UNIVERSITI PUTRA MALAYSIA

TECHNICAL EFFICIENCY OF THE DRIFTNET AND PAYANG SEINE (LAMPARA) FISHERIES OF WEST SUMATRA, INDONESIA

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By

LINDA WATY ZEN

Thesis Submitted in Fulfillment of the Requirements for the Degree of Master of Science in the Faculty of Economics and Management Universiti Putra Malaysia

May 1999

Especially dedicated to my dearly beloved :

Father and Mother,

Mohammad Zen Djamil & Hj. Fatimah Yunidar Zen

Brother and Sisters,

Rusdi Zen, Renita Zen, Hj.Sri Daryanti Zen & their families

Nephews and Niece,

Kahlil, Farrel, Sindu & Kamila

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May 1999

Chairman : Professor Nik Mustapha Raja Abdullah, Ph.D
Faculty : Economics and Management

This study examines resource use efficiency in the fish production from different types of fishing vessels operating different types of gears in West Sumatra. Specifically, this study addresses the issues on productivity and technical efficiency of fishing operations of driftnet and payang seine (lampara) fishing in order to determine the economic performance of the small-scale multi-gears fisheries.

The translog and Cobb-Douglas production frontier functions were specified as the empirical model of this study. The frontier regression model was estimated using the maximum likelihood estimation (MLE) technique. The Cobb-Douglas stochastic frontier model was found to be unsuitable to represent the data, while the translog model for both driftnet and lampara provide better estimates.

The estimates of regression coefficients for the driftnet differed between the OLS and MLE methods. These results could be due to the inefficient estimates by the OLS method. Meanwhile in the case of lampara, the estimated regression coefficients of the two methods were almost similar, indicating that lampara were technically efficient regardless which particular combinations of the selected bundle of inputs used.

The return to scale was found to be greater than one for driftnet but less than one for lampara. These results indicated that the level of fishing effort in the lampara fishery has already surpassed the maximum sustainable yield (MSY) level, while the opposite is true for the driftnet.

The computed technical efficiencies for individual driftnet fishing units ranged from 0.7272 to 0.9989 with an average of 0.9292, while for lampara it ranged from 0.9035 to 0.9829 with an average of 0.9829. The results also showed that about 70% of driftnet fishing units have achieved technical efficiency of more than 90% while all the lampara fishing units achieved more than 90% technical efficiency.

The findings of this study suggests that the room for expansion in the driftnet fishery is greater compared to lampara fishery, through the adoption of the best technology and through optimal resource allocation.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi sebahagian keperluan untuk Ijazah Master Sains.

KECEKAPAN TEKNIK PERIKANAN JARING HANYUT DAN PUKAT PAYANG (LAMPARA) DI SUMATRA BARAT, INDONESIA

Oleh

LINDA WATY ZEN

Mei 1999

Pengerusi : Profesor Nik Mustpaha Raja Abdullah, Ph.D
Fakulti : Ekonomi dan Pengurusan

Kajian ini mengkaji kecekapan penggunaan sumber di dalam hasil perikanan dari berlainan jenis perahu/kapal perikanan yang beroperasi dengan jenis alat tangkap yang berlainan di Sumatra Barat. Lebih khususnya, pada produktifi dan kecekapan teknik dari perikanan jaring hanyut dan pukat payang (lampara) dianalisa untuk menentukan pencapaian ekonomi dari perikanan yang menggunakan pelbagai alat tangkap skala kecil.

Model empirik dari kajian ini menerapkan fungsi 'translog' dan 'Cobb-Douglas'sebagai fungsi produksi frontier. Model frontier regresi diperhitungkan dengan menggunakan teknik 'Maximum Likelihood Estimation (MLE)'. Model 'Cobb-Douglas stochastic frontier' didapati tidak mencukupi untuk mewakili data, sementara model translog untuk jaring hanyut dan pukat payang memberikan anggaran yang lebih baik.

Anggaran koefisien regresi antara cara OLS dan MLE pada jaring hanyut adalah berbeda. Ini dapat disebabkan anggaran dari cara OLS adalah tidak cekap. Sementara itu bagi pukat payang (lampara), anggaran koefisien regresi dari kedua cara adalah hampir sama, menunjukkan bahwa pukat payang (lampara) didapati cekap dari segi teknik tanpa memperhatikan khusus kombinasi sejumlah input terpilih yang digunakan.

Skala kembalian didapati lebih besar daripada satu untuk jaring hanyut tetapi kurang daripada satu untuk pukat payang (lampara). Hal ini menunjukan bahwa tingkat usaha penangkapan pada pukat payang (lampara) telah melampaui tingkat 'Maximum Sustainable Yield (MSY)', sementara keadaan yang sebaliknya berlaku untuk jaring hanyut.

Perhitungan kecekapan secara teknik untuk perseorangan satuan jaring hanyut berada antara 0.7272 sampai 0.9989 dengan nilai rata-rata 0.9292, sedangkan untuk pukat payang (lampara) nilai itu berada antara 0.9035 sampai 0.9829 dengan nilai rata-rata 0.9829. Didapati juga bahwa sekitar 70% satuan penangkapan jaring hanyut mencapai lebih dari 90% cekap secara teknik sedangkan 100% satuan penangkapan pukat payang (lampara) diatas 90% cekap secara teknik.

Penemuan kajian ini menyarankan bahwa ada kesempatan untuk pengembangan jaring hanyut yang lebih banyak daripada pukat payang (lampara), dengan pengambilan teknik terbaik dan melalui alokasi sumber secara optimal.

CHAPTER I

INTRODUCTION

Background

Indonesia has 5.8 million square km of sea areas which includes 3.1 million square km of archipelagic water and 2.7 million square km of Indonesian exclusive economic zone. As an archipelagic nation, Indonesia has 17,508 islands with a coastline of 81,000 km, the longest in the world (Anon, 1983). These areas are very rich in natural resources especially marine resources which support the livelihood of many Indonesians. A careful and rational utilization of these resources are therefore important.

Constitutionally, Indonesia is a unitary republic comprising of 27 provinces. The total population was 192,216 million in 1994. The capital city is situated in Java, the most densely populated island which is inhabited by 61.9% of the total population. The geographical location of Indonesia is shown in Figure 1.1.

Indonesia has national development plans, embodied under REPELITA (*Rencana Pembangunan Lima Tahun*) or Five Year Development Plan (FYDP). The first FYDP covered the period between 1969 to 1973. This was then followed by FYDP II (1974-1978), FYDP III (1979-1983), FYDP IV (1984-1988), FYDP V (1989-1993), and the present FYDP VI (1994-1998). These

plans consist of development programs and projects which include infrastructure and non-infrastructure development.

The main priority of economic development as stated in national guidelines (*Garis Besar Haluan Negara* or GBHN) is to establish a balanced economic growth between the industrial and agricultural sectors. Fisheries development programmes established during FYDP VI (Directorate General of Fisheries, 1995) are aimed at :

1. improving the quality of manpower and fisheries income.
2. increasing the quality of domestic nutrition consumption of society by increasing fish production and more efficient fish/fish-stuff distribution.
3. providing new employment and productive business opportunities, and
4. increasing the growth of domestic industries through sustaining its raw material supply and enhance income earning for the state.

In order to achieve national goals, every sector and sub-sector including the fishery, developed its own set of strategies to guide development. Realizing the national importance of the fisheries sector the government has set a target in REPELITA (FYDP) VI (1994-1998) to increase fisheries production by 4.6% and 5.7% per annum for marine and inland fisheries, respectively. Overall, the national target of production of Indonesian fisheries which was outlined by the Directorate General of Fisheries (DGF) is about 4.9% per annum during REPELITA (FYDP) VI as shown in Table 1.1

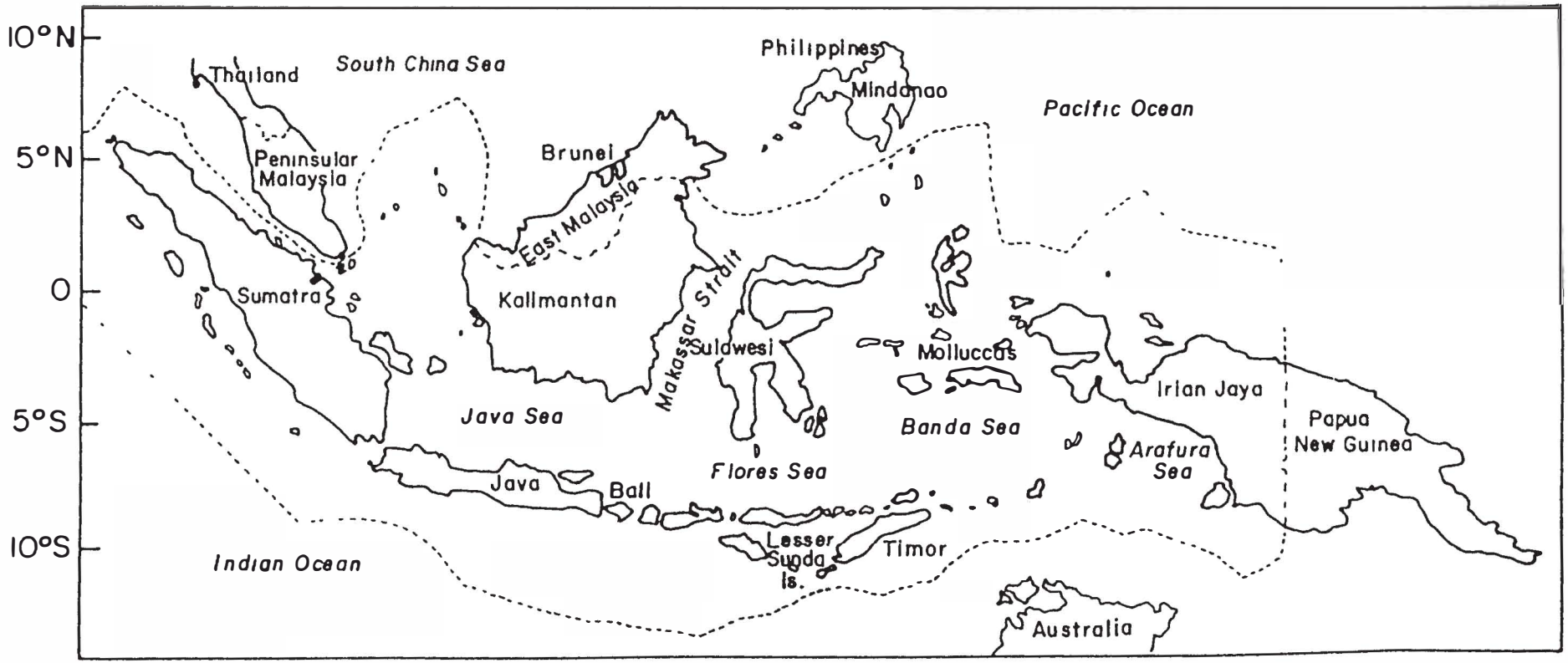

Figure 1 1 The Geographical Location of Indonesia

The operational strategy that was outlined to achieve the goals of fisheries development in REPELITA (FYDP) VI (Directorate General of Fisheries, 1995) among others include :

1. production : diversification, intensification, extensification, and rehabilitation of fisheries resources.
2. Marine capture fisheries : rationalization of the unproductive boats and encourage the offshore exploration ; intensive enforcement of fishing gear used ; emphasize the catch of high valued fish with export orientation ; and extend the demersal fishing gears such as long-line, gill-net , and others.
3. Culture: extensification of brackish-water, fresh-water and open fisheries cultures are to be maintained especially for the promotional commodities such as shrimp, milkfish, carp, catfish, red-snapper and ornament fishes.
4. Basic infrastructure development
5. Investment encouragement
6. Poverty alleviation
7. Fisheries resource management
8. Improve human resource quality, and
9. Implementing the main four fisheries programs: integrated agricultural development, agricultural effort development, food and nutrition diversification, and fisheries resource and infrastructure development.

Table 1.1.
Projected Fisheries Production in REPELITA (FYDP) VI
in Thousand Metric Tons

Category	1994	1995	1996	1997	1998	Average annual rate (%)
1. Marine Fisheries	**2,859.10**	**3,004.90**	**3,140.50**	**3,276.00**	**3,416.40**	**4.60**
1.1.Marine Capture	2,724.40	2,857.90	2,980.20	3,101.10	3,255.60	4.30
1.2.Marine Culture	134.70	147.00	160.30	174.90	190.80	9.10
2. Inland Fisheries	**1,047.90**	**1,094.20**	**1,159.10**	**1,229.30**	**1,305.60**	**5.70**
2.1. Capture	318.30	318.90	319.60	320.20	320.90	0.20
2.2. Aquaculture	729.60	775.30	839.50	909.10	984.70	7.80
2.2.1. Brackish-water	430.00	454.70	494.80	538.50	585.90	8.00
2.2.2. Fresh-water	169.30	179.40	191.30	203.90	217.40	6.50
2.2.3. Cage and other	9.20	10.00	11.40	12.90	14.80	12.60
2.2.4. Paddy Field	121.10	131.20	142.00	153.80	166.60	8.30
T O T A L	**3,907.00**	**4,099.00**	**4,299.60**	**4,505.30**	**4,722.00**	**4.90**

Source : Department of Agriculture, 1994

The Role of Marine Fisheries

Agriculture still plays an important role in the Indonesian economy. The fisheries share of Gross Domestic Products (GDP) although modest, has grown by over 40% in the last 15 years from 1.4% in 1987 to 2.0% in 1992 (Putro, 1995).

The fisheries have made significant progress since the First Five-Years Development Plan (FYDP), which commenced in 1969. The total fish production reached 4.5 million tons in 1996, of which 3.5 million tons came from marine fisheries and 1 million tones from inland fisheries.

With a total fish production of 4.3 million metric tons in 1995, Indonesia was the eight largest fish-producers, contributing around 3.3% of the world's fish production. Capture fisheries contributes some 77% of total production, while the share from aquaculture and inland capture were 15% and 7.7%, respectively (Directorate General of Fisheries, 1997).

Fisheries is an important sector in the Indonesian economy because it embraces the major part of the nation's natural resources and provides employment for the strategic portion of the country's rural poor.

Fish provides the single most important source of animal protein in the peoples diet and the only affordable source to the majority of the population. Given the relatively high cost of meat, eggs and milk products, fish is likely to continue to be the most important source of animal protein in Indonesia. It has been estimated to provide about 60% of the total domestic animal protein supply.

With a population of more than 200 million, however the average per capita fish consumption is still quite low. The national per capita consumption of fish in 1996 was 19.00 kg / year. Nonetheless, consumption rates vary regionally, with estimates for major island groups of Sumatra, with 15.9 kg / year, Java 5.5 kg / year, Kalimantan (Borneo) 33.2 kg / year, and Maluku (Moluccas) and Irian Jaya (New Guinea) at 30.6 kg / year (Directorate General of Fisheries, 1997).

Fisheries also provides sizeable employment opportunities to over 4.0 million fishermen and fish farmers, representing some 5% of the total labor force in the country. In 1995, there were 4,568,059 people engaged in the fisheries sector (Directorate General of Fisheries, 1997). About two million (almost half) fishermen were engaged in marine fishing which was mainly carried out in the inshore waters, especially along the coast of densely populated areas of Java, Sumatra and South Sulawesi.

Fishing Fleets and Fishing Gear

Indonesia's marine fisheries sector is subdivided into small, medium, and large scale sub-sectors. A clear distinction based on investment cost separates the small-scale sub-sector from medium and large scale. All boats powered by sail or outboard engines are defined by Directorate General of Fisheries (DGF) as small-scale, as are all fishing gears operated without use of boat (DGF, 1975) while boats powered by inboard engines (typically diesel) are classified as medium or large scale (Bailey *et al.*, 1987). The important difference between boats powered by inboard engines and those of the small-

scale sub-sector is not only in the higher investment of the former (Yamamoto, 1978) but also the technology used by fishing operators (Bailey *et al.*, 1987).

The marine fisheries in Indonesia are dominated by the small-scale operators. It is characterized by low technological inputs and low productivity. Small scale fisheries operators make-up about 90% of the total number of fisherman, and the contribution of small-scale fisheries to national fish production is substantial, accounting about 55% of overall fish produced (Directorate General of Fisheries, 1994).

Small-scale fishermen in Indonesia use gears similar to those found in other countries in Southeast Asia such as seines, gill-nets, fish traps, lift-nets, guiding barriers and hand lines (Bailey, 1987). The types of gear commonly employed without use of boat for the small-scale sub-sectors include cast-nets, push nets and various fixed gears.

During the 1960's the small-scale gears dominated Indonesian fisheries, where about 98.99% of all fishing boats operated without engines. Ten years after, increasing number of inboard and outboard powered boats entered Indonesian fisheries. By 1982, outboard powered boats accounted for two thirds of all boats with engines (Bailey *et al.*, 1987). Nowadays, most of the boats are equipped by at least outboard engine and the non- powered boat can rarely be found in fishing grounds.

The total number of fishing boats in Indonesia was 544,879 units in 1995, consisting of 74.27% marine boats and 25.73% for open water (such as lake, river, pond), of which about 378,263 were non-powered boats. Most of the

powered boats, however, are small in size, being less than 50 GT (BPS Indonesia, 1996).

West Sumatra Fishery

West Sumatra is one of the twenty-seven provinces in Indonesia. The province lies in the West coast of Sumatra at 0° 54' north latitude to 3° 30' south latitude and 98° 36' to 101° 53' east longitude. The most important economic activity in this region is fishing, especially the marine fisheries. This sector plays an important role in the socio-economic aspects of population in this area.

Dwiponggo (1987) stated that both demersal and pelagic resources in the coastal fisheries areas bordering the Indian Ocean (including West Coast Sumatra) appeared to be under-exploited. Cushing (1971) estimated that tertiary production of the Indian Ocean to be 5.8 tons/km^2, with between one-third to one-half was harvestable by man. For the Indonesian share of the Indian Ocean (West coast Sumatra, South Coast Java, and lesser Sunda Islands), total standing stock for both demersal and pelagic resources is estimated between 500,000 750,000 tons.

With a population of 4.4 million in 1996, about 3.41% of them were engaged in fishery sector, which composed of 54.37% fish farmer, 23.77% open water fishermen and 21.86% marine fishermen. Table 1.2 shows the number of people engaged in the fishery sector during the period of 1990 until 1996.

The total number of fishermen increased from 1990 until 1995, after which it declined in 1996. However, with the exception of 1991-1992 period,

the number of marine fishermen increased every year during 1990-1996. In 1990 there were only 28,446 marine fishermen in West Sumatra, but increased to 32,720 fishermen in 1996. The number of fish farmers meanwhile showed a similar trend as that of the total fishermen, while the number of open water fishermen fluctuated during this period.

Table 1.2.
Number of Fish Farmer, Open Water Fishermen and Marine Fishermen, 1990-1996.

Year	Fish farmer	Open water fishermen	Marine Fishermen	Total
1990	85,726 (54.99)	41,706 (26.76)	28,446 (18.25)	155,878
1991	87,277 (55.33)	40,863 (25.91)	29,587 (18.76)	157,727
1992	89,193 (55,67)	41,430 (25.86)	29,587 (18.47)	160,210
1993	88,259 (55.04)	41,500 (25.88)	30,600 (19.08)	160,359
1994	94,218 (56.50)	40,728 (24.43)	31,804 (19.07)	166,750
1995	94,695 (56.66)	40,451 (24.26)	31,895 (19.08)	167,131
1996	81,372 (54.37)	35,576 (23.77)	32,720 (21.86)	149,668

Source : West Sumatra in figures, various issues

Note : figures in parentheses indicate percentages

The total sea areas including those within the EEZ waters are huge measuring of 138,750 km^2 with a coast line of 450 km. Based on the 1991 survey of Directorate General Fisheries West Sumatra, the estimated Maximum Sustainable Yield (MSY) was 538,457 tons/year, of which only 37% was currently being exploited (Directorate General of Fisheries, 1992). The location of the study area within the province is shown in a map presented in Figure 1.2.