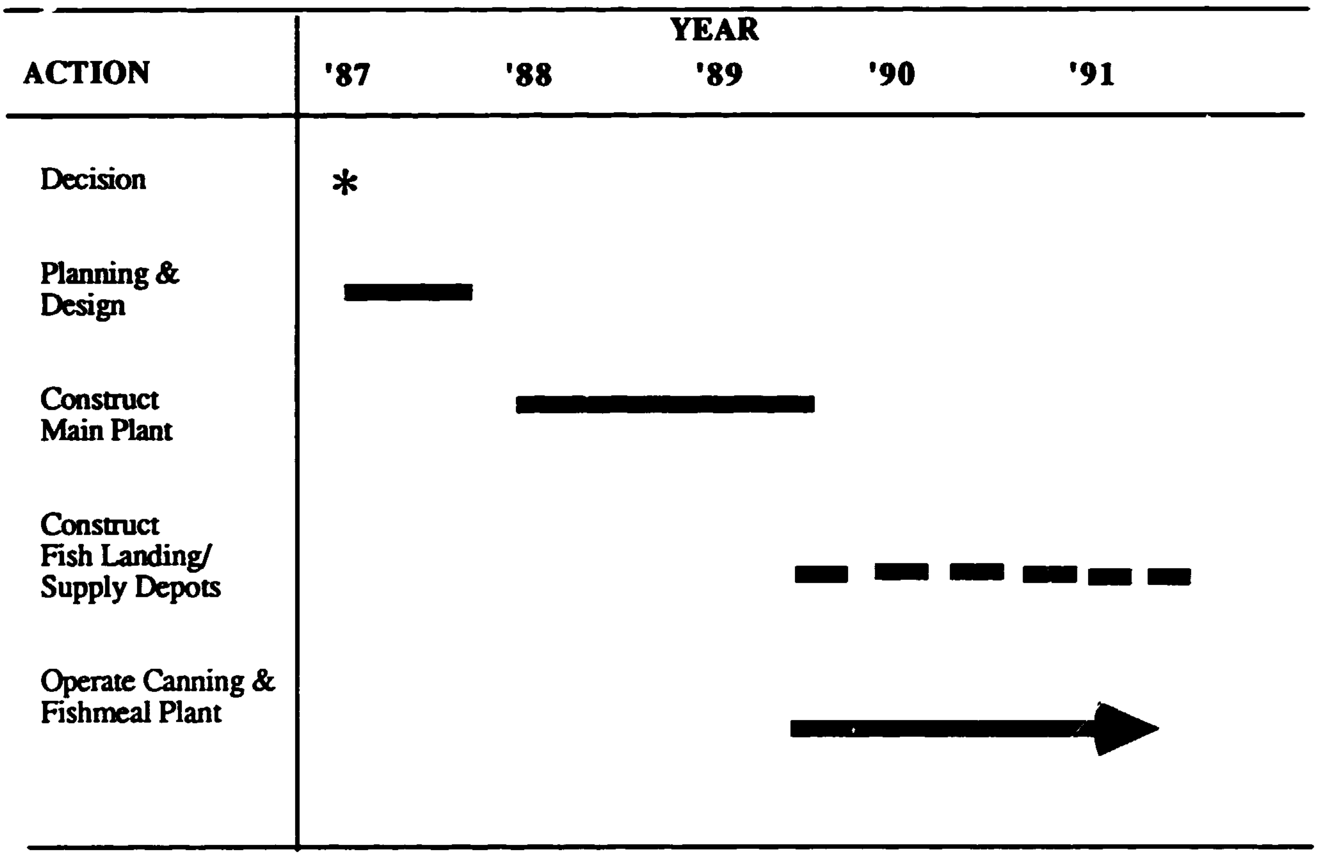
- Fish collection vessel (40 tonnes) to distribute ice to landing points along the coast north of Majene, to began off the coast, to Mamuju and to collect fish on a weekly or twice-a-week basis.

- One 8 to 10 tonne truck to serve and collect from landing sites and drop-off depots from Majene to Pankep and to collect/deliver to Ujung Pandang.

e) Cold Store (with freezing unit), to be located in Bau-Bau by 1990, with capacity of 100 to 200 tonnes.

From decision time to commencement of cannery operations would take approximately 18 months. The proposed cannery could, therefore, be expected to be operational by mid-1989 (see Exhibit 62).

EXHIBIT 62: SULSEL FISH CANNING PLANT (TUNA) APPROXIMATE SCHEDULE



8.0 TUNA CANNING

8.1 INTRODUCTION

A canning factory with a production capacity of 20 tonnes per 8 hour shift has been selected to be located on a site to the South of Pare Pare (see Chapter 7.0) Sufficient preliminary engineering has been carried out to identify costs.

The cannery will have the capability to process both fresh and frozen skipjack and larger tuna, such as yellowfin.

Fresh fish received by boat and by truck will generally be held on ice in insulated containers. Fish will be stored in a chilled room with a holding capacity of 200 tonnes (equivalent to 10 days production). On occasion, when fresh fish supplies are greater than can be handled, raw fish will be required to be held for longer periods. A blast freezer of 10 tonnes per 24 hour capacity is proposed to freeze this fish in order to store it for later use. Frozen fish will be stored in a cold store.

From time to time, frozen fish is expected to be discharged from refrigerated cargo vessels from other areas of Eastern Indonesia (e.g. Kendari, Ambon). The cold storage will hold fish from these sources and frozen on site in the blast freezer at -30 degrees C. The cold store will have a holding capacity of 500 tonnes.

The canning process consists of thawing and cutting (as necessary), pre-cooking, separation of loins/bones/skin/dark meat, packing in cans with brine or sauces, exhausting or vacuum sealing, sterilization (retorting), interim storage, inspection, labelling, master packing and storing ready for shipment. A detailed description of the process and operational requirements is included in Appendix J.

The plant will be provided with storage capacity equivalent to 6 months canned production. Staff facilities (canteen, showers, changing rooms, toilets), laboratory, offices, ice making and ice storage facilities will be included. Capacities and areas are detailed in a drawing included in the inside back cover of this report.

Waste fish and offal will be conveyed by flume to an adjacent fish meal plant described in Chapter 9.0 of this report.

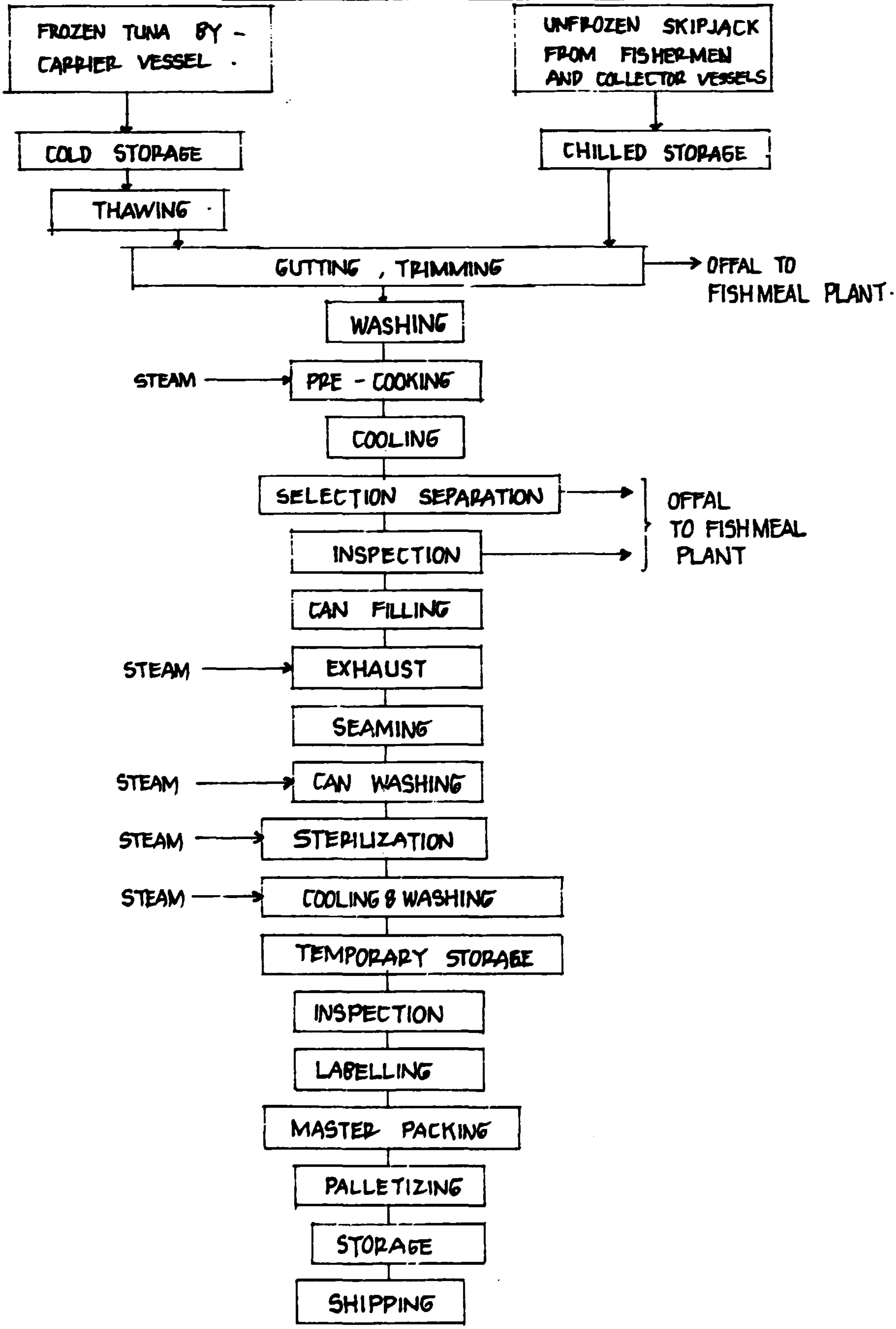
Boilers to generate steam for the canning operation and the fish meal plant will be located in the latter.

8.2 PROCESS OUTLINE

Sequential processing operations for canning tuna are illustrated in Exhibit 63 and described as follows:

(a) Fresh tuna enters the plant or frozen tuna is thawed by means of running water. The tuna is washed and inspected for quality or spoilage.

EXHIBIT 63: PROCESS FLOW CHART
TUNA CANNING FACTORY.



(b) The skipjack tuna (2 to 5 kg per fish) is usually processed fresh. From the chill room, the whole fresh fish is brought to a conveyor and transported to a gutting machine. After evisceration the tuna is conveyed to an inspection table where the final cleaning is completed manually; or, where those fish too large for the gutting machine (larger tuna) can be butchered.

(c) The tuna is pre-cooked at temperatures of 102-104°C for up to 2 hours (skipjack) and as long as 8 to 10 hours for larger fish (yellowfin.) The butchered fish are placed in baskets and rolled into a steam cooker.

(d) Tuna is cooled to firm the flesh before the manual cleaning operation can be performed.

(e) Head, skin, tail and backbone are removed. Loins are produced by splitting the halves of the fish along the median line. Red meat is removed from each loin; blood and dark meat are scrapped away and the loins, edible flakes and waste products are separated.

(f) Production of solid packs, formerly a hand-packing operation, is now carried out by machines. This machine produces a cylinder of tuna loins of uniform density from which can be cut can-sized segments of uniform weight.

Chunk packs are produced from loins which are cut on amoving belt by means of reciprocating cutter blades. The cut loins are then filled into cans by tuna filler machines.

Flakes are grated tuna produced from broken loins; flakes are packed in the same way as chunk packs.

(g) The open cans next pass the line where additives such as salt, vegetables, water or oil are added.

(h) Small cans may be closed, without a vacuum, and processed directly, whereas larger ones must be vacuum sealed.

In order to form a vacuum, cans are seamed by using either vacuum seamers or an exhaust system.

(i) Seaming operation.

(j) The sealed cans are transferred by a conveyor through a can washer and discharged into retort baskets.

(k) The retort baskets are transferred into the retort and the cans sterilized.

(l) When the recommended processing time has elapsed and the cans have been cooled down, the retort baskets are taken out of the retort and the cans are allowed to dry before further handling.

(m) Labelling and cartoning of fish product.

A drawing of the layout of a tuna cannery having a capacity of 20 tonnes whole fish (yellowfin and skipjack tuna) per 8 hour shift, is included at the rear of this report.

8.3 PROCESSING EQUIPMENT

Some of the most important equipment used for canning and pre-treatment of fish is described below. The items selected are chosen to give an impression of the processing principles, rather than to recommend particular equipment.

Retorts

Horizontal retorts, which are common within the fish canning industry, have the following general features:

- o the retort shell (body), crates and various controllers;
- o the capacity of the retort is optional and depends on the output of the cannery, however, as a guide, a retort which holds 1400 cans (850 ml) per batch would suit most medium sized batch operations. (In this case the retort would be approximately 4000 mm long and have a diameter of 1200 mm. The size of each crate would be 800 mm x 700 mm x 700 mm);
- o steam consumption would be approximately 400 kg per batch while water consumption during cooling would be approximately 10,000 litres per batch;
- o consumption of electricity would be approximately 5 kWh per hour for circulation pump etc.;
- o the retort would be normally operated by one person who, in many cases, would also be in charge of a batch of retorts.

Seaming Machines

There are several automatic seaming machines designed specially for closing filled square, oval and round aluminum or tin plate cans. Automatic seaming machines can operate at speeds of 3500 - 4000 cans per hour. Diameters of cans that may be seamed range from approximately 50 mm to 195 mm. The height of the cans may range from 15 mm to 120 mm. Approximate length of the seaming machine will be 2000 mm while the width will be 2000 mm.

Automatic machines are fitted with can end and can body feeding devices and also with equipment for automatic code marking of can ends. Additionally, may also be linked with the following devices:

- o **Automatic filling device:** The device is designed for filling of oil, tomato sauce and other liquid sauces into cans. It is pneumatically operated and fills precisely measured quantities into each can;

- **Lidplunger and Control Closing Device:** The device is mounted on the closing machine and is particularly useful for overpacked cans. It presses the lid down on the can, and if the lid is not lying on the can, the seaming operation is automatically stopped;

- **Electricity consumption** is approximately 30-35 kWh per 8 hours,(the machines can be operated by two workers);

Can washing and drying machines

Can washing and drying machines are used to clean cans after sterilization in order to remove residual oils that may have adhered to the can surface during filling and retorting.

These machines are frequently fitted with a variable speed drive to regulate the speed of the conveyor belt.

Approximate dimensions of these machines are 3600 mm (length), 1500 mm (height) and 1600 mm (width).

The drive motors will consume approximately 60-70 kWh per 8 hours when fully used. If a steam battery were used for heating it would consume approximately 200 kg steam per hour. If the machine were heated by electricity, it would consume approximately 100 kWh per 8 hours. All parts would be made from stainless steel. The machine would be automatic, but may be fed by one or two workers.

Cartoning Machine

Cartoning machines are used for packing cans into individual cartons. They may be equipped with a rotating infeed table. The cartons are separated and opened by use of vacuum and the machine is equipped with a pump for this purpose. The machine has two electric motors each of 0.25 hp.

The length of the machine is 2400 mm and width is 800 mm. The motors will consume approximately 3-5 kWh per 8 hours. Consumption of compressed air is 160-200 litres per min. The machine may be fully automatic or it may be fed by one or two workers. Cartoning machines with capacities of 120 or more cans per minute are available.

Equipment for Canning Tuna

Four major pieces of equipment would be required:

- **Gutting machine:** The gutting machine consists of a semi-automatic machine in which the fish is placed with its belly uppermost. A rotating knife opens the fish; viscera are removed by two successive ejectors and cleaning tools;

  - the machine has a capacity of 25 fish per minute and can be operated by one person;

- the consumption of electricity would be 3 kWh and approximately 1.5 mm of water per hour;

- the apprcximate dimensions are 1500 mm (length), 1380 mm (height) and 1950 mm (width).

o **Racks and Baskets:** baskets filled with tuna are placed on racks and loaded into the cooker;

- the racks are equipped with two fixed and two swivel wheels;

- approximate dimensions of a rack are 760 mm, width 838 mm and height 1400 mm without wheel;

- the material used in construction would be either galvanized or black iron;

- each basket would hold approximately 15-16 kg fish;

- dimensions of the baskets used for the racks described above are 810 mm x 380 mm x 100 mm and the net weight of each basket is 4 kg;

- galvanized wire is often used to construct these baskets;

- two workmen can fill the baskets and load the cooker.

o **High Speed Tuna Filler:** A high speed tuna filler is a fully automatic machine designed to cut and fill pre-cooked tuna meat into round and/or oval cans.

- the main components are the feeding unit, the cutting unit and the filling unit;

- the machine fills tuna tablets ranging from 100 g to 1 kg;

- length of the machine is 3600 mm, wiuth is 1700 mm and height is 1250 mm;

- only one person is required to feed tuna loins into the machine.

o **Exhaust Boxes:** are used for heating cans to ensure that when sealed and cooled a vacuum is produced in the can.

- The boxes are equipped with can feeding and discharge belts and an electric motor.

- The capacity of the exhaust box should be approximately 10 tons per 8 hours with an exhausting time varying between 1-10 minutes in steam open to the atmosphere.

- Length of the box is 3600 mm and width is 600 mm.

- The motor will consume approximately 25 kWh per 8 hours. Consumption of steam is 70-80 kg per hour.
- Material used in construction is mainly stainless steel.
- The machine can be operated by one or more workers, depending on the degree of automation used at the infeed and exit stations.

Storage of finished products

The final storage for canned products must be dry, with good air ventilation and at moderate temperatures. The cans should be stored in cartons or containers, after sterilization and washing.

This procedure will facilitate the inspection of the cans to ensure approoriate quality. The duration of the storage must be at least 4 weeks. During this period, inspection for swollen containers will reveal the majority of microbiologically unsound cans that may have been produced and damage to cans.

As a general rule, the store room must have sufficient space for 4-6 months normal production capacity; however, as costs rise, many manufacturers attempt to reduce their inventories. When storing without a rack system, three to four pallets can be stacked on top of each other in the store room without damaging the cans (with tine plate cans). The storage density is approximately 3 tons per square metre. Transport and working areas in the store are not included.

A storage system based on racks enables the best utilization of the store and gives greater scope for arranging the different types of products separately.

A store of 12.5 m x 8.5 m x 5.5 m (height) 580 m3) will contain approximately 315 pallets with a dimension of 0.8 m - 1.2 m (the Europallet). With approximately 800 kg on each pallet, the store will contain approximately 250 tons of final products (packaging material included).

Storage of Ingredients

Generally, ingredients should be stored in a clean, dry and preferably cool place. Dry commodities (i.e. flour, spices, salt) and oil for canning when kept in steel cans (drums) will withstand variable storage conditions.

Requirements for water and energy

Requirements for water and energy listed below correspond to the plant capacity quoted above. Electricity required for refrigeration installations is not included.

Water Requirements (m^3/hr)

Thawing and Dressing	20
Processing Line	10
Sterilization	30
Other	20
Total	80

Other Requirements

Equipment	2000 kWh/8 h
Plant	700 kWh/8 h
Steam	5000 kg/h
Fuel Oil	350 L/h

Material Handling Equipment

Requirements for material handling equipment are listed below by number of units.

Fork lift trucks	4
Battery charging unit	2
Pallets for finished products	240
Hand lifting trucks	4
Crates for autoclaves	16
Tuna cook baskets	280
Tuna racks	20
Containers for thawing	20
Bins/cages for whole fish and offal	70
Trays	

Quality Control Facilities

A quality control laboratory would be required to:

- o ensure that only acceptable fish are processed;
- o carry out inspection along the production line;
- o determine the quality of incoming raw material; and
- o ensure that the product complies with applicable bacteriological, chemical, and physical specifications and that it conforms with the buyer's specifications.

The laboratory would have a floor area of approximately 40 square metres.

Refrigeration

Refrigeration should be provided to suit the condition in which the fish are received for processing, i.e. iced fresh or frozen. Refrigeration is also required for ice production and freezing facilities.

8.4 CIVIL WORKS AND SITE REQUIREMENTS

Drains and sewage

The drains should have sufficient capacity for peak situations, and a system should be chosen so that water from processing can be separated from the general sewage water when there is need for treatment according to government pollution rules and regulations.

Screening to remove coarse solids is an essential procedure regardless of further treatment (0.5-0.75 mm openings). Both vibrating and rotating screens can be provided. Grease removal by means of a trap which allows the grease to float off is advisable for fish canneries. Sewage from washrooms, etc., should be connected to the public sewage system or if this is not possible, it should pass a septic tank.

Dimensions for in-plant roads, parking space and offices

Area requirements for parking space depends on local transport conditions. The main roads in the plant area should have a total width of 5m. The surfacing should be designed to allow a maximum axle load of 10 tons.

Office space requirements should be assessed according to the activities to be administered. Space requirements for office in connection with the plant capacities described in this report will vary approximately from 45 to 90 square metres.

Site Requirements

It is vital that a fish cannery be situated near a harbour to avoid high transport costs and other problems when fish is transported long distances after being landed. A cannery will also require labour, electricity, water, and disposal of waste.

A large amount of fish (approximately 40% of the raw material) becomes waste during the process of canning. Because of this, waste disposal should be considered during site selection. To avoid unnecessary cost by transporting waste to fish meal, or fish silage plants, it would be preferable to locate the cannery near such a plant.

The criteria to be considered when selecting plant sites are as follows:

- Nearness to supply of raw material
- Nearness to harbour
- Availability of labour
- Availability of electricity
- Availability of potable water
- Disposal facilities for waste
- Suitable land
- Communication and transport facilities

- Prospects for expansion
- Proximity to markets
- Availability of supportive infrastructure and facilities

Size of the site required for the plant capacity described in this report should be at least 4500 square m; 6000 square m if expansion were considered.

Building Construction

Buildings for fish processing are subject to internal conditions of use which, in many respects, would lead normally to rapid decay of building components unless special precautions are taken. The various types of processing rooms will pose different requirements regarding insulation, surface finish, bearing capacity of floors, resistance to intensive high pressure, hot water cleaning, resistance to chemical and mechanical wear, etc. Great care has, therefore, to be taken in choosing proper building materials and detailed design for fish processing buildings.

Cannery buildings should be planned in detail with considerable emphasis on hygiene, sanitary facilities and control. Further, all rooms used for full-time work should be equipped with a good ventilation system and some areas provided with air conditioning.

Floors should be hard-surfaced, waterproof, non-toxic, non-absorbent and easy to clean. Preferably they should be constructed of reinforced concrete coated with 1-4 mm slurry epoxy or acryl, anti-slip treated. Heavy duty ceramic tiles can also be used. Floor to be graded towards concrete drain ditches (also coated), covered with galvanized fork-lift-proof steel bar meshes. Height in processing rooms should be 4 m.

Column and main beams should be made of reinforced concrete with smooth surfaces.

Walls should be smooth, waterproof, resistant to fracture, light coloured and readily cleanable. They should be constructed of solid concrete blocks to approximately 1.2-2.0 m above floor level, clad with multi-coated aluminum steel sheet or glazed tiles.

All sheeting joints should be sealed with a mastic or other compound resistant to hot water and cover strips should be applied when necessary. Wall to wall and wall to floor junctions should be covered or rounded to facilitate cleaning.

Roofing should be with scantling of galvanized steel covered with asbestos sheets and gutters for rainwater. Ceiling should be of corrugated steel insulated against heat, and in noisy rooms covered with sound absorbing material, perforated plates or something similar.

Doors and windows should be made of aluminum or PVC-coated steel frames, single glazed. All doors should allow for fork-lift transportation (be at least 92.5 m x 3 m).

Area requirements in square metres for single shift operations (8 hours) for plant, products and capacities as discussed, are summarized below.

Approximate Area Requirements (square m)

<u>Processing Plant:</u>	
Pre-treatment	225
Pre-cooking	375
Packing	400
Filling/Seaming	275
Sterilization/Labelling	355
Total Process	**1630**
Chill Room	200
Cold Store	140
Dry Store (Finished Product)	105
Quality Control Lab	40
Office	45
Total Miscellaneous	**530**

Other Services

The requirements for other service installations, such as first aid services, security, welfare, refrigeration and wharfs depends on the capacity of the processing plant and the number of employees involved.

Sanitary installations and canteen requirements must be assessed according to the number of employees. In addition to the hand-washing facilities available in toilet rooms, washing basins with adequate supply of hot and cold water or clean sea water and liquid or soap powder should be provided, wherever the process makes these necessary. Canteen and changing rooms containing showers could also be provided for the workforce.

Where workers of both sexes are employed, separate facilities would ideally be provided but restrooms and canteen may be shared. Space requirements for these services are set out below.

Investment costs per square meter are estimated at NOK 2500 (including plant pipelines, electric installations and equipment).

Consumption of water per 8 hours is usually expected to approximate 80 litres per employee, but experience shows that consumption can range between 50 and 100 litres per employee.

Approximate Space Requirements for Sanitary and Staff Installations for the Plant Described with a Workforce of about 110 Employees

Installation	Net Space (m^2) [a]
Canteen	132
Showers (4)	4
Changing Rooms	220
Toilets (5)	12
Total	368

Note: a) Traffic areas are not included.

The requirement for electric power may be up to 0.5 kWh per worker.

First-aid services must be provided within the factory area.

Security will depend on the local conditions. Watchmen should always be included.

Fire protection equipment must be installed both inside and outside buildings. Extinguishers should be installed at strategic points indoors. Outdoors, fire hydrants or engines should be located at strategic sites.

8.5 MANPOWER REQUIREMENTS

Manpower requirements are summarized below . - Exhibit 64.

EXHIBIT 64: ESTIMATED NUMBER OF EMPLOYEES REQUIRED FOR CANNING TUNA

Operation	Bluefin-Yellowfin Frozen	Skipjack Fresh
Thawing	2	
Headcutting	2	
Band sawing	4	
Machine gutting		1
Inspection/manual gutting		1
Brining	1	
Inspection, filling baskets and racks	4	4
Cooking and transport	2	2
Feeding baskets to conveyor	2	2
Cleaning	40	40
Weighing	2	2
Packing	16	16
Pressing/filling	4	4
Inspection	2	2
Seaming	2	2
Retorting/can washing	2	2
Labelling	1	1
Internal transport/storing	4	4
General labour	2	2
Mechanics	2	2
Foreman	2	2
Inspector	1	1
Total direct production	97	90
Administration	5	5
Watchmen/canteen	3	3
Factory cleaning	2	2
Manager	1	1
Total	108	101

9.0 FISH MEAL PLANT

9.1 INTRODUCTION

In the past 10 years, the price of fish meal, in a market that has been dominated by soya bean mean, has tended to remain steady while production costs have increased.

The price of fish meal and the costs of production are such that the fish meal manufacturer cannot pay for raw material and remain profitable. Often the price of raw fish (for meal) is subsidized, depending on oil content and the amount of transport involved. However, a fish meal plant located adjacent to the proposed cannery would process "waste" raw material from the plant. Further, waste disposal costs would be reduced and a useful product (fish meal) created for consumption locally in poultry and shrimp feed.

The principles employed in fish meal manufacture have not changed over the years but there have been improvements and variations in the type of equipment and methods used.

Fish meal is manufactured on a small-scale at several locations in Indonesia. For example, as part of this assignment, small and experimental operations were inspected in Maluku and Bali. All installations inspected were using open air drying and very rudimentary equipment for pressing and cooking. Quality of this meal was poor and variable. High and variable moisture content, variable oil and protein content as well as impurities due to the method of drying, all account for the low quality of this meal. Of concern, also, is the possibility of salmonella infection of the fish meal produced locally in this manner. The potential for salmonella is high due to the relatively low drying temperatures used.

Here, we are concerned mainly with equipment and methods that would produce a uniformly high quality of meal with good protein yield and minimize environmental effects of waste disposal.

9.2 OUTLINE OF PROCESS

A typical Process Flow Chart is shown as Exhibit 65. A schematic diagram of the fish meal plant is shown as Exhibit 66. Full working drawings are included in the pocket inside the back cover of this report.

Raw Material Handling and Storage

Good practice demands that raw material should not be allowed to reach an advanced state of spoilage and should be transported (if required) in closed and watertight containers. Preservatives have been shown elsewhere to be of only limited effectiveness. Mechanical refrigeration is too costly but ice has been used effectively to chill industrial fish and fish waste. Holding raw material on ice, reduces processing difficulties and increases yield.

EXHIBIT 65: FISH MEAL PLANT PROCESS FLOW CHART

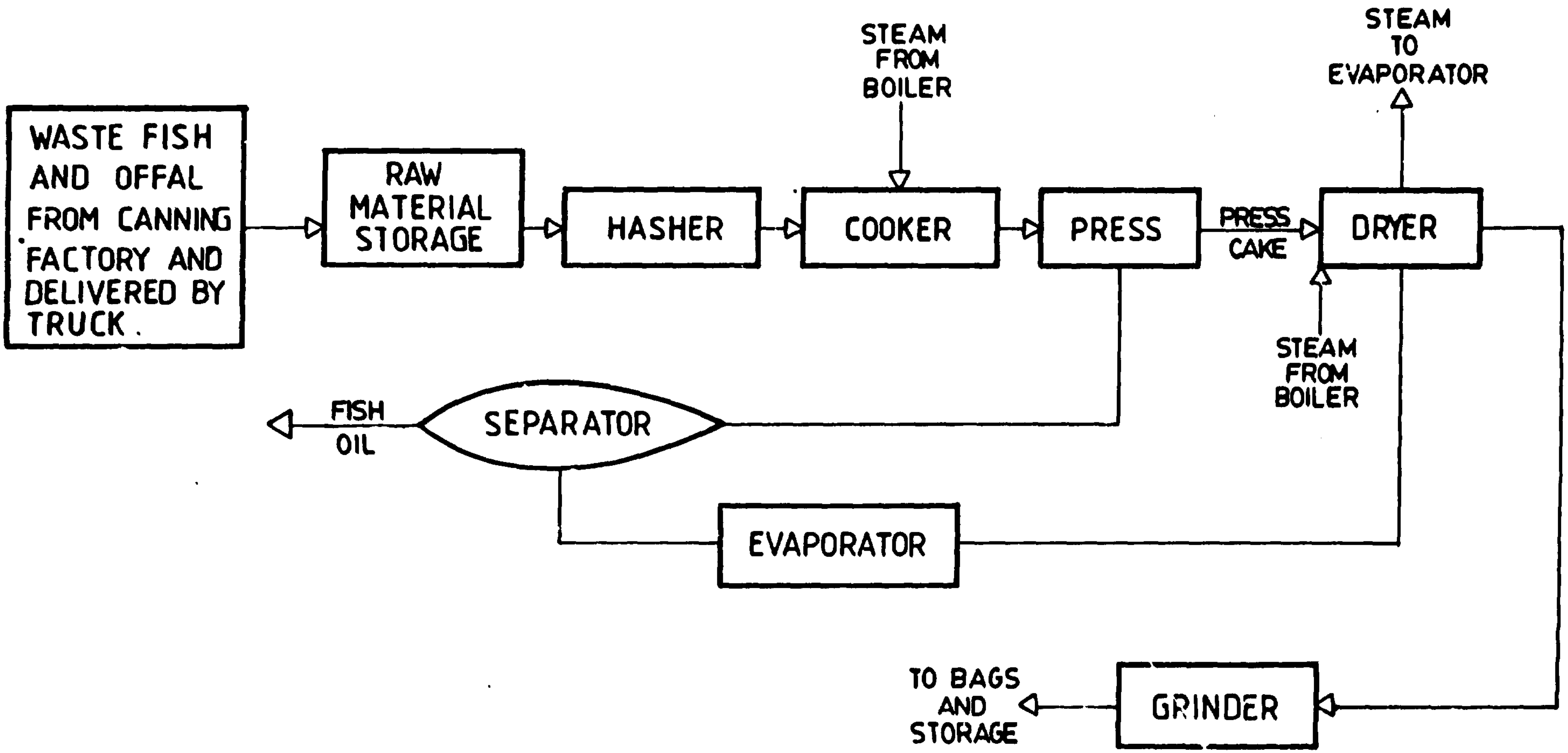
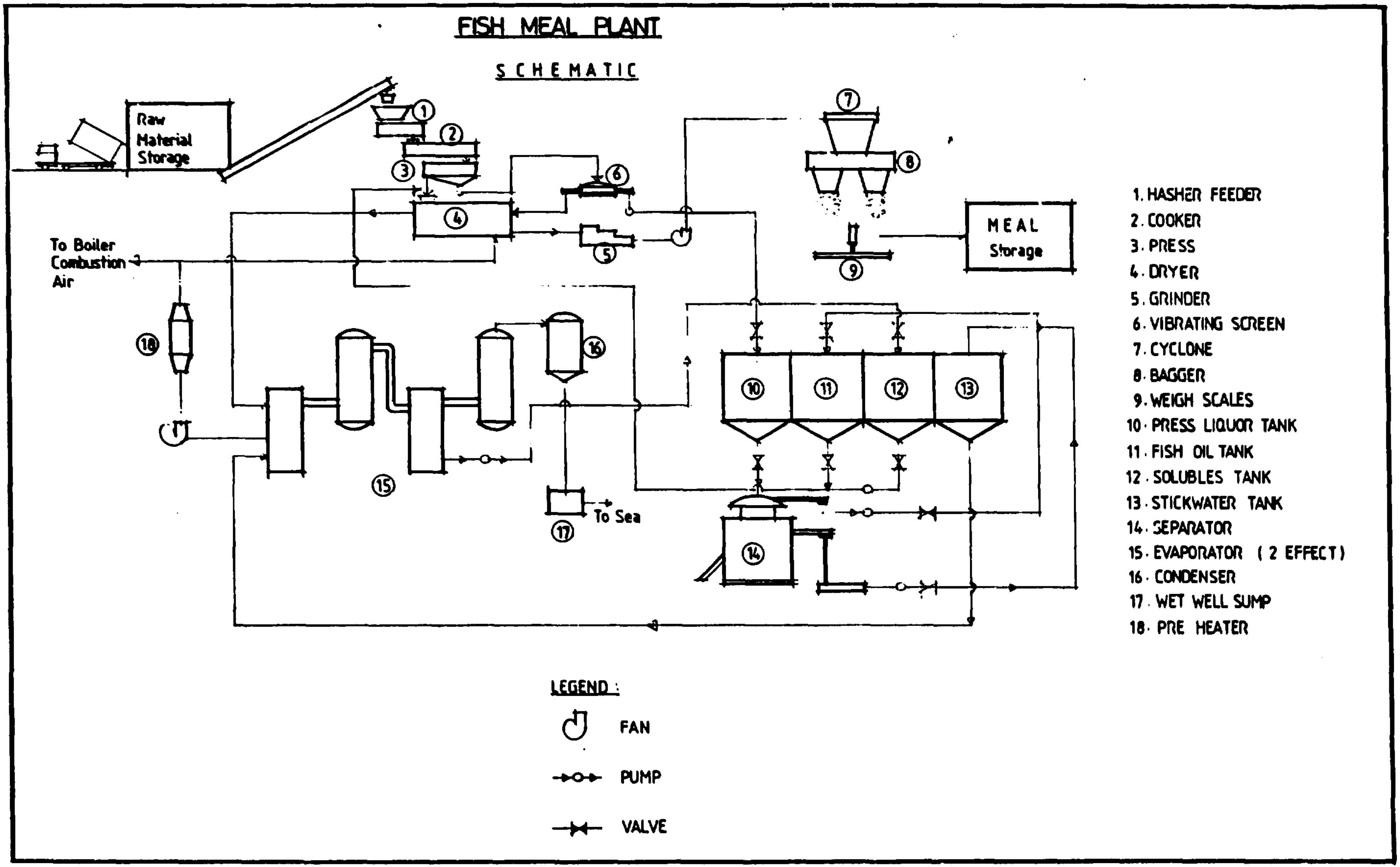


EXHIBIT 66:


FISH MEAL PLANT
SCHEMATIC
Raw Material Storage
To Boiler Combustion Air
To Sea
MEAL Storage
1. HASHER FEEDER
2. COOKER
3. PRESS
4. DRYER
5. GRINDER
6. VIBRATING SCREEN
7. CYCLONE
8. BAGGER
9. WEIGH SCALES
10. PRESS LIQUOR TANK
11. FISH OIL TANK
12. SOLUBLES TANK
13. STICKWATER TANK
14. SEPARATOR
15. EVAPORATOR (2 EFFECT)
16. CONDENSER
17. WET WELL SUMP
18. PRE HEATER
LEGEND:
FAN
PUMP
VALVE

The problem of water addition to raw material is common throughout the industry. Often drainage liquor, or blood water, is worth processing because of its high solids and fat content but the addition of water makes recovery less attractive.
Various arrangements have been adopted for storage of raw material at factory sites. In recent years, large storage tanks for the storage of raw material, especially industrial fish, have been introduced in some factories, notably in Scandinavia. They enable the confinement and treatment of odors but indications are that they are less suitable for offal which flows less easily and hence is more difficult to convey.

As far as odour nuisance is concerned, the freshness of the raw material is crucial. During processing, spoiled fish, which by itself can cause offence, will produce much more odour than fresh fish.

Cooking and Pressing

The fish raw material is cooked and pressed for oil extraction and to reduce water content. Sometimes, for soft material, a decanter is used instead of a press.

Cookers are usually steam cookers but there has been a trend over a number of years, away from the practice of admitting steam directly to the cooker and toward the use of indirect heating. The main reason for this is that the use of live steam can increased the water content of the fish by up to 10%; this is, of course, counter-productive. The purpose in the end, is to reduce water content.

Drying and Grinding

After pressing, the bulky solids are termed "press cake", the liquid "stickwater" - a mix of water, oil and solids remaining after pressing the cooked fish. The "press cake" is dried. The "stickwater" is separated into oil, solids and waste water, or, simply disposed of.

For drying the press cake, continuous dryers have been favoured by the fish meal industry for many years, although batch drying is practiced widely in the meat and bone industry. Steam heated batch dryers of the vacuum type have been used in a few factories. When they appear to have potential for reducing odour and fuel consumption (because lower temperatures can be employed and no air is used in drying). However, they are less convenient to operate in a continuous production line.

Of the different types of continuous dryers, direct (flame) dryers and indirect (steam) dryers are used widely in fish meal factories. Solar heated dryers are now available. Each of these drying alternatives has its advantages and disadvantages and there always has been argument about the quality of meal resulting from the different types. There is no doubt that the direct dryer generates more odour.

The pneumatic conveying of the dried material from the dryer to the grinder and then to bagging or bulk storage is favoured in the modern fish meal industry but, since air from the pneumatic system is normally discharged to the exterior, some odour is emitted.

Stickwater

The complete fish meal factory has a stickwater storage tank, a concentrator and associated plant. In many cases the stickwater is discarded.

The standard form of concentrator is a multiple-effect evaporator. This machine has to be properly operated, cleaned and maintained if stickwater concentration is to be financially worthwhile but often this is considered to be too troublesome and hence the evaporator is not used to its best advantage. Thus, stickwater is often discarded, even when an evaporator has been installed, causing pollution and loss of output.

Recovery of stickwater can increase the production of meal by 15% or higher. However, fuel requirements are substantial; about 25 kg of fuel per tonne of raw material is required.

Recovery of stickwater is not recommended for the proposed plant.

Salmonella Infection

Fish, like other foods high in protein, can become contaminated through poor handling. A lot of attention has been, and is being, given to the problem of salmonella infection of fish meal and other animal feeds. For example, it is well known that there is a risk of food poisoning to the consumer and that much poultry becomes infected by poor quality fish meal feed.

Various measures can be adopted to reduce the risk of salmonella, such as proper thawing and cooking of foodstuffs immediately before consumption, sterilization of animal feeds and, of concern here, the testing of fish meal and other feeds for infection at the point of manufacture and improved practices in factories.

There are two main features to recommendations that have been put forward for animal by-products and fish meal factories; cleanliness and the division of the factory into "wet" and "dry" areas. The need for cleanliness imposes high standards of factory design, construction and operation. Division of wet and dry parts of the process, in completely separate sections of the factory, with severe restrictions on the movement of personnel and equipment from one section to the other, would reduce the risk of infection. Normally the heat of the meal dryer is lethal to salmonella but the resulting meal must be kept very dry.

9.3 FISH MEAL PLANT RECOMMENDED

Capacity

The fish meal plant capacity is determined primarily by the anticipated quantity of waste product to be generated by the tuna canning factory.

The cannery proposed would have a capacity of 20 tonnes of raw material per 8 hour work shift (see Chapter 8.0). For this amount of fish, 6 to 7 tonnes of offal would be available for processing into fish meal.

Allowing for a doubling of the production from the cannery (by working two shifts), the quantity of offal generated would be 12 to 14 tonnes per day.

Other raw material for the fish meal plant can be expected from:

- o waste fish rejects from the cannery (about 5% of capacity, or 2 tonnes/day):
- o shark carcasses and non-marketable fish or fish waste from other sources (say, up to 3 tonnes/day).

Total meal plant raw material would be, therefore, 17 to 19 tonnes per day.

Allowance must be made for non-productive time for equipment start-up, equipment maintenance, and equipment clean-up. Experience indicates that this allowance should be in the order of 45% of each day, or 11 hours.

The fish meal plant would, therefore, require a capacity of 17 tonnes per 13 hours operating time (11 hours in non-productive time), or 1.3 tonnes per hour.

Due to the high energy costs of equipment start-up, fish meal plants are normally designed to operate on a continuous 24 hr per day basis. For this reason, the standard used by the industry, in terms of rating production capacities, is generally in units of tonnes per 24 hr. The rated capacity of the recommended plant would be 1.3 tonnes per hour for 24 hours, or approximately 30 tonnes/day.

Packaged, self contained plants are available in this size range which have a proven record of reliability, good quality product and long life. It is proposed that one of these plants would be operated initially for 2 to 4 days every week. The extra capacity would allow for future canning plant expansion (say to two shifts) and potential processing of other trash fish which may be available in the vicinity of the fish meal plant.

The meal plant would use indirect steam for the cooking, drying and evaporation process. Drying could perhaps be augmented by using solar energy fired dryers if the cost of fuel oil were to rise by much more than 20%. Common steam boiler equipment would provide steam for both the cannery and the fish meal plant. Exhibit 65 shows the meal plant process that is recommended.

The recommended process would incorporate the latest technology for energy conservation and odour control. The steam from the dryer would be used to heat the first stage of the evaporator. Air (bearing odors) and other non-condensable gases would be used for combustion in the boilers. Therefore, the foul smelling odors would be reduced by incineration.

The meal plant would include provision for raw material storage (approximately 100 tonnes), a multiple effect evaporator, a packaging plant, steam boilers, a quality control laboratory, meal bagging facilities, 30 tonne meal storage and two steam boilers. The boilers would have a total rated capacity of 6000 Kg per hour. This capacity would provide the steam to the fish meal equipment and canning equipment, and have some reserve capacity for standby when, for example, one boiler was out of service for maintenance purposes.

10.0 PROJECT FINANCIAL ANALYSIS

10.1 TUNA CANNERY SCHEDULE OF ASSUMPTIONS

a) Construction and Initial Operations

Following completion of project planning and arranging finance, a period of construction and trial operations would follow. Eighteen months should provide sufficient time. Two foreign advisors and all managerial positions would be filled during the 12 to 18 month period (from construction commencement) so that these people could become familiar with the plant and begin training at least 2-3 months prior to trial operations which would be expected to begin about month 18 from project planning commencement.

Capital and operating costs are set out in detail in Appendix L and summarized in Exhibit 67.

EXHIBIT 67: TUNA CANNERY CAPITAL COSTS

	Local	Local	Foreign	Total
Capital Expenditure	(Rp'sOOO's)	($USOOO's)	($USOOO's)	($USOOO's)
Site	49,200	30.0	---	30.0
Construction (1)	1,148,151	700.1	---	700.1
Equipment (1)(2)	1,352,600	725.6	750.0	1,475.6
Collection Vessels	42,000	25.6	100.0	25.6
Containers	---	---	43.2	43.2
Operating Capital	820,000	500.0	---	500.0

(1) Includes 10% contingency;

(2) Cost based on Canadian and European sources. Some of these items are available to suitable standards from Taiwan, Thailand, and of course, Japan. From these sources, up to 30% can be saved on imported items. Thus, total equipment cost could be reduced to about $ US 1,250,000.

b) Manpower and Management

On a one - shift basis, a total of 101 to 108 people will be required to manage and operate the cannery (see Chapter 8.0). Personnel are grouped by type below.

EXHIBIT 68: TUNA CANNERY PERSONNEL REQUIREMENTS

Management	Staff (nos)	Rp's Millions per Year per person	total	Total $ US/Year (000's)
General Manager	1	16.4	16.4	10
Plant Superintendent	1	13.1	13.1	8
Manager Finance	1	13.1	13.1	8
Manager Marketing	1	13.1	13.1	8
Supervision Quality	1	9.8	9.8	6
Office & Laboratoru	5	2.9	14.5	9
Skilled and Semi-Skilled	35	2.9	101.5	63
Total "Management"	59	---	181.5	111
Labour	49	0.8	51.6	31
Foreign Advisors (2yrs) (*including expenses, travel and accommodations)	2		--	200*

During the initial two years of operations, two foreign advisors, one in the role of manager of plant operations, quality and laboratory control, and the other as manager of fish purchasing and marketing, would be required to assist by way of management training and technology transfer.

With good supervision, it is expected that towards the end of the first year of operations (30 months after construction commencement), the plant should be at 50-60 percent capacity and reach 90 percent capacity within 1 year thereafter. By the third year of operation, it is reasonable to expect that plant output would reach 125 percent of the single shift capacity (by working a modest amount of overtime). For planning purposes, it is assumed that output would stabilize at this level in the fourth year of operations.

c) Operating Assumptions

Tuna would be packed in water in 6.5 oz. cans in a plant operating 220 days per year in 8 hour shifts. Twenty tonnes of tuna could be processed each 8 hour shift. Operating assumptions are summarized in Exhibit 69.

EXHIBIT 69: TUNA CANNERY OPERATING ASSUMPTIONS

A) Costs

Cost of Tuna at plant (cif)		$US 400 per mt
Canned tuna yield (1)		650 Kg/mt (raw fish)
No. cases (48 x 6.5oz) per mt		75 cases/mt (raw fish)

Packaging - Cans (2)	$US 3.20	$US 241.46/mt (raw fish)
- Cartons	$US 0.30	$US 22.50/mt (raw fish)
Water per year		$US 900 (8 hr shift)
Electricity per year		$US 43,000 (8 hr shift)
Maintenance & Repairs (3% of capital)		$US 68,070 year

B) Revenues

Price of canned tuna per case (48 cans x 6.5 oz cans) US or Europe (cif)	$US 22
Price per case net of transport (approx)	$US 20
Revenue (net of transport) from canned tuna per mt	$US 1500/mt (raw fish)

C) Plant Capacity and Utilization

Plant capacity	20 tonnes per 8 hr shift
Operating Days	220 days per year

Year	0	construction, utilization 0%	Utilization	0%
Year	1	construction, 50% for 6 mos	Utilization	25%
Year	2	50% for 6 mos, 90% of 6 mos	Utilization	70%
Year	3	90% for 12 mos	Utilization	90%
Year	4	125% for 12 mos	Utilization	125%

D) Financial

Inflation Rates	Sales 5%, Costs 10%
Depreciation (buildings)	4% $US 28,000/year
Depreciation (equipment)	8% $US123,500/year
Office O/H and sales	5% of sales
Insurance (2% bldgs. & equip)	$US 43,500/year
Discount Rate (for NPV)	18%
Interest Rate on Capital	18%

1) The yield of canned tuna may be slightly higher (and the yield of waste a little lower) as operating and quality control skills improve.
2) Quoted by United Can Company at Rp's 110 per can in Sulawesi.

10.2 TUNA CANNERY CASH FLOW AND FINANCIAL ANALYSIS

Costs and revenues for the initial ten years of operation are set out in Exhibit 70.

As mentioned previously, construction would take approximately 18 months (all of year 0 and half of year 1). Key personnel would be engaged over the three months before construction was completed. Trial production would commence about 18 months from construction start. during the first six months of production, it is assumed that output would be 50% of one - shift capacity, this is, 25% of a year's one - shift capacity (see Exhibit 70).

Operating costs are variable costs except for management (and advisors) and insurance. Office overhead and sales expenses are a function of sales; all other operating costs are a function of plant throughput or raw material input.

Inflation in the markets of North America and Europe can be expected to remain at around 5% over the next few years but inflation in Indonesia, the source of all operating inputs, can be expected to be higher than 5%; 10% has been assumed here.

Exhibit 71 shows the sensitivity of the project to changes in the revenue and cost assumptions. It can be seen that the Cannery as a stand-alone project would be profitable even if revenues were decreased by 40 per cent.

As planned, the tuna cannery would yield:

- **an internal rate of return (IRR) of 81.1 %, and**
- a net present value (NPV) of $ US 8.2 million.

Pay back would occur in the third year of operations.

The sensitivity analysis (Exhibit 71) shows that the IRR would remain high even under:

- inflationary conditions (IRR of 77.8%),
- cost increases of 20% (IRR of 53.8%),
- revenue decreases of 20% (IRR of 62.5%), and
- revenue decreases of 40% (IRR of 25.3%).

It should be noted that equipment costs are based on Canadian and European supplier costs. Equipment from Japan or Taiwan would be lower in cost and, hence, the expected IRR would be higher.

Thus, the tuna cannery as planned would be very viable financially.

While the tuna cannery would be feasible as a stand-alone plant, it is proposed in this report that a fish meal plant, ice making facilities, fish storage facilities and fish landing sites be developed. Each of these projects is considered in the following pages.

EXHIBIT 70: TUNA CANNERY CASH FLOW ($US 000'S)

	0	1	2	3	4	5	6	7	8	9	10
ASSUMPTIONS:											
Capacity Utilization	0	0.25	0.7	0.9	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Tonnes Raw Material	0	1100	3080	3960	5500	5500	5500	5500	5500	5500	5500
CAPITAL COSTS:											
Site and Construction	430	300	0	0	0	0	0	0	0	0	0
Equipment etc	500	1045	0	0	0	0	0	0	0	0	0
Operating Capital	0	800	0	0	0	0	0	0	0	0	0
OPERATING COSTS											
Management and Advisors	0	206	311	178	111	111	111	111	111	111	111
Labour	0	16	31	31	39	39	39	39	39	39	39
Raw Material	0	440	1232	584	2200	2200	2200	2200	2200	2200	2200
Cans & Packaging	0	288	807	1038	1441	1441	1441	1441	1441	1441	1441
Electricity	0	11	31	39	54	54	54	54	54	54	54
Water	0	1	1	1	1	1	1	1	1	1	1
Maintenance and Repair	0	18	49	64	88	88	88	88	88	88	88
Office Sales & Insurance	0	126	275	341	456	456	456	456	456	456	456
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Total Costs	930	3251	2737	3276	4390	4390	4390	4390	4390	4390	4390
REVENUE:											
Canned Tuna	0	1650	4620	5940	8250	8250	8250	8250	8250	8250	8250
Residual Value											
(Plant & Equipt 20%)	-	-	-	-	-	-	-	-	-	-	449
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Total Revenue	0	1650	4620	5940	8250	8250	8250	8250	8250	8250	8699
NET CASH FLOW (without infl	-930	-1601	1883	2664	3860	3860	3860	3860	3860	3860	4309
INTERNAL RATE OF RETURN (%)	81										
NPV IN US$000 @ 18%	8243										

EXHIBIT 71: TUNA CANNERY: INVESTMENT SENSITIVITY

SENSITIVITY TESTS

A. AS PLANNED												
-COST		930	3251	2737	3276	4390	4390	4390	4390	4390	4390	4390
-REVENUE		0	1650	4620	5940	8250	8250	8250	8250	8250	8250	8699
-CASH FLOW		-930	-1601	1883	2664	3860	3860	3860	3860	3860	3860	4309
-IRR (%)	0.810545											
B. WITH INFLATION												
-COST		930	3576	3041	3680	4986	5042	5099	5158	5217	5279	5341
-REVENUE		0	1733	4900	6366	8935	9030	9128	9228	9330	9435	10061
-CASH FLOW		-930	-1843	1859	2686	3949	3988	4029	4070	4113	4156	4720
-IRR (%)	0.777564											
C. INCREASED COSTS (20%)												
-COST		930	3901	3317	4018	5450	5517	5585	5655	5727	5801	5877
-REVENUE		0	1650	4620	5940	8250	8250	8250	8250	8250	8250	8699
-CASH FLOW		-930	-2251	1303	1922	2800	2733	2665	2595	2523	2449	2822
-IRR (%)	0.538357											
D. DECREASED REVENUE (20%)												
-COST		930	3251	2737	3276	4390	4390	4390	4390	4390	4390	4390
-REVENUE		0	1500	4158	5288	7264	7184	7103	7022	6942	6861	7149
-CASH FLOW		-930	-1751	1421	2012	2874	2794	2713	2632	2552	2471	2759
-IRR (%)	0.624705											
E. DECREASED REVENUE (40%)												
-COST		930	3251	2737	3276	4390	4390	4390	4390	4390	4390	4390
-REVENUE		0	1179	3267	4143	5674	5594	5513	5433	5353	5273	5476
-CASH FLOW		-930	-2072	530	867	1284	1204	1123	1043	963	983	1086
-IRR (%)	0.252987											

10.3 FISH MEAL PLANT: SCHEDULE OF ASSUMPTIONS

The fish meal plant would be located immediately adjacent to, and receive fish waste from, the cannery. The fish meal plant would commence operations at the same time as the cannery and employ only a small staff. Detailed assumptions are set out in Appendix L and summarized below.

EXHIBIT 72: FISH MEAL PLANT CAPITAL & OPERATING ASSUMPTIONS

Capital

Construction (Years 0 and 1)	$US 146,400
Plant and Equipment[1]	$US 817,000
Operating Capital	as for cannery

Operating Assumptions

Operating up to 220 days per year	
Fish waste yield	350Kg/mt (raw fish)
Fish meal yield	75Kg/mt (raw fish)
Fish meal price exfactory	$US 450/mt, or $US 33.75/mt
Fish oil yield	16Kg/mt (raw fish)
Fish oil price	$350/mt, or $U.S. 6.00/mt (rawfish)
Cost of waste disposal (savings)	$US 25/mt waste or $US 8.75/mt (raw fish)
Insurance (2% of capital)	$US 19,268
Maintenance and repair (3% of capital)	$US 28,902

Costs at Full Capacity[2]

Fuel oil	$US37,970
Electricity	$US 7,526
Water (salt water pumping costs)	$US 91
Labour	$US 5,097

Utilization rate:	Year 1	10%
	2	28%
	3	35%
	4	50%

1 Costs based on Canadian and European equipment of high efficiency. Taiwanese equipment was quoted to be up to 40% cheaper.

2 This capacity allows for a little over two full shifts in the canning plant. Costs variable as a function of throughput.

10.4 FISH MEAL PLANT CASH FLOW AND FINANCIAL ANALYSIS

As can be seen by Exhibit 73, which sets out the expected costs and revenues for the initial ten years of operation, the fish meal plant would not be a viable commercial proposition.

The internal rate of return would be minus 9% of the planned project. However, plant and equipment could be obtained, at up to 40% lower cost, from Taiwan. Also, it is expected that a smaller plant may be more economic, this is, produce a better cash flow.

Appendix M sets out detailed costs that would pertain to a smaller fishmeal plant (20 ton per day rated capacity). The capital costs would be approximately 40 percent lower than the proposed plant (30 ton per day rated capacity), a cost reduction similar to that for a Taiwanese plant would prevail. Assuming a 40 per cent lower capital cost, the IRR would become minus 4%, not significantly better than for the larger plant. Further, the smaller plant would not have the desirable feature of being able to handle fish waste from other sources.

The other option of reducing costs by eliminating the evaporation and separation units is not recommended. Not only would severe environmental difficulties be created in order to dispose of stick water but also a source of revenue would be lost.

The negative IRR for a stand alone fishmeal plant is to be expected, given the current price of fishmeal and its major competitor, soybean meal. Further, because of the huge fishery resource and very large fishmeal production plants in South America, it is unlikely that fishmeal could be produced elsewhere at competitive prices. Canada, for example, which also has huge fishery resources, cannot produce fishmeal at a profit. In Canada's case, the fishmeal plants are used largely to solve the waste disposal problem.

The fishmeal plant would also process other fish wastes from such sources as shark bodies (after liver oil extraction), flying fish bodies (after egg extraction) and minor quantities of unsold damaged fish from the markets and tambaks. This additional fish waste input would increase the revenues, and hence the IRR marginally, but not significantly.

The fishmeal plant should be seen as an adjunct to the cannery. The plant would provide an excellent way of waste handling and produce fishmeal suitable to substitute for imported meal.

For the fishmeal plant and cannery together, the overall IRR would be 67 percent, a very healthy rate of return.

EXHIBIT 73: FISH MEAL PLANT CASH FLOW ($ US 000'S)

	0	1	2	3	4	5	6	7	8	9	10
ASSUMPTIONS:											
Capacity Utilization	0	0.1	0.28	0.35	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Tonnes Raw Material	0	385	1078	1348	1925	1925	1925	1925	1925	1925	1925
CAPITAL COSTS:											
Site and Construction	46	100	0	0	0	0	0	0	0	0	0
Equipment etc	0	817	0	0	0	0	0	0	0	0	0
Operating Capital	0	0	0	0	0	0	0	0	0	0	0
OPERATING COSTS:											
Management and Labour	0	2	2	3	3	3	3	3	3	3	3
Fuel	0	4	10	13	17	17	17	17	17	17	17
Electricity & Water	0	1	2	3	4	4	4	4	4	4	4
Maintenance and Repair	0	3	8	10	15	15	15	15	15	15	15
Insurance	0	19	19	19	19	19	19	19	19	19	19
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Total Costs	46	946	41	48	58	58	58	58	58	58	58
REVENUE:											
Fishmeal	0	13	36	45	65	65	65	65	65	65	65
Fish Oil	0	2	6	8	12	12	12	12	12	12	12
Waste Disposal Savings	0	3	9	12	17	17	17	17	17	17	17
Residual Value											
(Plant & Equipt 20%)	-	-	-	-	-	-	-	-	-	-	163
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Total Revenue	0	18	51	65	94	94	94	94	94	94	257
NET CASH FLOW	-46	-928	10	17	36	36	36	36	36	36	199
INTERNAL RATE OF RETURN (%)	-9										
NPV IN US$000 @ 18%	-592										

10.5 FISH STORAGE AND DISTRIBUTION, ICE MAKING, AND LANDING SITES

The possibilities of improving fish handling, storage and distribution were discussed in Chapters 5.0 and 7.0. The project plan purposes:

- a large ice manufacturing facility (25 mt/day) at the cannery;
- a jetty and boat ramp and boat repair workshops at the cannery;
- ice making facilities (10 mt/day) and insulated storage capacity at several locations (Palopo, Watampone, Bulukumba, Majene, Pare Pare).

Exhibit 55 shows the volume of South Sulawesi 'tuna' landings in 1985. The main "points" of landing were: Palopo, Watampone, Bulukumba, Pare Pare, Majene and Mamuju.

It is proposed to locate the cannery (and fishmeal plant) in Pare Pare. Adjacent to the cannery and on the same site, a jetty and boat workshop, with ice manufacturing equipment would be established to service the fishing vessels (expected to bring their 'tuna' to the cannery) and supply ice to the fishermen and the cannery operated collector vessels picking up fish along the coast (Majene to Mamuju area). This facility would be constructed at the outset of the project.

The ice making and insulated storage facilities would be located in one building (see plan in pocket at back of report). Ice would be sold at low prices (Rps 1300 for 20 kg) to fishermen, fish traders and others. The availability and proper use of ice will improve fish shelf life and, with transportation, facilitate inter-city trading in fresh fish.

The insulated storage facilities would be divided into two compartments. One compartment for 'tuna' for the cannery. The other for storage of 'market' fish. Tuna would be collected by truck twice a week.

Ice and storage facilities would be located initially in Palopo and Watampone, and later in Bulukumba and Majene. This is because of the greater volumes of 'tuna' landed currently in Palopo and Watampone and because ice is already available in Majene. At a later date, boat supply and repair facilities could be located near the ice and storage facilities.

Exhibit 74 sets out the assumptions and cash flow for the ice manufacture and fish landing site project.

With a NPV of $US 492,000, on an investment of $US 220,500, **the project would produce an IRR of 62.0 per cent.** The project would be very sound financially. Furthermore, profitability, as measured by the IRR, would increase to 66.0 per cent, under inflationary conditions.

Assuming a revenue reduction of 40%, the IRR would be a healthy 43 per cent.

Thus, the project would be very sound and financially attractive.

Exhibit 75 summarizes the assumptions and sets out the cash flow for the proposed ice dispensing and insulated storage facilities.

From the financial analysis, it can be seen that each of these facilities would be profitable. **The planned facility would produce an IRR of 75.0 per cent** and an NPV of $US 254,000 on an investment of $US 85,000.

Sensitivity testing showed that with revenues decreased by 40 per cent, the IRR would remain a robust 52.0 per cent.

Again, this project would be very sound financially.

10.6 CONCLUSION

The financial analysis shows that the combined collection system and tuna cannery would be profitable. While the project internal rates of return as shown are rather high, the analysis showed that even with 20 per cent higher costs and 40 per cent lower revenues, the projects would be profitable, with internal rates of return of over 25 per cent.

The probability of revenues being lower than expected would be somewhat greater than that of costs being higher. The largest cost component consists of capital costs and these are known. Revenue, a function of production and sales, is very dependent upon management and marketing.

The success of this project will depend upon management but, managed well, the project promises to produce a very good profit.

EXHIBIT 74: ICE MANUFACTURE AND FISH LANDING SITE CASH FLOW ($ US 000'S)

YEAR	0	1	2	3	4	5	6	7	8	9	10
ASSUMPTIONS:											
Capacity Utilization	-	0.3	0.6	0.9	0.9	0.9	0.9	0.9	[illegible]	[illegible]	[illegible]
Tonnes Ice Produced	-	2100	4200	6300	6300	6300	6300	6300	[illegible]	[illegible]	[illegible]
CAPITAL COSTS:											
Site and Construction	77.0	-	-	-	-	-	-	-	-	-	-
Equipment etc	102.5	-	-	-	-	-	-	-	-	-	
Jetty Construction	23.2	-	-	-	-	-	-	-	-	-	-
Workshop and Equipment	19.8	-	-	-	-	-	-	-	-	-	-
OPERATING COSTS:											
Labour	-	3.5	5.0	6.5	6.5	6.5	6.5	6.5	6.5	[illegible]	[illegible]
Electricity	-	5.6	11.1	16.7	16.7	16.7	16.7	16.7	16.7	[illegible]	[illegible]
Maintenance and Repair	-	6.7	6.7	6.7	6.7	6.7	6.7	6.7	[illegible]	[illegible]	[illegible]
Insurance	-	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	[illegible]
Total Costs	222.5	20.2	27.2	34.3	34.3	34.3	34.3	34.3	34.3	[illegible]	[illegible]
REVENUE:											
Sale of Ice @ $40/	0.0	84.0	168.0	252.0	252.0	252.0	252.0	252.0	252.0	[illegible]	[illegible]
Residual Value (Plant & Equipt 20%)	-	-	-	-	-	-	-	-	-	-	[illegible]
Total Revenue	0.0	84.0	168.0	252.0	252.0	252.0	252.0	[illegible]	[illegible]	[illegible]	[illegible]
NET CASH FLOW	-222.5	63.8	140.8	217.7	217.7	217.7	217.7	217.7	[illegible]	[illegible]	[illegible]
INTERNAL RATE OF RETURN (%)	62.0										
NPV IN US$000 @ 18%	492.0										

EXHIBIT 75: ICE DISPENSING AND STORAGE FACILITY CASH FLOW ($ US 000's)

YEAR	0	1	2	3	4	5	6	7	8	9	10
ASSUMPTIONS:											
Capacity Utilization	-	0.3	0.6	0.9	0.9	0.9	0.9	0.9	0.9	[illegible]	[illegible]
Tonnes Ice Produced	-	840	1680	2520	2520	2520	2520	[illegible]	[illegible]	[illegible]	[illegible]
Storage Capacity	-	300	600	900	900	900	900	[illegible]	[illegible]	[illegible]	[illegible]
CAPITAL COSTS:											
Site,Construction,Equipment	85.0	-	-	-	-	-	-	-	-	-	-
OPERATING COSTS:											
Labour	-	2.5	3.2	3.2	3.2	3.2	3.2	3.2	[illegible]	[illegible]	[illegible]
Electricity	-	2.3	4.5	6.8	6.8	6.8	6.8	[illegible]	[illegible]	[illegible]	[illegible]
Maintenance and Insurance	-	4.3	4.3	4.3	4.3	4.3	4.3	4.3	[illegible]	[illegible]	[illegible]
Total Costs	85.0	9.1	[illegible]	14.3	14.3	14.3	14.3	14.3	14.3	[illegible]	[illegible]
REVENUE:											
Sale of Ice @ $40/tonne	-	33.6	67.2	100.8	100.8	100.8	100.8	100.8	100.8	[illegible]	[illegible]
Storage @ $20/tonne	-	6.0	12.0	[illegible]	18.0	18.0	18.0	18.0	18.0	[illegible]	[illegible]
Residual Value (Plant & Equipt 20%)	-	-	-	-	-	-	-	-	-	-	[illegible]
Total Revenue	0.0	39.6	79.2	118.8	118.8	118.8	118.8	118.8	118.8	[illegible]	[illegible]
NET CASH FLOW	-85.0	30.6	67.2	104.5	104.6	104.5	104.5	104.5	104.5	[illegible]	[illegible]
INTERNAL RATE OF RETURN (%)	75.0										
NPV IN US$000 @ [illegible]%	254.0										

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APPENDICES

A

APPENDIX A: PEOPLE CONTACTED

A. SULAWESI SELATAN

1.0 Departments and Agencies

a) Ujung Pandang

- Dr. Ing Sularto Hadisuwarno, Chairman, BAPPEDA TK I
- Gary Holm, Regional Development Advisor, BAPPEDA TK I
- Drs. M. T. B. Randa, BKPMD
- Ir.S. Muranto, Director, Dinas Perikanan (DP) I
- Ir. Natsir Suleman, Quality Control, DP I
- Ms. Shirley R. Hendriks, DP I
- Ir. Djamaluddin Hasbullah, Director, DP II
- Ir. Moertolo, Tech Director, Departmen Perhubungan
- Ir. Djarwo Surjanto, Departmen Perhubungan
- Mr. Simon Sitoroes, Economist, Departmen Perhubungan
- Drs. Masud Sikong, Professor of Fisheries, Hasannudin University
- Ir. Uddin, Lecturer, Fisheries, Hasannudin University
- Ir. Nadjamuddin, Fishing Gear Specialist, Hasannudin University

b) Other

- Ir. Azis Mattola, Chariman, Bappeda, Pare Pare
- Ir. Andi Singke, Director, DP II, Maros
- Ir. Naharuddin, Director, DP II, Pangkajene
- Mr. Dueng Lee, Head, DP II, Sinjai
- Ir. Syamsuddin Hammal, Director, DP II, Pare Pare
- Ir. Achmad Danigoro, Director, DP II, Pinrang
- Ir. Uddin Talle, Director, DP II, Majene
- Ir. H.M. Nurabu, Director, Public Works, Pare Pare

2.0 Companies and Individuals

- M. Jusuf Kalla, Chairman, Chamber of Commerce and President, NV Hadji Kalla Trd. Coy. (Animal Feeds)
- Hubert Andries, Director, Lokon Raya Veem
- Ir. Paul Yen Andries, PT Pattene KT
- Mua Rumengan, Sales Manager, Garuda Indonesia
- Ir. Safari A. Husain, President, PT Sumber Tirta Sulawesi (Seaweed Culture and Export) and Ir. Irwan Mantigi, Director of Finance
- Ir. Nur Tjahjanto, PT Reka Cipta
- Ir. David E. Mustakim, Consultant with PT Sulawesi Agro Utama (Hatchery and Tambak Operators)
- Manager, Toko Nelayan, Fishing Equipment Suppliers
- Ir. Jassin Sugeha, Mahakam Shipping Company
- Ir. Delsim H. Manglassa, Branch Manger, Trikora Shipping
- Captain D. Tomasoa, Chief of Shipping and Operations, PT Pelayaran Meratus
- Dr. Ismed Sawir, Tech. Advisor, PT Cargill
- Capt. H.N. Inaray, PT Djakarta Lloyd
- Ir. Mochtar Amien, Production Director, PT Bantimurung Indah (Food and Marine Algae Processors)
- Ir. M. Hatta Katombo, Manager, PT Bonecom
- Ir. H.S. Widarsa, PT, EMKL Jasa Utma Sakti Sulawesi Freight Forwarder for Pelni Lines
- Ir. Sonny Tanyadji, PT Kanik Utama, Contractor
- Ir. Frans Aryanto, PT Kanik Utama, Contractor
- Drs. S. Simorangkir, Director, PT Perikanan Samodra Besar
- Ir. Nurtjahjanto, Agronomist, PT Agronoma Jaya
- Ir. Herutomo Mustafa, Director, PT Reka Cipta, Consulting Engineers

- o Ir. Buntaran, Director, - - - - - - - - - - - - - - - - - -
- o Ir. A. Satief, Managing Director, PT Mitra Kartika Sejati (TDK)
- o Ir. T. Kodama, Director, - - - - - - - - - - - - - - - - - -
- o Ir. Thamrin Husen, PT Marco Piposs
- o Ir. Shoyo Kitahara, Supervisor, PT Makassar Cold Storage (Marco PT)
- o Ir. Herman Sentosa, Manager, Sentos Cold Storage
- o Ir. M. Aksa Mahmud, Director General, PT Dataran Bosowa
- o Ir. M. Arief Kadir, Director PT Dataran Bosowa
- o Ir. Soesanto, Manager, PT Cargill Indonesia
- o Mr. Wilfred G. Yap, FAO Shrimp Culture Devt. Project, (Chief Technical Advisor)

Note: It should be noted that members of the team talked with many fishermen and Tambak operators.

B. SULAWESI TENGGARA

1.0 Departments and Agencies

- Dr. S.P. Djalante, Chairman, BAPPEDA TK I
- Mr. Leroy Hollenbeck, Regional Plan Advisor, BAPPEDA TK I
- Mr. R. Catchpole, Regional Plan Advisor, BAPPEDA TK I
- Ir. Zainal Abidirs, BAPPEDA TK II, Kolaka
- Ir. Tommy Poedjhiar, Departmen Perdagangan
- Ir. Kuraniawan, Dinas Perikanan I
- Ir. Ufui Jhi, Manager of Bau Bau Fish Auction
- Dwight Watson, Rural Development Advisor, Bappeda TK II, Baubau
- Daniel R. Patambianan, PT Pelayaran Nasional Indonesia. Cobang Kendarc

2.0 Companies and Individuals

- Manager, Fajar Pabrik Es, Kolaka
- Ir. Syarifuddin Syam, Manager, PT Perken (Bonecom)
- Muhammad Guntur Dahlan, Fisheries Extension Supervisor, DP I
- Ir. B. Nugroho, Manager, PT Dharma Samudra

C. MALUKU

1.0 **Departments and Agencies**

- Drs S.P. Leatemia, Kantor Statistik
- Ir. F.J. Siahainenia, Departmen Perdagangan
- Sj Joisangadji, Dinas Perikanan I
- Ir. Harinto Wibowo, Dinas Perikanan I
- J. van de Straaten, Regional Economist, BAPPEDA TK I
- Ir. J.M. Nanlohy, Dean, Faculty of Fisheries, Pattimura Univ.
- Ir. N. Telelepta, Professor, Faculty of Fisheries, Pattimura Univ.

2.0 **Companies and Individuals**

- Ir. Jusuf Sudradjat, GM PT Daya Guna Samudera (Djajanti Group)
- Sujono Varianata, Manager, PT Daya Guna Samudra (Djajanti Group)
- Ir. E.L. Soewito, Director Operations, Perum Perikanan Maluku
- Ir. E.E. Gaspersz, Manager, PT Maprodin
- Ir. Iswan Bintan, Pt. Sumber Haslindo (Perikanan)
- Manager, PT. Tofico
- Ir. Hadi Budoyo, Director, PT Mina Kartika
- Tadashi Iijima, President, PT Nusantara Fishery
- Ir. Edwin Huwae, Manager, PT Dok and Perkapalan "Waiame"
- Ir. Sonny Waplau, PT Modern Widya Technical

D. JAKARTA

1.0 Departments and Agencies

- Mr. G.L. Narasimhan, Senior Industrial Development Field Advisor, UNIDO
- Ir. Narjo Martokusumo, Assistant Field Advisor, UNIDO
- Ir. F. Sartono, Project Director, LKI, UNIDO
- Mr. J.P. Van Gansberghe, Chief Technical Advisor LKI, UNIDO
- Mr. J. Templeton, Fish Processing Consultant, LKI, UNIDO
- Mr. O. Heinonen, Market Development Consultant, LKI, UNIDO
- Mr. R.L. Cameron, Boat Buidling Expert, LKI, UNIDO
- Ir. Soesanto Sahardjo, Director of Program Development, Multifarious Industries, Dep. Perindustrian (Perind).
- B. Kadir, UNIDO Project Manager, Multifarious Industries, Perind
- Ir. Soeprijono, Multifarious Industries, Perind
- Ir. Nunuk Mahastuti, Multifarious Industries, Perind
- Ir. Ferry Yahya, Multifarious Industries, Perind
- Dr. K. Randolph, Fisheries Development Officer, US AID
- Ing. G.J. van Rinsum, First Secretary Development, Royal Netherlands Embassy
- Ms. Ann M. Brazeau, First Secretary Development, Canadian Embassy
- Dr. Purweto Martosubroto, Directorate General of Fisheries (DGF)
- Drs. Sadir Tausin, National Centre for Quality Control and Fish Processing Development, DGF
- Drs. Burhanuddin Lubis, Director, Fisheries Enterprise and Processing Development, DGF
- Ir. Zulkifli Jangkaru, Head of Research Results Dissemination, Central Fisheries Inst., DGF
- Dr. Nurzala Naamin, Research Inst. for Marine Fishes, DGF

2.0 Companies and Individuals

- Drs. M. Junus Bandie, Assitant to Chairman, Djajanti Group
- Ir. Harris Nasution, Director, PT Nusantara Fishery and Secretary of HPPI (Shrimpers' Association)
- Ir. Umar Achmad, Marine Surveyor, PT Carsurin Ltd.
- Mr. Mark A. Pahl, GM, Feed Division, Cargill
- Mr. Edward Swandi, PT Maswandi (Fish meal Plant Manufacturer)
- Ms. B. Robertson, Australian Centre for Int'l Agricultural Research, Australian Embassy
- Mr. P. Ellerich (Naval Architect), Duroncan Graha Development
- Dr. Hiroyo Saski, Japan Int'l Co-operation Agency

E. SURABAYA AND BALI

- Ir. Soetikno, Dinas Perikanan I
- Ir. H. Soehardiman, Director PT Perikanan Samodra Besar
- Ir. Hendra Effendi, Nutritionist, PT Comfeed Indonesia Ltd. and Ir. Martuti Koesni, Technical Services
- Michael Dubbelt, Matrico b.v., Amsterdam
- Poernomo Setiodjojo, Director, PT Indo Bali
- Sukardi Wibowo, Principal, PT Bali Maya Permai
- F. X. Dianto, Export Manager, PT Bali Raya

F. OTHER

- Mr. M. Kohonen, Purchase and Contract Service, UNIDO, Vienna
- Mr. S. Mimura, Feasibility Specialist, UNIDO, Vienna
- Ms. M. Samper, Senior Development Officer, Indonesia Desk, CIDA, Ottawa
- Dr. N. Thomas, External Monitor, CIDA, Sulawesi Regional Development Project, Ottawa
- Dr. K. Hay, Resource Economist, Econolynx International, Ottawa
- Dr. F.H. Cummings, Associate Professor and Director CIDA Sulawesi Regional Development Project, Guelph University
- D. Ian Neish, Regional Buyer, FMC Int., Philippines
- Ruben T. Barraca, Marine Agnonomist, - - - - - - - - - - - -
- Dr. I. Smith, Director, ICCARM, Philippines
- Dr. V. Soesanto, Chief Technical Advisor, ICCARM, ASEAN/UNDP/FAO Regional Small-Scale Coastal Fisheries Development Project
- Mr. E. Peterson, Fisheries Specialist, Asian Development Bank
- Dr. Yong Ki Shin, Senior Fisheries Specialist, Asian Development Bank
- Mr. Barry V. Lanier, Economist, Asian Development Bank

B

APPENDIX B

INDONESIAN, COMMON, AND SCIENTIFIC NAMES OF FISHES CAUGHT IN INDONESIAN SEAS

Indonesian Name	English Name	Scientific Name
Ikan Sebelah	Indian halibut	Psettodes erumei
Ikan Lidah	Tongue sole	Cynoglossus spp.
		Pleuronectus spp.
Ikan Nomei	Bombay duck	Harpodon nehereus
Ikan Peperek	Ponyfish	Leiognathus spp.
	Slip mouth	
Manyung	Marine catfish	Tachysurus spp.
Beloso	Lizard fish	Saurida spp.
Biji nangka	Goat fish	Upeneus spp.
Ikan Gerot-gerot	Grunters/Sweetlip	Pomadasys spp.
Ikan Merah/	Red snapper	Lutjanus spp.
Bambangan	Blood Snapper	Lutjanus sanguineus
Kerapu	Bleeker's Grouper	Epinephelus bleeker
Lencam mataheri	Redspotted Emperor	Lethrinus lentjan
Kakap	Barramundi bream	Lates calcarifer
Kurisi	Japanese Threadfin bream	Nemipterus japonicu
Swanggi	Bigeye	Priacanthus spp.
Ekor kuning	Yellow tail	
Pisang-pisang	Fusilier	Caesio spp.
Gulamah	Amoy Croacker	Argyrosomus amoyensis

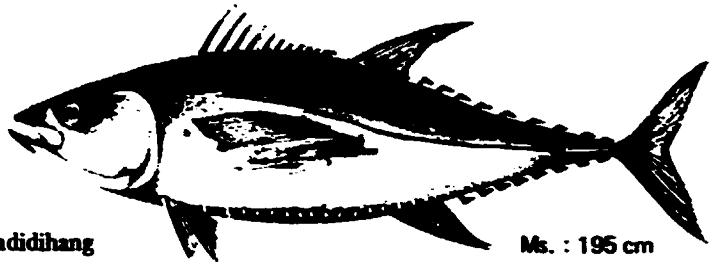
Cucut	Maclot's Sharks	*Carcharias maclot:*
Cucut martil	Arrowheaded/hammer-head sharks	*Sphyrna levini*
Pari	Devil-ray	*Manta Birostris*
Bawal hitam	Black pomfret	*Formio niger*
Bawal putih	Silver pomfret	*Pampus argenteus*
Alu-alu	Obtuse Barracuda	*Sphyraena obtusata*
Ikan Layang	Scad mackerel	*Decapterus russelli*
Selar	Trevalies	*Selar* spp.
	Yellowstripe travallies	*Selaroides* spp.
Kuwe	Jacks, Trevallies	*Caranx* spp.
Tetengkek	Hardtail scad	*Megalaspis cordyla*
Daun bambu/ Talang-talang	Queen fish	*Chorinemus* spp.
Sunglir	Rainbow runner	*Elagatis bipinnulatus*
Ikan terbang	Flying fish	*Cypselurus* spp.
Belanak	Mullet	*Mugil* spp.
Kuro/Senangin	Thread fin	*Polynemus* spp.
Julung-julung	Garfish and	*Tylosurus* spp.
	Halfbeak	*Hemirhamphus* spp.
Teri	Indian Anchovy	*Stolephorus* indicus
Japuh	Rainbow Sardine	*Dussumieria acuta*
Tembang	Fringescale sardine	*Sardinella fimbriata*
Lemuru	Indian oil sardine	*Sardinella longiceps*
Parang-parang	Wolf-herrings	*Chirocentrus dorab*

Terubuk	Toli shad (Chinese Herring)	Clupea (Alosa) toli
Kembung	Indo Pacific mackerel	Rastrellinger spp.
Tenggiri papan	Indo Pacific Spanish mackerel	Scomberomorus guttatus
Tenggiri	Narrow-barred Spanish mackerel	Scomberomorus commersoni
Layur	Hairtail	Trichiurus spp.
Tuna	Tuna	Thunnus spp.
	Bigeye tuna	Parathunnus obesus
	Broadbill/Swordfish	Xiphias spp.
	Indo-Pacific marlin	Makaira spp.
	Indo-Pacific	Istiophorus orientalis
Cakalang	Skipjack tuna	Katsuwonus pelamis
Tongkol	Eastern Little Tunas	Euthynnus spp.
Ikan-ikan lain	All fishes other than those listed above	
Rajungan	Swimming crab	Portunus spp.
Kepiting	Mangrove crab	Scylla serrata
Udang barong	Spiny lobster	Panulirus spp.
Udang windu	Tiger prawn	Penaeus monodon Penaeus semisulcatus
Udang putih/ Jrebung	Banana prawn	Penaeus merguiensis Penaeus indicus

Udang dogol	Endeavour	*Metapenaeus* spp.
Jenis-jenis udang lain, seperti, rebon, udang pasir	All shrimp other than those listed above	
Binatang berkulit keras lainnya	All Crustacean other than those listed above	
Tiram	Cupped oyster	*Crassostrea* spp.
Simping	Scallop	*Amusium* spp.
Remis	Clams	*Meretrix* spp.
Keranga darah	Blood cockles	*Anadara* spp.
Cumi-cumi	Common squid	*Loligonidae*
Sotong	Cuttle fishes	*Sepia* spp.
Gurita	Octopuses	*Octopus* spp.
Binatang lunak lainnya	All Molluscs other than those listed above	
Penyu	Marina turtles	*Chelonia mydas*
Teripang	Sea cucumbers	*Stichopus* spp.
Ubur-ubur	Jelly fishes	*Rhopilema* spp.
Binatang air lainnya	All aquatic animals other than those listed above	
Rumput laut	Sea weeds	*Euchema* spp. *Gracillaria* spp.

58. Tongkol
Auxis thazard
Frigate mackerel

Ms. : 50 cm
Cs. : 25–40 cm

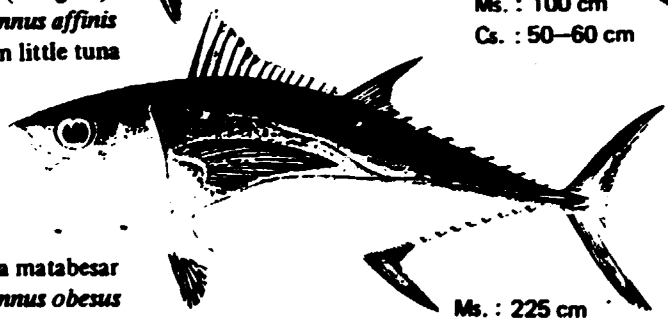


63. Madidihang
Thunnus albacores
Yellowfin tuna

Ms. : 195 cm
Cs. : 40–170 cm

59. Komo (Tongkol)
Euthynnus affinis
Eastern little tuna

Ms. : 100 cm
Cs. : 50–60 cm

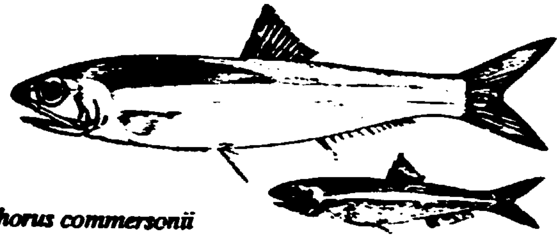


64. Tuna matabesar
Thunnus obesus
Bigeye tuna

Ms. : 225 cm
Cs. : 60–180 cm

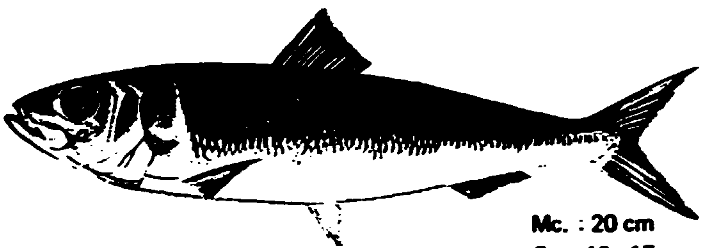
60. Cakalang
Katsuwonus pelamis
Skipjack tuna

Ms. : 90 cm
Cs. : 40–60 cm



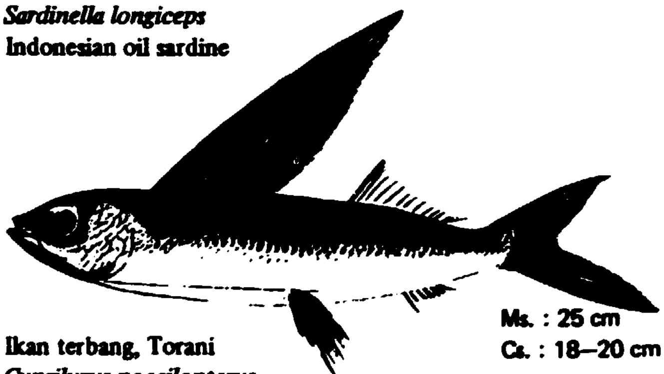
5. Teri
Stolephorus commersonii
Anchovy

Ms. : 15 cm
Cs. : 12 cm



Mc. : 20 cm
Cs. : 10–15 cm

8. Lemuru
Sardinella longiceps
Indonesian oil sardine



Ms. : 25 cm
Cs. : 18–20 cm

13. Ikan terbang, Torani
Cypsilurus poecilopterus
Spotted flyingfish

Ms. : 20 cm
Cs. : 15 cm

34. Selar kuning
Selaroides leptolepis
Yellowstripe trevally

Ms. : 30 cm
Cs. : 20–25 cm

35. Layang, benggol
Decapterus russelli
Scad mackerel

56. Tenggiri
Scomberomorus commersoni
Barred Spanish mackerel

Ms. : 200 cm
Cs. : 60–90 cm

57. Tenggiri papan
Scomberomorus guttatus
Spotted Spanish mackerel

Ms. : 82 cm
Cs. : 45–55 cm

C

PERIKANAN LAUT/ *MARINE FISHERY*

Tabel/*Table* 1.3. Jumlah perahu/kapal penangkap perikanan laut menurut besarnya perahu/kapal, daerah perairan pantai dan Propinsi, 1984
Number of marine fishing boats by size of boat, coastal area and Province, 1984

Satuan : Buah
Unit : No.

Perairan Pantai *Coastal area*	Propinsi *Province*	Jumlah *Total*	Kategori perahu – *Size of fishing boat*: Perahu tanpa motor – *Non powered boat*: Sub jumlah *Sub total*	Perahu papan - *Plank build boat*: Jukung *Dug-out boat*	Kecil *Small*	Sedang *Medium*	Besar *Large*	Motor tempel *Out-board motor*	Kapal motor – *In-board motor*: Sub jumlah *Sub total*	5 GT	5 – 10 GT	5 · 10 GT	20 · 30 GT	30 · 50 GT	50 · 100 GT	100-200 GT	> 200 GT
Jumlah – *Total*		313 640	219 929	114 112	61 759	38 499	5 559	61 789	31 922	24 777	4 247	1 563	790	268	45	149	83
BARAT SUMATERA	Sub jumlah – *Sub total*	18 419	14 277	6 149	4 828	2 637	663	2 377	1 765	1 034	507	218	4	1	1	–	–
	D.I. Aceh	3 827	2 724	535	1 213	645	331	671	432	203	216	13	–	–	–	–	–
	Sumatera Utara	6 911	5 498	3 781	1 576	141	–	557	856	567	165	124	–	–	–	–	–
	Sumatera Barat	6 347	5 132	1 384	1 840	1 626	282	919	296	110	109	71	4	1	1	–	–
	Bengkulu	874	633	159	199	225	50	61	180	153	17	10	–	–	–	–	–
	Lampung	460	290	290	–	–	–	169	1	1	–	–	–	–	–	–	–
SELATAN JAWA	Sub jumlah – *Sub total*	8 782	3 908	2 792	855	261	–	4 382	492	35	291	77	89	–	–	–	–
	Jawa Barat	3 072	653	431	55	167	–	2335	84	25	46	13	–	–	–	–	–
	Jawa Tengah	2 392	816	816	–	–	–	1 183	393	–	240	64	89	–	–	–	–
	D.I. Yogyakarta	62	–	–	–	–	–	62	–	–	–	–	–	–	–	–	–
	Jawa Timur	3 256	2 439	1 545	800	94	–	802	15	10	5	–	–	–	–	–	–
SELAT MALAKA	Sub jumlah – *Sub total*	36 480	20 201	74	11 749	7 902	476	1 975	14 304	12 250	1 349	493	212	–	–	–	–
	D.I. Aceh	3 207	1 403	74	517	519	293	1 021	783	401	300	82	–	–	–	–	–
	Sumatera Utara	17 999	9 466	–	5 094	4 372	–	210	8 323	7 356	561	285	121	–	–	–	–
	Riau	15 274	9 332	–	6 138	3 011	183	744	5 198	4 493	488	126	91	–	–	–	–
TIMUR SUMATERA	Sub jumlah – *Sub total*	13 135	6400	520	3694	1 816	370	1 222	5 513	5 030	472	11	–	–	–	–	–
	Jambi	1 715	427	–	177	250	–	4	1 284	1 244	40	–	–	–	–	–	–
	Sumatera Selatan	7 791	4 065	120	3 085	699	161	702	3 024	2 874	144	6	–	–	–	–	–
	Lampung	3 629	1 908	400	432	867	209	516	1 205	912	288	5	–	–	–	–	–
UTARA JAWA	Sub jumlah – *Sub total*	54 306	27 667	5 258	10 009	10 953	1 447	24 905	1 734	481	389	389	313	158	1	2	1
	DKI Jakarta	1 820	518	–	429	28	61	470	832	296	158	281	81	16	–	–	–
	Jawa Barat	12 100	5 431	549	2 134	2 616	132	6 448	221	145	56	7	13	–	–	–	–
	Jawa Tengah	11 594	3 076	1 509	528	1 034	5	8 025	493	30	12	90	215	142	1	2	1
	Jawa Timur	28 792	18 642	3 200	6 918	7 275	1 249	9 962	188	10	163	11	4	–	–	–	–
BALI-NUSA TENGGARA TIMOR	Sub jumlah – *Sub total*	36 674	29 286	24 767	3 873	521	125	7 073	315	250	37	7	1	–	–	17	3
	Bali	12 740	10 397	10 397	–	–	–	2 306	37	–	10	7	–	–	–	17	3
	Nusatenggara Barat	11 053	7 339	6 890	449	–	–	3 704	10	10	–	–	–	–	–	–	–
	Nusatenggara Timur	11 839	10 597	6 527	3 424	521	125	974	268	240	27	–	1	–	–	–	–
	Timor Timur	1 042	953	953	–	–	–	89	–	–	–	–	–	–	–	–	–
SELATAN/ BARAT KALIMANTAN	Sub jumlah – *Sub total*	8 808	4 690	191	2 133	2 096	270	1 676	2 442	1 831	466	102	42	1	–	–	–
	Kalimantan Barat	5 160	2 515	24	845	1 380	270	1 676	965	470	361	91	42	1	–	–	–
	Kalimantan Tengah	3 648	2 171	167	1 288	716	–	–	1 477	1 361	105	11	–	–	–	–	–
TIMUR KALIMANTAN	Sub jumlah – *Sub total*	13 196	5 036	454	2 185	2 328	69	4 056	4 104	3 449	522	131	1	1	–	–	–
	Kalimantan Selatan	4 601	2 337	454	696	1 161	26	658	1 606	1 406	186	14	–	–	–	–	–
	Kalimantan Timur	8 595	2 699	–	1 489	1 167	43	3 398	2 498	2 043	336	117	1	1	–	–	–
SELATAN SULAWESI	Sub jumlah – *Sub total*	43 628	35 680	17 945	11 248	5 364	1 123	7 254	694	415	192	53	24	6	–	2	2
	Sulawesi Selatan	28 353	20 933	7 814	7 619	4 377	1 123	6 792	628	410	188	8	16	2	–	2	2
	Sulawesi Tenggara	15 275	14 747	10 131	3 629	987	–	402	66	5	4	45	8	4	–	–	–
UTARA SULAWESI	Sub jumlah – *Sub total*	37 557	32 218	25 645	4 221	2 104	248	5 267	72	2	5	10	20	35	–	–	–
	Sulawesi Utara	28 744	24 337	21 287	1 674	1 257	119	4 335	72	2	5	10	20	35	–	–	–
	Sulawesi Tengah	8 813	7 881	4 358	2 547	847	129	932	–	–	–	–	–	–	–	–	–
MALUKU/ IRIAN	Sub jumlah – *Sub total*	42 655	40 566	30 317	6 964	2 517	768	1 602	487	–	17	72	84	66	43	128	77
	Maluku	30 681	29 599	23 651	3 724	1 772	452	821	261	–	17	72	66	38	11	24	33
	Irian Jaya	11 974	10 967	6 066	3 240	745	316	781	226	–	–	–	18	28	32	104	44

PERIKANAN LAUT / *MARINE FISHERY*

Tabel / *Table* 1.5. Produksi perikanan laut menurut jenis ikan, 1978 – 1984 r) / *Marine fishery production by species, 1978 – 1984 r)*

Satuan : Ton / *Unit : Ton*

Jenis ikan – *Species*	1978	1979	1980	1981	1982	1983	1984
Jumlah – *Total*	1 227 386	1 317 744	1 394 810	1 408 272	1 490 719	1 682 019	1 712 804
IKAN – *FISHES*	1 029 335	1 120 669 *)	1 218 167 *)	1 206 983 *)	1 326 447	1 467 824	1 529 553
Ikan sebelah – *Indian halibuts*	2 611	5 655	2 538	2 901	9 650	1 540	2 683
Ikan lidah – *Flat fishes*	1 700	2 632	1 205	1 937	5 940	1 121	1 730
Ikan nomei – *Bombay duck*	7 963	5 274	7 413	4 672	7 064	16 946	13 960
Peperek – *Pony fishes/Slip mouths*	37 751	41 235	43 638	34 544	38 961	36 602	36 940
Manyung – *Sea catfishes*	20 204	21 995	24 085	26 655	30 952	33 369	34 782
Beloso – *Lizard fishes*	5 479	5 336	5 015	1 292	871	2 811	1 870
Biji nangka – *Goat fishes*	7 269	7 427	8 413	2 350	3 285	3 280	3 764
Ikan gerot-gerot – *Grunters/Sweetlips*	3 269	3 728	4 710	3 785	5 034	5 869	5 323
Ikan merah/Bambangan – *Red snappers*	16 698	17 806	20 190	21 661	22 110	27 453	26 275
Kerapu – *Groupers*	6 005	6 087	7 032	6 701	6 985	9 618	9 285
Lencam – *Emperors*	8 196	9 547	10 696	12 913	13 877	14 580	14 569
Kakap – *Giant sea perch/Baramundi*	9 314	8 456	10 938	9 845	9 697	14 158	12 609
Kurisi – *Treadfin breams*	8 [illegible]	9 859	9 939	8 266	8 194	10 823	10 282
Swanggi – *Big eyes*	968	1 110	1 332	1 079	877	1 144	956
Ekor kuning/pisang-pisang – *Yellow tail/Fusiliers*	8 403	10 087	9 953	7 835	8 156	10 672	11 039
Gulamah/Tiga waja – *Croakers, drums*	25 960	26 747	34 344	18 641	18 136	19 578	20 751
Cucut – *Shark*	19 189	20 254	28 174	29 007	30 351	33 620	36 998
Pari – *Rays*	11 148	11 147	14 681	14 167	14 668	16 257	15 766
Bawal hitam – *Black pomfret*	5 732	5 988	6 959	8 142	8 508	7 970	8 554
Bawal putih – *Silver pomfret*	5 750	8 809	9 419	8 469	9 746	15 467	9 111
Alu-alu – *Barracudas*	3 571	4 076	5 016	5 095	6 294	7 089	7 106
Ikan layang – *Scads*	69 284	78 162	64 107	65 637	77 366	91 937	135 253
Selar – *Trevallies*	36 212	47 094	47 533	48 189	52 394	64 737	56 811
Kuwe – *Jacks crevallies*	9 979	8 910	9 771	11 324	11 360	13 988	14 145
Tetengkek – *Hardtail scads*	6 179	6 705	6 539	6 966	7 499	8 798	8 256
Daun bambu – *Queen fishes*	3 944	3 360	3 648	7 135	6 504	7 164	5 333
Sunglir – *Rainbow runner*	3 033	4 447	4 909	3 821	3 813	3 693	2 795
Ikan terbang – *Flying fishes*	8 325	14 326	13 249	13 250	11 418	12 098	13 760
Belanak – *Mullets*	12 685	14 430	15 964	15 390	15 943	19 289	16 771
Kuro/Senangin – *Treadfins*	11 108	9 468	10 706	10 879	13 488	12 747	12 115
Julung-julung – *Needle fishes*	17 778	19 648	17 939	18 085	20 399	19 196	21 908
Teri – *Anchovies*	105 388	96 147	101 002	99 681	104 575	104 690	109 299
Japuh – *Rainbow sardine*	5 167	7 304	6 839	9 483	10 936	11 416	12 229
Tembang – *Fringescale sardinella*	75 627	79 168	92 646	108 714	98 980	104 617	109 393
Lemuru – *Indian oil sardinella*	49 617	45 625	52 354	44 172	56 987	90 900	79 365
Golok-golok/Parang parang – *Wolf herrings*	8 884	9 529	11 043	11 375	11 585	13 345	11 766
Terubuk – *Tolishad (Chinese herring)*	2 223	1 483	1 493	2 074	2 437	2 884	20 017
Kembung – *Indian mackerels*	78 790	84 485	83 590	85 747	99 311	95 738	114 281
Tenggiri papan – *Indo pasific king mackerels*	4 047	5 165	4 254	5 249	5 653	7 122	6 100
Tenggiri – *Narrow barred king mackerel*	26 394	27 711	35 156	37 382	42 727	47 289	42 293
Layur – *Hairtails, cuttlass fishes*	13 267	12 717	11 694	10 735	15 846	18 364	20 515
Tuna – *Tunas*	13 412	17 899	20 898	25 239	28 080	26 088	30 697
Cakalang – *Skipjack tuna*	33 515	42 834	51 818	57 430	61 577	76 790	80 658
Tongkol – *Eastern little tunas*	55 244	66 582	76 797	87 731	106 012	103 878	103 179
Lainnya – *Others*	163 195	183 716	208 186	190 993	204 201	221 183	237 262

*) Termasuk produksi Timor Timur, tanpa perincian menurut jenis ikan/
Includes catches from Timor-Timur, not available separately by species.

Source : Fisheries Statistics of Indonesia (1984)

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
45.03		Articles of natural cork:					
	300	Parts of fishing net	(20) 5		10		

CHAPTER 51. MAN-MADE FIBRES (CONTINOUS).

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
51.01		Yarn of man-made fibres (continous) not put up for retail sale:					
		Of polyamide fibres:					
		Non-textured yarn, untwisted or with a twist on not more than 50 turn per metre:					
	122	For the use in fishing net manufacturing	(15) 5		10		

CHAPTER 73. IRON AND STEEL AND ARTICLES THEREOF.

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
73.07		Blooms, billets, slabs and sheet bars (icluding tinplate bars), of iron or steel:					
	910	Tinplate bars	(10) 5		10		

CHAPTER 85. ELECTRICAL MACHINERY AND EQUIPMENT; PARTS THEREOF

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
85.01		Motors and generators:					
		D.C. motors and generator:					
	111	In completely knocked down conditions	(30) 5		10		
	119	Others	30		10		
		ther motors icluding universal (AC/DC):					
	121	in completely knocked down conditions	(30) 5		10		
	129	Others	30		10		
		A.C. generators					
	131	In completely knocked down conditions	(40) 5		10		
	139	Others	30		10		
		Generating sets with internal combustion piston engines:					
	200	Generating sets, consisting of a generator and its prime mover, mounted (or designed to be mounted) together as aunit or on a common base	(40) 30		10		
85.08	400	Starter motors and generators (dynamo and alternators)	(20) 10		10		

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
84.10		Pumps (including motor pumps and turbo pumps) for liquids, whether or not fitted with measuring devices;					
	100	Pumps for dispensing fuel or lubricants, of the types used in filling stations or garages, fitted or designed to be fitted, with measuring device	(30) 10		10		
	200	Reciprocating pumps	(30) 10	50	10		
	300	Centrifugal pumps	(30) 20	50	10		
	400	Rotary pumps	(30) 20	50	10		
		Other pumps for liquids and liquid elevators:					
	510	Pumps of all kind for internal combustion piston engines	(30) 20		10		
	520	Hand operated pumps	(30) 20		10		
	530	Liquid operators	(30) 20		10		
	540	Other	(30) 20		10		
	900	Parts	(30) 20		10		
		Air pumps, vacuum pumps and air or gas compressors (including motor and turbo pumps and compressors, and free piston generators for gas turbines);					
		Pumps and compressors:					
		Pumps:					
	111	Hand or foot operated pumps	(50) 20		10		
	119	Other	20		10		
	120	Compressors	(30) 20		10		
	200	Parts of pumps or compressors	(50) 20		10		
	300	Free piston generators for gas turbines and parts	(20) 20		5		
84.15		thereof					
		Refrigerators and refrigerating equipment (electrical and other):				10	
	200	Other refrigerators and refrigerating equipment	(30) 20		10		
84.17	900	Parts	(40) 20		10		
84.19	920	Heating and cooling plant machinery	(20) 15	50	10		
	230	Packing or wrapping machinery	(40) 10		10		
84.22	290	Other	(40) 10		10		
		Pulley tackle and hoist, other than skip hoist; winches and capstans:					
	110	Marine winches and capstans	(10) 5	30	10		
	190	Other	5		10		
	210	Ship's derricks	(10) 5	30	10		
	220	Gantry and bridge cranes	(10) 5	30	10		
84.30	290	Other	(10) 5	30	10		
	400	Machinery for the preparation of meat or fish	(50) 5	50	10		
		Parts:					
	910	For machinery for the preparation of meat or fish	(50) 20		10		

D

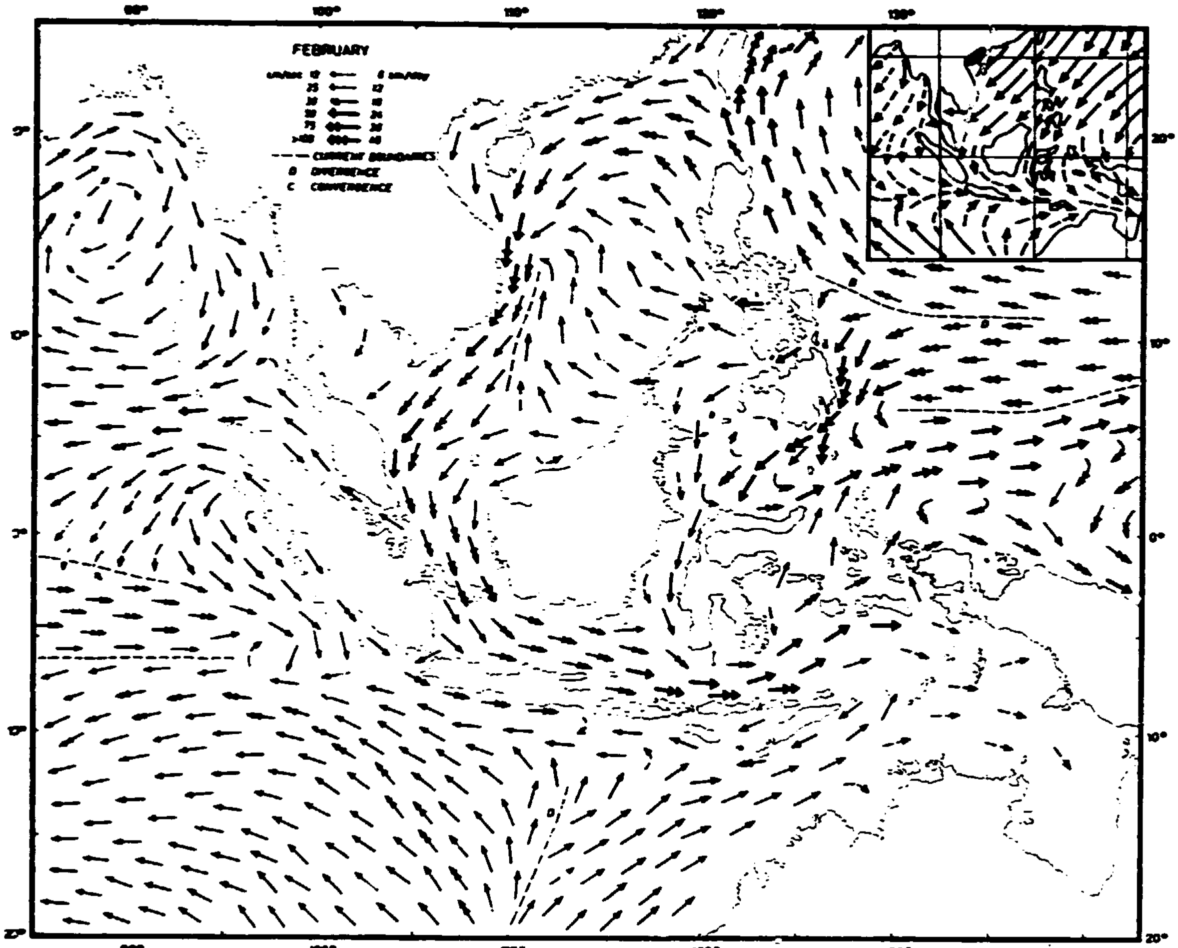
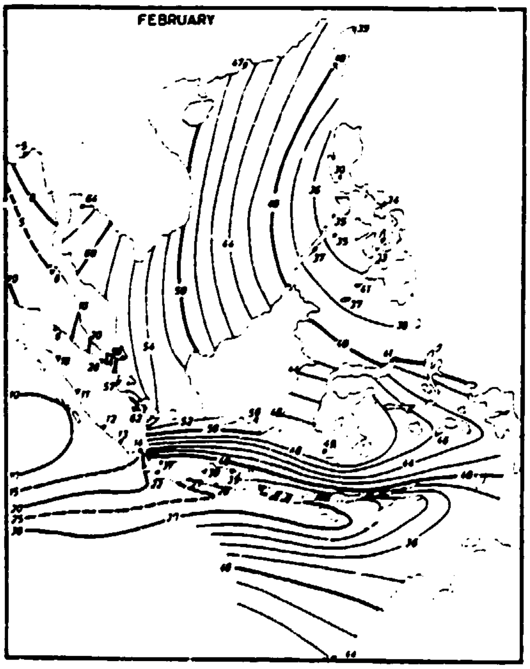


Plate 1. a. Surface currents in February.

b. Transports of surface circulation in million m³ sec. — upwelling, o sinking.



c. Topography of sea level in cm.

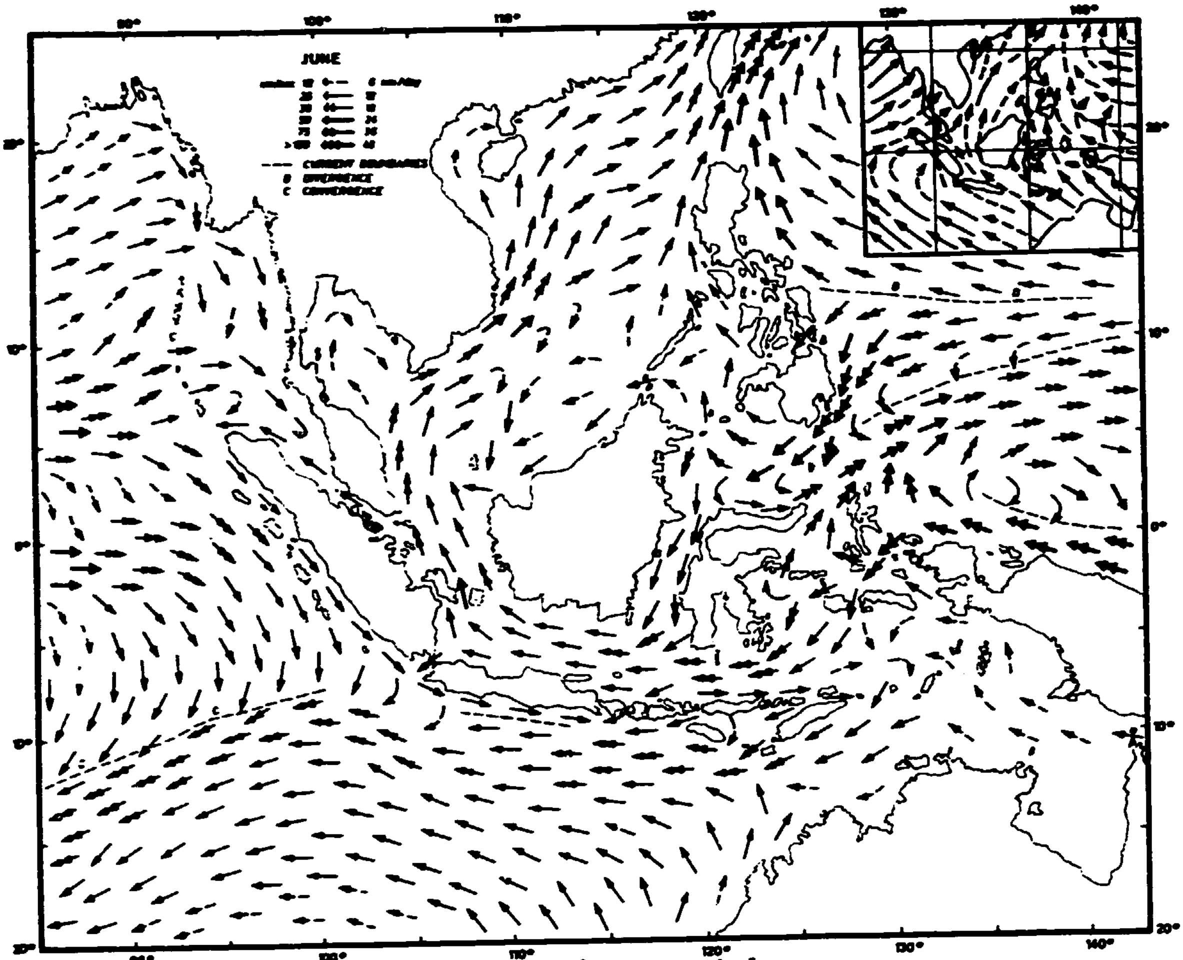
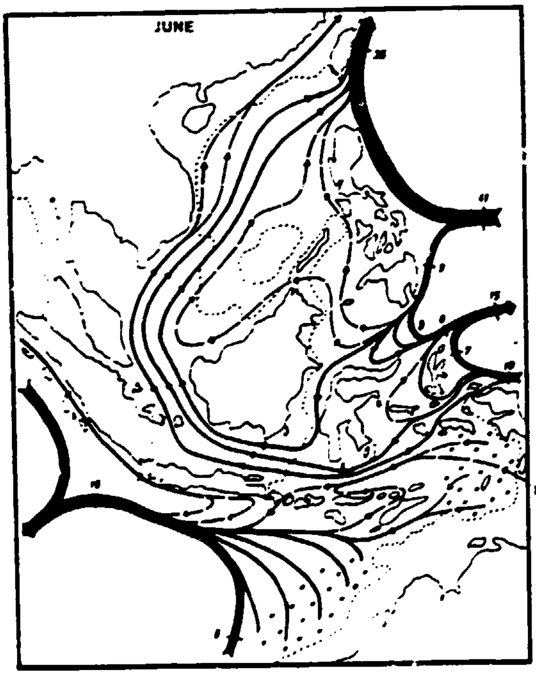
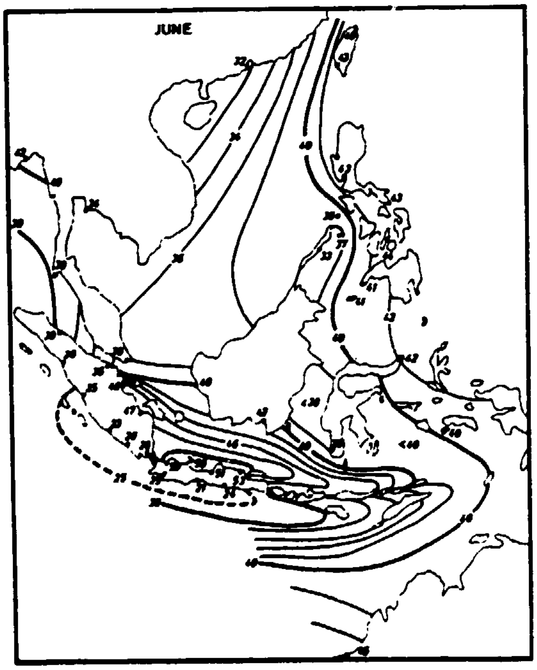


Plate 3. a. Surface currents in June.



b. Transports of surface circulation in million m³/sec. — upwelling, o sinking.



c. Topography of sea level in cm.

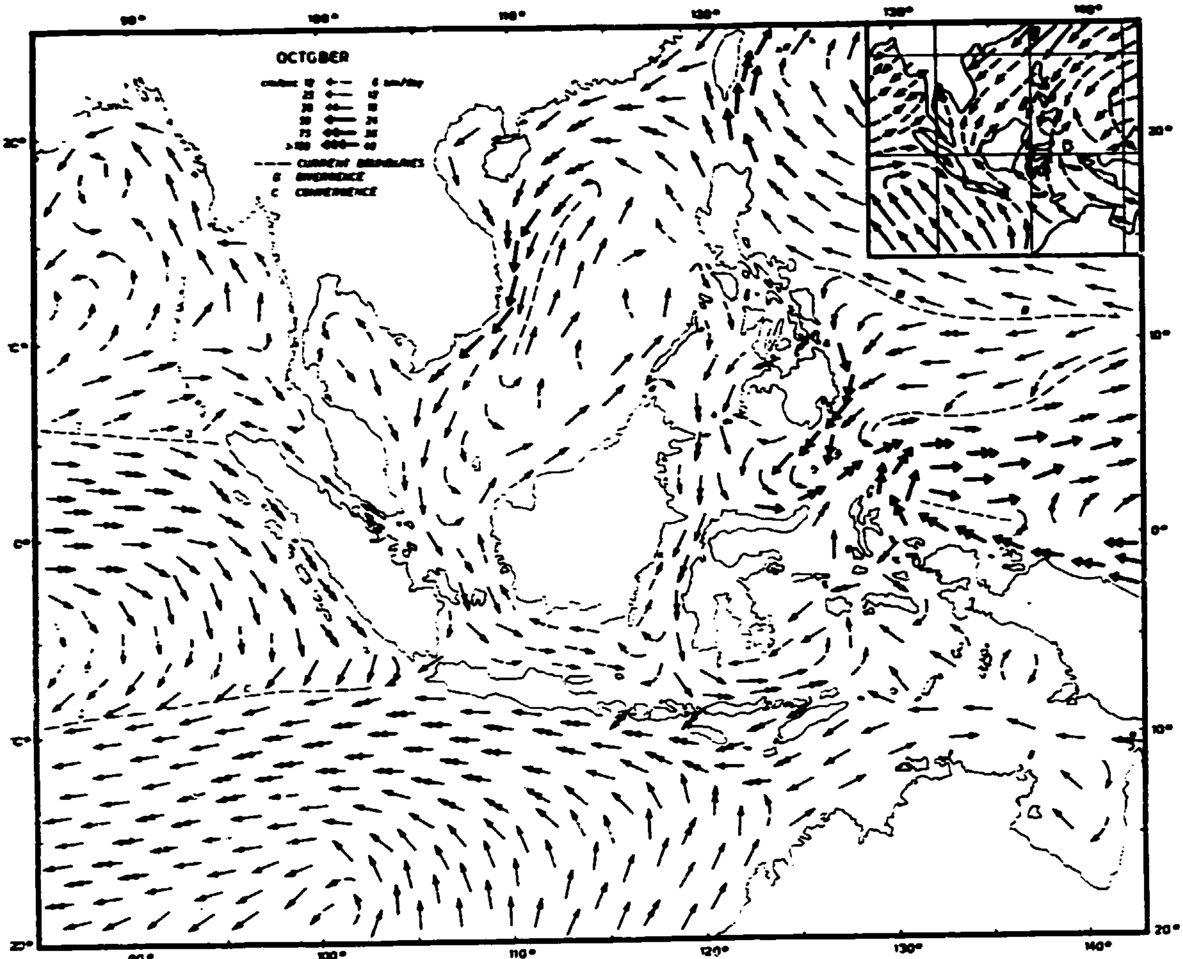
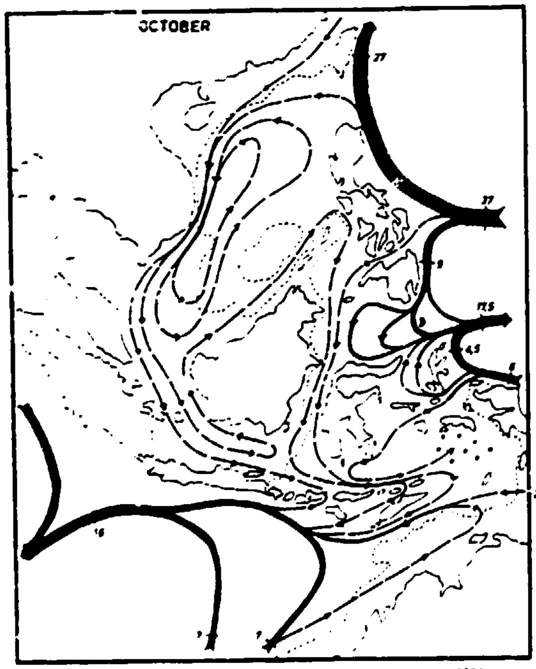
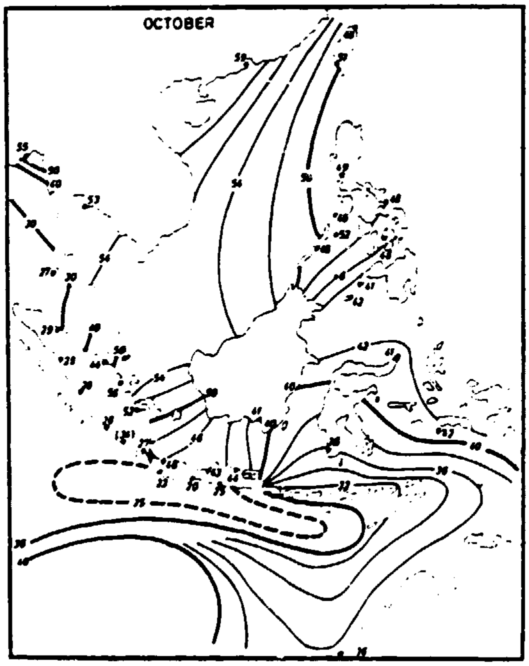


Plate 5. a. Surface currents in October.



b Transports of surface circulation in millicn m³/sec. + upwelling, o sinking.



c. Topography of sea level in cm.

E

TABLE 7 (Continued)

SUMMARY ASSESSMENTS OF THE STATUS OF SELECTED MARINE FISHERIES RESOURCES IN INDONESIA

AREA and STOCK	Estimated MSY (mt)	1979 Landings (mt)	Standardized Fishing Effort[a] Optimum	1979	Level of Exploitation
Bali-NTB-NTT-Timor					
Demersal fish/shrimp	N/A	19,400	N/A	N/A	N/A
Penaeid shrimp	N/A	400	N/A	N/A	N/A
Small pelagics	48,000	48,700	494	464	Fully Exploited
Oil sardines	37,000	24,000	N/A	190	Fully Exploited
Tuna	N/A	2,300	N/A	N/A	N/A
Skipjack	N/A	1,300	N/A	N/A	N/A
South Coast Sulawesi					
Demersal fish	34,000	46,300	187	203	Overexploited
Penaeid shrimp	N/A	4,700	N/A	N/A	N/A
Small pelagics	114,800	132,500	1,972	1,910	Fully Exploited
Flying Fish roe[c]	135	120	2,700	2,262	Moderately
North Coast Sulawesi					
Demersal fish	N/A	10,800	N/A	N/A	N/A
Penaeid shrimp	N/A	720	N/A	N/A	N/A
Small pelagics	N/A	34,200	N/A	N/A	N/A
Tuna	N/A	2,900	N/A	N/A	N/A
Skipjack	N/A	8,500	N/A	N/A	N/A
Moluccas					
Demersal fish/shrimp	18,000	16,598	340	207	Developing
Penaeid shrimp	5,200	5,122	153	165	Fully Exploited
Small pelagics	27,000	25,833	1,650	1,268	Developing
Tuna	N/A	2,100	N/A	N/A	N/A
Skipjack	N/A	10,999	N/A	N/A	N/A
Irian Jaya					
Demersal fish/shrimp	7,000	7,203	50	74	Fully Exploited
Penaeid shrimp	4,700	4,900	39	54	Fully Exploited

SOURCE: Dwiponggo (in press)

a: For demersal species, levels of fishing effort are estimated using otter trawlers as the standard measure (=1) and assigning values based on effectiveness to all other demersal gear operating in a particular area. For pelagic species, purse seiners are used as the standard measure of fishing effort.

b: Overexplited in nearshore waters but underexploited in offshore waters.

c: Levels of fishing effort for this fishery are defined by number of traps (pakkaja).

F

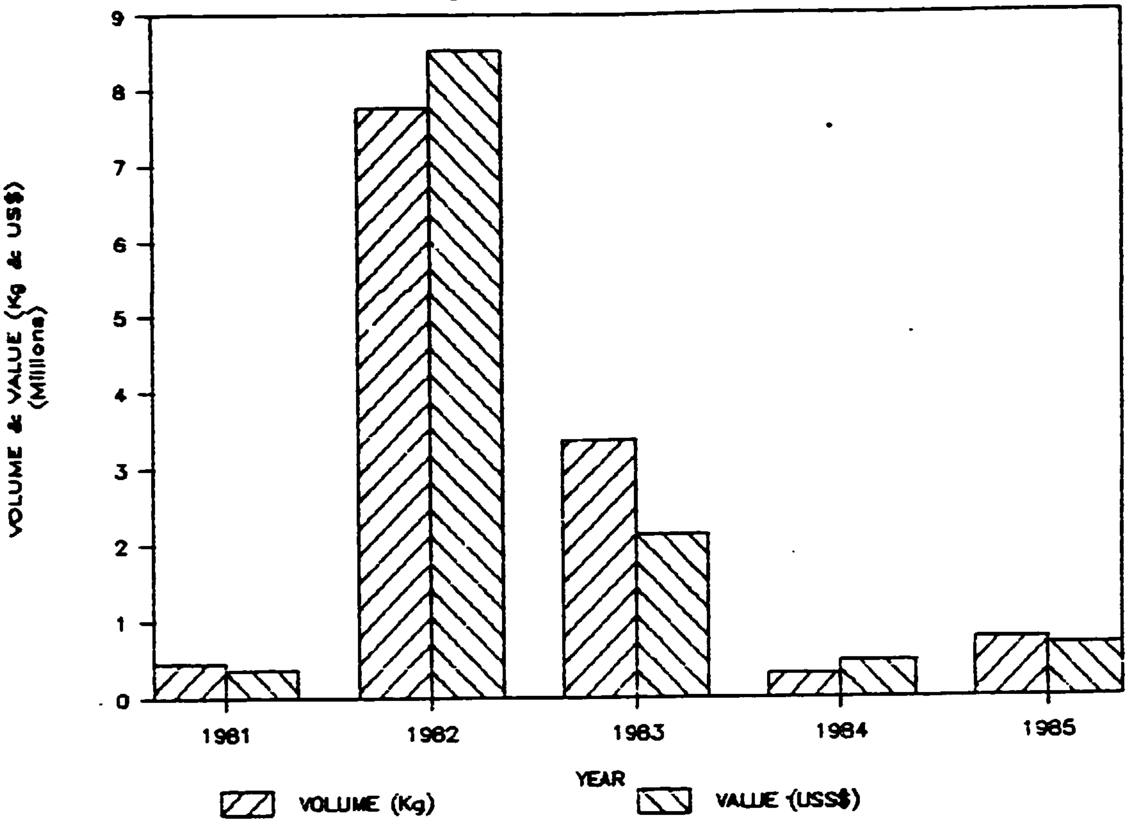
TABLE: VOLUME/EXPORT VALUE OF FISH PRODUCTS IN EAST INDONESIA 1981-1985

NO	PROVINCE	1981		1982		1983		1984		1985	
		VOLUME (Ton)	VALUE (1000 US$)	VOLUME (Ton)	VALUE (1000 US$)	VOLUME (Ton)	VALUE (1000 US$)	VOLUME (Ton)	VALUE (1000 US$)	VOLUME (Ton)	VALUE (1000 US$)
1	BALI	2956	5140	2874	4729	2291	3066	2227	3002	1809	2482
2	WEST NUSA TENGGARA	-	-	-	14	-	-	-	-	14	28
3	EAST NUSA TENGGARA	8153	2833	17635	6077	5784	1977	542	332	46	20
4	EAST TIMOR	-	-	-	-	-	-	-	-	-	-
5	NORTH SULAWESI	465	438	7822	8605	3733	2124	474	726	768	677
6	CENTRAL SULAWESI	-	-	-	-	-	-	36	65	277	598
7	SOUTH SULAWESI	5233	22219	6786	29516	8051	28442	9117	35043	11204	34978
8	SOUTHEAST SULAWESI	672	570	766	548	3525	2190	1428	1054	1927	2518
9	MALUKU	966	30864	8407	29115	6737	30428	3835	23945	5547	26973
10	IRIAN JAYA	7961	25084	7196	24019	8941	23788	12291	22201	13837	24556

Source: Directorate General of Fisheries, Jakarta

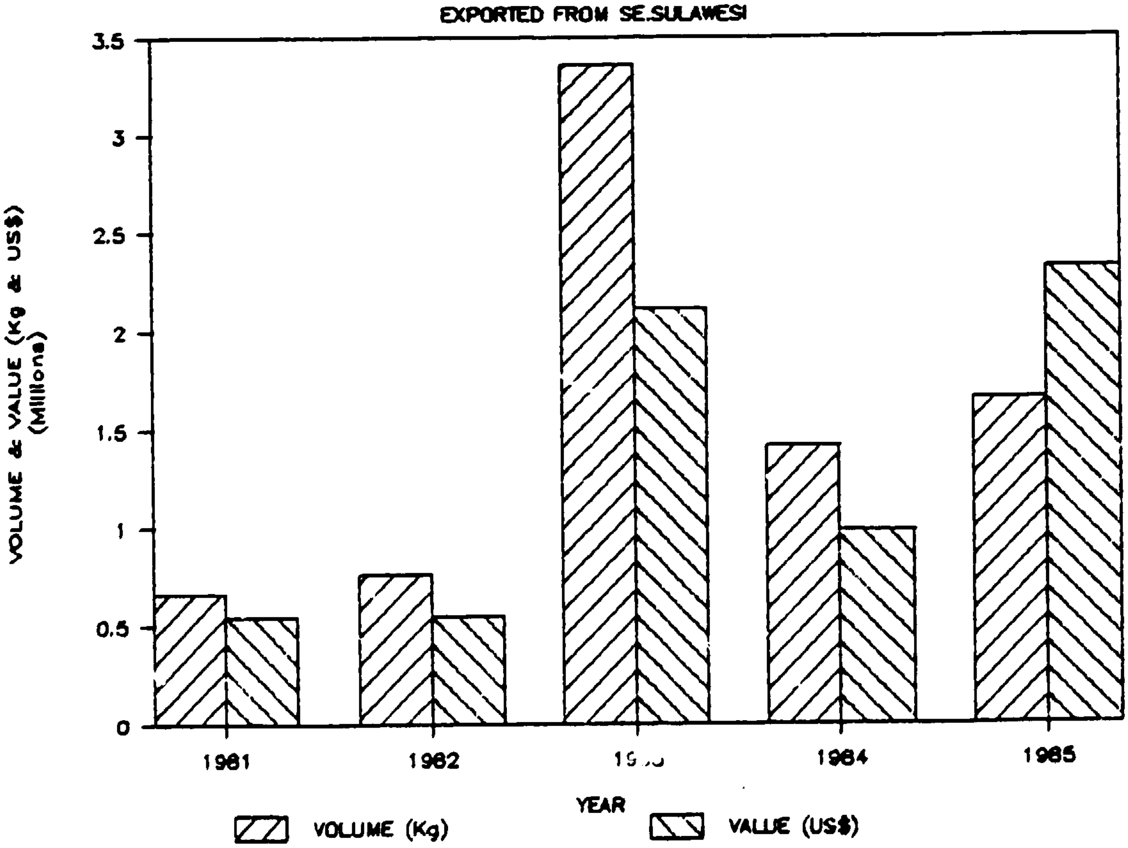
VOLUME & VALUE OF FROZEN TUNA/SKIPJACK

EXPORTED FROM N.SULAWESI



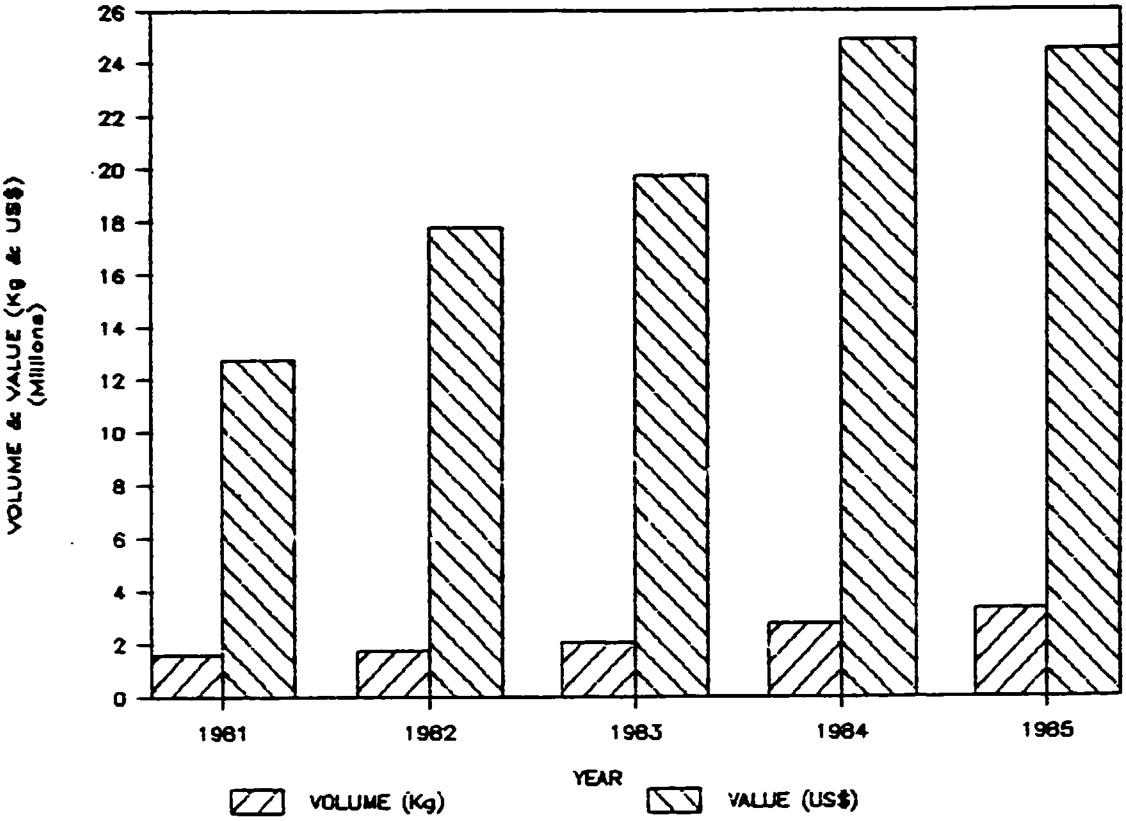
VOLUME & VALUE OF FROZEN TUNA/SKIPJACK

EXPORTED FROM SE.SULAWESI



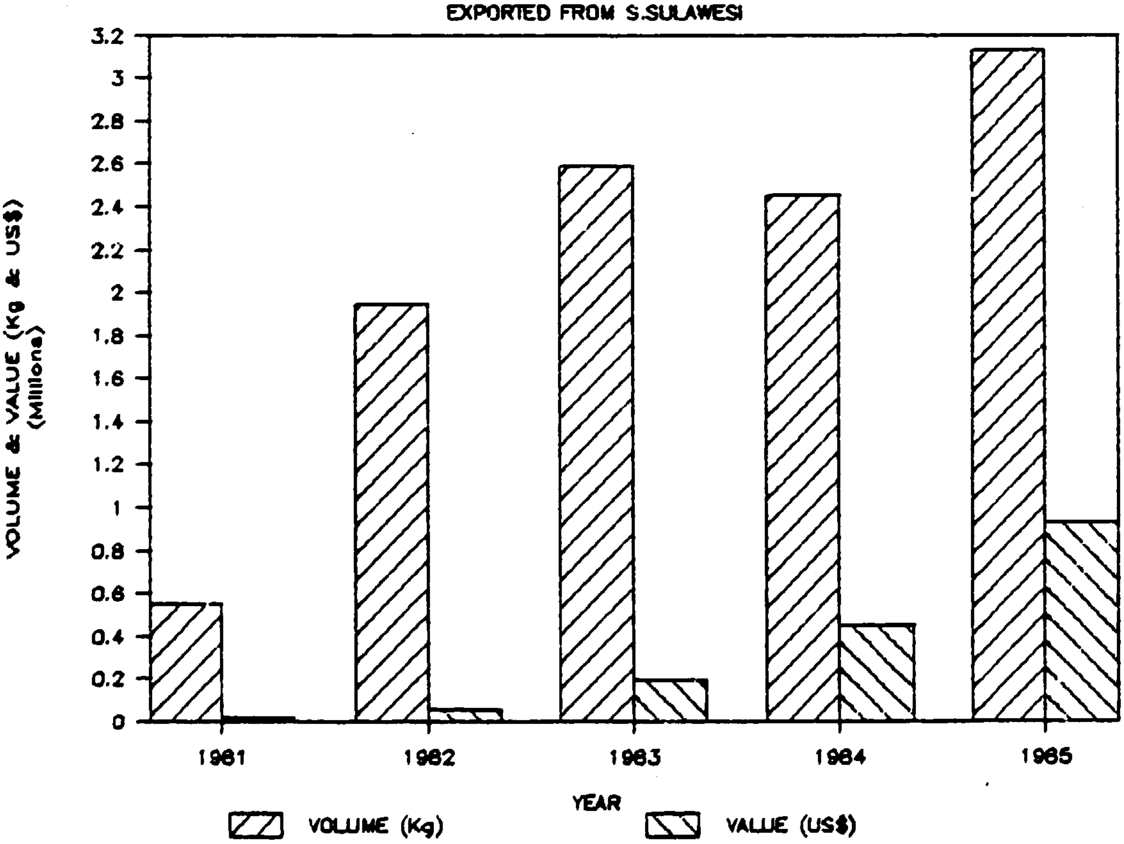
VOLUME & VALUE OF FROZEN PRAWNS/SHRIMPS

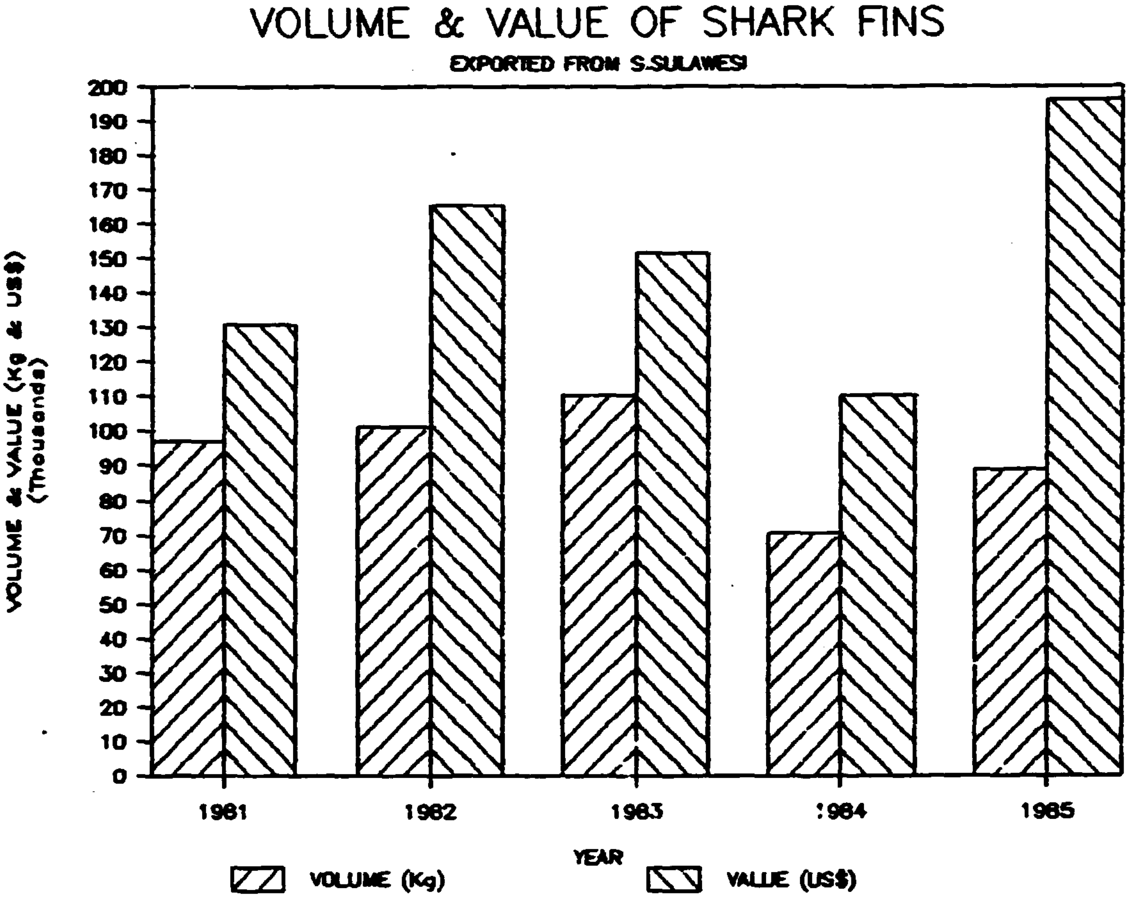
EXPORTED FROM S.SULAWESI

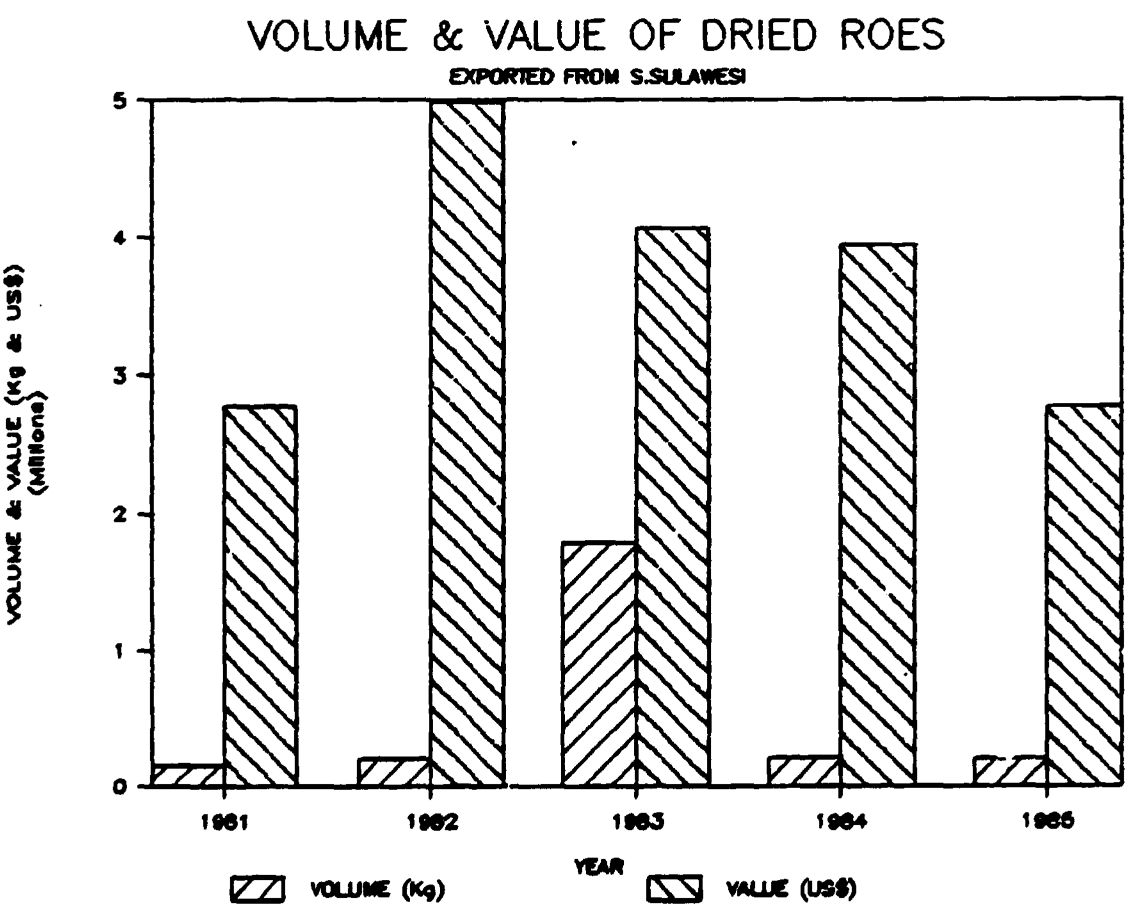


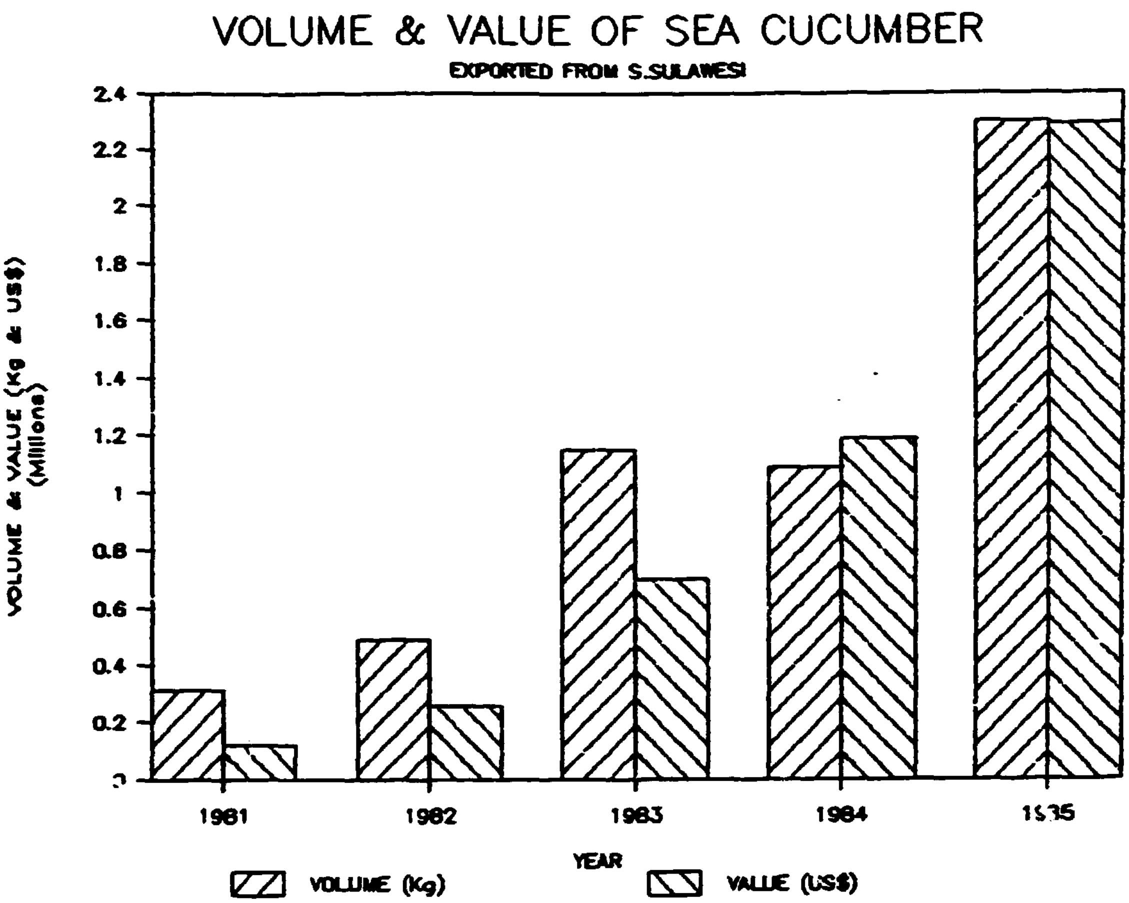
VOLUME & VALUE OF SEAWEED

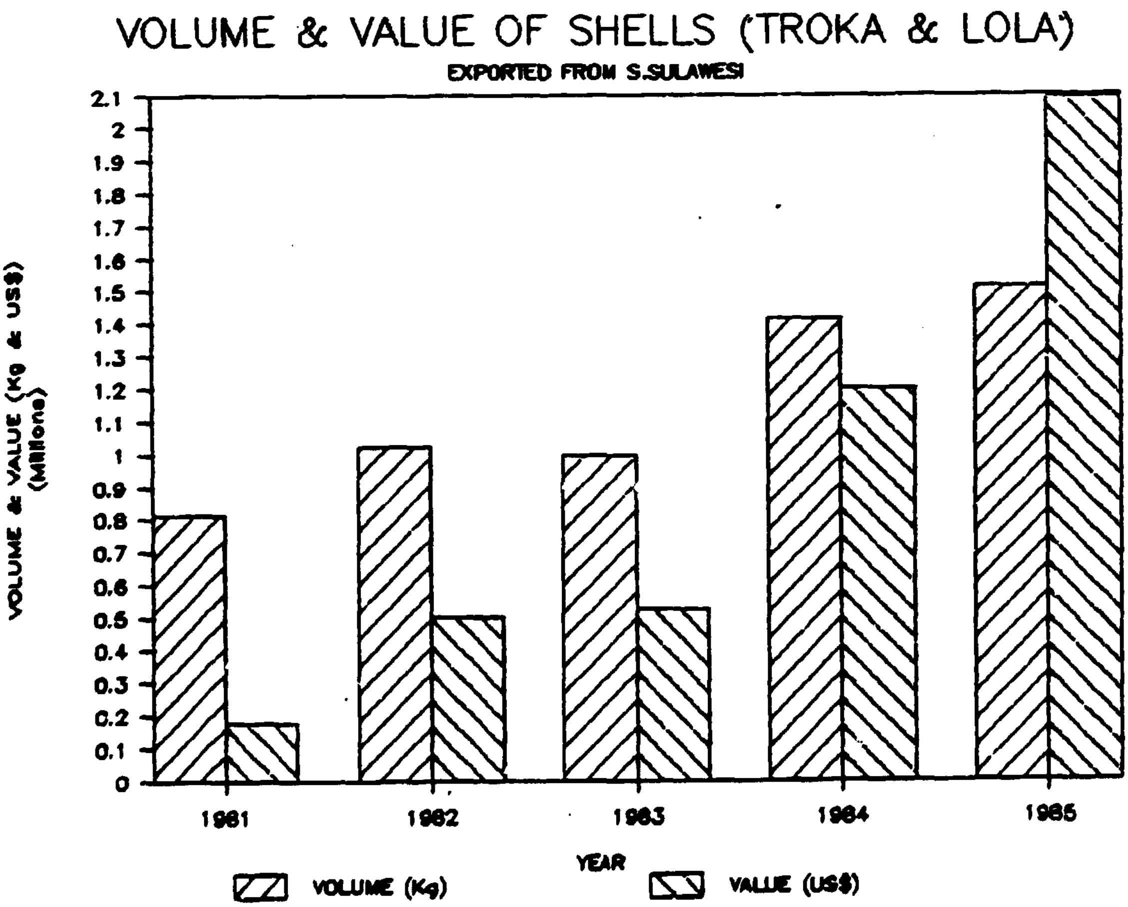
EXPORTED FROM S.SULAWESI

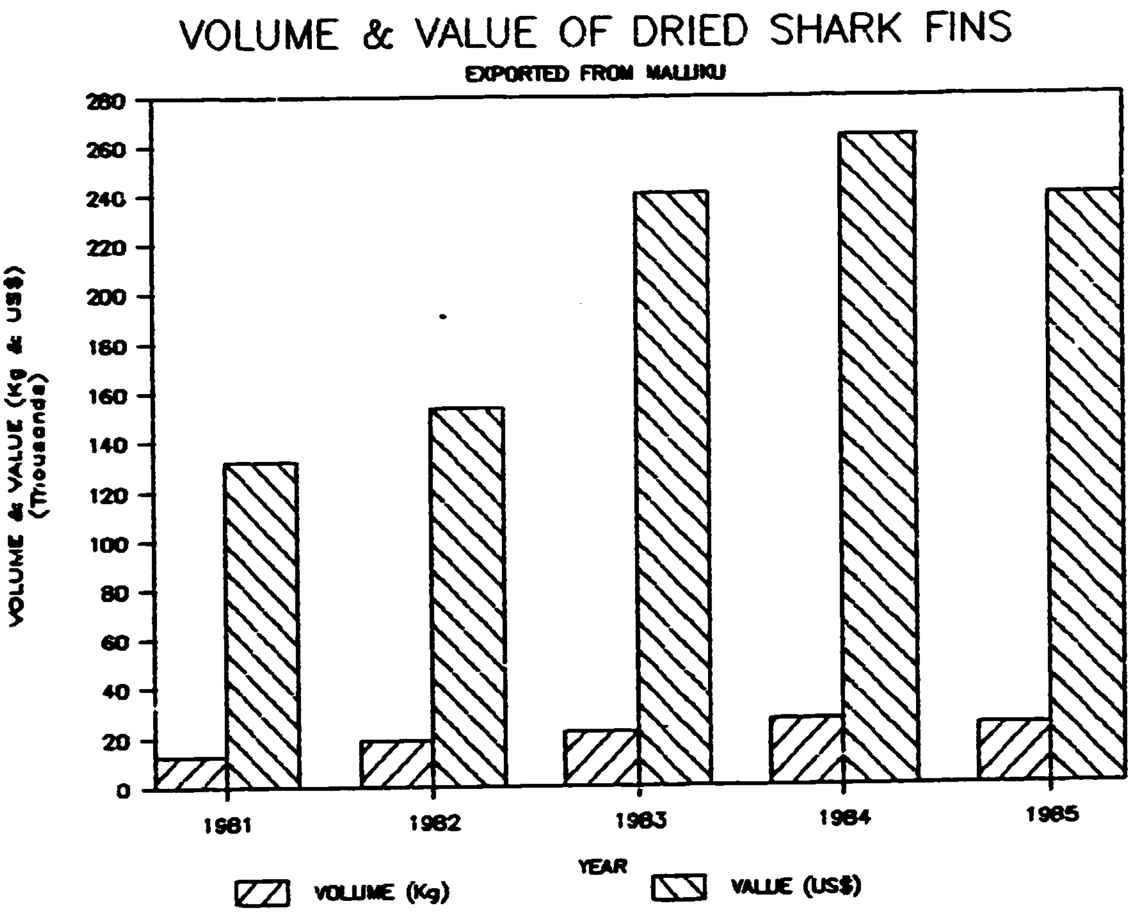



VOLUME & VALUE OF SHARK FINS
EXPORTED FROM S.SULAWESI
VOLUME & VALUE (Kg & US$)
(Thousands)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)

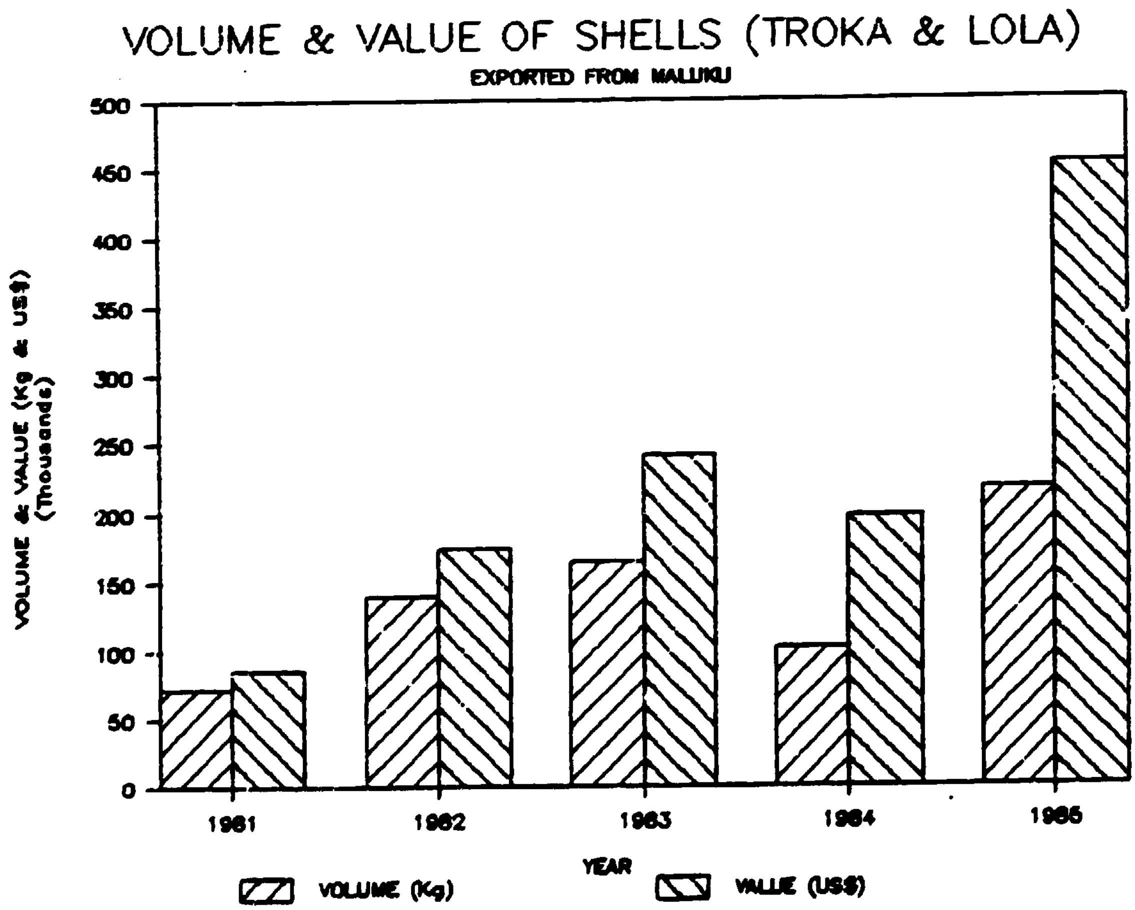

VOLUME & VALUE OF DRIED ROES
EXPORTED FROM S.SULAWESI
VOLUME & VALUE (Kg & US$)
(Millions)
5
4
3
2
1
0
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)


VOLUME & VALUE OF SEA CUCUMBER
EXPORTED FROM S.SULAWESI
VOLUME & VALUE (Kg & US$) (Millions)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
1981
1982
1983
1984
YEAR
VOLUME (Kg)
VALUE (US$)

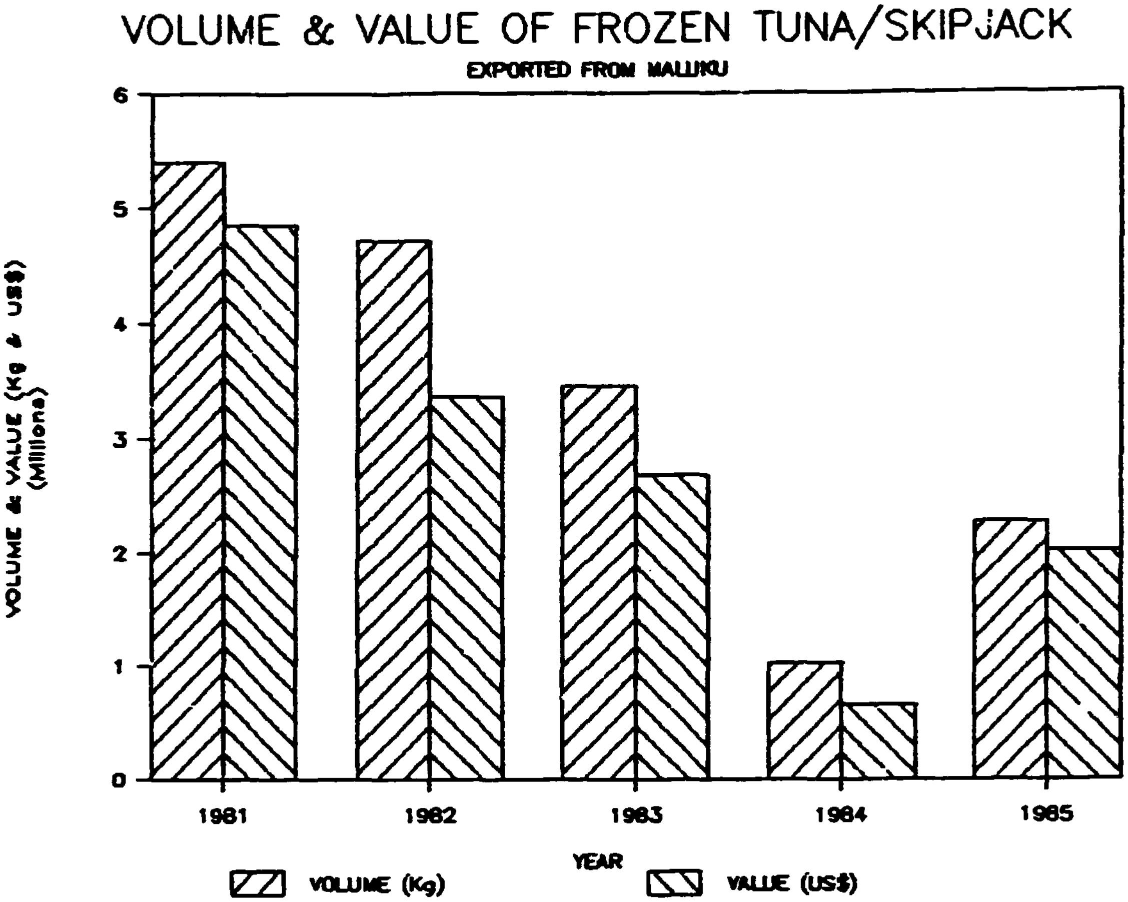

VOLUME & VALUE OF SHELLS (TROKA & LOLA)
EXPORTED FROM S.SULAWESI
VOLUME & VALUE (Kg & US$) (Millions)
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)

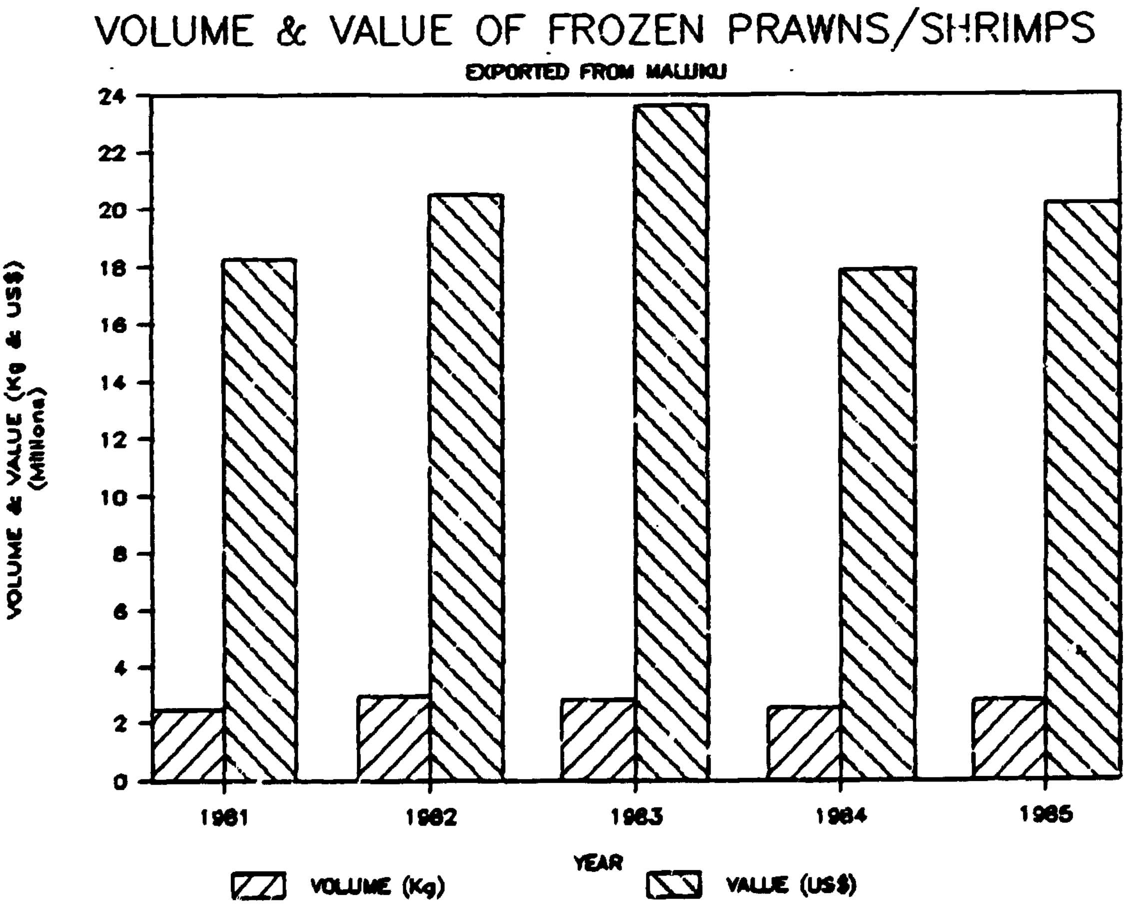


VOLUME & VALUE OF DRIED SHARK FINS
EXPORTED FROM MALUKU
VOLUME & VALUE (Kg & US$) (Thousands)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)



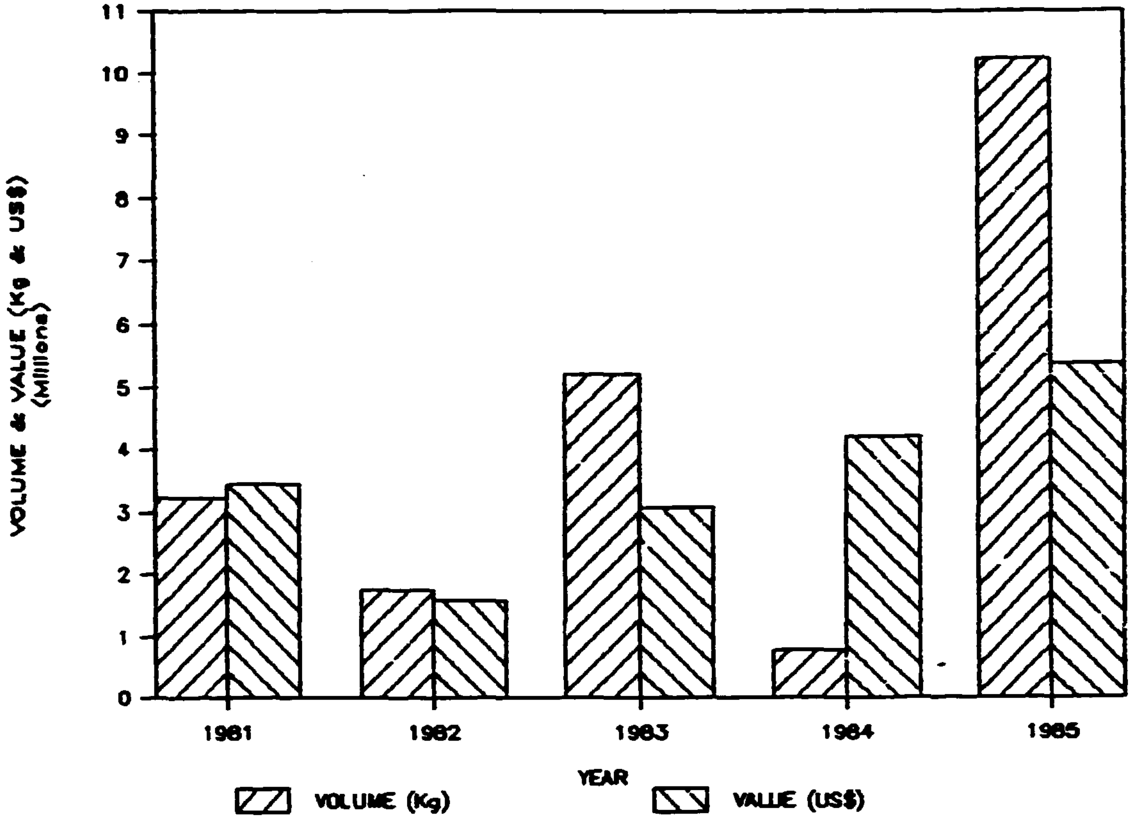
VOLUME & VALUE OF SHELLS (TROKA & LOLA)
EXPORTED FROM MALUKU
VOLUME & VALUE (Kg & US$) (Thousands)
0
50
100
150
200
250
300
350
400
450
500
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)


VOLUME & VALUE OF FROZEN TUNA/SKIPJACK
EXPORTED FROM MALUKU
VOLUME & VALUE (Kg & US$)
(Millions)
0
1
2
3
4
5
6
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)


VOLUME & VALUE OF FROZEN PRAWNS/SHRIMPS
EXPORTED FROM MALUKU
VOLUME & VALUE (Kg & US$)
(Millions)
0
2
4
6
8
10
12
14
16
18
20
22
24
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)

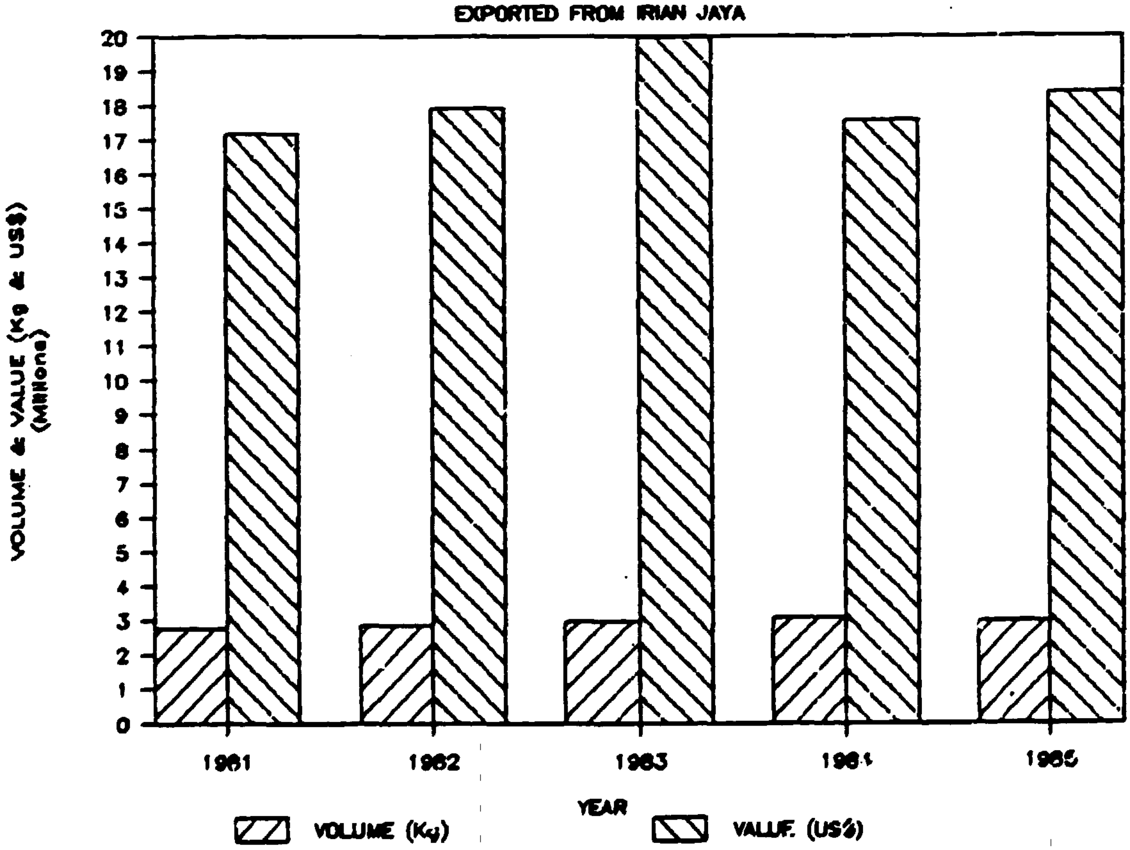
VOLUME & VALUE OF FROZEN TUNA/SKIPJACK

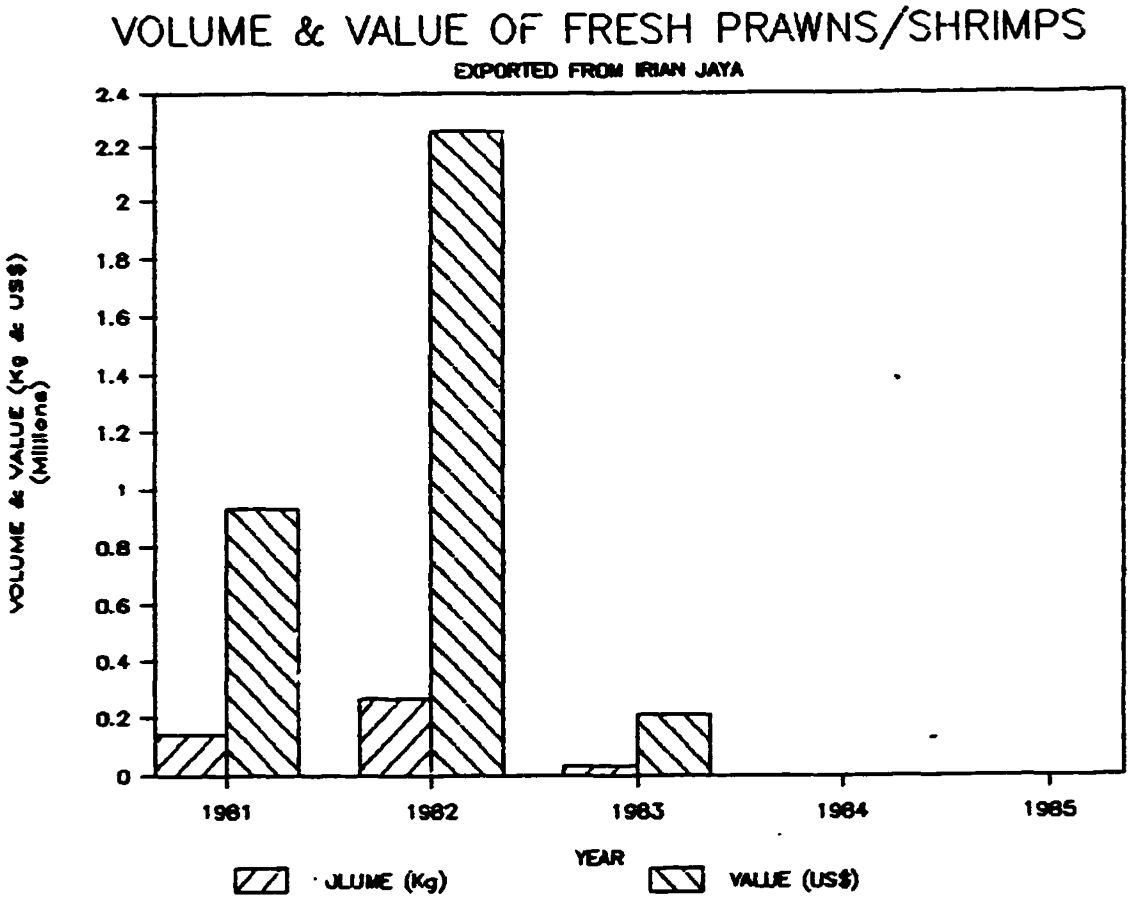
EXPORTED FROM IRIAN JAYA

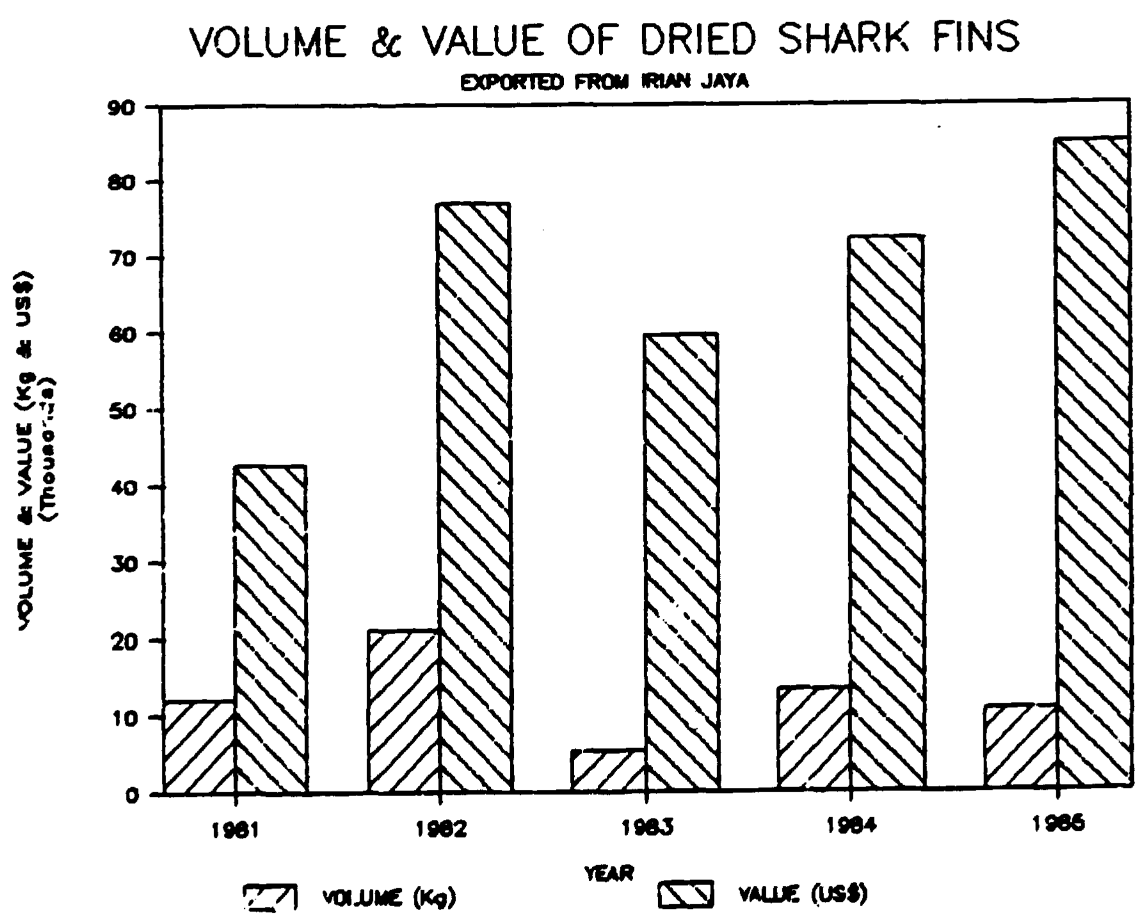


VOLUME & VALUE OF FROZEN PRAWNS/SHRIMPS

EXPORTED FROM IRIAN JAYA

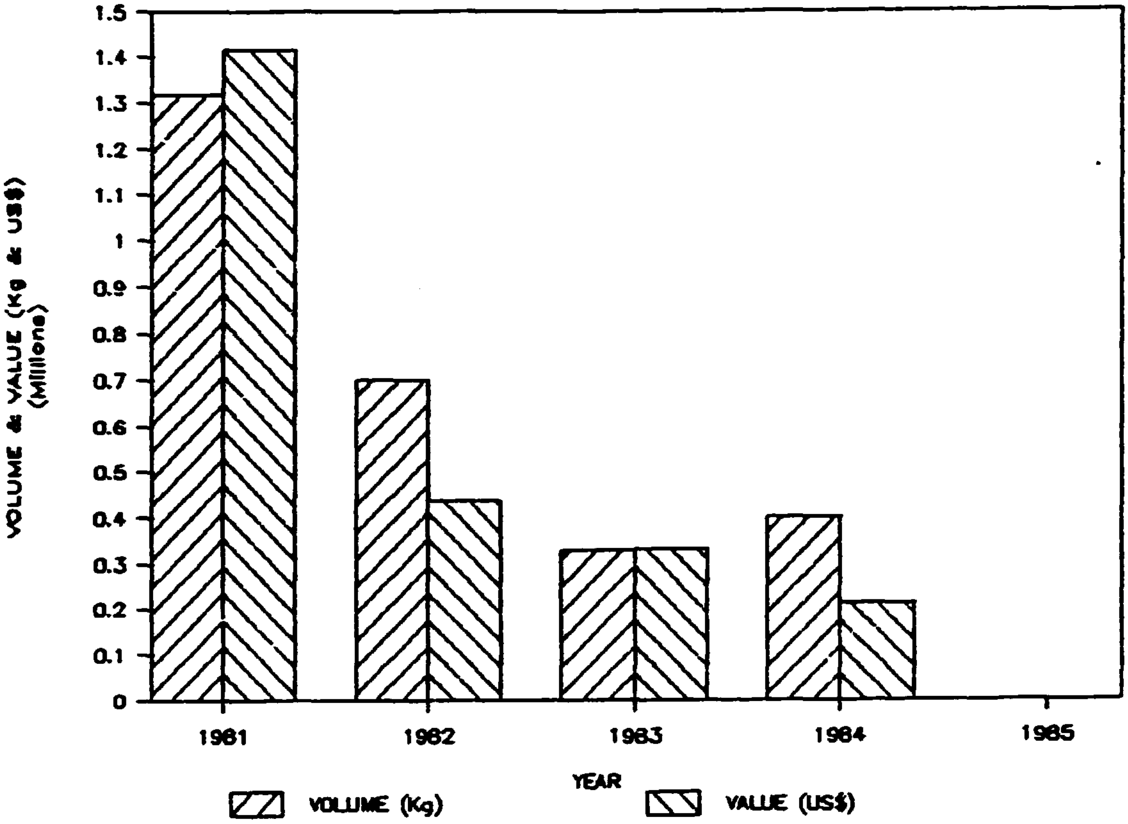



VOLUME & VALUE OF FRESH PRAWNS/SHRIMPS
EXPORTED FROM IRIAN JAYA
VOLUME & VALUE (Kg & US$)
(Millions)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)


VOLUME & VALUE OF DRIED SHARK FINS
EXPORTED FROM IRIAN JAYA
VOLUME & VALUE (Kg & US$)
90
80
70
60
50
40
30
20
10
0
1981
1982
1983
1984
1985
YEAR
VOLUME (Kg)
VALUE (US$)

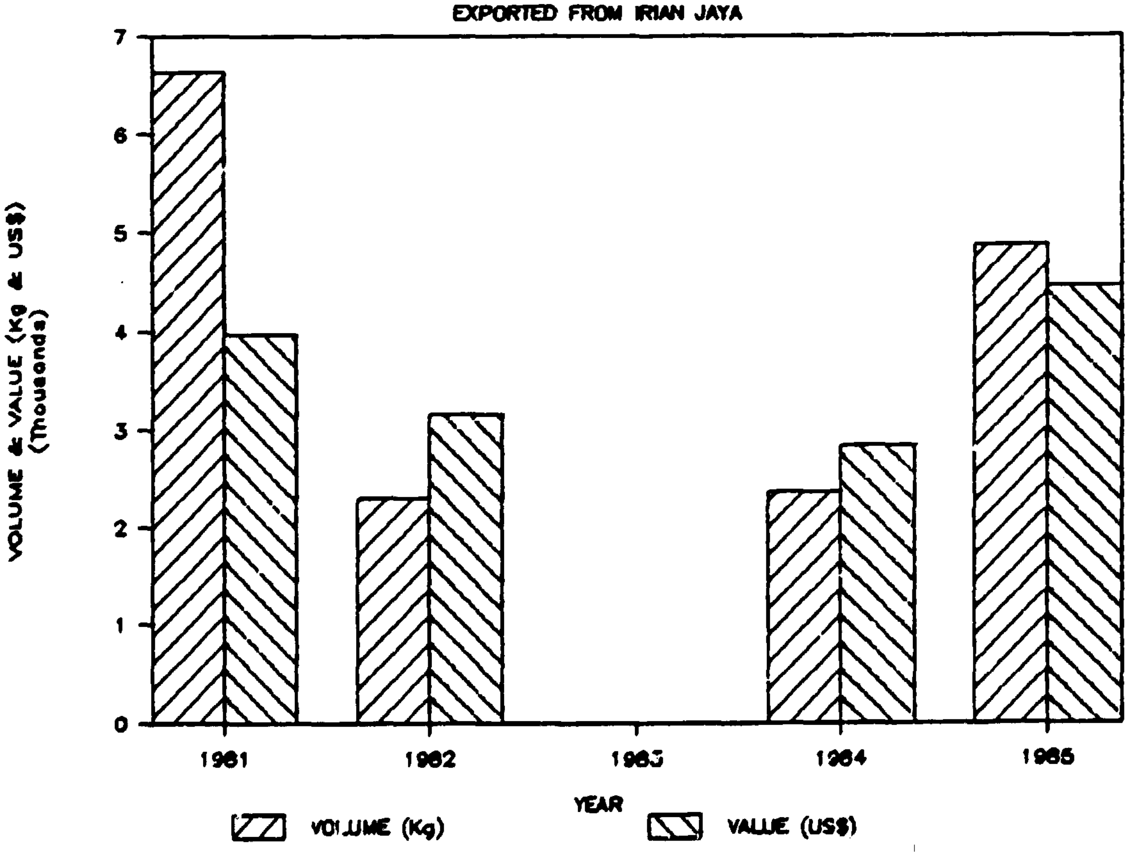
VOLUME & VALUE OF FROZEN SQUIDS

EXPORTED FROM IRIAN JAYA



VOLUME & VALUE OF SHELLS (TROKA & LOLA)

EXPORTED FROM IRIAN JAYA



G

APPENDIX G: THE PELAGIC FISHERY (TUNA, ETC.)

a) The "pelagic" fish stocks (large species) in the study region consist of tuna and other pelagics as shown below:

Tuna:

Skipjack (Katsuwonis pelamys)
Eastern little tuna (Euthynnus affinis)[1]
Yellowfin (Thunnus albacores)
Bigeye tuna (T. obesus)
Long tail tuna (T. tonggol)
Dog tooth tuna (Gymnosarda auda)
Albacore (Thunnus alalunga
Southern blue fin (Thunnus macoovi)

Other Large Pelagics:

Swordfish Xiphias gladius
Billfish Marlin Tetrapturus spp.
Large mackerel, Scomberomorus spp.
Frigate mackerel, Auxis thazard
Bullet mackerel Auxis rochei
Indian mackerel (Rastrelliger kanagurta).

Most of these fish are sole piscivores, but the Indian mackerel is a planktivore and frigate and bullet mackerel are facultative feeders on zoo plankton. All, no doubt, will feed on swimming crabs, squid and other such animals when they are available.

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1 In some provinces, catches of frigate and bullet mackerel (Auxis spp.) and small tonggol (Thunnus tonggol) are included in the landings data for Eastern little tuna.

TABLE 1: PELAGIC FISH RESOURCE ESTIMATES

a) Soesanto, 1985:

REGION	Fishing Area 1000 km²	Stock Density t/km²	Biomass Tonnes (000's)	Potential t/yr (000's)
North Western Sulawesi	119	1.74	375.8	103.5
South Eastern Sulawesi	97	1.74	207.1	84.4
Molukas				
North West Irian Jaya	790	1.56	1,232.4	616.2
Arafura Sea	160	2.50	400.0	200.0

b) Bailey et al, 1985:

Coastal Fishing Area	Resource Potential Incl. EEZ tonnes (000's)	Level of Exploitation, 1981 (%)
Southern Sulawesi	155.1	100%
Northern Sulawesi	368.1	17.7
Maluku/Irian Jaya	1,530.0	4.1

It is important to note that estimates of pelagic fish production cannot simply be translated into amounts of sustainable annual catches without substantial uncertainty. DGF (1983) has tabulated estimates of the marine fisheries resource potential in Indonesian and EEZ waters that are derived from estimates of stock density (in tons/km²). Their estimates for pelagic fish in the study region (shown in table 2) appear to have formed the basis for yield projections such as those mentioned by the ADB (1984, 1986) and Bailey et al. (1985). It is impossible to determine the uncertainty in these yield estimates because no information exists about the error in the components of the yield function.

TABLE 2: PELAGIC FISH RESOURCES IN INDONESIAN WATERS

Region	Area (000's km^2	Stock Density per km^2	Biomass (000's tonnes)	Sustainable Yield/yr (000's tonnes)
a) Territorial Waters				
West/North Sulawesi	119	1740	207.1	103.5
East Sulawesi	97	1740	168.8	84.4
North/West Irian Jaya - Maluku	790	1560	1,232.4	616.2
Arafura Sea	160	2500	400.0	200.0
b) EEZ Waters				
North Sulawesi	190	1740	330.6	165.3
North West Irian Jaya	620	1560	976.2	483.6

Source: DGF, 1983

Unar (1982) gives information on catch rates obtained by exploratory surveys undertaken in 1975 by the Directorate General of Fisheries. Catch rates obtained using a 22 GT wooden pole-and-line vessel were, around Kendari and Buton, 693 kg and 522 kg/day respectively in December; in the Gulf of Bone an average catch of 250 kg/day was obtained during the period January to October. Yenmori et al. (1985) give the most recent and detailed information on pole-and-line vessel catch rates (see table 3 below). Again, without good measures of fishing effort, it is not possible to determine whether changes in catch rate were caused by changes in fishing effort or in skipjack abundance.

TABLE 3

YONEMONI et al. (1985)

Number of tuna fishing boats operating in Eastern Indonesian waters.

Base	State enterprise	Private	Fishing ground
Bitung	A 15	A 30	Around NE Sulawesi I.
(NE Sulawesi)	L 1		Banda Sea
Ternate		A 8	West off Halmahera I.
(Halmahera)		B 29	" "
		C 2	Around Halmahera I.
		D 1	Western Pacific Ocean
Ambon	A 10	A 10	around Ambon, Ruru and Seram Is.
(Maluku)			
	C 2		" "
	L 1		Banda Sea and Indian Ocean
Sorong	A 25		NW off Western Irian Jaya
(Irian Jaya)	C 3		" "
Biak		C 4	NW off Western Irian Jaya
(Irian Jaya)		D 1	Western Pacific Ocean
Benoa	L 17		Banda Sea and Indian Ocean
(Bali)			

A: 30 GT pole & line B: 15 GT pole & line C: > 100 GT pole & line
D: 500 GT purse seine L: longline

TABLE IX

Monthly CPUE (kg/fishing day) of Skipjack caught by 30 GT pole and line boats of state fisheries enterprises (1981 - 1983).

Sorong	1981	625	440	684	759	848	939	549	867	861	569	649	343
	1982	354	526	438	448	411	561	233	183	561	959	822	1164
	1983	670	491	588	905	1414	1144	1471	619	860	1134	991	578
	Ave.	550	486	570	717	891	881	733	556	761	887	821	695
Ambon	1981	642	539	808	628	692	591	1648	338	769	725	1038	1401
	1982	885	696	854	613	405	261	380	1058	710	927	1064	1268
	1983	823	439	606	2183	1491	760	239	795	1681	1069	802	737
	Ave.	783	558	756	1141	863	537	756	730	1053	907	968	1135
Bitung	1981	768	684	523	486	685	633	998	868	1241	858	555	949
	1982	589	547	611	718	646	959	1250	663	1247	1742	2309	1282
	1983	1065	1399	1384	1542	1453	1188	823	477	798	731	747	548
	Ave.	807	877	839	915	928	927	1024	669	1095	1110	1204	926

Each value includes 7 - 8 % of Yellowfin tuna.

TABLE 4: FISH SPECIES USED AS LIVE BAIT FOR SKIPJACK POLE-AND-LINE FISHING.

Scientific Name	Indonesian Name	Common Name
PRIMARY SPECIES:		
Stolephorus heterolobus	kure	blue anchovy
Stolephorus commersonii	teri	anchovy
Thryssa baelama	lompa	thryssa
Sardinella fimbriata	terbang	fringscale sardinella
Secondary Species:		
Decapturus kurcides spp	layang	scad
Decaphurus maruadsi	layang	
Caesio coerulareus	ikor kuning	fusilier
Rastrelliger brachysoma	kempang	mackerel
Spratelloides spp.	djapah	sardine
Atherinidae	kawna	silverside
Minor:		
Leiognathidae	peperek	ponyfish
Upeneus sp.	gerot	goatfish
Dussumiera	teri	rainbow sardines
selar sp.	selar	bigeye scad

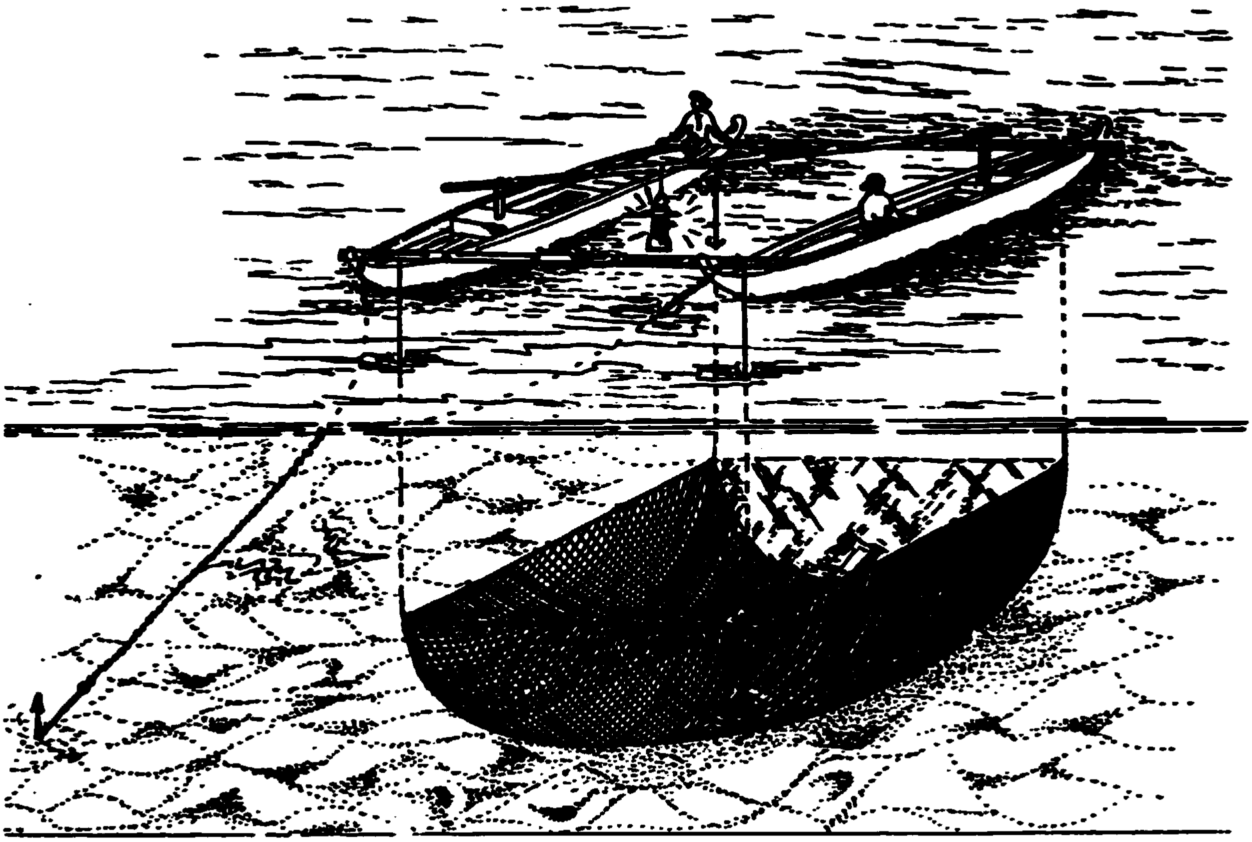
Source: Haskoning (1983).

TABLE 5: NUMBER OF BAGAN AND THEIR CATCH

Region	Number	Catch[1] (tonnes)	Catch/ bagan
Bagan Umpang			
Sulawesi Selatan	1,338	16,166	12.08
Sulawesi Tenggara	1,791	13,208	7.37
Sulawesi Utara	830	7,190	8.66
Sulawesi Tengah	558	2,712	4.86
Maluku	263	1,319	5.01
Irian Jaya	355	967	2.72
Bagan tancap (Stationary lift nets)			
Sulawesi Selatan	2,998	20,489	6.83
Sulawesi Tenggara	662	3,439	5.19
Sulawesi Tengah	129	505	3.91
Maluku	470	767	1.63

Source: SPI, 1986

1. About 15% of catch is apparently suitable as live bait (Anon, 1984).



Gambar 6. Atas. Tipe "bagan apung" di Bau-Bau (Buton)
Bawah. Tipe "bagan apung" di Morotai.

Figure 6. Above Type of "floating lift net" in Bau-Bau (Buton).
Below. Type of "floating lift net" in Morotai.

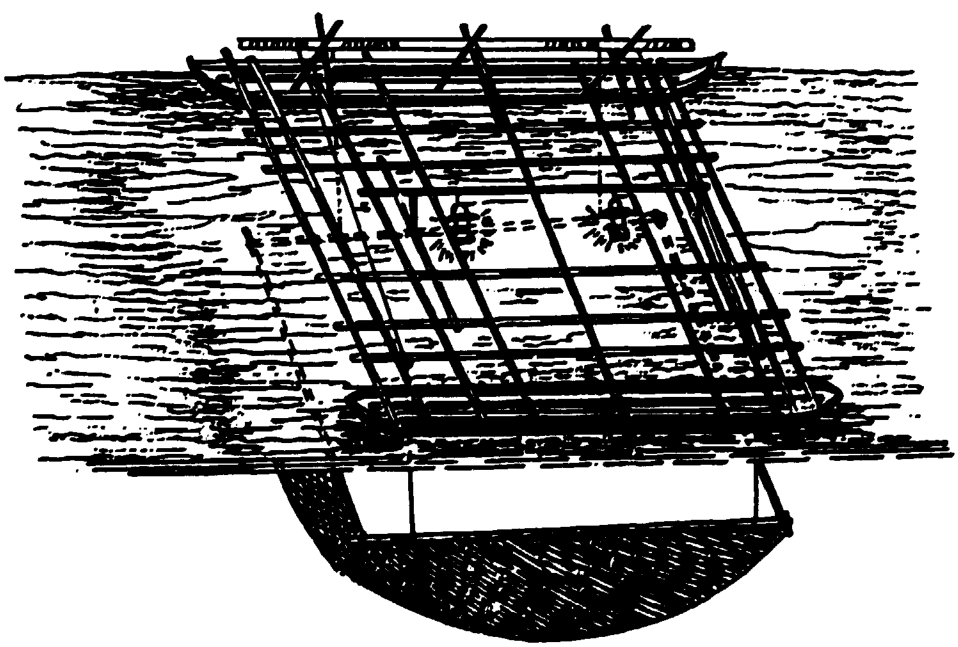


TABLE 6: BAIT FISH CONSUMPTION BY SKIPJACK POLE-AND-LINE VESSELS

Date	Area	Catch No.	Catch Wt(kg.)	No. Buckets of Bait Used	Catch/Bucket No. Fish	Catch/Bucket Kg.	Bait Fish Bucket[1]
Dec. 1975	Kendari	259	693	23	10.8	30.1	180 - 250
Sept. 1975	Buton	144	522	15	9.6	34.8	550 - 700
Sept. 1975	Kolaka	72	253	3	24.0	84.4	450 - 600

Source: Kawakami (1976)

1. One bucket contains 3kg to 4kg of fish.

TABLE 7: MONTHLY EFFORT, CATCHES AND CATCH PER UNIT EFFORT OF 100 GT LONGLINERS[1], 1984 (area 71)

MONTH	NO. OF FISH	SETS	HOOKS	HOOK RATES[2]
JAN	3220	141	235792	1.36
FEB	1684	99	165528	1.02
MAR	2420	110	183480	1.31
APR	616	28	46704	1.32
MAY	6532	181	318588	1.05
JUNE	1656	72	120096	1.38
JULY	1556	92	153456	1.01
AUG	3588	166	293568	1.22
SEPT	5197	230	385250	1.35
OCT	5845	206	343608	1.70
NOV	4793	166	276888	1.73
DEC	7074	213	371964	1.90
	44181	1704	2894882	Mean: 1.44

Source: IPTP, 1985 (Bali, Flores, Sawa, Timor, Bonda, Maluku and Sulawesi Seas) from Table 17

1 Vessels of Pt Perikanan Samodra Besar, 1984

2 These hook rates are comparable to those specified by Sibert (1986) for the Western Pacific.

TABLE 8: PRODUCTION OF OTHER PELAGICS IN STUDY AREA (1984)
(tonnes)

	Sulsel	Sultra	Moluku	I. Jaya
Sharks	2,694	96	473	151
Scads	15,646	2,334	4,220	253
Selar spp	6,004	712	5,088	519
Caraux spp	1,951	1,445	1,966	362
Megalaspis cordyla	1,691	165	1,122	11
Elagatis bispinnulatus	1,269	111	172	100
Stole phorus spp.	8,512	215	1,978	24
Sardinella spp.	34,016	9,628	4,947	235
Rastrelligar spp.	12,701	2,209	2,847	503
Scomberomous spp.	3,920	225	1,757	345
Other	1,728	299	195	29
TOTAL	90,132	17,439	24,765	2,532

Source: SPI, 1986

H

THE PROCEDURE AND TYPES OF LICENCES FOR THE MARINE INDUSTRY BUSINESS

To arouse the interest of investors in the marine industry sector, simplification of procedures for obtaining licences has been stimulated.

There are four kinds of licences for the marine industry:

1. Business licences for marine industry enterprises established within the framework of foreign investments (PMA). The legal regulation is Law No. 1 1967 re. Law No. 12, 1970.

   Licences for foreign investments (PMA) and home capital investment (PMDN) are issued by the Foreign Investment Coordinating Board (BKPM) on behalf of the Minister of Agriculture.

   This is based on the Minister of Agriculture's Decree No. 565/Kpts/Org/1977 dated October 13, 1977 regarding the authority to issue business licences in the agriculture sector in connection with capital investment to the Chairman of BKPM.

   These PMA and PMDN enterprises are granted tax reduction benefits by the government. The would-be investor who chooses PMA or PMDN status for his company should direct his letter of applcation for a business licence to BKPM, enclosing a list of investments (Model I/PMA or Model I/PMDN) provided by the BKPM.

   For businesses using motor boats to haul fish, the Application for fishing boat licences (SIKP) should be directed to the Directorate General of Fisheries.

2. Business licences for national private companies having no PMA and PMDN benefits, and in which there are foreign elements (such as capital equipment or staff), should be requested from the Directorate General of Fisheries by enclosing the application required by the Directorate General of Fisheries.

   A company having this status (if it uses fishing boats), will be issued a Fishery/Marine Industry Business Licence (SIUP) and SIKP by the Directorate General of Fisheries according to Law No. 9, 1985, and the Minister of Agriculture's Decree No. 277/Kpts/IK.120/5/1987 dated May 6, 1987.

3. For national private marine industry businesses without PMA/PMDN benefits, aside from the two cases for business licences mentioned above, should apply for a business licence to the Agency Chairman of Marine Industry of the provincial government in which the company will be located.

   The appropriate law in this case is Government Provision No. 64, 1957.

4. The Fish hauling license for foreign boats that will operate in Indonesia's Exclusive Economic Zone, usually called an agency license

business (Usaha Lisensi), is requested from the Directorate General of Fisheries by enclosing the content list required. The company will become an agent in Indonesia and should have a SIUP. The laws covering this license are Regulation No 5, 1983; Government Provision No. 15, 1985; the Minister of Agriculture's Decree No 473-A/Kpts/IK.250/6/1985, No. 476/Kpts/IK.120/7/1985 and No. 477/Kpts/IL/120/7/1985.

To request a license for fishery business, a work plan which covers the following items is needed:

1. Establishment document/certificate.
2. Capital: concerning the structure of PMA, PMDN or a national private business without PMA/PMDN benefits.
3. Business field: concerning hauling, processing, collecting as well as the types of fish to be hauled or processed.
4. Business region: concerning the location of processing.
5. Boat: the country and date of manufacture, the size and type, the hauling equipment used, the method of purchase (rent/buy), the price, etc., should be explained
6. The number of boats to be operated.
7. The anchorage.
8. The number of staff needed (Indonesian/foreign). If foreign staff are needed, the country of origin should be stated.
9. Production capacity and marketing.

Source: *Buletin Warta Mina*, Jakarta.

1.a. TRADE REGULATION - EXPORT OF MARINE PRODUCTS

To export marine products, each fishing company should have an Export Producer Identity Number (*Angka Pengenal Ekspor Produsen*/APE) issued by the Minister of Trade. The issue of an APE is related to the Permanent Business License (*Izin Usaha Tetap*/IUT) issued by the Minister of Agriculture based on Decision (SK Men. Tan) No: 277/'87, article 6.

All Indonesian fishing companies hauling fish in Indonesia and/or in the Exclusive Economic Zone (EEZ), may export products directly from the fishing area to the importer country (Minister of Agriculture, Decision No: 277/'87, article 10).

All fishing boats operating in and departing from fishing areas in Indonesia's EEZ should report to the appointed port official (Minister of Agriculture, Decision No: 277/'87, article 11).

The quality of each marine commodity exported is supervised and should follow the production standard (*Standar Produksi*/SP) established by the Minister of Trade. Quality is supervised through a Quality Statement (*Surat Pernyataan Mutu*/SPM) and a Quality Certificate (*Sertifikat Mutu*/SM), based on the Decision of the Minister of Trade (SK Men. Perdag) No: 872/'85.

For fishery commodities there is a different production standard called the Indonesian Agricultural Standard - Fishery (*Standar Pertanian Indonesia - Perikanan*/SPI-KAN). Therefore all existing production standards are revised based on SPI-KAN in accordance with the Trade Minister's Decision No: 394/'85.

The implementation expenses for sample withdrawal and quality testing are borne by the exporter, according to the Decision of the Director General of Foreign Trade (SK Dir. Jen DAGLU) No: 59/'85.

1.b. TRADE REGULATION -- IMPORT OF MARINE PRODUCTS

Import trade is conducted by companies having an Import Identity Number (*Angka Pengenal Import*/API) or Temporary Import Identity Number (*Angka Pengenal Import Sementara*/APIS), or Limited Import Identity Number (*Angka Pengenal Impor Terbatas*/APIT). The import requirements are stated further in the Decision of the Minister of Trade No: 28/'82.

As long as Indonesian fishing companies are not able to fulfill the needs of domestic fish-processing plants, fishery products taken by foreign persons/legal institutions from the Indonesian EEZ to be processed by Indonesian companies are not affected by these import requirements (Minister of Agriculture, Decision No: 277/'87, article 10).

Specific to fish-flour commodities, all imports are carried out by PT TJIPTA NIAGA (Minister of Trade, Decision No: 165/'83).

For other fishery commodities, there is no import limit.

1.c. TRADE REGULATION - IMPORT OF MARINE INDUSTRY INPUTS

To import of capital commodities (such as: fishing equipment, freezers, ice-making machines, insulation material, canning machinery, fish-meal manufacturing equipment, etc.), the company or the capital investor having a permanent license (*Surat Persetujuan Tetap*/SPT) can request tax exemption/import duty reduction for a Main List of Capital Commodities or Raw Materials as required by the Investment Coordinating Board (*Badan Kordinasi Penanaman Modal*/BKPM).

There is no obligation for businessmen to buy domestic fishing boats. They can buy new or second-hand boats from foreign countries.

Motor boats up to maximum size of 600 GT, and used exclusively to catch fish, will not be granted a reduction in import duty (Head of the Investment Coordinating Board, Decision No: 2/'86).

The import tariff for fishing boats is stated in point 2.c.

1.f. TRADE REGULATION - LICENSES

A Limited Import Identity Number (*Angka Pengenal Impor Terbatas*) is issued by the Investment Coordinating Board on behalf of the Indonesian Minister of Finance. This license is used to import capital commodities or raw materials to be used in production processes for capital investment projects approved by the government (Investment Coordinating Board, Decision No: 10/'85, article 13).

A Limited Export Identity Number (*Angka Pengenal Ekspor Terbatas*) is issued by the Investment Coordinating Board on behalf of the Indonesian Minister of Finance. This license is used to export domestic products of investment projects approved by the government (Investment Coordinating Board, Decision No: 10/'85, article 13).

2.b. TARIFF POLICIES - IMPORT OF MARINE PRODUCTS

Import duties for various fishery commodities are listed in a book, *Daftar Tarif Bea Masuk pada tahun 1985*, publi[illegible]ed by the Ministry of Finance.

2.c. TARIFF POLICIES - IMPORT OF MARINE INDUSTRY INPUTS

The import of capital commodities and raw materials is subject to the import duty published in *Daftar Tarif Bea Masuk pada tahun 1985*. If investors request exemption from or reduction of import duty, they must wait for the import duty approved by the Investment Coordinating Board.

Based on the Decision of the Minister of Finance (SK Menteri Keuangan No: 23/'87), import duty for fishing boats with a seine and other fishing boats, factory boats and other boats used for catching fish weighing 750 DWT or less is 5%, and 10% for value-added tax (*Pajak Pertambahan Nilai*). However, the import duty for other kinds of fishing boats is 10%, and 10% for value-added tax.

3.a. FOREIGN INVESTMENT - EXPORT OF MARINE PRODUCTS

A Limited Export Identity Number is issued by the Investment Coordinating Board on behalf of the Indonesian Minister of Finance. This license is used to export local products of capital investment projects approved by the government (Investment Coordinating Board, Decision No: 10/'85, article 13).

3.b. FOREIGN INVESTMENT - IMPORT OF MARINE PRODUCTS

A Limited Import Identity Number is issued by the Investment Coordinating Board on behalf of the Indonesian Minister of Finance. This license is used to import capital commodities or raw materials needed for production processes of capital investment projects approved by the government (Investment Coordinating Board, Decision No: 10/'85, article 13).

Import trade is conducted by companies that have an Import Identity Number, a temporary Import Identity Number, and a Limited Import Identity Number.

3.c. FOREIGN INVESTMENT - IMPORT OF MARINE INDUSTRY INPUTS

To import capital commodities (such as: fishing equipment, freezers, ice-making machines, insulation material, canning machinery, fish-meal manufacturing equiptment, etc.), capital investors who have a permanent license (*Surat Persetujuan Tetap*/SPT) can request exemption from or reduction of import duty on the main list of capital commodities or raw materials (*Daftar Induk Barang Modal atau Bahan Baku*), as required by the Investment Coordinating Board.

There is no obligation for businessmen to buy domestic boats for catching fish. They can buy new or second-hand boats from foreign countries.

Motor boats used exclusively for catching fish with a maximum size of 600 GT are not granted a reduction in import duty (Head of the Investment Coordinating Board, Decision No: 2/'86).

3.d. FOREIGN INVESTMENT - TAXATION

Since the new tax regulations were issued, there is no longer a tax holiday for businessmen. The tax regulations

Coordinating Board (Decision No: 10/SK/1985, dated April 27, 1985). The Decision contains the following articles:

Article 1.	Request for new and expanded capital investments.
Article 2.	Request for changes in capital investment.
Article 3.	Request for import duty reduction.
Article 4.	Form of request for capital investment.
Article 5.	Requirements for request for capital investment.
Article 6.	Details of request for changes in capital investment.
Article 7.	Submission of request for capital investment.
Article 8.	Approval of the model I request.
Article 9.	Approval of request for changes in capital investment.
Article 10.	Validity of temporary agreement.
Article 11.	Schedule for project completion.
Article 12.	Schedule for implementation of project expansion.
Article 13.	License for implementation of capital investment.
Article 14.	Schedule for completion of request and license.
Article 15.	Completion of approval of model IV of the list of capital commodities and raw materials.

Article 16.	Completion of foreigners' work permits.
Article 17.	Supervision and control methods.
Article 18.	Report methods.
Article 19.	Capital investment in "bonded" areas.
Article 20.	Sanctions.
Article 21.	Other stipulations.
Article 22.	Stipulation of transition.
Article 23.	Stipulation of conclusion.

4.a. FOREIGN EXCHANGE - EXPORT OF MARINE PRODUCTS

Exporters may use or own foreign exchange obtained from commodity export and or services according to their needs. If part or all of the foreign exchange obtained is sold to the Bank of Indonesia, the sale will be made through the Foreign Exchange Bank with the rate stated by the Foreign Exchange Bureau (Government Regulation No: 1/'82).

4.b. FOREIGN INVESTMENT - IMPORT OF MARINE PRODUCTS

When an importer buys part or all of the foreign exchange for the import requirement from the Bank of Indonesia, the purchase will be made through the Foreign Exchange Bank with the rate stated by the Foreign Exchange Bureau (Government Regulation No: 1/'82).

4.c. FOREIGN INVESTMENT - IMPORT OF MARINE INDUSTRY INPUTS

The same as section 4.b. above.

4.e. FOREIGN INVESTMENT - RESTRICTION

Everyone is free to obtain and use foreign exchange (Government Regulation No: 1/'82).

5. TAXATION

The value-added tax on commodities and services (*Pajak Pertambahan Nilai*/PPN) is the tax regulation issued by the government to replace the purchase tax. In accordance with the fishing industry in UURI, it is stated that fishery commodities are not included as commodities for tax assessment. The fishery commodities which are considered as commodities for tax assessment are those fabricated/processed. What is meant by an unprocessed commodity is fish/shrimp taken directly from the sea/fishpond, salted fish and dried fish. While fresh fish, frozen fish, and canned fish are considered to be tax assessment commodities, since they have undergone packing, cooking, and mixing processes. If these commodities are exported, they will not be subject to value-added tax (PPN).

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp. DUTY	GATT	VAT	SALES TAX on	REMARKS
84.10		Pumps (insluding motor pumps and turbo pumps) for liquids, whether or not fitted with measuring devices;					
	100	Pumps for dispensing fuel or lubricants, of the types used in filling stations or garages, fitted or designed to be fitted, with measuring device	(30) 10		10		
	200	Reciprocating pumps	(30) 10	50	10		
	300	Centrifugal pumps	(30) 20	50	10		
	400	Rotary pumps	(30) 20	50	10		
		Other pumps for liquids and liquid elevators:					
	510	Pumps of all kind for internal combustion piston engines	(30) 20		10		
	520	Hand operated pumps	(30) 20		10		
	530	Liquid operators	(30) 20		10		
	540	Other	(30) 20		10		
	900	Parts	(30) 20		10		
		Air pumps, vacuum pumps and air or gas compressors (including motor and turbo pumps and compressors, and free piston generators for gas turbines);					
		Pumps and compressors:					
		Pumps:					
	111	Hand or foot operated pumps	(50) 20		10		
	119	Other	20		10		
	120	Compressors	(30) 20		10		
	200	Parts of pumps or compressors	(50) 20		10		
	300	Free piston generator sfor gas turbines and parts	(20) 20		5		
84.15		thereof					
		Refrigerators and refrigerating equipment (electrical and other):				10	
	200	Other refrigerators and refrigerating equipment	(30) 20		10		
84.17	900	Parts	(40) 20		10		
84.19	920	Heating and cooling plant machinery	(20) 15	50	10		
	230	Packing or wrapping machinery	(40) 10		10		
84.22	290	Other	(40) 10		10		
		Pulley tackle and hoist, other than skip hoist; winches and capstans:					
	110	Marine winches and capstans	(10) 5	30	10		
	190	Other	5		10		
	210	Ship's derricks	(10) 5	30	10		
	220	Gantry and bridge cranes	(10) 5	30	10		
84.30	290	Other	(10) 5	30	10		
	400	Machinery for the preparation of meat or fish	(50) 5	50	10		
		Parts:					
	910	For machinery for the preparation of meat or fish	(50) 20		10		

CHAPTER 45. CORK AND ARTICLES OF CORK.

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
45.03		Articles of natural cork:					
	300	Parts of fishing net	(20) 5		10		

CHAPTER 51. MAN-MADE FIBRES (CONTINOUS).

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
51.01		Yarn of man-made fibres (continous) not put up for retail sale:					
		Of polyamide fibres:					
		Non-textured yarn, untwisted or with a twist on not more than 50 turn per metre:					
	122	For the use in fish..g net manufacturing	(15) 5		10		

CHAPTER 73. IRON AND STEEL AND ARTICLES THEREOF.

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
73.07		Blooms, billets, slabs and sheet bars (icluding tinplate bars), of iron or steel:					
	910	Tinplate bars	(10) 5		10		

CHAPTER 85. ELECTRICAL MACHINERY AND EQUIPMENT; PARTS THEREOF

Heading	SUB HEADING	DESCRIPTION OF GOODS	Imp.DUTY	GATT	VAT	SALES TAX on	REMARKS
85.01		Motors and generators:					
		D.C. motors and generator:					
	111	In completely knocked down conditions	(30) 5		10		
	119	Others	30		10		
		Other motors icluding universal (AC/DC):					
	121	In completely knocked down conditions	(30) 5		10		
	129	Others	30		10		
		A.C. generators					
	131	In completely knocked down conditions	(40) 5		10		
	139	Others	30		10		
		Generating sets with internal combustion piston engines:					
	200	Generating sets, consisting of a generator and its prime mover, mounted (or designed to be mounted) together as aunit or on a common base	(40) 30		10		
85.08	400	Starter motors and generators (dynamo and alternators)	(20) 10		10		

I

ECUADOR - FROZEN HEADLESS SHELL-ON WHITE SHRIMP

Count:	U-15	16-20	21-25	26-30	31-35	36-40	41-50	51-60	61-70
1978									
Jan.	4.77	4.25	3.70	3.30	3.00	2.47	2.27	2.00	1.77
Feb.	4.75	4.20	3.65	3.30	2.90	2.45	2.25	2.00	1.80
March	4.75	4.20	3.60	3.25	2.90	2.45	2.20	2.00	1.85
April	4.85	4.30	3.65	3.35	3.00	2.55	2.35	2.15	1.90
May	5.00	4.30	3.70	3.40	3.05	2.60	2.35	2.15	1.90
June	5.05	4.35	3.75	3.40	3.05	2.70	2.45	2.20	1.95
July	5.15	4.50	3.85	3.47	3.10	2.82	2.47	2.15	1.87
Aug.	5.35	4.62	4.05	3.55	3.10	2.95	2.55	2.20	1.95
Sept.	6.05	5.05	4.60	4.00	3.65	3.50	3.00	2.55	2.15
Oct.	6.30	5.35	4.75	4.15	3.75	3.55	3.10	2.60	2.20
Nov.	6.60	5.55	4.85	4.30	3.85	3.65	3.25	2.80	2.35
Dec.	-	5.70	5.05	4.35	4.00	3.75	3.37	2.95	2.40
1979									
Jan.	7.00	5.90	5.05	4.55	4.10	3.95	3.50	3.10	-
Feb.	7.12	6.00	5.15	4.65	4.30	4.10	3.65	3.20	-
March	7.20	6.05	5.20	4.80	4.55	4.35	3.80	3.35	-
April	7.15	6.20	5.25	5.10	4.77	4.47	4.00	3.45	3.10
May	7.10	6.60	5.65	5.40	5.05	4.85	4.15	3.60	-
June	7.20	7.15	6.10	5.65	5.25	5.00	-	3.65	3.30
July	7.05	7.00	6.35	5.85	5.25	4.95	3.80	3.20	2.90
Aug.	6.40	6.40	6.35	5.80	5.25	4.55	3.70	3.10	2.80
Sept.	6.75	6.65	6.60	5.90	5.25	4.50	3.80	3.15	2.90
Oct.	6.75	6.70	6.65	5.90	5.30	4.65	3.80	3.25	2.90
Nov.	6.55	6.50	6.40	5.70	5.25	4.65	3.90	3.20	3.00
Dec.	6.40	6.30	6.20	5.60	5.15	4.40	3.90	3.25	3.00
1980									
Jan.	6.15	5.90	5.80	5.45	5.00	4.30	3.80	3.20	2.95
Feb.	-	-	-	5.45	4.85	4.15	3.90	3.25	2.95
March	-	-	-	5.15	4.70	4.00	3.80	3.20	2.90
April	5.55	5.10	4.85	4.65	4.45	3.80	3.40	3.10	-
May	5.10	4.80	4.50	4.20	3.90	3.50	3.25	2.95	2.75
June	5.35	5.00	4.80	4.40	3.90	3.60	3.45	3.00	2.75
July	5.30	5.10	5.05	4.50	3.90	3.70	3.45	3.00	2.75
Aug.	5.40	5.20	5.15	4.55	3.90	3.72	3.40	3.00	2.80
Sept.	5.65	5.45	5.35	4.70	3.95	3.75	3.40	3.10	2.80
Oct.	5.40	5.05	4.90	4.40	3.65	3.45	3.25	3.00	2.80
Nov.	5.35	5.20	4.95	4.40	3.70	3.50	3.30	3.00	2.80
Dec.	5.40	5.05	4.95	4.35	3.70	3.50	3.25	2.95	2.80

Selling prices ex-warehouse New York, as reported by original receivers in the Metropolitan area, in US dollars per lb., the first price reported each month.

Source: Fishery Market News Reports, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, New York; generally referred to as the Green Sheet.

ECUADOR - FROZEN HEADLESS SHELL-ON WHITE SHRIMP

Count:	U-15	16-20	21-25	26-30	31-35	36-40	41-50	51-60	61-70
1981									
Jan.	5.60	5.35	5.10	4.35	3.60	3.45	3.30	3.02	2.82
Feb.	5.75	5.50	5.25	4.50	3.65	3.45	3.35	3.10	2.85
March	5.95	5.75	5.45	4.75	3.80	3.60	3.45	3.25	3.05
April	6.15	6.05	5.80	4.85	3.90	3.75	3.50	3.30	3.15
May	6.30	6.20	5.80	4.80	3.90	3.70	3.45	3.25	3.10
June	6.35	6.30	5.85	4.75	3.80	3.70	3.40	3.20	3.05
July	6.35	6.30	5.80	4.70	3.75	3.55	3.30	3.10	2.90
Aug.	6.30	6.10	5.10	3.95	3.35	3.05	2.75	2.65	2.50
Sept.	6.40	6.35	5.10	4.10	3.45	3.15	2.90	2.80	2.60
Oct.	6.70	6.50	5.45	4.30	3.75	3.30	3.00	2.80	2.65
Nov.	7.00	6.50	5.45	4.35	3.90	3.30	3.05	2.85	2.65
Dec.	7.15	6.60	5.50	4.45	4.00	3.50	3.15	2.90	2.70
1982									
Jan.	7.15	6.30	5.50	4.50	4.15	3.70	3.35	3.05	2.70
Feb.	7.40	6.65	6.00	5.25	5.10	4.35	3.90	3.50	3.00
March	7.30	6.90	6.30	5.70	5.50	4.90	4.35	3.90	3.25
April	6.70	6.70	6.25	5.90	5.65	5.15	4.65	4.10	3.20
May	6.75	6.70	6.35	6.10	5.90	5.47	4.80	4.15	3.25
June	6.75	6.70	6.47	6.27	6.05	5.57	4.90	4.20	3.25
July	6.60	6.60	6.35	5.95	-	5.00	-	-	2.85
Aug.	6.90	6.80	6.45	6.05	5.00	4.45	3.80	-	2.85
Sept.	7.20	7.15	6.85	6.45	5.55	-	-	3.85	3.30
Oct.	7.30	7.25	6.95	6.55	-	4.95	-	4.00	-
Nov.	7.40	7.25	7.00	6.50	5.50	5.00	4.50	4.10	3.75
Dec.	7.65	7.45	-	6.75	5.80	5.35	4.80	4.25	3.95
1983									
Jan.	7.65	7.40	7.15	6.60	5.80	5.35	4.80	-	4.00
Feb.	7.70	7.40	7.15	6.45	5.67	5.35	4.80	4.35	4.00
March	7.65	7.35	7.05	6.20	5.60	5.30	4.75	4.35	-
April	7.50	7.15	6.80	5.85	5.45	5.17	4.65	4.15	3.87
May	7.40	7.10	6.75	5.70	5.40	5.10	4.70	3.90	3.65
June	7.60	7.40	7.10	6.00	5.50	5.35	4.85	3.85	-
July	7.60	7.55	7.35	6.05	5.55	5.27	4.85		-
Aug.	7.50	7.40	7.20	5.80	5.40	5.05	-	3.45	3.10
Sept.	7.50	7.35	7.10	5.75	5.45	5.15	4.65	3.60	3.25
Oct.	7.45	7.30	6.85	5.65	5.35	5.10	4.50	3.70	3.25
Nov.	7.50	7.30	6.80	5.60	5.30	5.00	4.45	3.75	3.20
Dec.	7.70	7.35	6.70	5.55	5.20	4.75	4.30	3.75	3.20

Selling prices ex-warehouse New York, as reported by original receivers in the Metropolitan area, in US dollars per lb., the first price reported each month.

Source: Fishery Market News Reports, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, New York; generally referred to as the Green Sheet.

ECUADOR - FROZEN HEADLESS SHELL-ON WHITE SHRIMP

Count:	U-15	16-20	21-25	26-30	31-35	36-40	41-50	51-60	61-70
1984									
Jan.	7.95	7.30	6.50	5.35	5.00	4.45	3.95	3.75	3.15
Feb.	7.90	7.20	6.35	5.35	4.85	4.20	3.90	3.70	3.05
March	8.00	7.30	6.40	5.45	4.95	4.20	3.90	3.70	3.10
April	8.30	7.70	6.65	5.60	5.10	4.30	4.05	3.85	3.25
May	8.50	7.75	6.35	5.35	5.10	4.20	3.90	3.75	3.25
June	8.60	7.70	6.25	5.30	5.05	4.20	3.85	3.70	3.15
July	8.70	7.75	6.30	5.30	5.05	4.15	3.75	3.70	3.05
Aug.	8.75	7.70	6.25	5.25	4.70	3.95	-	3.45	3.00
Sept.	8.70	7.60	6.15	5.10	4.60	3.90	-	3.35	3.05
Oct.	8.70	7.50	6.15	5.15	4.50	3.85	3.50	3.30	3.05
Nov.	8.75	7.35	6.25	5.30	4.35	3.80	3.55	3.35	3.05
Dec.	8.70	7.30	6.20	5.30	3.95	3.70	3.50	3.30	3.05
1985									
Jan.	8.50	7.10	6.05	5.15	3.75	3.60	3.40	3.30	3.05
Feb.	8.35	7.05	6.00	5.10	3.65	3.55	3.40	3.25	3.05
March	8.00	6.75	5.65	4.75	3.50	3.45	3.35	3.15	2.95
April	7.65	6.40	5.25	4.55	3.65	3.60	3.40	3.20	3.00
May	7.50	6.20	5.05	4.50	3.85	3.70	3.60	3.15	3.05
June	7.60	6.20	5.05	4.50	4.05	3.85	3.65	3.20	3.00
July	7.60	6.25	5.10	4.55	4.15	3.90	3.70	3.15	2.95
Aug.	7.65	6.25	5.15	4.70	4.25	4.10	3.80	3.25	2.90
Sept.	7.75	6.50	5.45	5.00	4.50	4.35	4.00	3.30	3.00
Oct.	7.75	6.50	5.50	5.05	4.55	4.30	3.95	3.35	3.00
Nov.	7.55	6.30	5.50	4.95	4.55	4.30	3.85	3.30	2.95
Dec.	7.15	6.30	5.55	5.05	4.65	4.25	3.85	3.30	3.00
1986									
Jan.	7.15	6.30	5.60	5.10	4.75	4.30	3.85	3.25	2.95
Feb.	7.05	6.65	6.25	5.65	5.20	4.60	4.10	3.45	3.05
March	7.05	6.65	6.40	5.85	5.40	4.70	4.10	3.55	3.05
April	7.10	6.65	6.45	5.80	5.40	4.70	4.15	3.55	3.05
May	-	6.70	6.60	5.85	5.45	4.85	4.30	3.65	3.10
June	7.50	7.45	7.40	6.50	5.95	5.45	4.90	3.90	3.15
July	7.50	7.50	7.35	6.35	5.70	5.35	4.80	3.85	3.05
Aug.	7.55	7.50	7.30	6.15	5.20	5.00	4.60	3.70	2.95
Sept.	7.80	7.75	7.50	6.20	5.20	4.95	4.55	3.80	3.05
Oct.	7.70	7.35	6.80	5.80	4.75	4.50	4.30	3.70	3.05
Nov.	7.80	7.20	6.55	5.65	4.65	4.45	4.30	3.80	3.15
Dec.	8.00	7.35	6.65	5.75	4.80	4.50	4.40	3.90	3.20

Selling prices ex-warehouse New York, as reported by original receivers in the Metropolitan area, in US dollars per lb., the first price reported each month.

Source: Fishery Market News Reports, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, New York; generally referred to as the Green Sheet.

ECUADOR - FROZEN HEADLESS SHELL-ON WHITE SHRIMP

Count:	U-15	16-20	21-25	26-30	31-35	36-40	41-50	51-60	61-70
1987									
Jan.	-	7.35	6.50	5.65	4.70	4.40	4.40	3.90	3.25
Feb.	8.15	7.40	6.30	5.50	4.50	4.15	4.10	3.80	3.25
March	8.30	7.50	6.20	5.35	4.35	4.05	3.95	3.80	3.25
April	-	7.90	6.30	5.30	4.35	4.10	.3.95	3.85	3.30
May									
June									
July									
Aug.									
Sept.									
Oct.									
Nov.									
Dec.									
1988									
Jan.									
Feb.									
March									
April									
May									
June									
July									
Aug.									
Sept.									
Oct.									
Nov.									
Dec.									
1989									
Jan.									
Feb.									
March									
April									
May									
June									
July									
Aug.									
Sept.									
Oct.									
Nov.									
Dec.									

Selling prices ex-warehouse New York, as reported by original receivers in the Metropolitan area, in US dollars per lb., the first price reported each month.

Source: Fishery Market News Reports, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, US Department of Commerce, New York; generally referred to as the Green Sheet.

holesale prices in Japan market, in Yen per 4lbs blocks.

1984 June	July	Aug	Sept	Oct	Nov	Dec
5800-5900	5900-6000	6000-6100	6000-6100	6200	6300-6400	6400
5600-5700	5700-5800	5800-5900	5800-5900	5200	5300-6400	6300
5300-5400	5500-5600	5500-5600	5500-5600	5500-5600	5500-5600	5500
5200-5300	5200-5300	5200-5300	5200-5300	5200-5300	5200-5300	5000-5100
4000	3800-3900	3900-4000	4700-4800	4700-4800	4700-4800	4500-4600
3100-3200	3100-3200	3200-3300	3700-3800	3700-3800	3700-3800	3500-3600
-	-	-	3000	3000	3000	2800-2900

1985 June	July	Aug	Sept	Oct	Nov	Dec
6900-7000	7000-7200	7000			6000-6700	6500
6900-7000	6900-7000	6900			6300-6400	5700-5900
6400-6500	6600-6800	6400-6500	No	No	5300-5400	4600-4800
5600-5800	5900-6100	5400-5600	quotes	quotes	4300-4400	3800
4900-5000	5200-5400	4700-4900			4000-4100	3300-3500
3900-4000	4200-4300	3700-3900			3500-3600	3000-3100
2900-3000	3100-3200	3000-3100			3000	2600-2700
-	-	-			-	-

1986 June	July	Aug	Sept	Oct	Nov	Dec
5400-5500	4800-5000	4700-4800	5000-5200	5000-5200	5400-5500	5400-5500
5200-5300	4500-4600	4200-4300	4600-4700	4500-4600	4600-4700	4700
4000-4200	3600-3700	3300-3400	4200-4300	4100-4200	4400	4400-4500
4000-4100	3600	3200-3300	3400-3500	3400-3500	3600-3700	3600-3700
3400-3500	3300-3400	3100-3200	3000-3100	3100-3200	3300-3400	3300-3400
3100-3200	3000-3100	2800-2900	2700-2800	2800-2900	2900-3000	2900-3000
2800-3000	2800-3000	-	-	-	2800	2700-2800
-	-	-	-	-	-	-

J

APPENDIX : WORLD TUNA CATCH BY PRINCIPAL COUNTRIES (1970-1984)
(000's mt)

	1970	1975	1980	1981	1982	1983	1984
Japan	502	542	723	642	674	696	788
USA	214	259	226	222	199	266	263
Spain	47	77	101	122	131	126	132
Indonesia	21	39	73	84	90	103	115
Philippines	52	84	79	95	103	119	104
France	50	58	72	69	69	84	100
Taiwan	89	90	106	90	104	104	99
Mexico	11	23	34	68	45	38	78
Korea	n/a	119	110	105	108	89	71
Venezula	2	1	4	6	4	39	53
Solomon Is.	0	7	23	26	20	34	36

Source: Infofish

K

PERUSAHAAN EKSPEDISI MUATAN KAPAL LAUT
P.T. EMKL.

LOKON RAYA VEEM

Jalan Sulawesi No. 126 – Ujung Pandang – SULSEL
Telp. 7605 – 28529 – Alamat kawat : LOKONVEEM

Pro : Mr. PETER MARRIOT
Room 407 Marannu City Hotel

PERINCIAN BIAYA TRANSPORT.

Jenis barang : I K A N.

Pembungkus : Boxes / Fibreglass

Pemuatan ketruck dan pembongkaran dari truck oleh tenaga manusia.

---

1. Palopo	– Pare-2	Rp. 3[illegible].050,oo /M3-ton	[illegible]37 km.
2. B o n e	– Pare-2	Rp. [illegible]1.450,oo /M3-ton	1[illegible] km.
3. Sinjai	– Pare2	Rp. 30.200,oo /M3-ton	[illegible] km.
4. Bulukumba	– Pare2	Rp. 35.230,oo /M3-ton	[illegible]7[illegible] km.
5. Jeneponto	– Pare-2	Rp. 31.050,oo /M3-ton	[illegible]45 km.
6. U.Pandang	– Pare-Pare	Rp. 19.650,oo /M3-ton	155 km.
7. Mamuju	– Pare-Pare	Rp. 36.[illegible],oo/ M3-ton	[illegible] km.
8. Majene	– Pare-Pare	Rp. 18.625,oo /M3-ton	147 km.

Kapasitas truck : 8.000 kg / 10,8 M3 (2 x 4 x 1,35 M)

Ujung Pandang, 01 Juli 1987.

H. Andries
Manager.

A-k

L

APPENDIX

CONSTRUCTION COST ESTIMATION

FOR CANNING FACTORY BUILDING

No.	Items	Volume	Unit	Unit Price (Rp)	Cost (Rp)
I.	PRELIMINARY WORK	Lumpsum	-	-	2,500,000.
II.	SAND & SOIL WORKS				
1.	Soil excavation	556	m3	2,200.	1,223,200.
2.	Soil fill	1,708	m3	4,500.	7,686,000.
3.	Sand fill	850	m3	4,825.	4,101,250.
					13,010,450.
III.	STONE WORK				
1.	Foundation with 1 cement: 4 sand mortal	305	m3	49,000.	14,945,000.
IV.	CONCRETE WORKS				
1.	R.C. Sub structures	215	m3	285,000.	61,275,000.
2.	R.C. machine foundation	40	m3	285,000.	11,400,000.
3.	R.C. floor tile incl. galley and ramps	410	m3	250,000.	102,500,000.
4.	Hollow brick wall	220	m3	62,500.	13,750,000.
5.	Gutter	232	m'	10,000.	2,320,000.
					191,245,000.
V.	METAL WORKS				
1.	Columns,Bars, etc.	135,000	Kg	2,500.	337,500,000.
2.	Roof tile	3,200	m2	13,500.	43,200,000.
3.	Aluminium window and ventilation frame	790	m'	14,000.	11,060,000.
4.	Rolling doors	140	m2	60,000.	8,400,000.
5.	Swing doors incl. hinges and frame	14	units	150,000.	1,800,000.
6.	Locks	Lumpsum	-	-	2,000,000.
7.	Roof gutter incl.its supporting frame structure	140	m'	14,500.	2,030,000.
8.	Aluminium/glass louvres	198	m2	12,500.	2,475,000.
9.	Window glass	158	m2	16,000.	2,528,000.
					410,993,000.

VI.	PLUMBING, SANITARY MECHANICAL				
1.	PVC, rain water pipe D-5"	24	units	125,000.	3,000,000.
2.	Plumbing	Lumpsum	-	-	32,000,000.
3.	Lavatory (urine, wash basin, wc, ceramic floor and wall tile)	Lumpsum	-	-	22,000,000.
4.	Steam and Compressed Air Piping	Lumpsum	-	-	40,000,000.
					97,000,000.
VII.	ELECTRICAL & LIGHTNING CONDUCTOR				
1.	Electrical wiring/ installation incl- swtichs & plugs	80	points	18,000.	1,440,000.
2.	Cable rack	260	m'	15,000.	3,900,000.
3.	Various lamp armatures (fluorescent lamps)	60	points	40,000.	2,400,000.
4.	Lightning conductor	Lumpsum	-	-	2,500,000.
5.	Equipment Control Wiring	Lumpsum	-	-	14,000,000.
					24,240,000.
VIII.	PAINTING				
1.	Wall painting	2,950	m2	2,000.	5,900,000.
2.	Steel painting	Lumpsum	-	-	2,500,000.
					8,400,000.
IX.	FINISHING				
1.	Clearing the site	Lumpsum	-	-	1,000,000.

Insulated Panels	280,440,000
Sub Total	$1,043,773,450
Contingency 10%	104,377,345
Total (Non foreign content)	Rp's 1,148,150,795
(converted to US dollars at Rp's 1,640)	$ US 700,100

CANNING FACTORY EQUIPMENT COSTS

1.	Thawing Containers (20)	U.S.$	5,400.00
2.	Band Saw (2)		27,000.00
3.	Brining Containers (5)		1,300.00
4.	Conveyor 7 M		3,900.00
5.	Conveyor 5 M		2,700.00
6.	Tuna Cook Baskets (280)		2,500.00
7.	Pre-Cooker		35,000.00
8.	Basket Washer		5,000.00
9.	Conveyor for Tuna Basket (2)		16,200.00
10.	Cleaning Table (2)		8,000.00
11.	Roller Conveyor (2)		1,600.00
12.	Scale (2)		12,000.00
13.	Packing Table (2)		18,000.00
14.	Hydraulic Press (2)		27,000.00
15.	Empty Can Feeder (2)		4,000.00
16.	Automatic Filling Machine (2)		160,000.00
17.	Inspection Conveyor (2)		2,100.00
18.	Exhausting Box (2)		24,000.00
19.	Automatic Can seamer (2)		60,000.00
20.	Conveyor 0.5 ml (2)		600.00
21.	Can Washer (2)		6,000.00
22.	Conveyor 6 M		3,500.00
23.	Retort Crates (20)		12,000.00
24.	Retorts (3)		114,000.00
25.	Washer/Dryer		24,300.00
26.	Conveyor 3 M		1,600.00
27.	Labelling M/C		20,000.00
28.	Cartoning M/C		25,000.00
29.	Palletizing Equipment		5,000.00
30.	Bulk Elevator		18,000.00
31.	Gutting Machine		27,000.00
32.	Offal Chute		2,000.00
33.	Conveyor 5 M		2,700.00
36.	Refrigeration equipment		260,000.00
37.	Ice Making 10 tonnes/day (2)		110,000.00
38.	Pallets (400)		10,800.00
39.	Compressed Air Plant (2500 l/hr)		4,500.00
40.	Water Pumps (4)		12,000.00
41.	Fork Lift Trucks (2)		50,000.00
42.	Laboratory Equipment		30,000.00

43.	Tuna Rack (20)	20,000.00
44.	Battery Charging Units (2 sets of batteries - 1 charging Unit)	5,000.00
45.	Trucks (2)	50,000.00
	SUB-TOTAL	$1,229,700.00
	Shipping and Contingency @ 20%	245,900.00
	TOTAL	U.S. $1,475,600.00
	Estimated Foreign (Non-Indonesian) Content	U.S. $ 750,000.00
	Indonesian Content	U.S. $ 725,600.00 *

* Fish Meal Plant contains boilers with sufficient capacity to supply necessary steam to cannery. Add U.S. $60,000 to Equipment costs for Cannery, if meal plant is not constructed.

OPERATING COSTS

TUNA CANNING FACTORY

ASSUMPTIONS

Plant capacity - 20t/8hr. of raw material
Capital cost - US $2,143,900
Insurance - 2% of capital cost/yr
Maintenance and repairs - 3% of capital cost/yr
Water consumption 10,000 l/hr
Electrical power consumption 400 kwh/hr
Days of production - 220 days/yr
Employees - total 108 - 24 skilled/administrative
- 35 semi skilled
- 49 unskilled

Cost of Cans Rp. 110/6.5oz. cans (Rp.6,560,000/day)
Product yield 55% of round weight
Unit cost assumptions - same as for fish meal plant

Operating Costs

Electrical Power Costs 400x8xRp100x220 =	Rp70,400,000
Water Costs 10,000 l x 8hr x 100 ÷ 1000 x 220 =	1,760,000
Insurance 0.02 x 2,143,900 x 1640 =	70,360,000
Maintenance and repair 0.03 x 2,143,900 x 1640 =	105,480,000

INSULATED FISH BOXES

RECOMMENDED SIZES FOR INDONESIA

A. 500 lb. (227 kg) holding capacity (fish and ice or ice)

B. 1500 lb. (680 kg) holding capacity (fish and ice or ice)

ITEM A: Has an empty weight of 26 kg and can be easily handled by one man.

ITEM A: Can nest inside ITEM B for shipping purposes.

Landed Cost for one shipping unit of ITEM A plus ITEM B in Indonesia is $975 (US$720)

The above prices are quotations valid through July 1987 for MODELS X-309 and X-327 as manufactured by XACTICS LTD., ST. JOHN, NEW BRUNSWICK, CANADA (See attached technical literature).

Shipping Costs are estimated based on a rate of US$200/M3 from Factory to Ujung Pandang port.

WOODEN BOAT

POSSIBLE TUNA COLLECTOR VESSEL

(MADE IN INDONESIA)

-	Length (LOA)		20 M
-	Breadth		4.3 M
-	Depth		1.35 M
-	Hold Capacity		20 Tonnes
-	Main Drive		75 HP, 3 Cyl, 1200 RPM KUBOTA
-	Cost to Build (June, 1987)	Rp.	75,000,000.
-	Useful Life		5 Years
-	Diesel Fuel Cost	Rp. 225/l.	
-	Lubricating Oil Cost	Rp. 1800/l.	
-	Days at Sea	220	
-	Crew Size	5	

- Fuel Consumption 15 l/HR. or 180 l/12 HR. day at sea
- Oil Consumption 1 l/day.
- Food for crew Rp. 18,000/day

ANNUAL OPERATING COST:

-	Fuel	180 x 220 x 225 =	Rp.	8,910,000.
-	Oil	1 x 220 x 1800 =	Rp.	396,000.
-	Food	18,000 x 220 =	Rp.	3,960,000.
-	Salaries			3,750,000.
-	Repairs/Maintenance:			4,000,000.
	TOTAL:		Rp.	21,016,000.

ESTIMATED CONSTRUCTION COSTS

30 TONNES/24 HR FISH MEAL PLANT

(For Detailed Cost Breakdown, see Appendix)

I.	PRELIMINARY WORKS	Rp.	1,000,000.
II.	SAND & SOIL WORKS	"	2,087,600.
III.	STONE WORK	"	6,664,000.
IV.	CONCRETE WORKS	"	47,730,000.
V.	METAL WORKS	"	85,493,000.
VI.	PLUMBING, SANITARY & MECHANICAL	"	50,420,000.
VII.	ELECTRICAL & LIGHTNING CONDUCTOR	"	30,100,000.
VIII.	PAINTING	"	4,880,000.
IX.	FINISHING	"	300,000.
	SUB-TOTAL	Rp.	228,674,600.
	CONTINGENCY @ 5%		11,433,700.
		Rp.	240,108,300.

(US $146,400 @ 1640:1) NO FOREIGN CONTENT

TOTAL COST EQUIPMENT AND CONSTRUCTION (U.S $)

	Indonesian	Foreign	Total
Equipment	707,000.	682,000.	817,000.
Construction	146,400.	-	146,400.
TOTAL	$256,400.	$682,000.	$963,400.

ESTIMATED COST - FISH MEAL PLANT EQUIPMENT

	Foreign Costs	Local Cost	Total
Meal Plant Package	297,000.	-	297,000.
Hasher	33,600.	-	33,600.
Grinder/Bagger	31,400.	-	31,400.
Oil Separator	100,000.	-	100,000.
Evaporator	150,000.	-	150,000.
Boilers (2) including Ancilliaries	50,000.	20,000.	70,000.
Conveyors, Pumps, Lift Truck, Installations	20,000.	90,000.	110,000.
Sub-Totals:	682,000.	110,000.	792,000.
Shipping Costs:	25,000.	-	25,000.
TOTAL:	$707,000.	$110,000.	US $817,000.

OPERATING COSTS

FISH MEAL PLANT

ASSUMPTIONS

Water consumption - 400 l/tonne
Electrical power cost Rp 100/kwh
Employees - 2 skilled (Rp 2 x 5000 = 10,000/day)
4 semi skilled (Rp 4 x 300. = 12,000/day)
8 unskilled (Rp 8 x 2000 = 16,000/day)

Electrical power consumption - 33 kwh/+
Potable water Costs - Rp 100/1000 l
Insurance - 2% of Capital Costs/yr
Maintenance and Repairs 3% of Capital cost/yr
Fuel Oil Consumption - 74 l/tonne (for fish meal plant)
- 875 l/tonne (for canning factory)
Fuel Oil - Rp 225/l
Raw material input - 17 tonnes/day
Fish meal production - 3.4 tonnes/day
Fish oil production - 0.8 tonnes/day
Days of production - 220 day/yr

OPERATING COSTS

Fuel costs -	74 x 17 x Rp225 x 220 =	Rp. 62,271,000
Electrical costs -	33 x 17 x Rp100 x 220 =	Rp 12,342,000
Water costs -	400 x 17 x Rp100 ÷ 1000x220 =	150,000
Labour costs -	(10,000+12,000+16,000)x 220 =	8,360,000
Maintenance and repairs	0.03xUS963,400x1640 =	47,400,000
Insurance	0.02 x 963,400 x 1640 =	31,600,000
TOTAL		Rp.162,123,000

(US $98,855 @ 1640:1)

ICE FACILITY AND FISH LANDING SITE

S U M M A R Y

ESTIMATED CONSTRUCTION COST

(For Detailed Cost Breakdown, See Appendix)

I	PRELIMINARY WORK	Rp.	500,000.
II	SAND AND SOIL WORKS	Rp.	679,475.
III	STONE WORKS	Rp.	2,940,000.
IV	CONCRETE WORKS	Rp.	15,375,000.
V	METAL WORKS	Rp.	27,733,000.
VI	PLUMBING, SANITARY	Rp.	500,000.
VII	ELECTRICAL	Rp.	22,000,000.
VIII	PAINTING	Rp.	1,500,000.
IX	INSULATED PANELS	Rp.	49,000,000.
	SUB-TOTAL	Rp.	120,227,475.
	CONTINGENCY @ 5%		6,011,355.
	TOTAL	Rp.	126,238,830.
			(US $ 76,975. @ 1640:1)

NO FOREIGN CONTENT

ESTIMATED EQUIPMENT COSTS (U.S.$)

Ice Machine	-	55,000.	55,000.
Workshop Tools	6,500.	1,000.	7,500.
Fuel/Water Pumps/Winches	3,000.	1,000.	4,000.
Diesel Generator	8,000.	22,000.	30,000.
Spare Parts	2,000.	4,000.	6,000.
	19,500.	83,000.	102,500.

TOTAL ESTIMATED COSTS

Construction	76,975.	-	76,975.
Equipment	19,500.	83,000.	102,500.
TOTAL	$96,475.	$83,000.	$179,475.

B. JETTY (5m X 60 m)

I. Wooden Jetty: 5 x 60 x Rp. 90,000.	=Rp.	27,000,000.
II. Utilities		
(lighting, poles, etc.): (approx)	=Rp.	5,000,000.
Total of jetty cost	=Rp.	32,000,000.

C. BOAT RAMP (10 m x 20 m)

Wooden boat ramp: 10x20xRp.30,000.	=Rp.	6,000,000.

D. WORK SHOP

I. Mechanical work shop		
36m2 x Rp. 250,000.	=Rp.	9,000,000.
II. Wood working shop		
36m2 x Rp. 250,000.	=Rp.	9,000,000.
III. Fishermen's Lockers		
12 units x Rp. 200,000.	=Rp.	2,400,000.
Total of Work Shop Cost	=Rp.	20,400,000.

E. WORKSHOPS EQUIPMENT AND TOOLS

	=Rp.	12,000,000.

OPERATING COST

ICE DISPENSING DEPOT

ASSUMPTIONS:

Capital Cost - US $85,000 (ice machine and ice storage only)
ice making capacity - 10 t/24hr
Power consumption - 22 kwh/hr
Employees - 5 (1 Administrative, 1 Chief Mechanic, 3 Shift Operators) (These employees are only required part-time and would share responsibilities with other fish landing site tasks)
Operating Period - 280 days/yr 20 hrs/day
Repair and maintenance - 3% of capital cost
Insurance - 2% of capital cost

Unit cost assumptions - same as for fish meal plant

Operating Costs

Power costs - 22x20 hr x Rp 100x280 =	Rp 12,320,000
Labour - 280 (5000+5000+3x3000)=	Rp 5,320,000
Regional Maintenance - $85,000x.03x1640=	Rp 4,182,000
Insurance - $85,000x.02x1640 =	Rp 2,788,000
TOTAL	Rp 24,610,000

(US $15,000 @ 1640:1)

APPENDIX

COST ESTIMATE

FOR ICE MAKING PLANT BUILDING, JETTY, BOAT RAMP

A. ICE MAKING PLANT

No.	ITEMS	Volume	Unit	Unit Price (Rp)	Cost (Rp)
I.	PRELIMINARY WORK	Lumpsum	-	-	500,000.
II.	SAND & SOIL WORKS				
1.	Soil Excavation	55	m3	2,200.	121,000.
2.	Soil fill	78	m3	4,500.	351,000.
3.	Sand fill	43	m3	4,825.	207,475.
					679,475.
III.	STONE WORK				
1.	Foundation with 1 cement: 4 sand mortal	60	m3	49,000.	2,940,000.
IV.	CONCRETE WORKS				
1.	R.C. Sub structures	15	m3	285,000.	4,275,000.
2.	R.C. Floor tile	32	m3	250,000.	8,000,000.
3.	Hollow brick wall	40	m3	62,500.	2,500,000.
4.	Gutter	60	m'	10,000.	600,000.
					15,375,000.
V.	METAL WORKS				
1.	Columns, Bars,etc	9,200.	Kg	2,500.	18,000,000.
2.	Roof tile	224	m2	13,500.	3,024,000.
3.	Aluminium window and ventilation frame	280	m'	14,000.	3,920,000.
4.	Rolling doors	21	m2	60,000.	1,260,000.
5.	Swing doors incl. hinges & frame	2	unit	150,000.	300,000.
6.	Locks	Lumpsum	-	-	200,000.
7.	Roof gutter incl. its supporting structure	28	m'	14,500.	406,000.
8.	Aluminium louvres	14	m2	12,500.	175,000.
9.	Window glass	28	m2	16,000.	448,000.
					27,733,000.
VI.	PLUMBING,SANITARY	Lumpsum	-	-	500,000.

VII. **ELECTRICAL** Incl: wiring, cable rack lamps & Armatures, power and control wiring	Lumpsum	-	-	22,000,000.
VIII **PAINTING** Incl: wall paint, steel paint	Lumpsum	-	-	1,500,000.

M

REPORT TO JAMES F. HICKLING

EFFECT OF REDUCING THE SIZE (CAPACITY) OF

FISHMEAL PLANT

MARINE RESOURCE STUDY - EASTERN INDONESIA

FEBRUARY 1988

INTRODUCTION

JFH requested, in January 1988, a review of the size of the proposed fishmeal plant, in an attempt to reduce its capital cost. The preliminary design and cost estimates were based on a Stord-Bartz (Norwegian) package plant. Included with the package plant were:

- oil separating unit
- evaporator package
- milling and bagging package
- hasher

PLANT CAPACITY

As discussed in the previous report to JFH (August 1987) the amount of raw material (fish waste) generated is as follows:

- 6 to 7 tonnes of offal per day from tuna cannery
- 2 tonnes reject fish per day
- 3 tonnes per day shark carcasses and non-marketable fish waste (from other operations)

Allowing for equipment clean up, maintenance and start-up time, the effective operating period is reduced to 3 hours per 24 hour day (average).

The cost estimates were based on a Stord-Bartz model T3WH pant with a nominal capacity of 30-35 tonnes per day or 1.25 - 1.5 tonnes per hour. This would provide an actual production (of raw material feed) of 16 to 20 tonnes per day.

Reducing the plant size to a nominal rating of 20 tonnes per day, the actual capacity would be 11 tonnes per day. This capacity would be adequate for the cannery wastes plus the reject fish and most of the anticipated fish or fish waste (from off site). The smaller plant would not allow for any future expansion.

Stord-Bartz model T2W package plant has a nominal size of 20 tonnes per day. This plant would have been well suited to the reduced production rate. Due to lack of demand, this model together with their smallest model (T1W) have been discontinued. Comparable models from other manufacturers are available and would have similar costs and technical characteristics.

In order to further reduce costs, the evaporator and oil separation units can be eliminated. The effect of this will be to reduce yield from approximately 20% (of the raw material by weight) to approximately 15%. In addition, no oil would be recovered. Financial projections must reflect the decrease in yield and the elimination of fish oil production.

A potentially serious environmental hazard might also result. By eliminating oil separation and evaporation, the press - liquid must be discharged. This is a fairly concentrated organic pollutant and may be subject to environmental regulations. Although the waste is not toxic it has a high biological oxygen demand (BOD) and can cause environmental problems.

The revised estimated costs as a result of the above changes are shown on the following table.

ESTIMATED COST - FISH MEAL PLANT EQUIPMENT

(U.S. $)

	Foreign Costs	Local Cost	Total
Meal Plant Package	265,000.	-	265,000.
Hasher	33,600.	-	33,600.
Grinder/Bagger	31,400.	-	31,400.
Boilers (2) including Ancillaries	50,000.	20,000.	70,000.
Conveyors, Pumps, Lift Truck, Installations	20,000.	90,000.	110,000.
Sub-Totals:	400,000.	110,000.	510,000.
Shipping Costs:	25,000.	-	25,000.
TOTAL:	$425,000.	$110,000.	US $535,000.

Note: The above estimates are based on equipment of European manufacture. Several attempts were made to obtain information (technical and cost) from manufacturers in Taiwan and all unsuccessful to date.

ESTIMATED CONSTRUCTION COSTS

30 TONNES/24 HR FISH MEAL PLANT

(For Detailed Cost Breakdown, see Appendix)

I.	PRELIMINARY WORKS	Rp.	1,000,000.
II.	SAND & SOIL WORKS	"	2,087,600.
III.	STONE WORK	"	6,664,000.
IV.	CONCRETE WORKS	"	47,730,000.
V.	METAL WORKS	"	85,493,000.
VI.	PLUMBING, SANITARY & MECHANICAL	"	50,420,000.
VII.	ELECTRICAL & LIGHTNING CONDUCTOR	"	30,100,000.
VIII.	PAINTING	"	4,880,000.
IX.	FINISHING	"	300,000.
	SUB-TOTAL	Rp.	228,674,600.
	CONTINGENCY @ 5%		11,433,700.
		Rp.	240,108,300.

(US $146,400 @ 1640:1) NO FOREIGN CONTENT

TOTAL COST EQUIPMENT AND CONSTRUCTION (U.S $)

	Indonesian	Foreign	Total
Equipment	110,000.	425,000.	535,000.
Construction	146,400.	-	146,400.
TOTAL	$256,400.	$425,000.	$681,400.

ADDENDUM TO FINAL REPORT

ALTERNATIVES TO FISHMEAL PROCESSING

INTRODUCTION

During the past 10 to 15 years the production of fishmeal using traditional equipment and processes has become uneconomic for most processors. During this period of time the international price for fishmeal has declined, or at best remained stable; largely due to competition from soya meal. During the same period of time, the cost of energy has increased several fold. Since the traditional methods of processing fishmeal have used large amounts of energy the process has therefore become uneconomic in most locations. The following discussion, therefore, is about alternative use of fish waste or fish by-products.

These alternative processes, although tried in many locations in various countries around the world, have still some developmental work required before large scale production can be considered. For this reason the markets are not well developed and it is difficult to determine market prices.

These alternative processes can be divided into three main categories:

I. Fish wastes with little or no further processing,

II. Fish silage,

III. Fish protein hydrolysates.

I. <u>Fish Wastes Unprocessed</u>: The offal or wastes resulted from the processing of tuna or other wet fish processing, can be used directly as:

A. animal feed

B. bait

C. fertilizer

For many years the waste by-products from fish processing operations were converted into fishmeal. As profitability decreased in this operation the collection and handling of fish waste became increasingly a net cost of waste disposal. Increasing efforts therefore began to find ways of disposing of this waste with a minimum of costs or perhaps with a modest profit.

A. <u>Animal feed</u>: Fish waste is used in many countries with very little processing for feeding animals. In North America, this practice is growing in popularity. The wastes are ground, placed in small containers and frozen for shipment to farms (primarily mink).

B. <u>Bait</u>: Approximately 20% of fish by-product wastes in North America is reused in the fishery as bait as this waste is very species specific it is difficult to estimate the amount which could be used in the marine fishing industry of Indonesia. There has also been an increasing interest in the use of manufactured baits. This concept is an old and much tried one but still not widely used. It involves the use of processing plant wastes to be liquified an extruded, formed or gelled product.

C. Fertilizer: Industrial fish and fish wastes have been tried on very small scales, in various countries, as agricultural fertilizer. With the increased costs of waste disposal, increased interest has been shown in this method of disposal. Raw fish wastes mixed with high carbon organic materials such as peat or sawdust over a relatively short period of time will be converted into an odorless organic fertilizer which, according to growing trials, has been more effective and less costly than using chemical fertilizers.

II. Fish Silage: Fish silage is the process of hydrolyzing fish waste solids using one of a number of acids, (notably formic, sulphuric or lactic acid) to stabilize the bacteria in the fish during an enzymatic hydrolysis process. While the fish spoilage is inhibited by the presence of the acid the natural enzymes in the fish hydrolyze the protein of the waste. The hydrolyzed product is then called fish silage and it is 'shelf stable', relatively easy to handle and transport. It has been used as a fertilizer with some success on some crops. It has also been used for livestock feeds. The growing interest in the use of fish silage, however, is as an additive in the dry and/or moist feeds now being manufactured for use in aquaculture.

A. Fish Farming: Fish farming in countries around the world has been going into a phase during the past few years of intensification. This process uses manufactured feeds to increase the growth rates of the farmed species. Fish silage has been used in these feeds in concentrations varying from 5 to 45 % content. The Government of Indonesia's plan to intensify the Tambac Ponds in Indonesia will require large increases in the demand for pellet feeds. Already several companies have, during the past 2 years, constructed pellet feed manufacturing plants. Most of the raw materials for these plants are still imported. There is significant potential therefore, in import substitution, using good quality fish silage as an additive to the pellet feed industry.

III. Fish Protein Hydrolysate: This process, also described as fish protein concentrate, involves the hydrolyzing of fish proteins using high temperatures to reduce or inhibit the protein spoilage while enzymatic digestion takes place. The digestion uses elevated temperatures to inhibit the spoilage but as a result the natural enzymes in the fish are also inhibited. Therefore, artificial enzymes are added during the digestion process. After the protein is liquified the product goes through an evaporation and drying process. The resultant product is a high grade of powdered fish protein. Its markets are fairly well developed in Europe and include livestock feed for the veal industry and aquaculture feeds in Scandinavia. The rapidly growing market for this product is again in aquaculture feeds as an additive. Another type of fish protein hydrolysate has been tried years ago using solvents to extract the oil and stabilize the product during the digestion of the protein which is then dried. This process had serious problems both in production and marketing, and has been essentially abandoned.

IV. <u>Chitin</u>: Chitin is a biopolymer resembling cellulose chemically. It is essentially insoluble, but can be made soluble in dilute acids by altering its structure to that of chitosan.

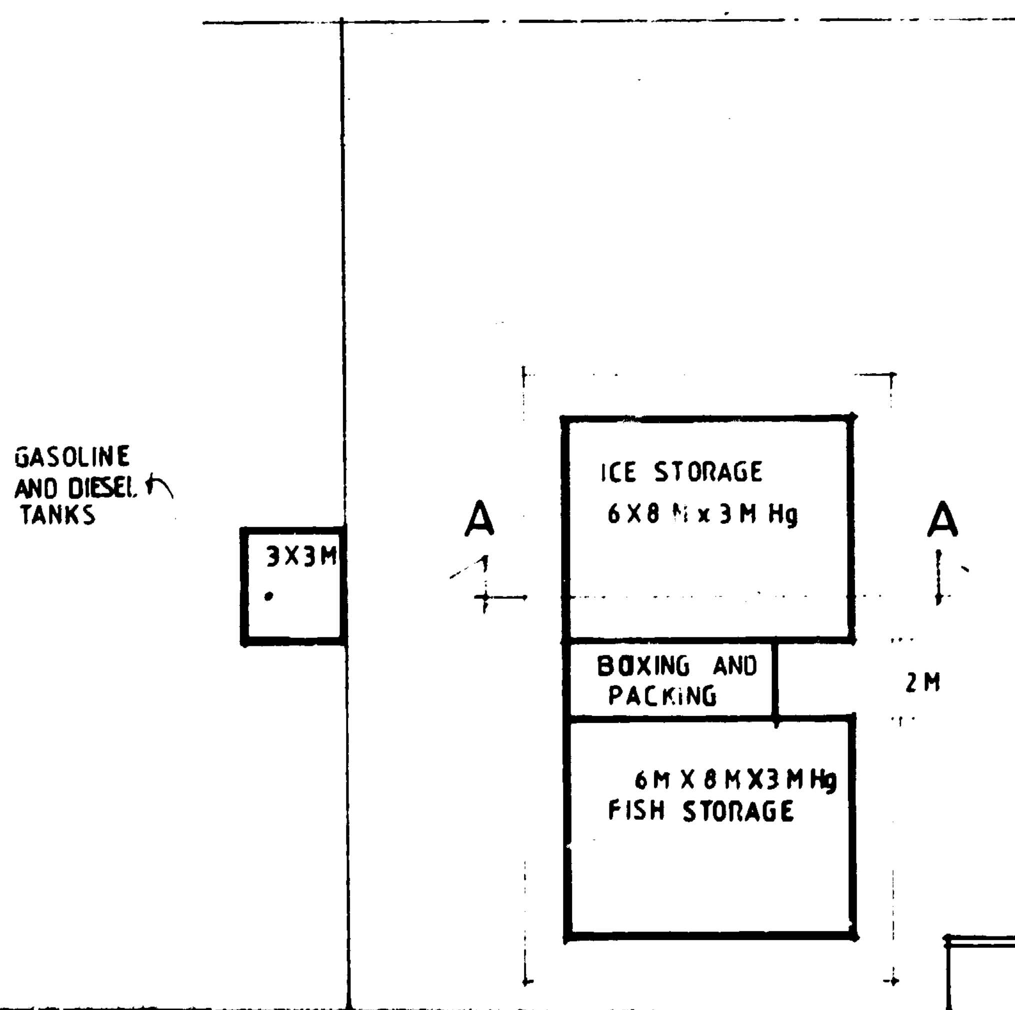
Chitin composes much of the shell of crustacea, such as shrimp, crabs and lobster. It also occurs in the beak or pen of squid and octopus.

Chitin and chitosan are used, as floculating or coagulating agents to recover biomass from dilute processing wastes or in waste water treatment. Chitin has a very large number of potential uses in the food industry and in the paper/textile/ non-woven fabrics and adhesives industries. It also has uses in the biomedical field. The Japanese market demand is established at 300-500 metric tons per year.

Full scale production technology exists for the extraction of chitin from shrimp and other crustacea wastes.

SECTION 1

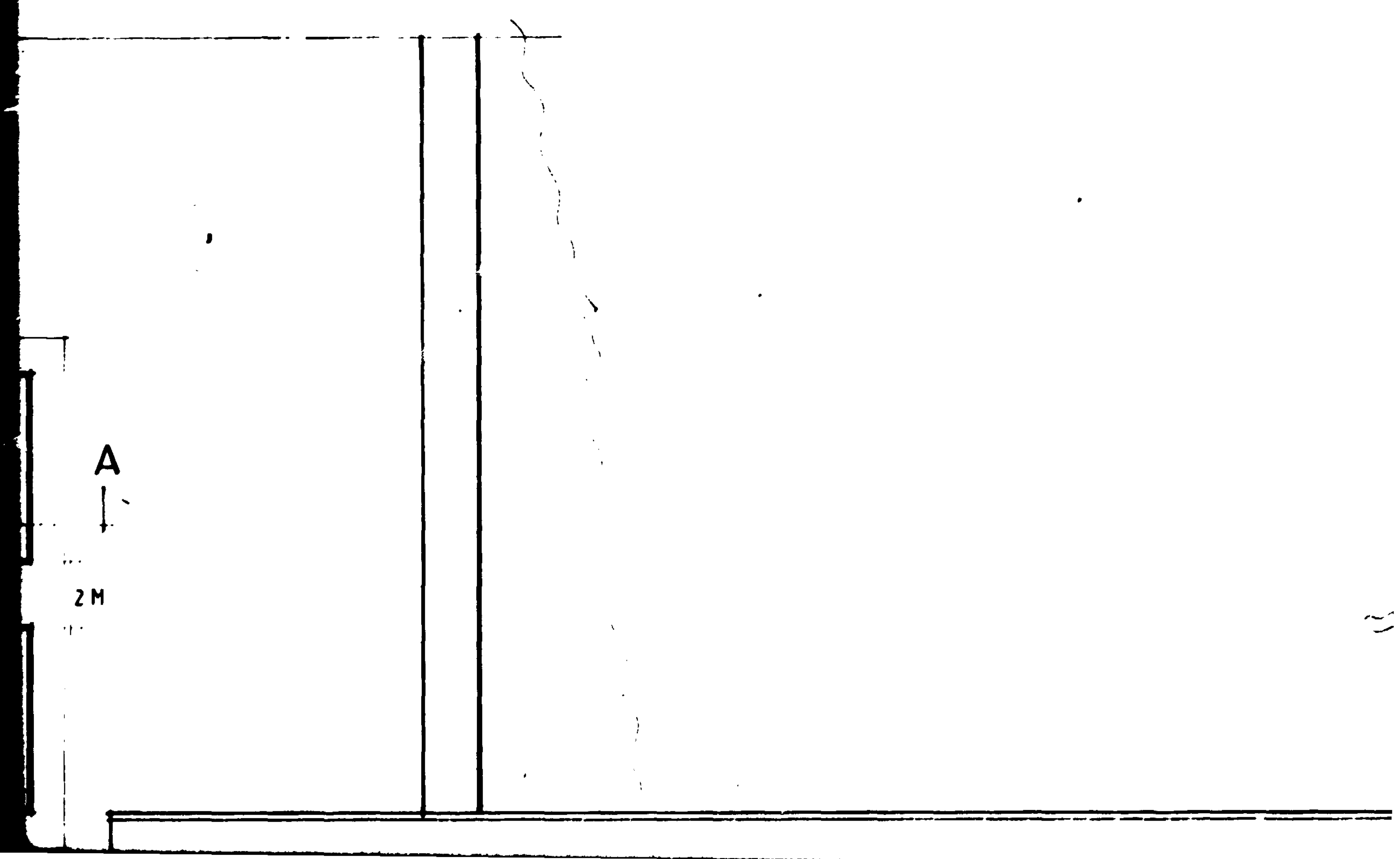
IMPROVED FISH LANDING / IC



SECTION 2

ING / ICE DISPENSING SITE

SKALA 1:200



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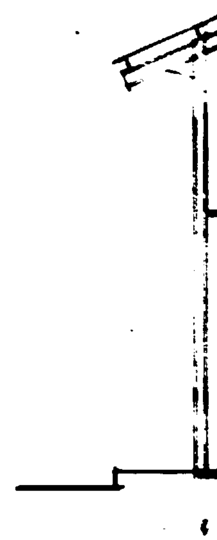

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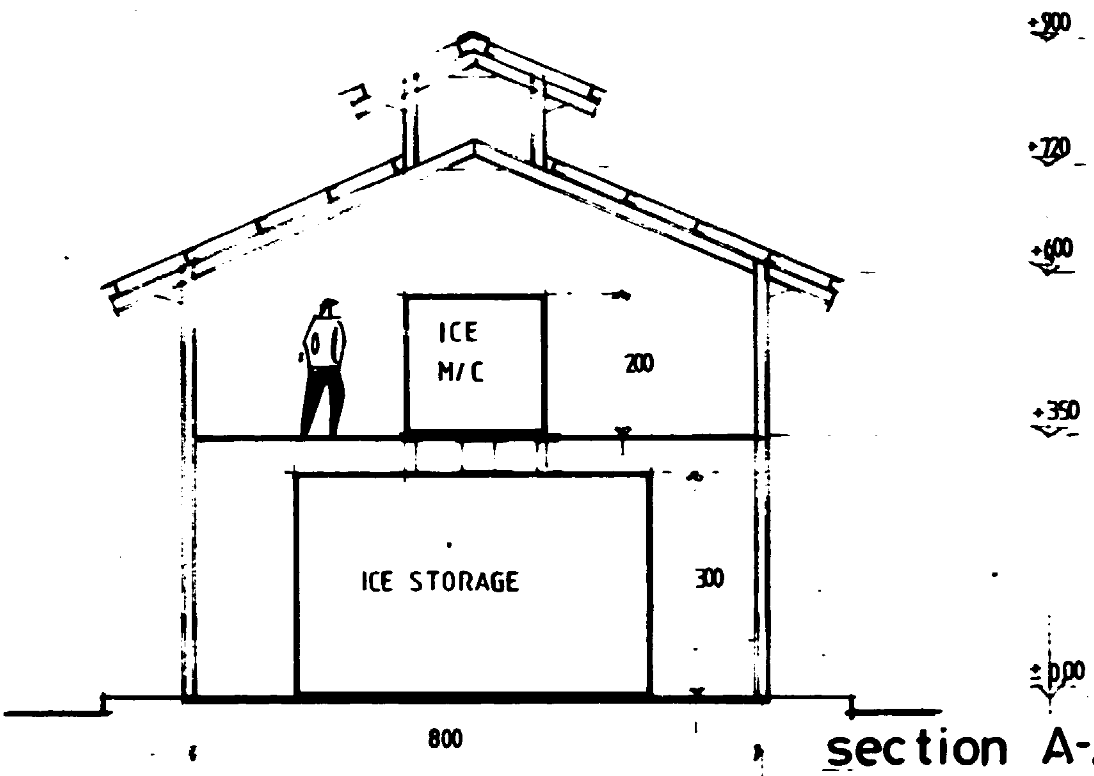

section A-A
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SECTION 5

NOTES:

CHANGES

PROJECT

UNIDO MARINE RESOURCES STUDY

JOB DESCRIPTION

IMPROVED FISH LANDING / ICE DISPENSING SITE

DESIGNERS		SIGNATURE
ARCHITECT	IR. BUNTARAN IAI .	
STRUCTURAL ENGINEER		
ELECTRICAL		

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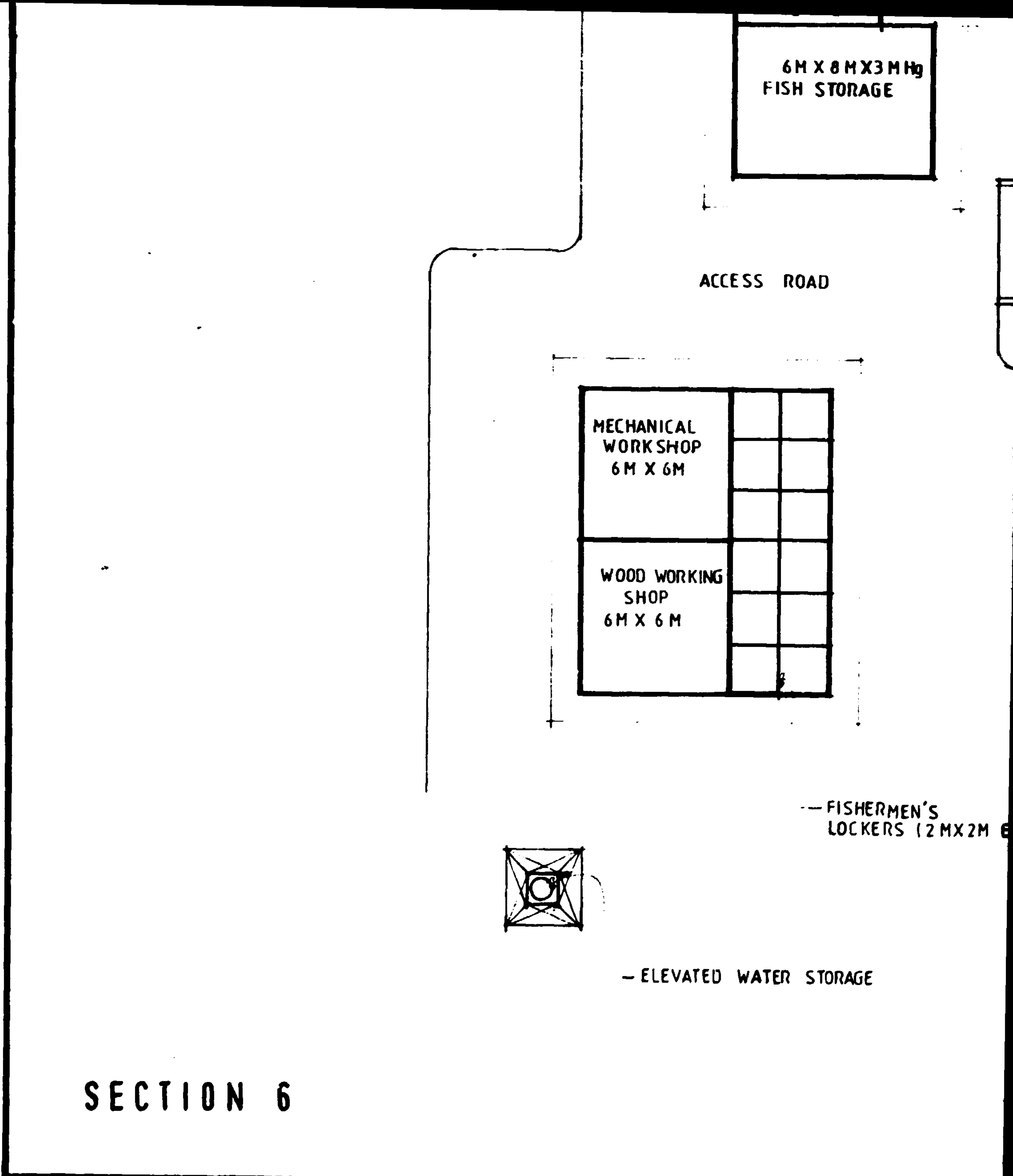
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ACCESS ROAD
MECHANICAL
WORKSHOP
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WOOD WORKING
SHOP
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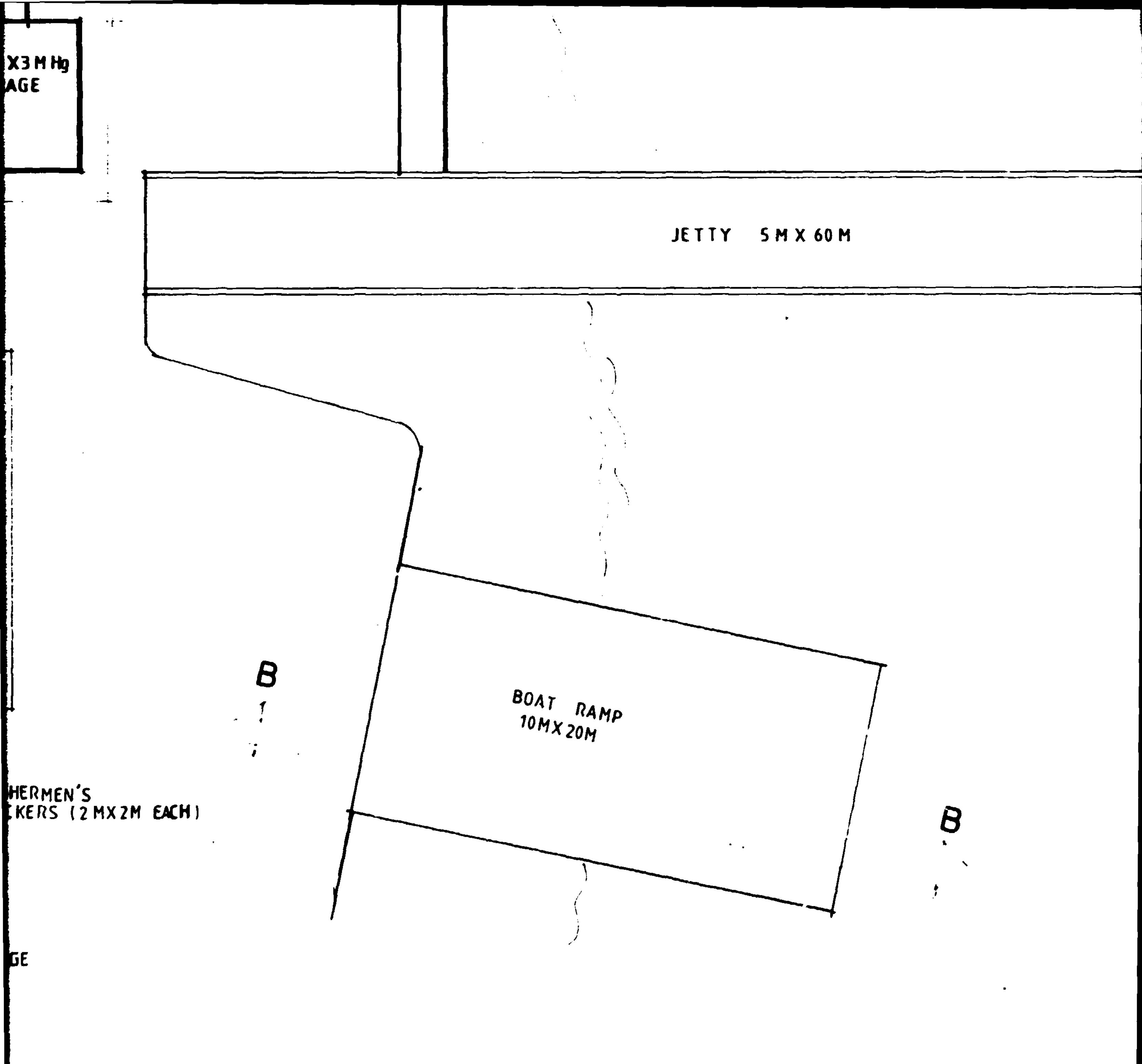
FISHERMEN'S
LOCKERS (2MX2M
ELEVATED WATER STORAGE
SECTION 6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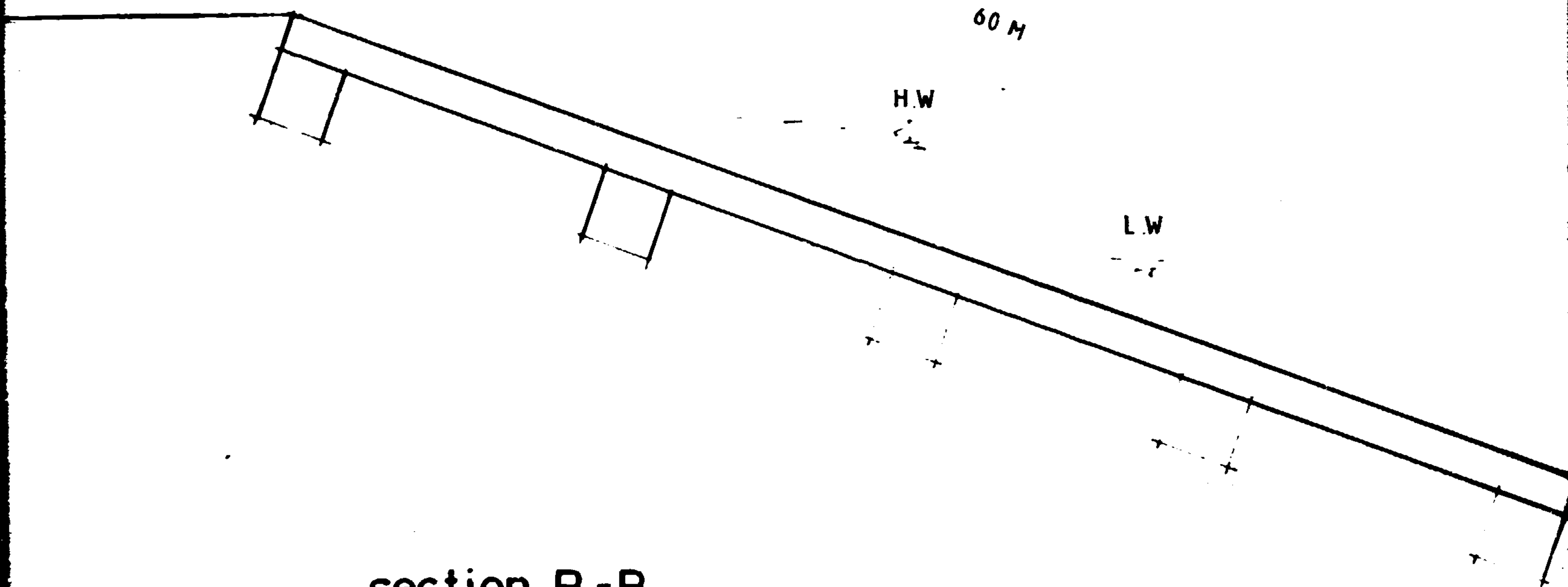
AGE
JETTY 5 M X 60 M
B
BOAT RAMP
10 M X 20 M
HERMEN'S
KERS (2 M X 2 M EACH)
GE
B

SECTION 7

SECTION 8



section B-B

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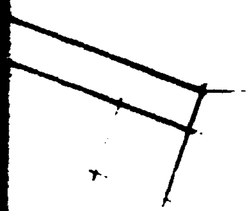
SECTION 9



SECTION 10

DESIGNERS		SIGNATURE
ARCHITECT	IR. BUNTARAN IAI .	[signature]
STRUCTURAL ENGINEER		
ELECTRICAL MECHANICAL		

DRAWING :

SITE and SECTION

DRAWN BY	MASDAR IDRIS PUTRABA .	
CHECKED BY		
APPROVED BY		
ISSUED BY		

SCALE	DRAWING CODE	DRAWING NO.
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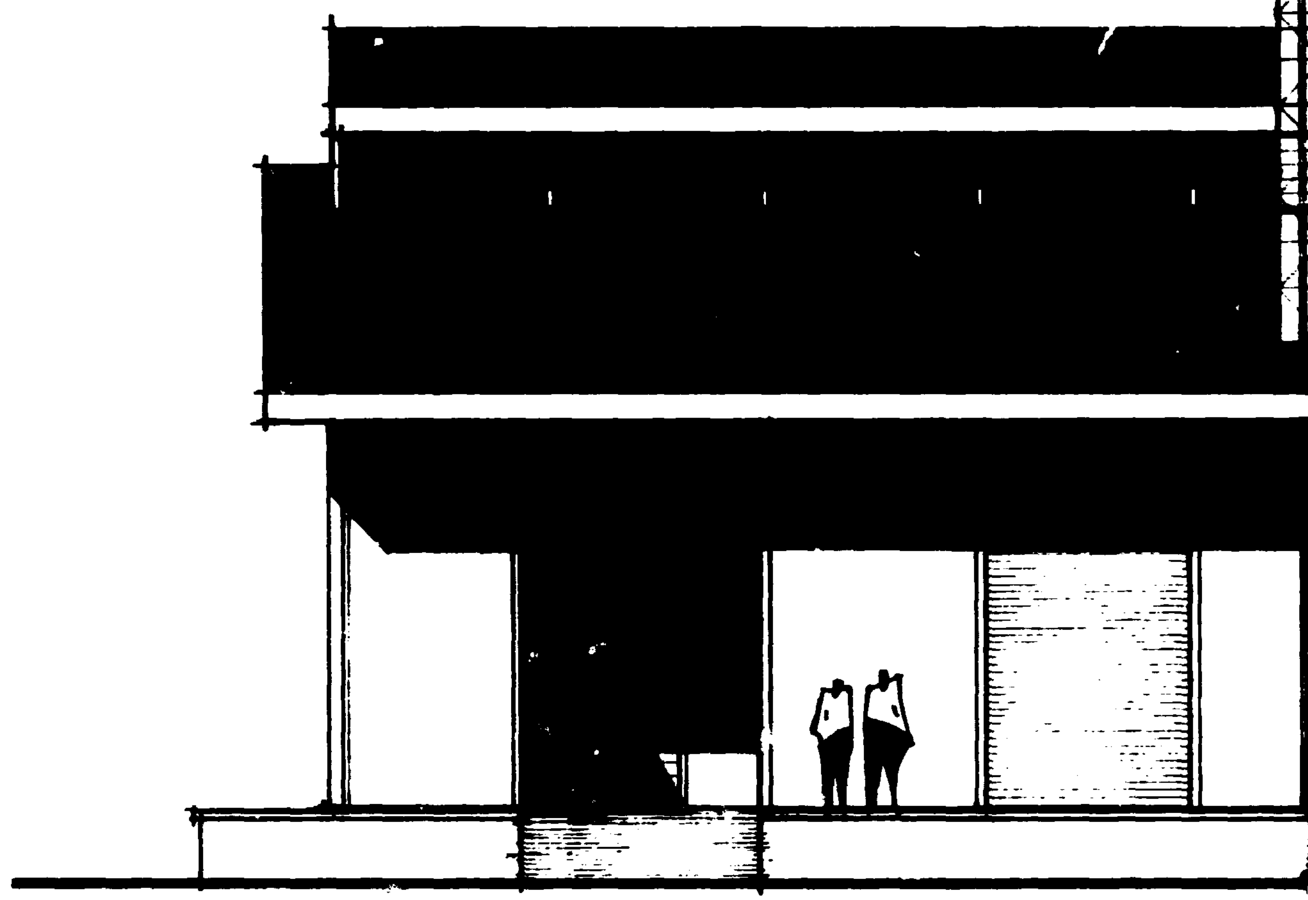
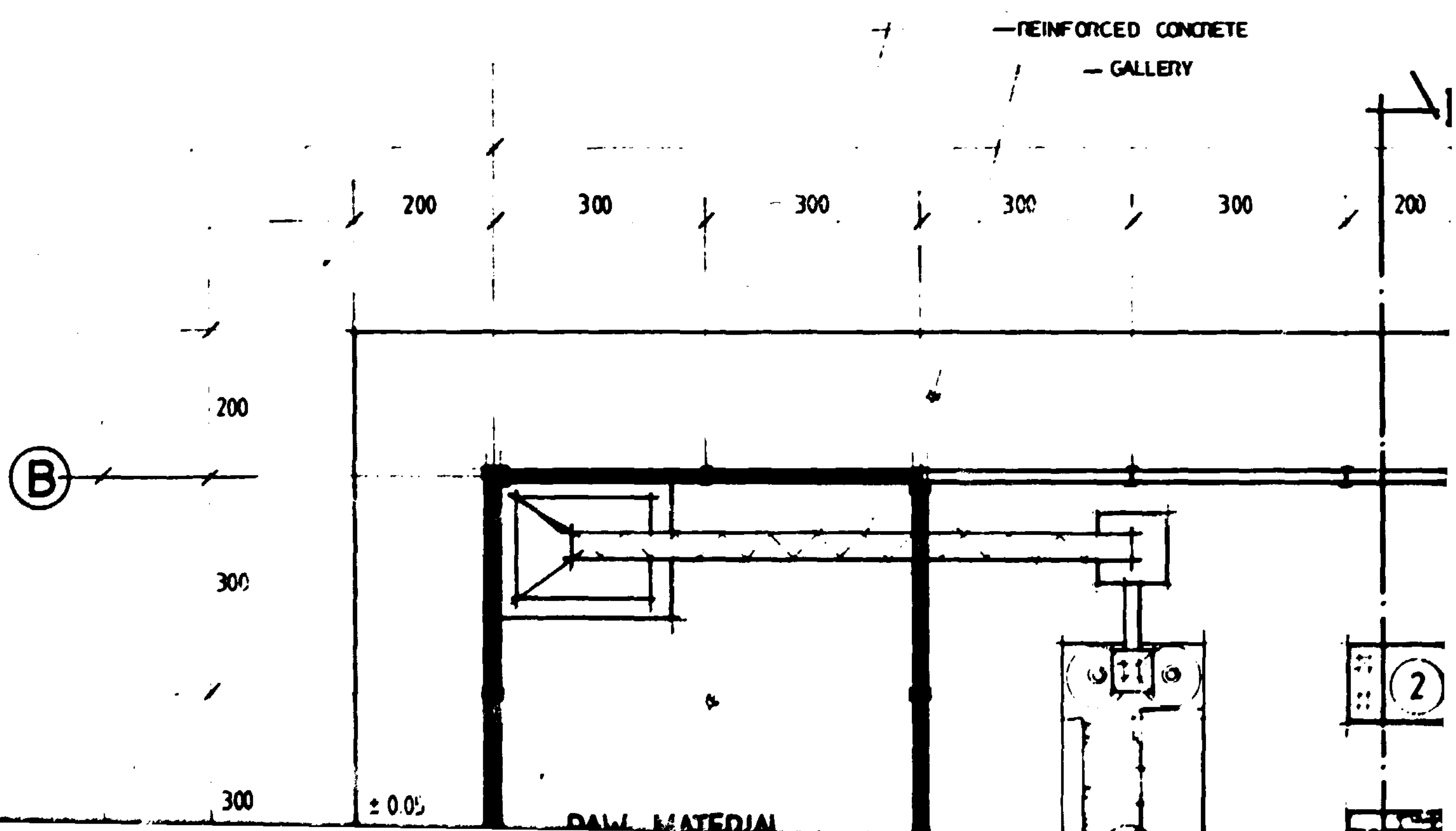
CANADIAN
FISHERY
CONSULTANTS
LIMITED
HALIFAX, NOVA SCOTIA, CANADA

PT REKA CIPTA
ENGINEERING CONSULTANT
JLN. BALAIKOTA NO. 11 TLP. 4846 UJUNG PANDANG
TELEX 71563 RAMA UP IA

SECTION 1





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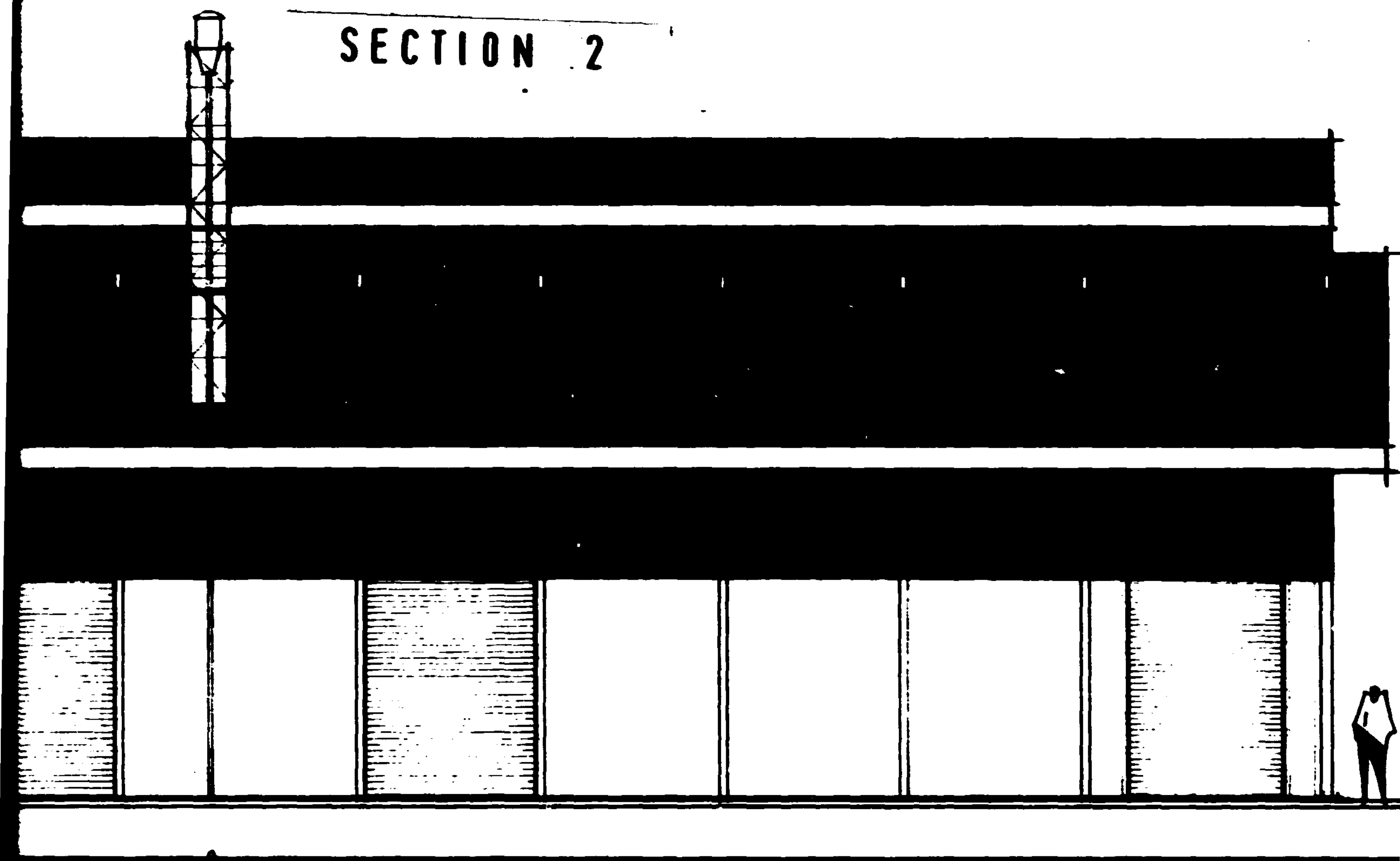
SECTION 2



FRONT ELEVATION

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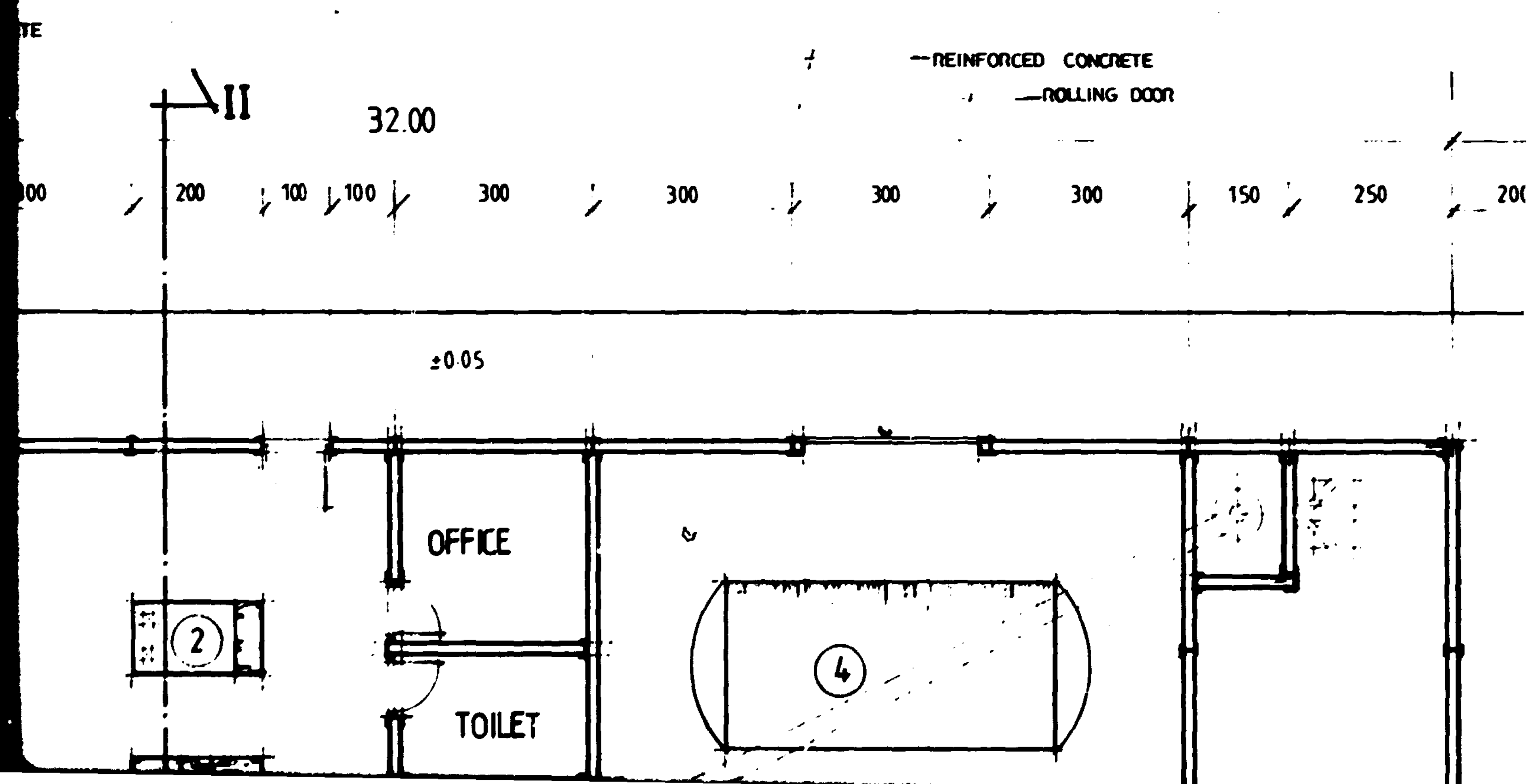

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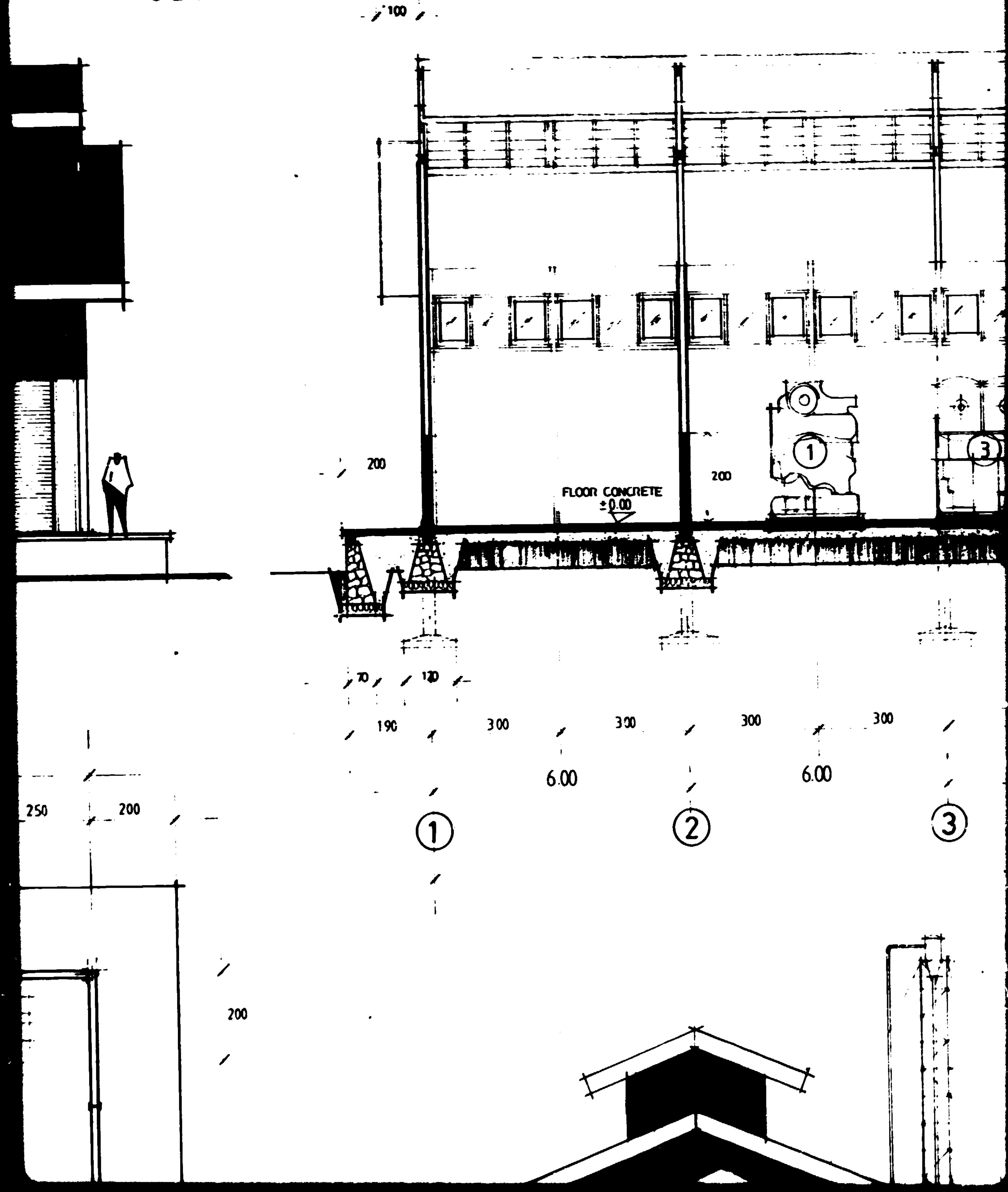
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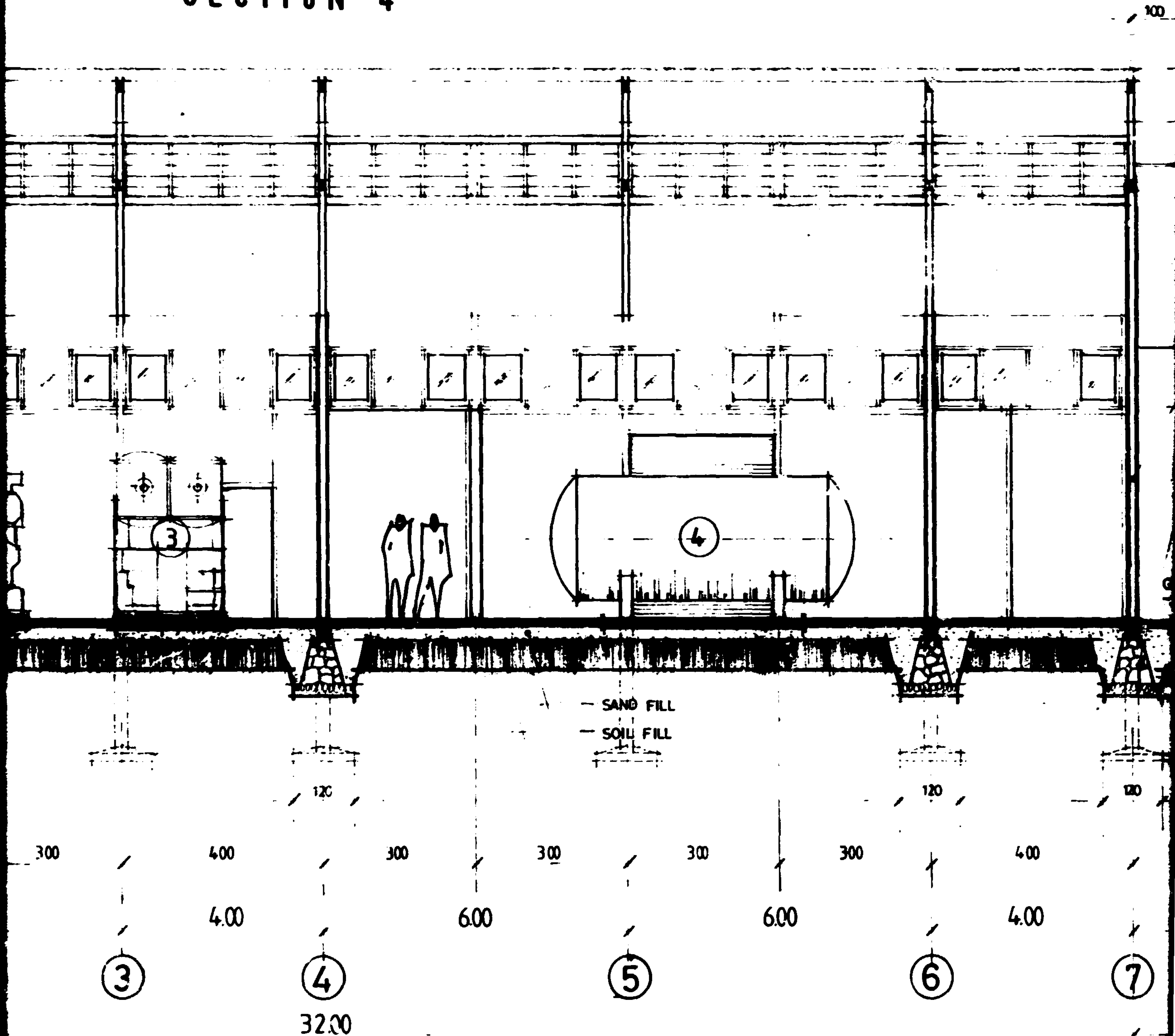

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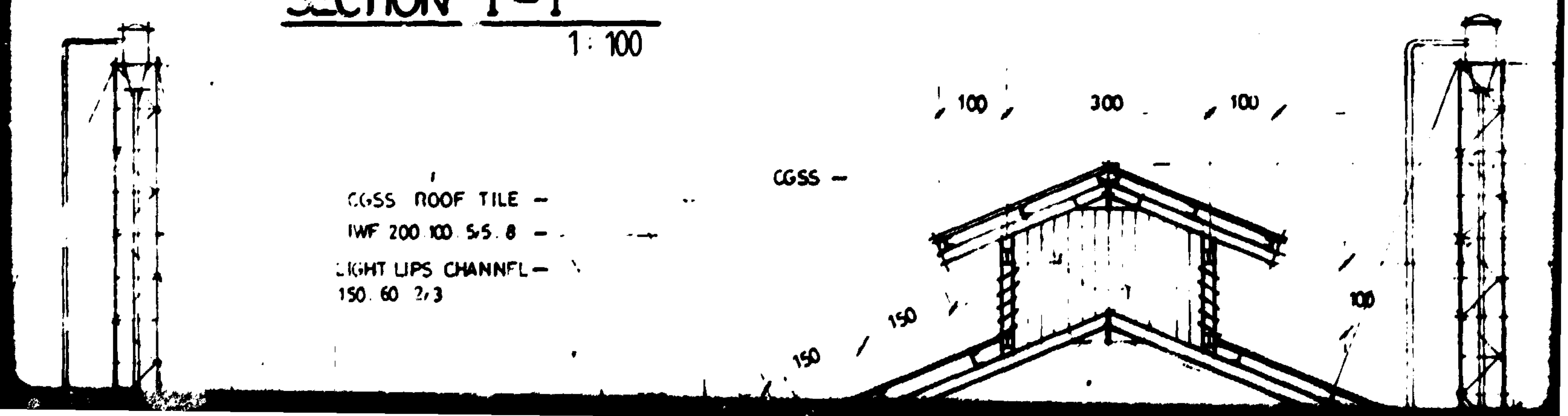
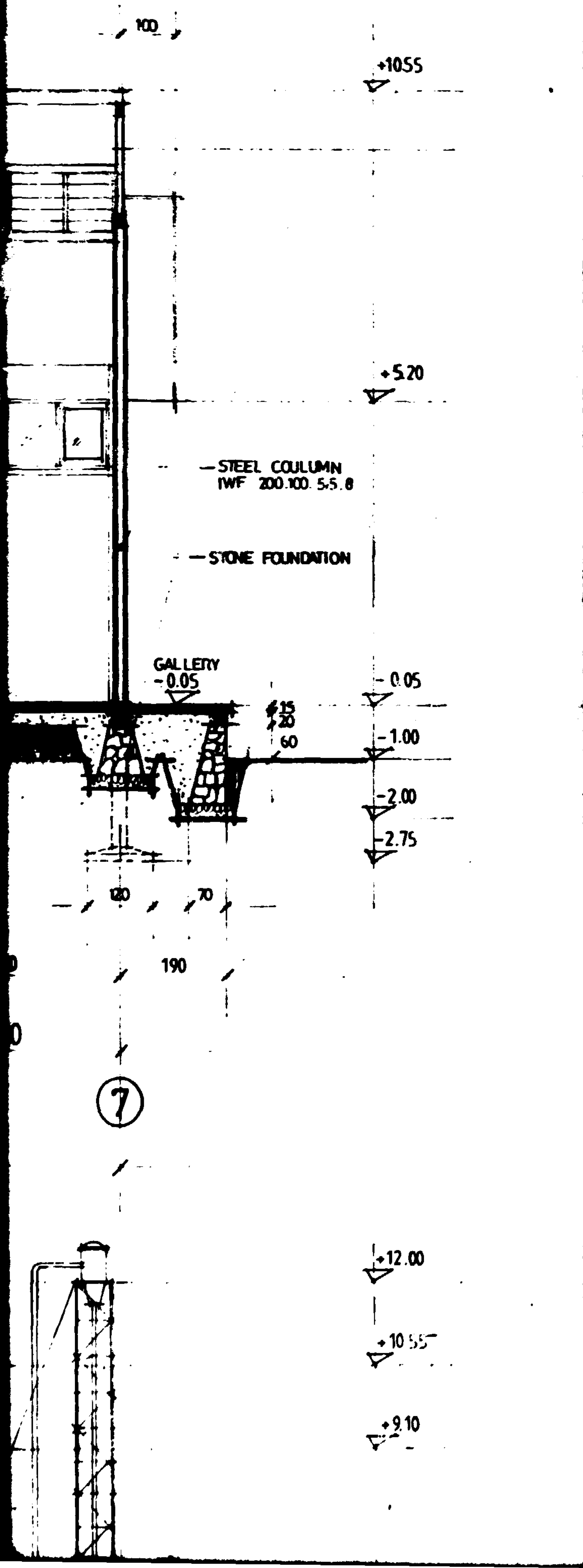




NOTES.

SECTION 5

CHANGES

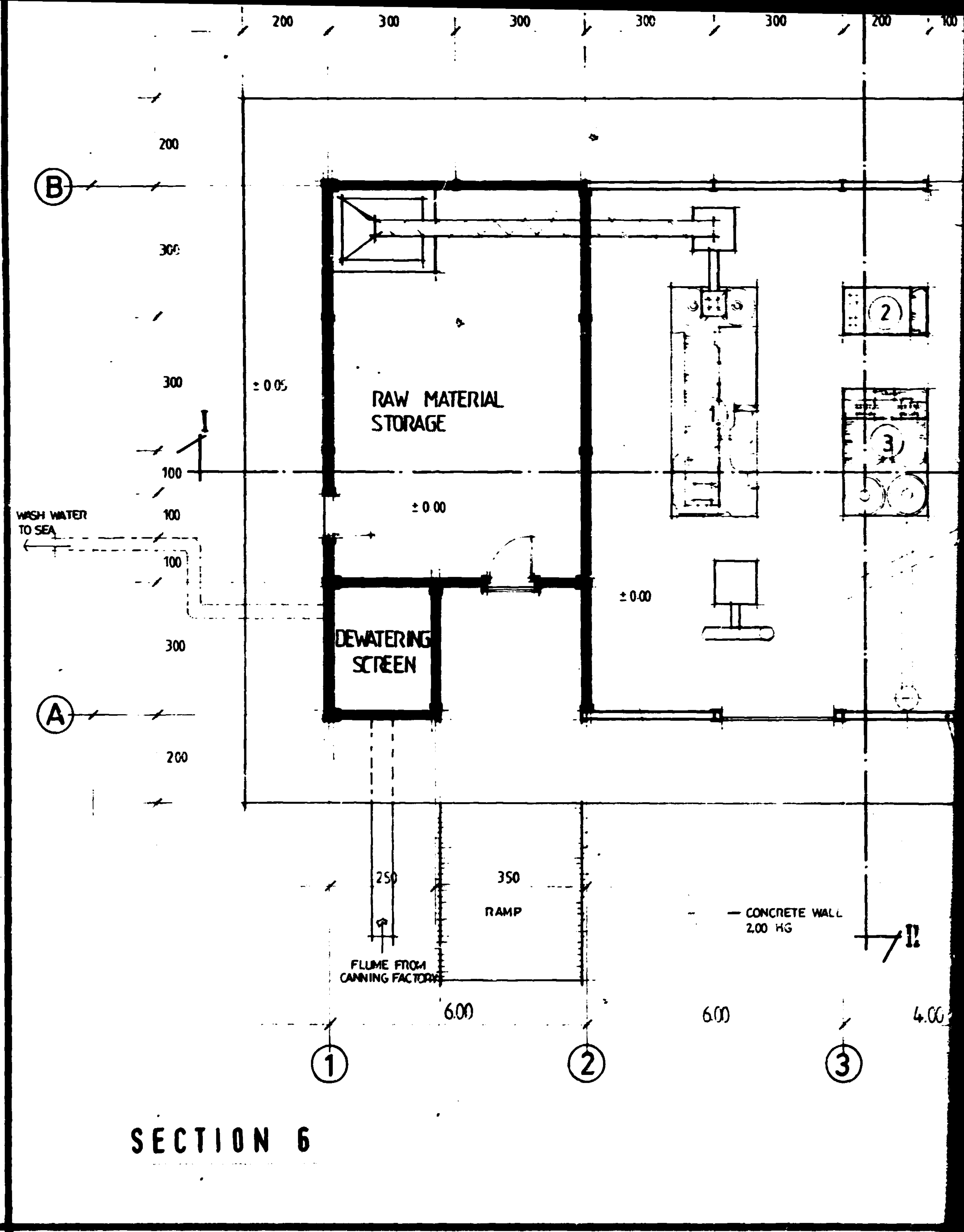
PROJECT

UNIDO MARINE RESOURCES STUDY

JOB DESCRIPTION

FISH MEAL PLANT

DESIGNERS		SIGNATURE
ARCHITECT	IR. BUNTARAN IAI	
STRUCTURAL ENGINEER		
ELECTRICAL MECHANICAL		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± 0.00
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WASH WATER
TO SEA
DEWATERING
SCREEN
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350
RAMP
CONCRETE WALL
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FLUME FROM
CANNING FACTORY
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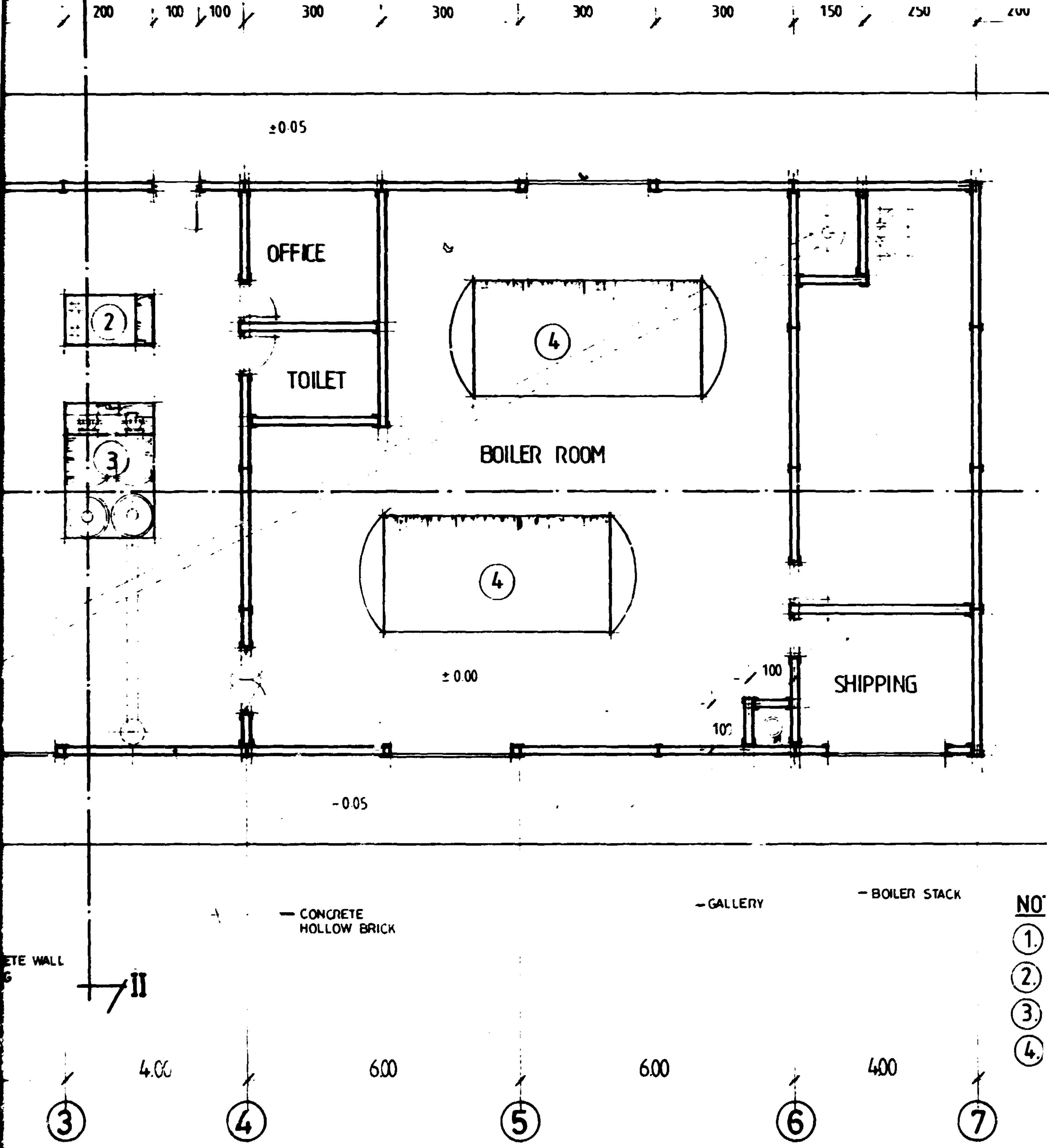
I
II

SECTION 6



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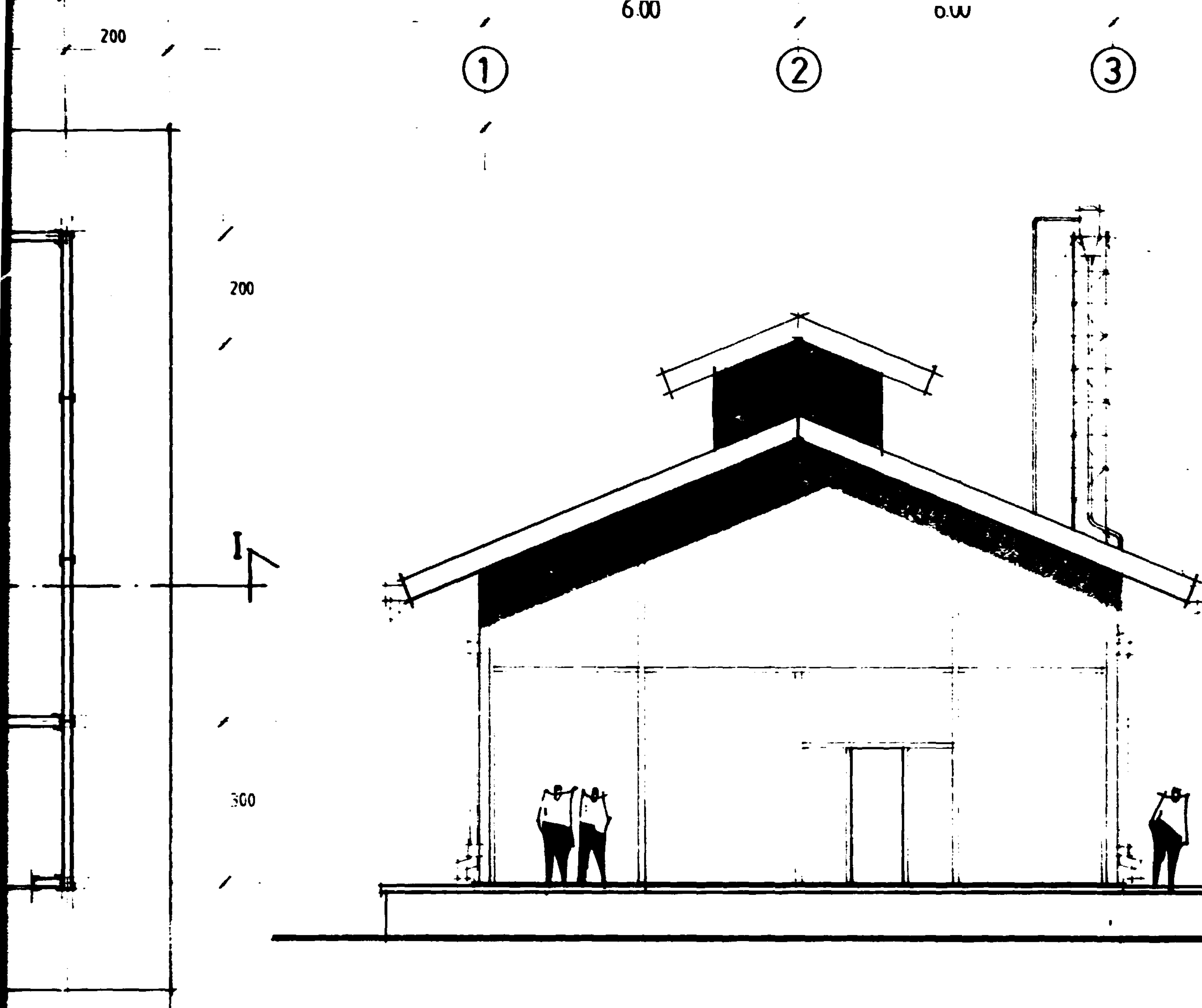

SIDE ELEVATION
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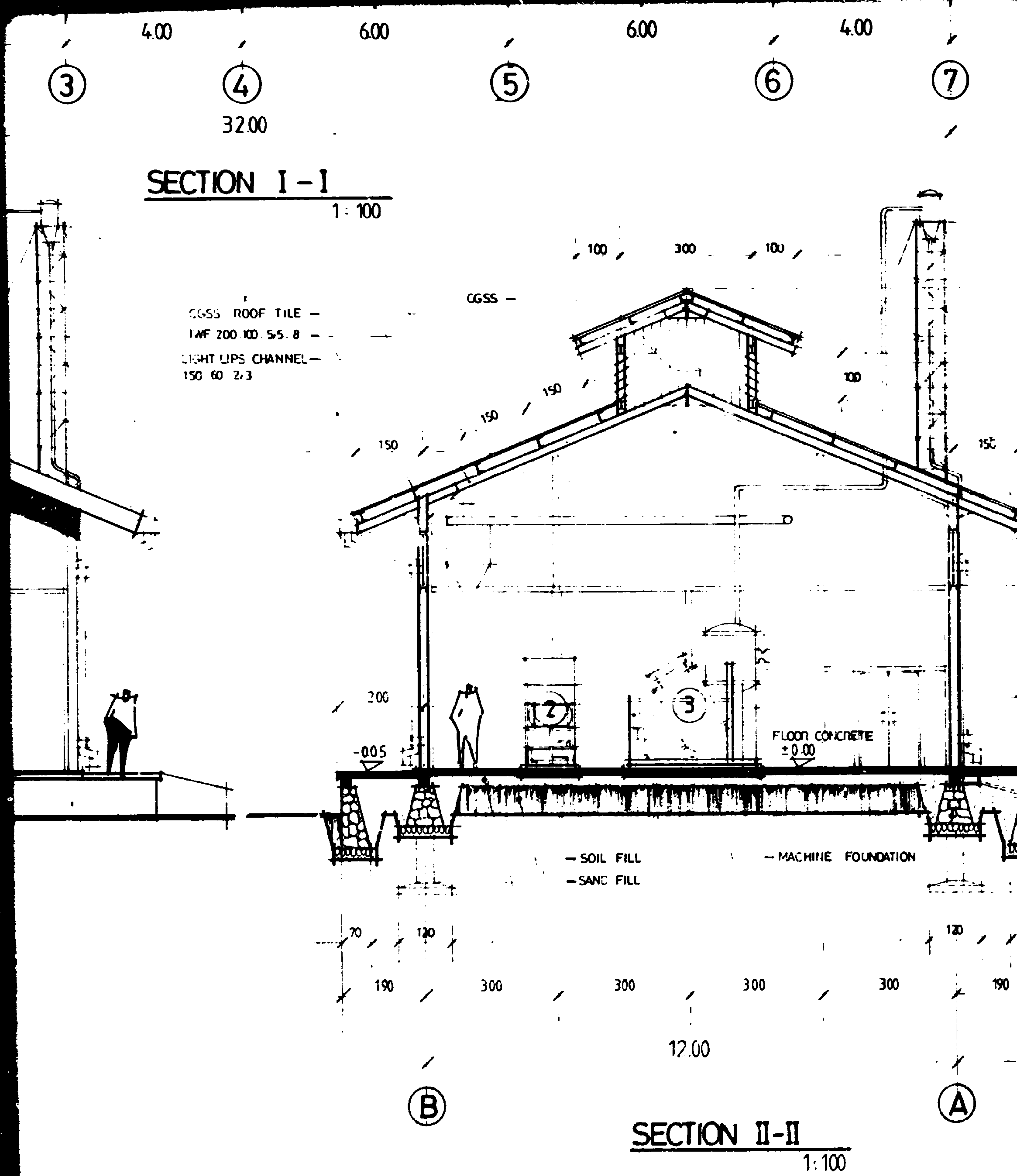
NOTES:

1. FISH MEAL PLANT
2. FISH OIL PLANT
3. CONSENTRATING PLANT (EVAPORATOR)
4. BOILERS

SECTION 8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CGSS ROOF TILE
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150
150
150
100
200
-0.05
FLOOR CONCRETE
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SOIL FILL
SAND FILL
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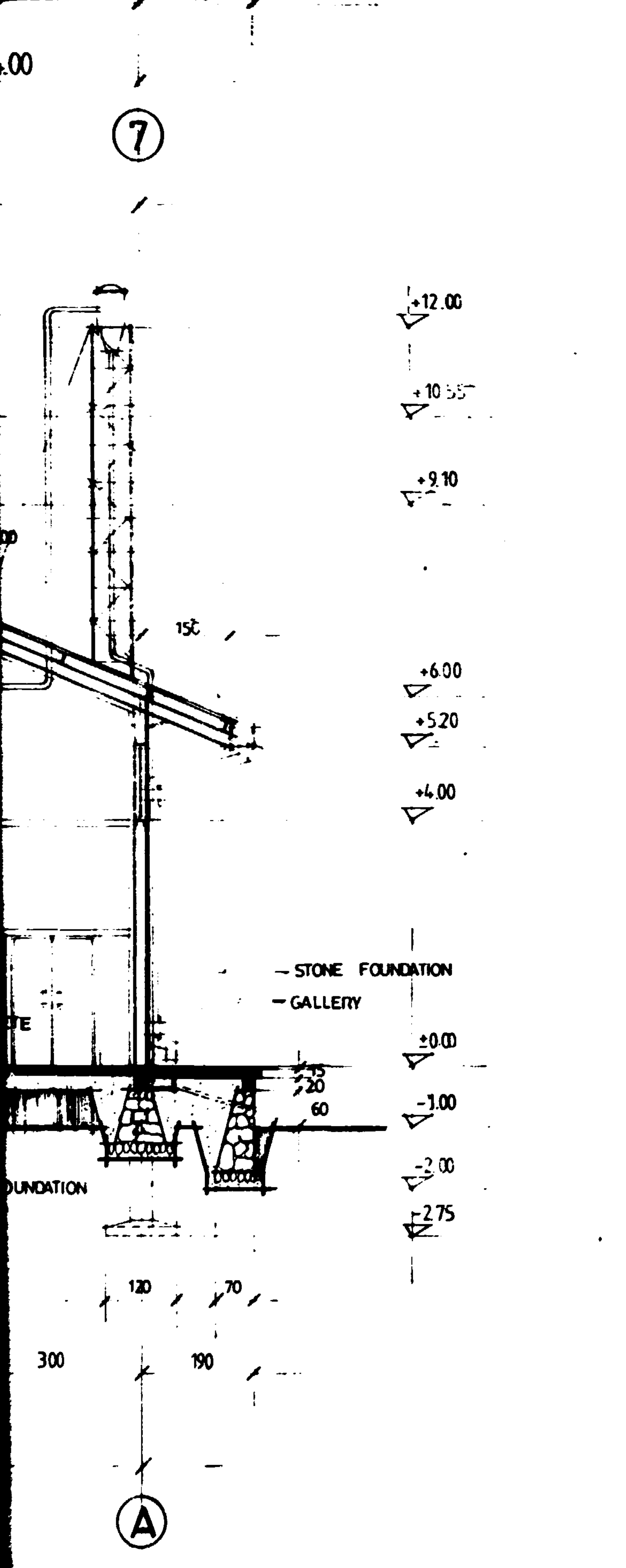
SECTION 9



SECTION 10

UNIDO MARINE RESOURCES STUDY

JOB DESCRIPTION

FISH MEAL PLANT

DESIGNERS		SIGNATURE
ARCHITECT	IR. BUNTARAN IAI	
STRUCTURAL ENGINEER		
ELECTRICAL MECHANICAL		

DRAWING :

- PLAN
- ELEVATION
- SECTION

DRAWN BY		
CHECKED BY		
APPROVED BY		
ISSUED BY		

SCALE	DRAWING CODE	DRAWING NO.
1 : 100		01

CANADIAN FISHERY CONSULTANTS LIMITED

HALIFAX, NOVA SCOTIA, CANADA

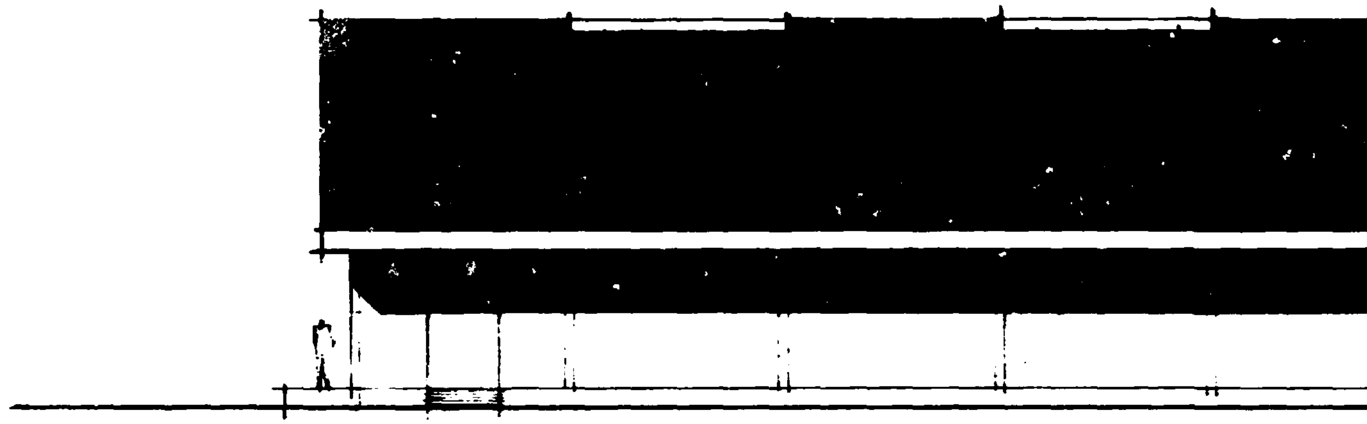
PT. REKA CIPTA

ENGINEERING CONSULTANT

JLN. BALAIKOTA NO.11 TLP. 4846 UJUNG PANDANG

TELEX 71563 RAMA UP IA

SECTION 1



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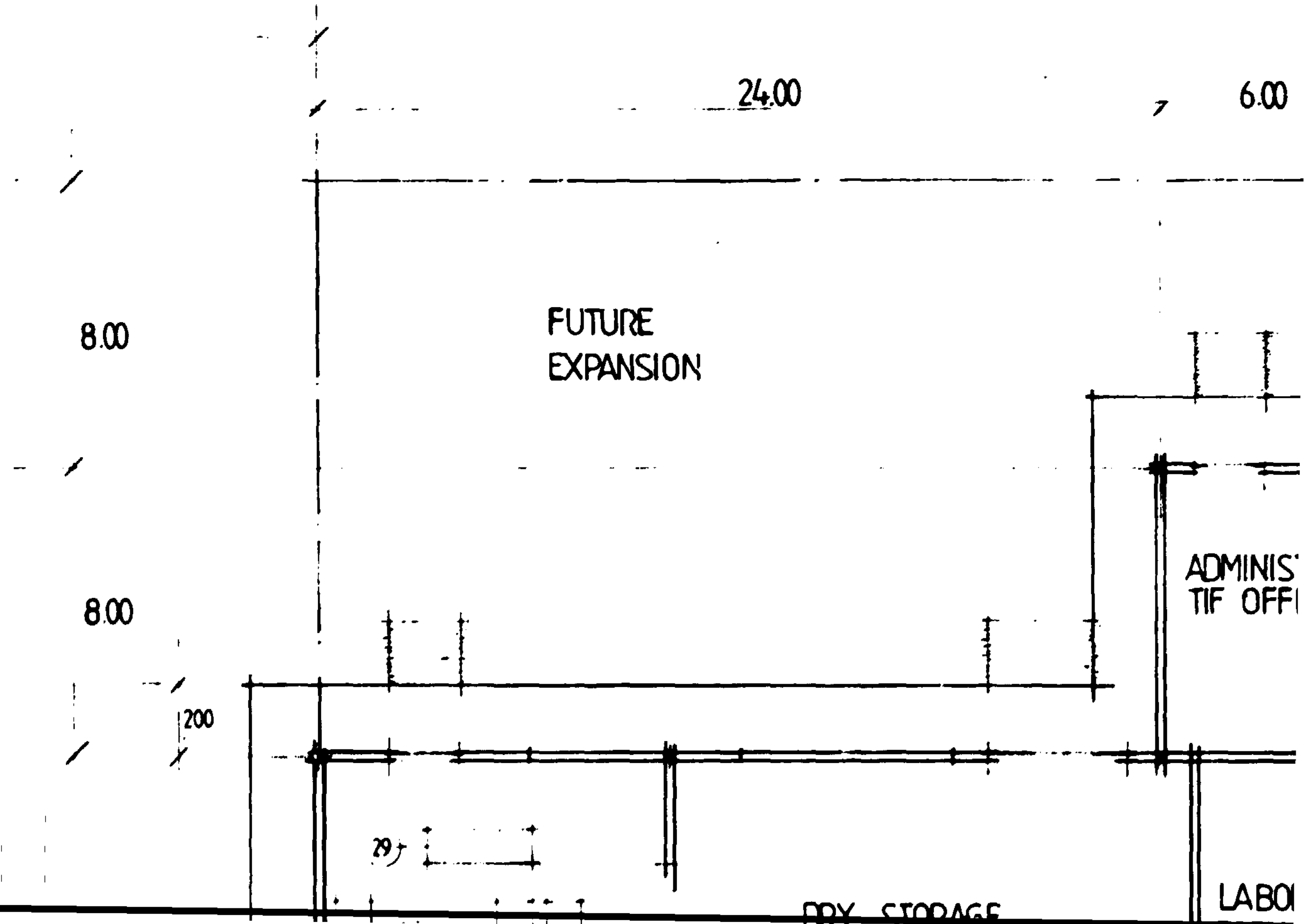

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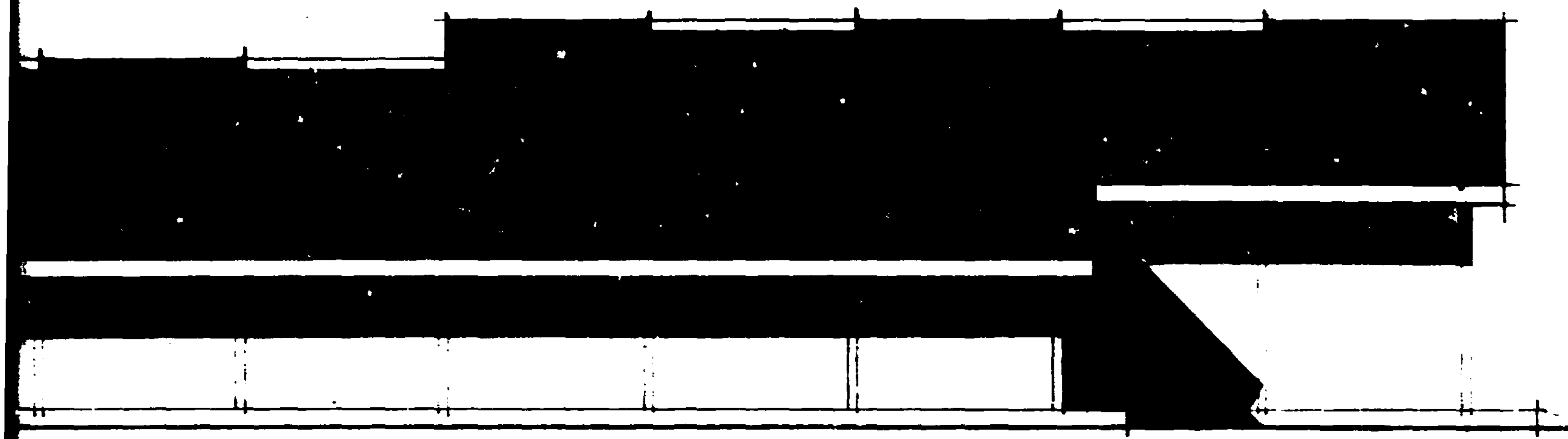
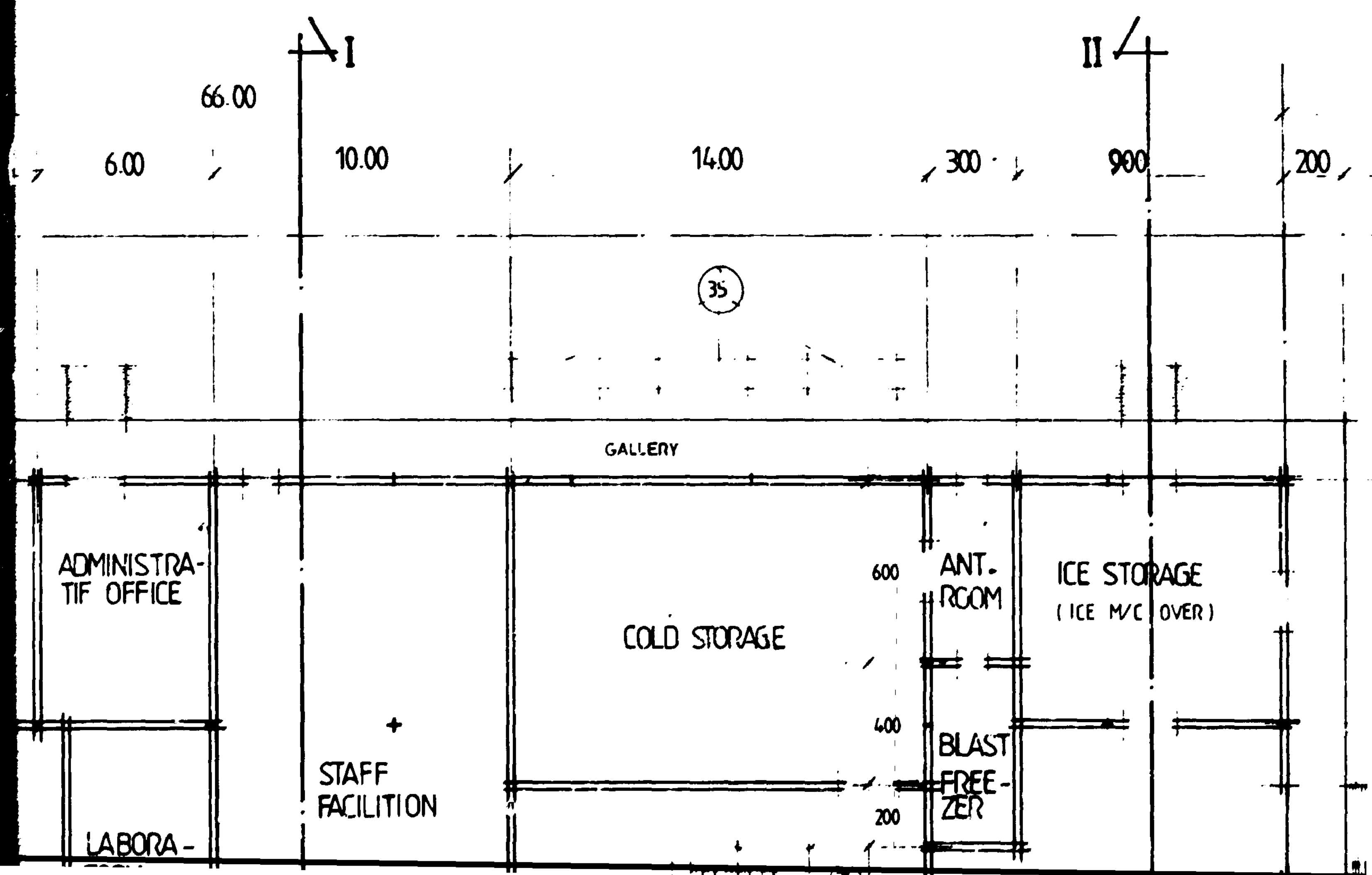
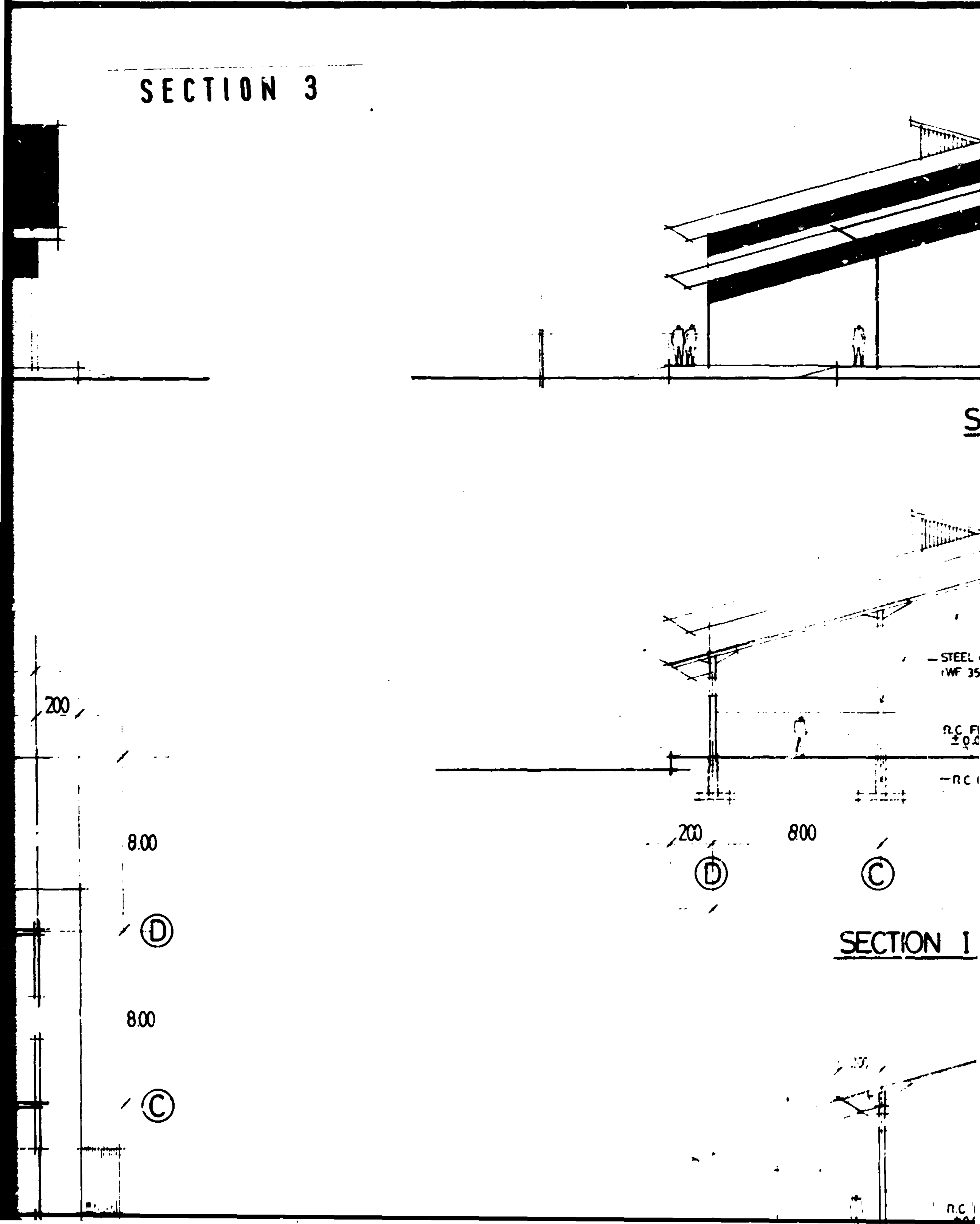


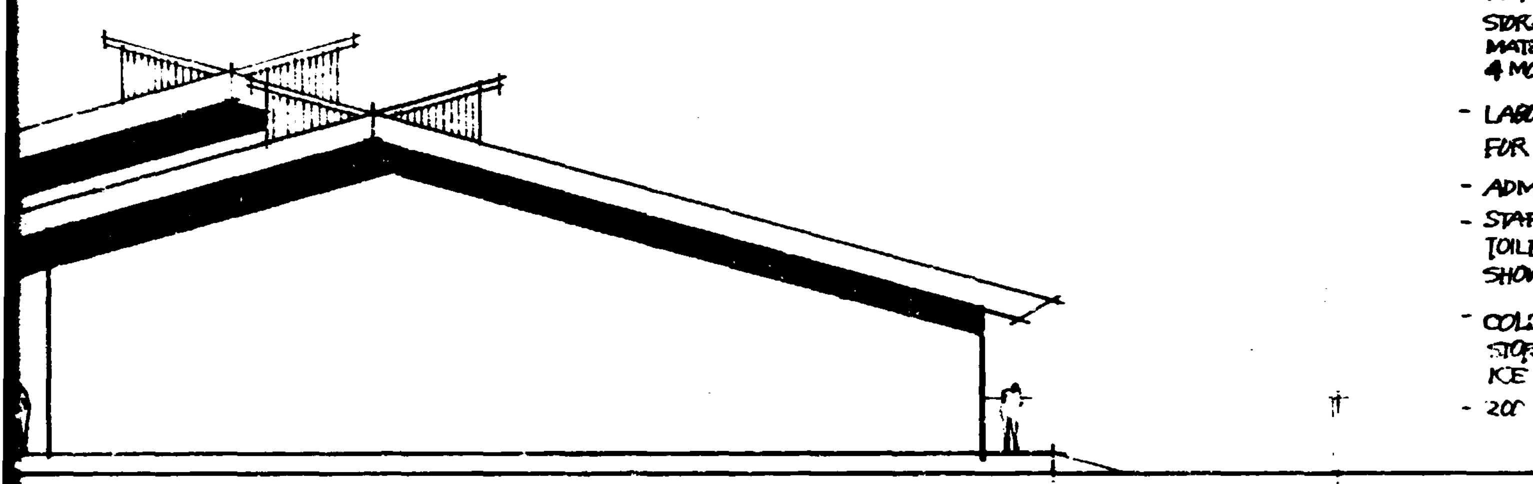
FRONT ELEVATION

1:200



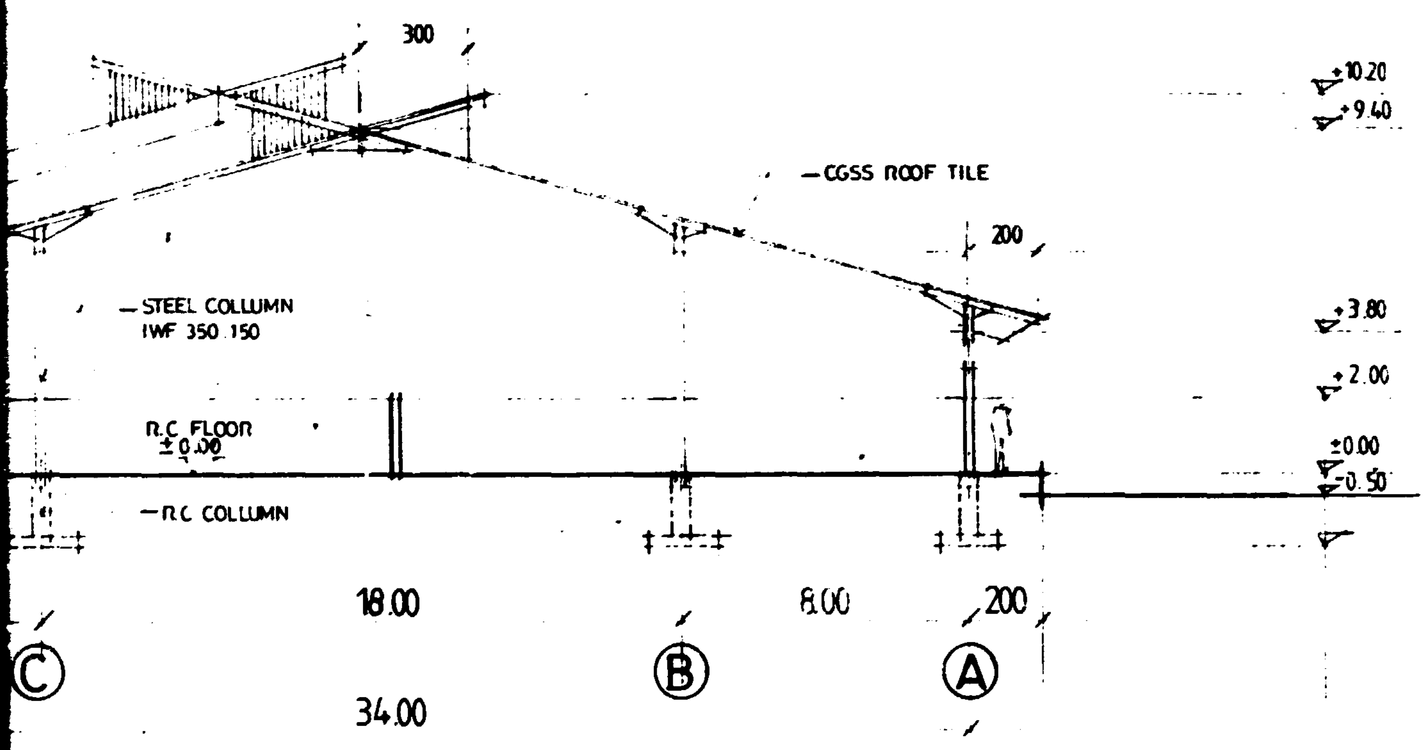

SECTION 3
200
8.00
D
8.00
C
STEEL
200
8.00
D
C
SECTION I

SECTION 4

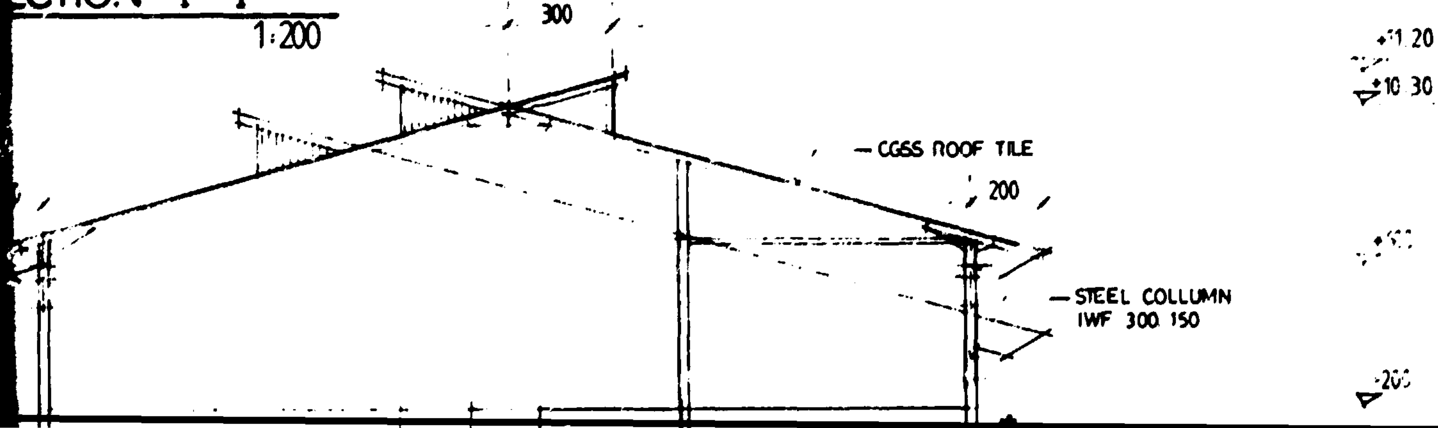


- DRY STRAGE ,
  STORAGE OF EM
  MATERIALS ET
  4 MONTHS PRODU
- LABORATORY 5
  FOR QUALITY C
- ADMINISTRATIV
- STAFF FACILIT
  TOILETS , CHAN
  SHOWERS FOR
- COLD STORAGE
  STORAGE OF L
  ICE IN INSULAT
- 200 TONNESCAP
- ICE STORAGE
  CAPACITY 80
  OR PLATE ICE
- ICE MAKING
  CAPACITY 20
- BLAST FREEZ
  CAPACITY 10

SIDE ELEVATION
1:200



ECTION I - I
1:200



SECTION 5

- DRY STRAGE. 150 M²
  STORAGE OF EMPTY CANS, LIDS PACKING MATERIALS ETC AND APPROXIMATELY 4 MONTHS PRODUCTION OF CANNED PRODUCT.
- LABORATORY 50 M²
  FOR QUALITY CONTROL, PRODUCT DEVELOPMENT
- ADMINISTRATIVE OFFICES 64 M².
- STAFF FACILITIES 180 M².
  TOILETS, CHANGE ROOMS, CANTEEN, SHOWERS FOR PRODUCTION WORKERS
- COLD STORAGE 200 M²
  STORAGE OF UNFROZEN SKIPJACK ON ICE IN INSULATED CONTAINERS.
- 200 TONNES CAPACITY
- ICE STORAGE 72 M².
  CAPACITY 90 TONNES OF FLAKE OR PLATE ICE
- ICE MAKING
  CAPACITY 20 TONNES / DAY.
- BLAST FREEZER
  CAPACITY 10 TONNES / DAY.

+10.20
+9.40
+3.80
+2.00
±0.00
-0.50
+11.20
±10.30

NOTES:

OPERATION MACHINERY EQ EQUIPMENT.

1. THAWING CONTAINERS.
2. BAND SAW
3. BRINING PREPARATION
4. CONVEYOR
5. BRINING
6. CONVEYOR
7. TUNA COOK BASKETS.
8. WASHING MACHINE FOR BASKETS.
9. TUNA PRE - COOKER
10. FEEDING CONVEYOR FOR TUNA BASKETS.
11. CLEANING TABLE
12. ROLLER CONVEYOR.
13. SCALE
14. PACKING TABLE
15. HYDRAULIC PRESS.
16. EMPTY CANS.
17. AUTOMATIC FILLING MACHINE FOR TUNA
18. INSPECTION
19. EXHAUSTING
20. AUTOMATIC SEAMING MACHINE
21. CONVEYOR
22. WASHING
23. CONVEYOR
24. RETORT CRATES.
25. RETORTS
26. WASHING AND DRYING MACHINE
27. CONVEYOR
28. LABELLING
29. CARTONING
30. PALLETIZING.
31. BULK ELEVATOR
32. GUTTING MACHINE
33. TO OFFAL FLUME TO FISHMEAL PLANT.
34. INSPECTION / MANUAL GUTTING
35. REFRIGERATION CONDENSERS

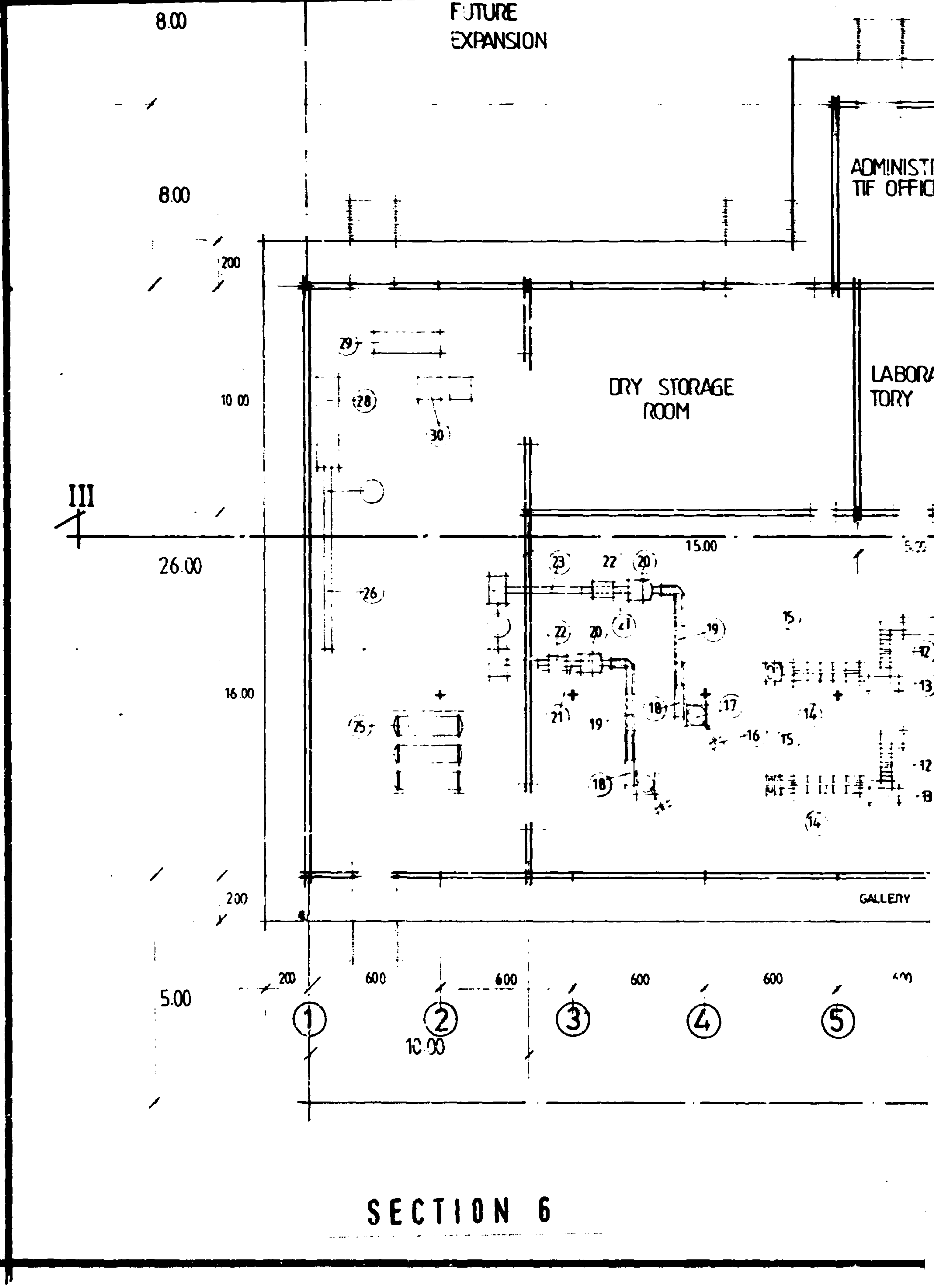
PROJECT

UNIDO MARINE RESOURCES STUDY

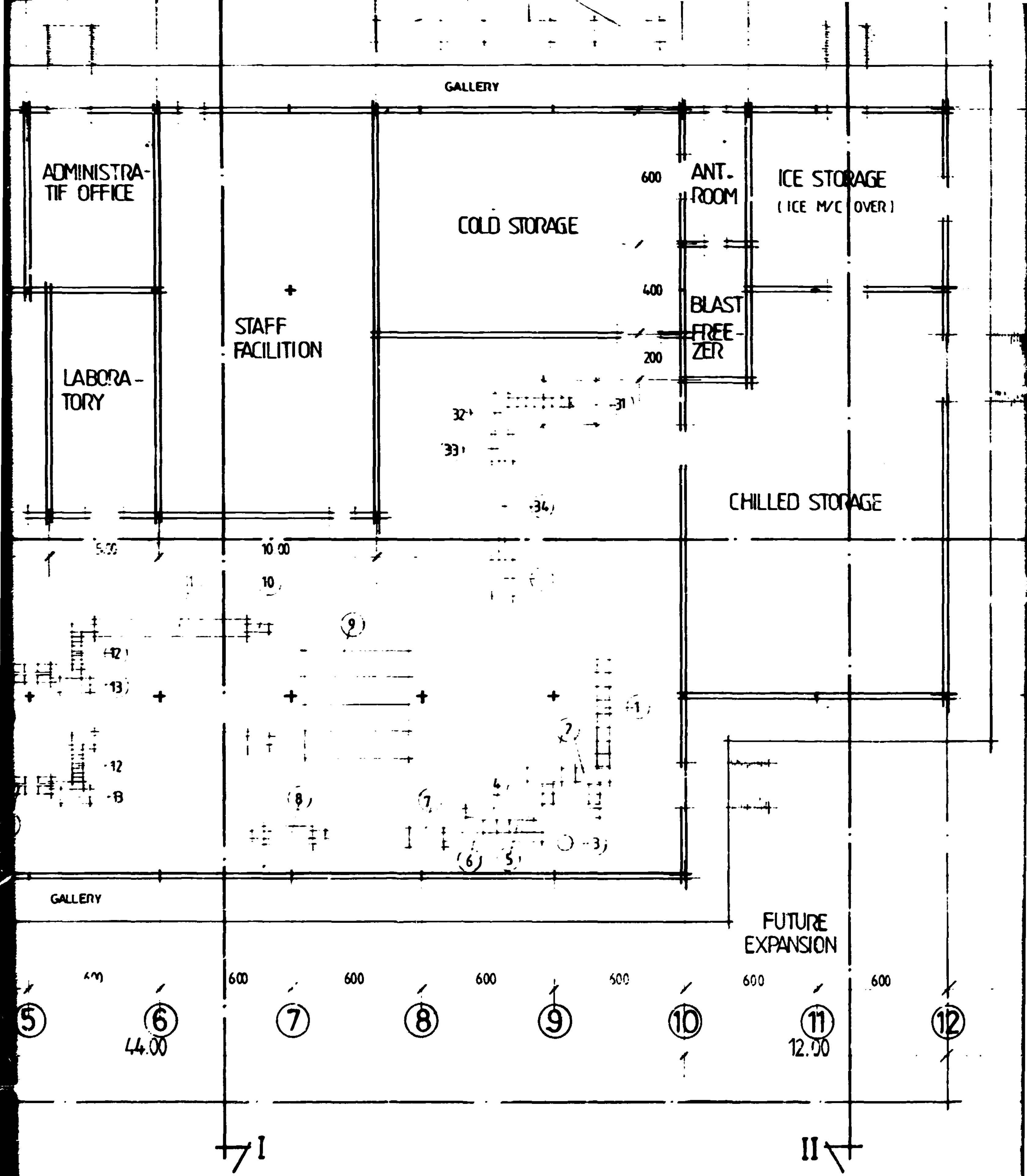
JOB DESCRIPTION

FISH CANNING FACTORY

DESIGNERS		SIGNATURE
ARCHITECT	IR. BUNTARAN TAI	[signature]
STRUCTURAL ENGINEER		
ELECTRICAL		

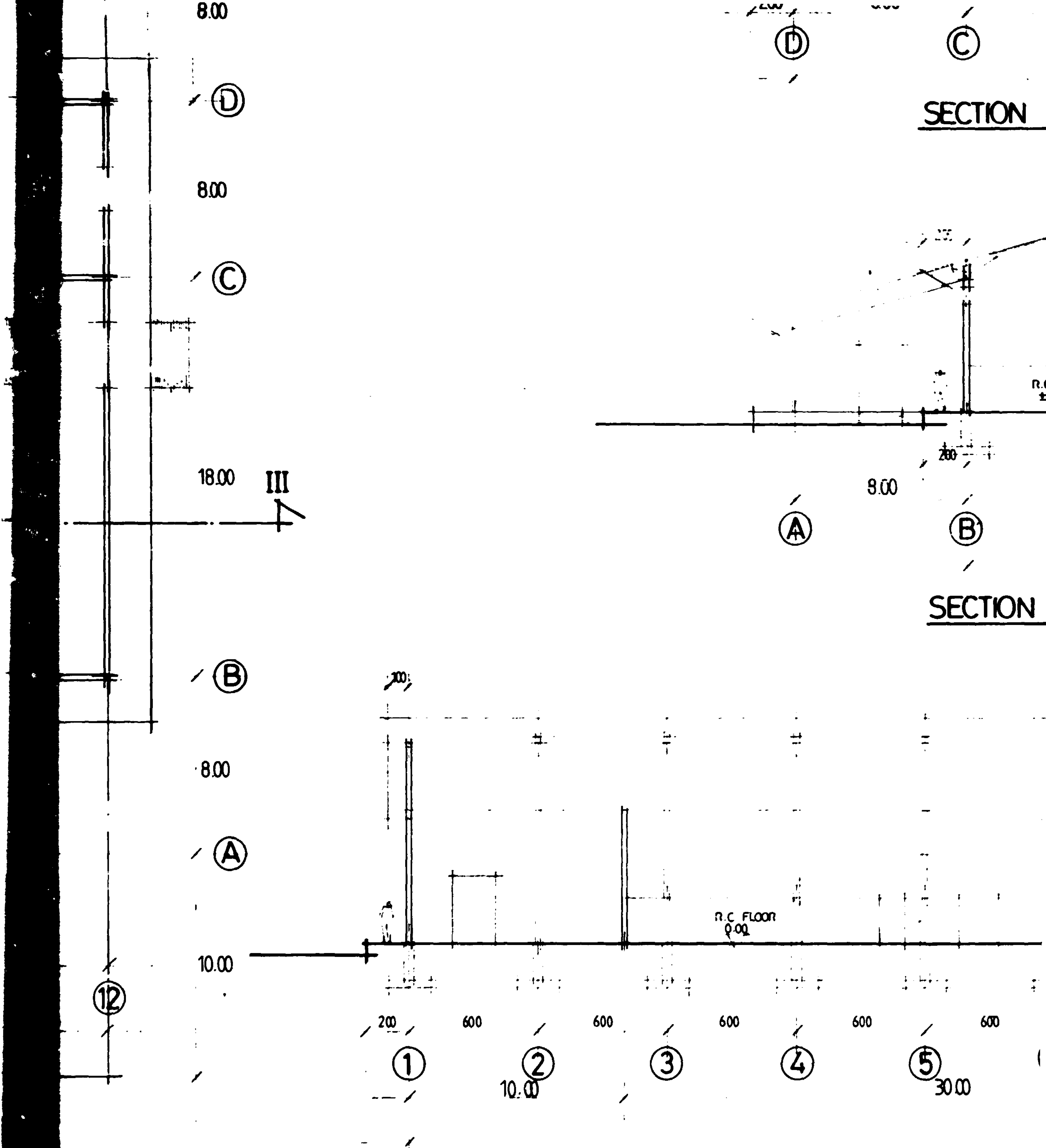

FUTURE
EXPANSION
ADMINISTRA-
TIF OFFICE
DRY STORAGE
ROOM
LABORA-
TORY
GALLERY
III
8.00
8.00
26.00
5.00
10.00
15.00
16.00
10.00
200
600

SECTION 6



PLAN
1:200

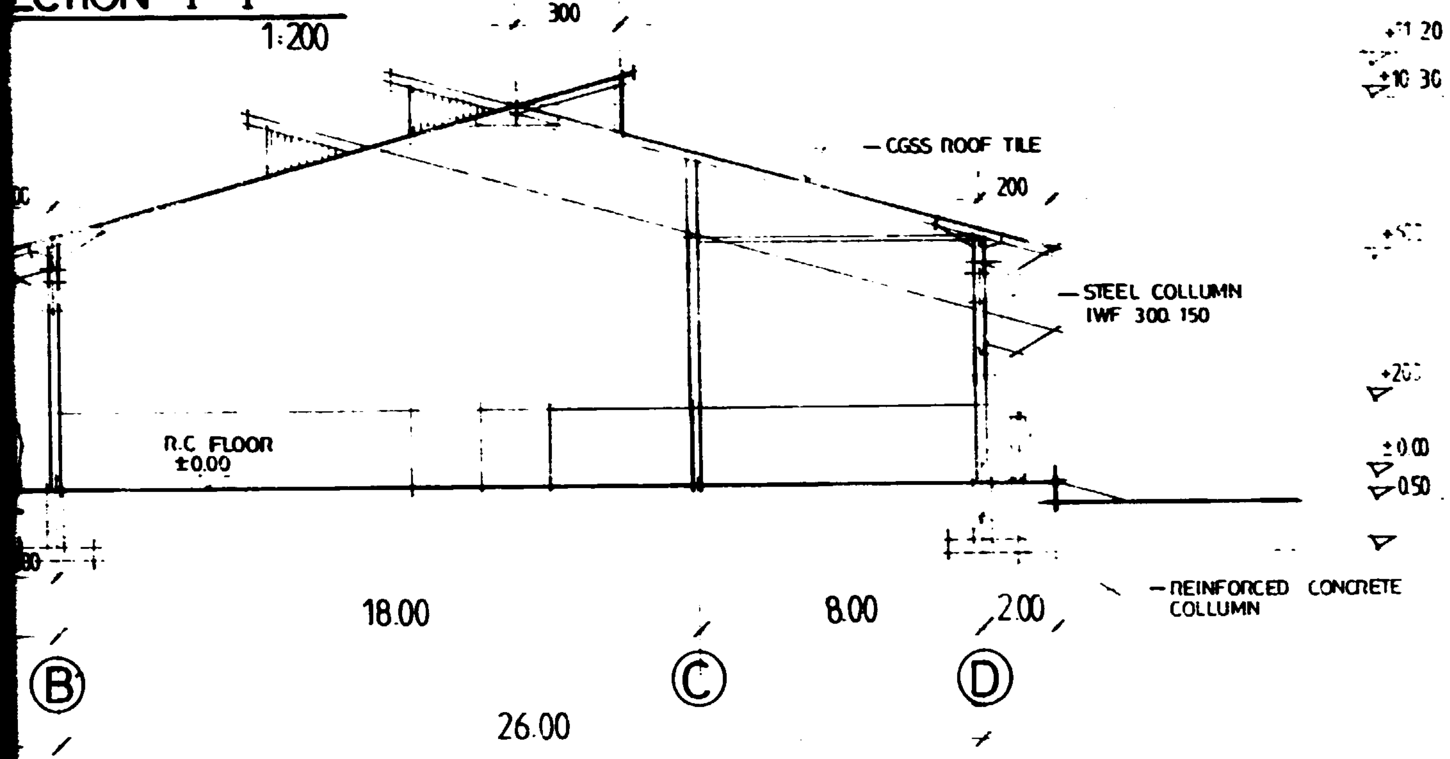
SECTION 7


8.00
D
C
SECTION
8.00
D
C
18.00
III
8.00
A
B
SECTION
B
8.00
A
10.00
12
R.C FLOOR
0.00
200
600
600
600
600
600
1
2
3
4
5
10.00
30.00

SECTION 8

ECTION I - I

1:200



ECTION II - II

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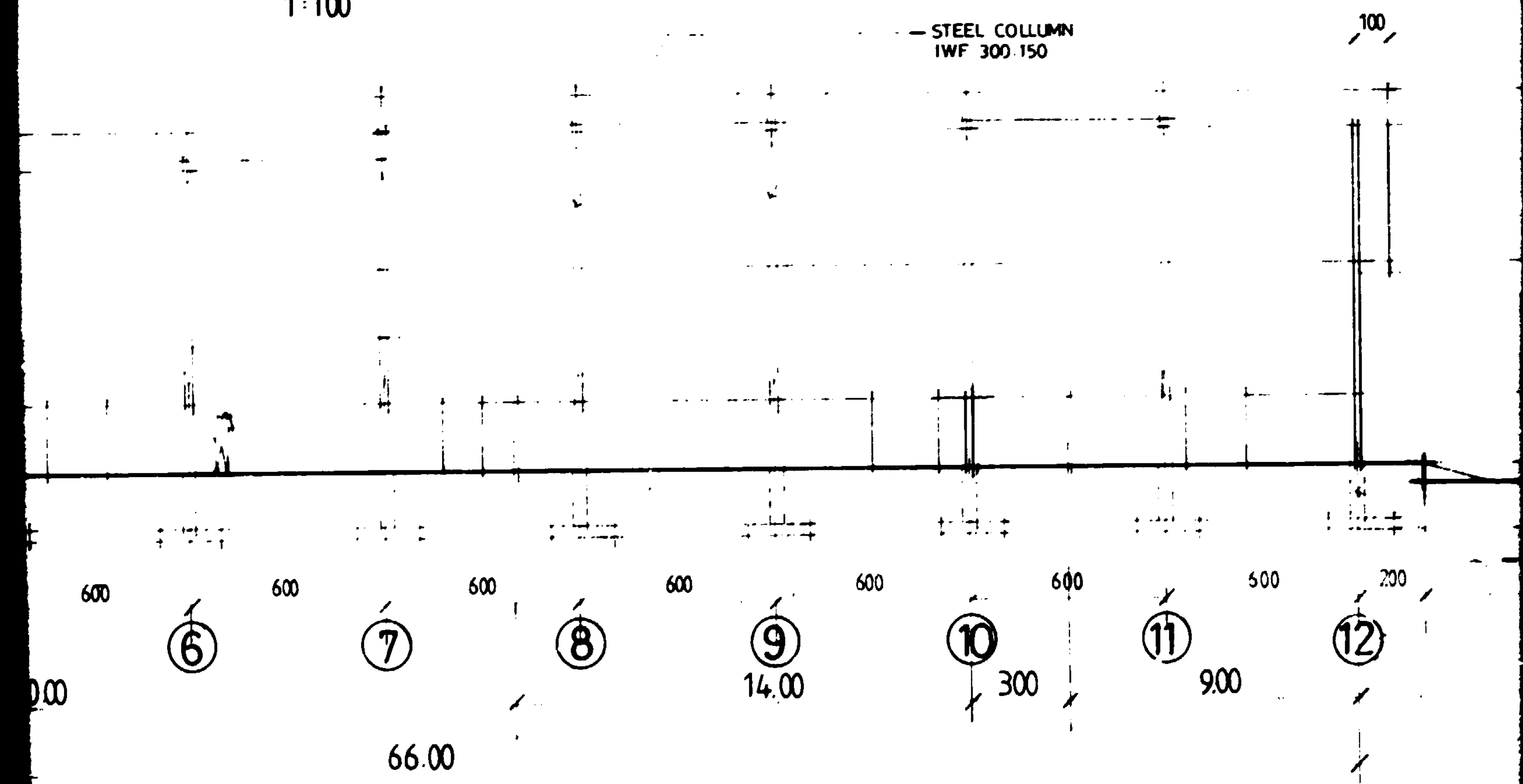

SECTION III - III

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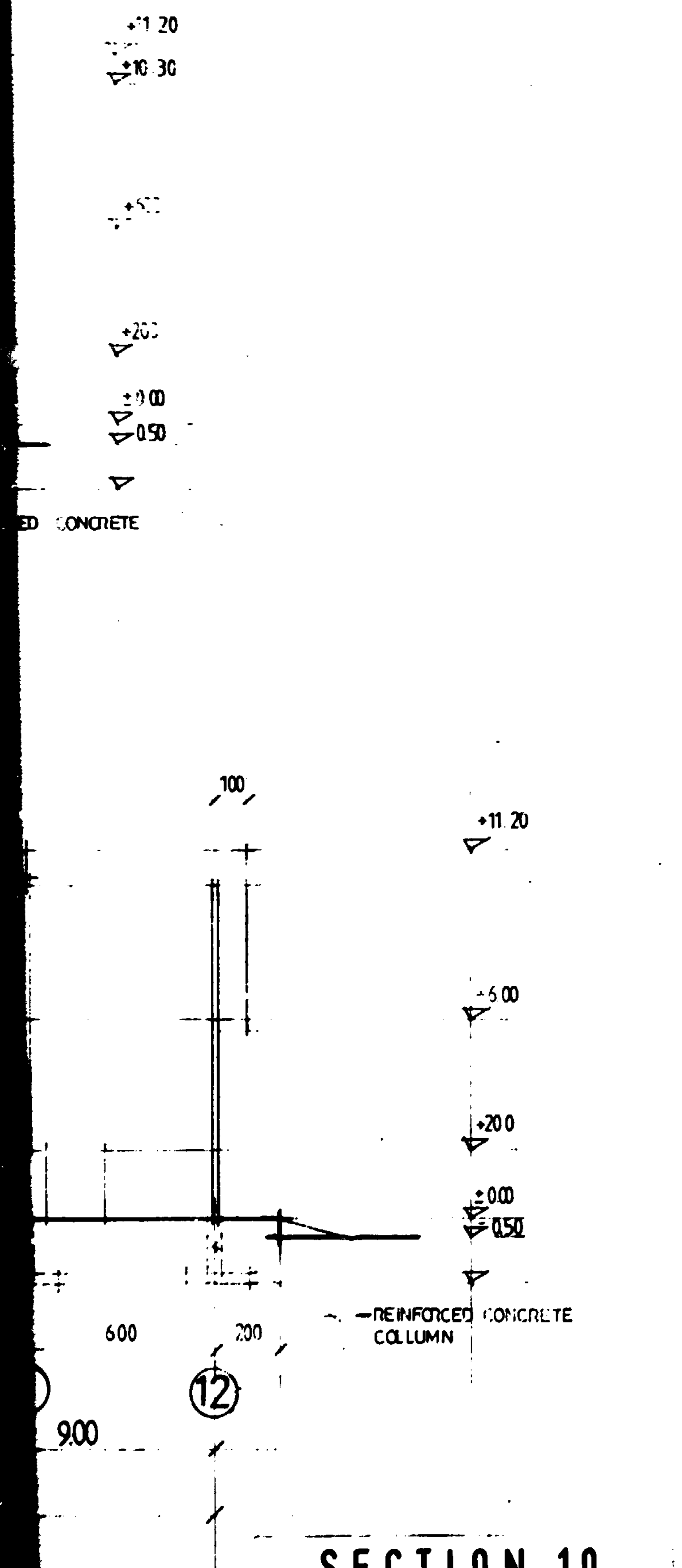
SECTION 9



SECTION 10

RESOURCES STUDY

JOB DESCRIPTION		
FISH CANNING FACTORY		
DESIGNERS		SIGNATURE
ARCHITECT	Ir. BUN[illegible]AN IAI	
STRUCTURAL ENGINEER		
ELECTRICAL MECHANICAL		
DRAWING : -PLAN -ELEVATION -SECTION		
DRAWN BY		
CHECKED BY		
APPROVED BY		
ISSUED BY		

SCALE	DRAWING CODE	DRAWING NO

CANADIAN FISHERY CONSULTANTS LIMITED
HALIFAX, NOVA SCOTIA, CANADA

PT REKA CIPTA
ENGINEERING CONSULTANT
JLN. BALAIKOTA NO.11 TLP. 4846 UJUNG PANDANG
TELEX 71563 RAMA UP IA.