BIODYNEX WORKSHOP

23-25 MARCH 1994

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INTRODUCTION

This workshop was held, from the 23th to the 25th March in Jakarta. Scientists of the project, Indonesian institutions and ASEAN countries attended this workshop (see list of participants). Under the supervision of the experts invited, some particular aspects underscored during the seminar were studied. To achieve these tasks, basic data available at the project were used and four working groups, each coordinated by an expert, were formed. After two days of analysis, the conclusions of each group were discussed during a general meeting and recommendations were given.

Group I : J. WIDODO

Bio-geography analysis of the main species found in the fishery. Bibliographic comparison of some biological and ecological parameters among the same or related species in different parts of the world..

Group II : F.C. GAYANILO

Analysis of length-frequencies with FiSAT software. Case study: *Decapterus macrosoma, Rastrelliger kanagurta, Amblygaster sirm.*

Group III : P. FREON

Analysis of catch and effort data.

Group IV : S.B. SAILA

Environment. Based on the study of historical data.

GROUP I : Bio-geography

This group analyzed the growth rate and the natural mortality parameters of the main species caught by the fishery and compared them to the same or related species in other parts of the world in order to estimate some richness indexes and exploitation rates of the Java Sea and to confirm the ecological status of the studied species (coastal or oceanic, migrant or sedentary).

These comparisons were based on results (tab. I) found prior to the project by some Indonesian scientists on *Decapterus spp.* (Sadhotomo and Atmaja, 1985; Widodo, 1988), *Rastrelliger kanagurta* (Sujastani, 1974; Nurhakim 1993), on *Selar crumenophthalmus* and *Sardinella gibbosa* (Dwippongo *et al.*, 1986) in the Java Sea, in the Indo-Pacific region (Ingles and Pauly, 1984) and in other parts of the world (Van Nierop and Nhwani, 1986).

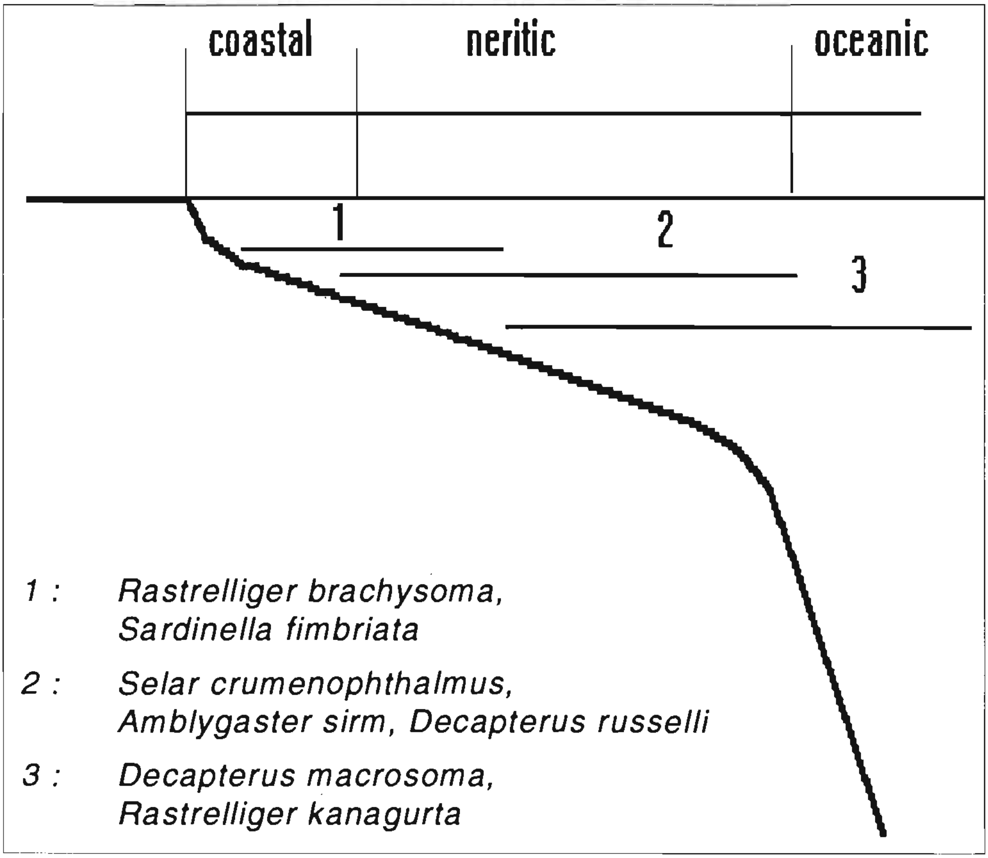


Figure 1

Ecological distribution of the main pelagic species caught by the seiners

Distribusi geografis dari spesies ikan-ikan pelagis utama yang tertangkap oleh purse-seine

Table I

NATURAL MORTALITY AND GROWTH RATE FOR DIFFERENT SPECIES IN THE JAVA SEA AND OTHER PARTS OF THE WORLD.

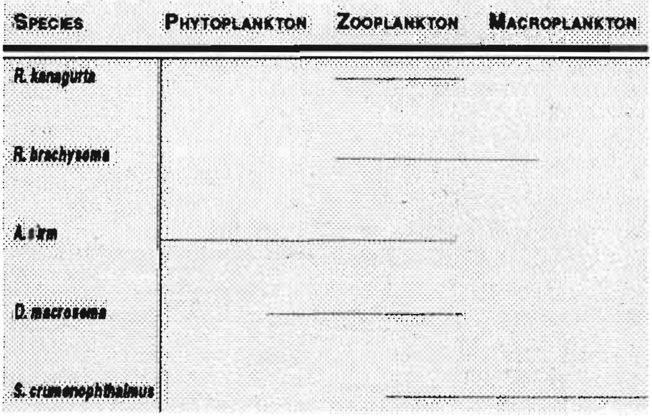
MORTALITAS ALAMI DAN LAJU PERTUMBUHAN DARI BEBERAPA SPESIES YANG BERBEDA DI LAUT JAWA DAN PADA BEBERAPA TEMPAT DI DUNIA.

SPECIES	REGION	M	K
Decapterus russelli	Java Sea	.65< M <1.19	.39
	Java Sea	2.0	1.18
	Java Sea	1.8	.95
	Philippines	1.1< M <1.19	.54
Decapterus macrosoma	Java Sea	62< M <1.73	.73
	Java Sea	1.86	.98
	Philippines	1.1< M <2.3	1.25
Rastrelliger kanagurta	Java Sea	1.625	
	Java Sea	.64< M <1.04	.68
	Java Sea	2.58	1.63
	Malacca Strait	.78	
	Mozambique	84	
	Philippines	2.43	1.55
Selar crumenophthalmus	Java Sea	2.17	1.25
	Hawaii	2.57	
	Philippines	.89	
	Mariana Islands	.61	.89
Sardinella gibbosa	Java Sea		
	South China Sea	2.29	1.2
	Mozambique	1,46	,58

Table II

FEEDING HABITS OF THE MAIN PELAGIC SPECIES CAUGHT BY THE SEINERS IN THE JAVA SEA.

KEBIASAAN MAKAN DARI SPESIES IKAN PELAGIS UTAMA YANG TERTANGKAP OLEH PURSE SEINE DI LAUT JAWA



The heterogeneity of the methods used to estimate these parameters in the various analyzed studies don't allow us to find clear conclusions. Nevertheless the values of M and K seem relatively high in the Java Sea.

Pelagic species caught by the seiners are tropical species with a worldwide distribution(*S. crumenophthalmus*), Indo-Pacific (*R. kanagurta*, *Amblygaster sirm*, *S. gibbosa*) or a more restricted South-East Asia (*Rastrelliger brachysoma*, *Sardinella fimbriata*).

Most of them are typically shoaling fish which live mostly over continental shelves and make migrations across deep waters (*R. kanagurta*, *Decapterus macrosoma*). Their dispatch over the continental shelves (fig. 1) is conditioned by the tolerance to salinities, some of them being euryhaline (*R. brachysoma*, *S. gibbosa*, *Sardinella fimbriata*) some others stenohaline being unable to live in waters less than 32 ‰ (*R. kanagurta*,*D. macrosoma*, *Decapterus russelli*).

They are predominant zooplankton and macroplankton feeders, showing different diet behaviors according to their life stage (tab. II).

Most of these species due to their feeding diet are not dependent on a major seasonal upwelling system with its associated phytoplankton bloom. Nevertheless, relationship exists between regions of high plankton abundance and scads fishing grounds (Longhurst and Pauly, 1987).

Some species (*S. crumenophthalmus*, *Decapterus spp.*) show different behavior being epipelagic fish during their juvenile phase and bentho-demersal fish during their adult phase (Tiews *et al.*, 1970).

This group noted that a systematic bibliographic research has to be started to get better knowledge on the biology of these species or related ones through their extension area and as many of them have a large South-East Asia dispatch, some regional studies could be implemented.

GROUP II: Length Frequencies analysis.

Starting in May 1991, the project set a sampling scheme on the large and medium seiners fisheries in the main landing places (Boely *et al.*, 1990; Potier and Sadhotomo, 1991). Length frequencies measurements are made every day on the main species and by fishing grounds. Five species represent 90% of the total catch. Among them, *D. russelli* and *D. macrosoma* which form the bulk of the catch (60%) as well as *R. kanagurta* which is the most valuable species were chosen for the study.

In first approach the data were pooled in two groups (Java Sea, South China Sea) corresponding to the best assumptions in terms of stocks units. The analysis was performed using the FiSAT software developed by ICLARM and which is a synthesis of ELEFAN and FSAS systems (Gayanilo, 1994).

The results obtained were compared to previous results on the same species in the Java Sea and other areas (tab. III). Most of the results are expressed in TL (Total Length). As the measurements made in the project are in FL (Fork Length), a relationship between these two parameters would be useful to compare the different studies.

Nevertheless, the values of L_∞ found with the project data do not vary much from previous results in the Java Sea. Values of L_∞ found in the Java Sea are generally smaller than the L_∞ found on the same species in other areas.

The project samples purse seiners which catch fish over the continental shelf in water no more than 100 m deep. As the increasing mean size of fish with depth is common (Johannes, 1981) and as sometimes size specific migration into deeper water can occur for lowering maintenance metabolism (Longhurst and Pauly, 1987) the largest sizes may be not accessible to this gear.

Another explanation can be found in the conditions prevailing in the Java Sea. Marchal (1992) noted than the most part of coastal species off the Ivory Coast and Ghana present nanism phenomena (*Sardinella aurita, Decapterus ronchus*) due to sedentary behavior and to the low productivity of these waters. As the productivity of the Java Sea seems low, the same phenomena could occur.

SPECIES	REGION	L∞	K
Decapterus russelli	Jakarta Bay	27.0 (TL)	1.18
	Java Sea	28.3 (TL)	0.39
	Java Sea*	24.5 (FL)	0.90
	Philippines		
Decapterus macrosoma	Java Sea	25.4(TL)	0.98
	Java Sea	24.4 (TL)	0.73
	Java Sea *	19.6	2.50
	Philippines	24.4 (TL)	0.95
Rastrelliger kanagurta	Java Sea		
	Java Sea*	26.3 (FL)	0.68
	Malacca Strait	28.7 (TL)	0.78
	India	22.4 (FL)	4.32
	Red Sea	42.0 (TL)	0.30
	Mozambique	22.1 (FL)	0.81

TL: Total Length
FL: Fork Length
**** Project values***

Table III

L∞ AND K VALUES FOUND FOR DIFFERENT SPECIES IN THE JAVA SEA AND OTHER AREAS

NILAI L∞ DAN K YANG DIPEROLEH DARI BEBERAPA SPESIES YANG BERBEDA DI LAUT JAWA DAN DAERAH LAIN

To deal with these hypothesis, as the sampling of the large and medium seiners covers a limited part of the population (fish between 10 to 19 cm) it has to be extended to fisheries which catch other parts of the last one (juveniles or old individuals) and the analysis of the data has to be performed with more than one method.

GROUP III : Analysis of catch and effort data.

When comparing with some temperate stocks, the catch and effort data for large seiners appear to cover a short period, twelve years. But such a database is quite noticeable in tropical fisheries. Catch data are available by commercial category and by fishing grounds for the large and medium seiners fisheries. Most of the work consisted to study these data using time series analysis which helped us to find tendencies and to try to standardize the effort in order to get a representative index of the abundance. Mini purse seiners and Danish seines data (catch, effort) covers three years only and comes from one landing place located in West Java (Tuti *et al.*, pp. 185-194).

The series show a high variability (seasonal and inter-annual) (fig. 2), a great instability and the interaction between them is strong. The CPUE (catch per unit of effort) series of the large and medium seiners fleets show a similar pattern and the differences between them tend to decrease from 1987 to 1992 (fig. 3) as these two categories of vessels tend to overlap (Potier and Sadhotomo, pp. 195-214). The CPUE of the mini and Danish seiners present trends which are not so different from large and medium seiners. Since 1990, the CPUE increases slightly in every fishery (fig. 4).

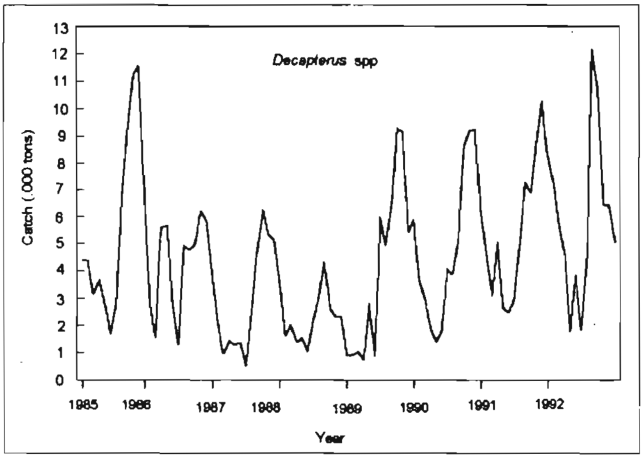


Figure 2

Monthly landings of scads (*Decapterus spp.*) by the seiners fisheries from 1985 to 1992

Jumlah ikan layang, scad (*Decapterus spp.*) yang didaratkan setiap bulan oleh perikanan purse seine dari tahun 1985 sempai dengan 1992

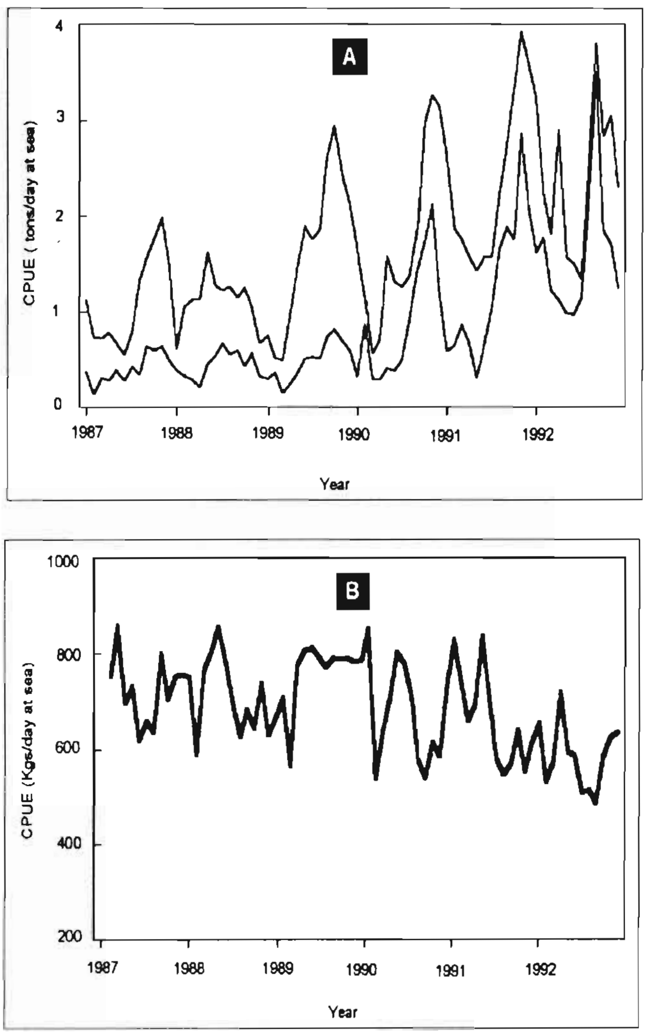


Figure 3

Evolution of the large and medium smoothed CPUE (A) and of the relative difference between their CPUE (B) from 1987 to 1992.

Evolusi hasil tangkapan per unit upaya dari purse seine besar dan sedang (A) serta perbeda relatif antara kedua hasil tangkapan per unit upaya (B) dari tahun 1987 sempai dengan 1992

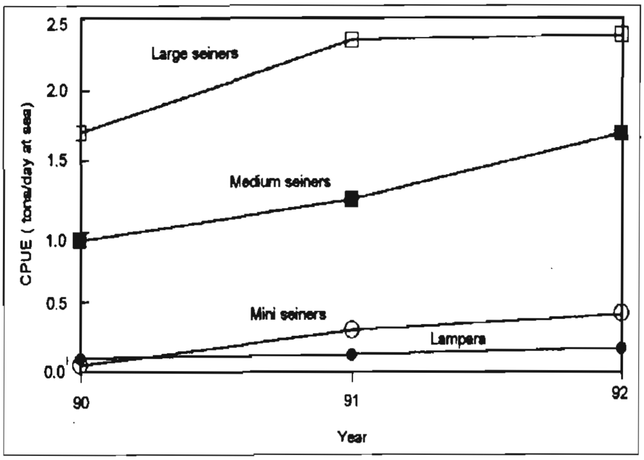


Figure 4

EVOLUTION OF THE ANNUAL AVERAGE CPUE FOR DIFFERENT FLEETS FROM 1990 TO 1992

EVOLUSI RATA-RATA TAHUNANA HASIL TANGKAPAN PER UNIT UPAYA UNTUK JENIS ARMADA YANG BERBEDA DARI TAHUN 1990 SEMPAI DENGAN 1992

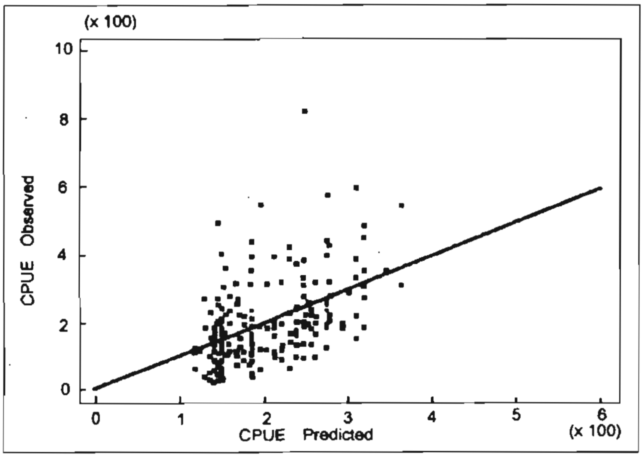


Figure 5

RELATIONSHIP BETWEEN CPUE AND SOME CHARACTERISTICS (LENGTH, CAPACITY) OF THE PURSE SEINERS

HUBUNGAN ANTARA HASIL TANGKAPAN PER UNIT UPAYA DAN BEBERAPA KARAKTERISTIK KAPAL PURSE SEINE (PANJANG, KAPASITAS)

In order to use surplus models, an essay of standardization of the effort was implemented. Some fleets qualitative parameters (spatial, temporal, changes in fishing techniques) as well as quantitative (length, horse power and vessel capacity) were compared to the CPUE by means of a global linear model. The sample used was too small (60 large and 25 medium seiners with data covering three months of CPUE) and no relationship between CPUE and different parameters was found (fig. 5).

Thus, the surplus models we used, even those including environmental variables, explain only a small part of the variance. Two explanations can be given to this poor result. First the starting point of the year for the series must follow the biological cycle of the fish in the Java Sea and cannot coincide with the civil year. Secondly, the estimation of the effort must be improved. A study of the characteristics of the vessels must be done and the changes in the fishing techniques (Potier and Petit, pp. 171-184) have to be taken into account. The logistic model suggest a robustness of the stocks to exploitation (Widodo, 1988 ; Nurhakim, 1993), but this could be due to the mixture of species.

Even if the analysis does not show a relationship between environment and fishing, the high variability of the fishing data seems coming from external factors to the fishery.

A synthesis of the knowledge on the environment of the Java Sea has been given by Durand and Petit (pp. 14-38). As noted by these authors, there are no long time series on environmental parameters except for rainfall. Salinities series cover a short scale time (1950-1954, Veen 1953), or are given for the time of cruises. Winds and productivity parameters are scarcely known on limited geographical areas. More, most of these series were collected before the second world war or immediately after. Since 1960, studies on the environment lack for the Java Sea area.

Available series were studied with the same manner as catch and effort data. Salinities give a good picture of the mean annual pattern of the water masses dispatch in the Java Sea with low salinities (30-32 ‰) during the first part of the year (North-West monsoon) and higher salinities (34-35 ‰) during the second one (South-East monsoon). A well established West-East gradient occurs along the year. Rainfalls show the same pattern as catch and effort with a great spatio-temporal variability.

Primary productivity is high along the southern coast of Kalimantan (Nontji, 1977) during April-May when large runoffs of the Kalimantan rivers occur. This type of situation is often associated to spawning grounds and a detailed study of this area would be useful. We can notice that the fishing grounds are located in the East-southern part of Kalimantan during that period. Satellite imagery could be helpful to follow the intensity of the rivers runoffs and chlorophyll a dispatch.

CONCLUSIONS AND RECOMMENDATIONS

Some conflicting piece of information are obtained from the Java Sea. Referring to the surface of the prospected area (Nurhakim *et al.*, pp. 145-155) which is entirely located in waters comprised between 50 and 100 m deep the total landings are rather low. The exploitation area of the stocks does not cover the whole biomass area of the populations and taking the production per km^{-2} as an index of the biomass is only a last resort. Nevertheless, comparing with similar fisheries existing in other parts of the world, the value found in the Java Sea (2tons/km^{-2}) seems low, against 5 tons/km^{-2} in Ivory Coast (Marchal 1993), 7 tons/km^{-2} in Senegal (Samba et Laloe, 1986) and 15 tons/ km^{-2} in Ghana (Marchal 1993).

Even if the comparison of the catch rate among fisheries harvesting different ecosystems is difficult the observed values can give us some informations on the exploitation. The mean catch rate in the Java Sea is 3 tons/day, as in Senegal it is 30 tons/10 hours and in Chile 500 tons/day. Different factors can explain such differences;

- The exploitation does not concern species living at the same trophic level, mainly *Decapterus spp.* zooplanktonophageous species in the Java Sea and anchovies planktonophageous species in Chile. It can explain the great differences in the abundance among these species.
- The biological productivity of the Java Sea which is low compared to the upwellings regions.
- The scarcity of the resource revealed by the small number of shoals encountered in the Java Sea during the acoustic cruises. The fish is scattered in the whole water column and this spatial dispatch explains the use of rafts and lights by the seiners which have to aggregate the fish to catch it.

- The technical stage reached by the Javanese fishermen whose fishing techniques (wood vessel, no mechanical assistance to haul the net....) do not allow a high yield.

In conclusion, it is premature to make any exclusive statement on management. In the stage of the project the use of surplus and analytical models is not really convenient and the time series analysis, even if they do not explicitly model population processes and cannot provide information on optimal harvesting policies, can however provide valuable forecasts to guide short-term management decisions.

All the recommendations have consequences in terms of management (tab. IV). Nevertheless, three are important;

- study the life cycle on one or two year classes,
- find the most accurate estimate of the effort,
- Implement a regional approach as some stocks seem shared between different countries (round scads).

Table IV

CONCLUSIONS AND RECOMMENDATIONS ISSUED BY EACH GROUP AT THE END OF THE WORKSHOP SESSION

KESIMPULAN DAN REKOMENDASI YANG DIBUAT OLEH SETIAP KELOMPOK PADA AHKIR LOKAKARYA

	GROUP I BIO-GEOGRAPHY	GROUP II LENGTH FREQUENCY	GROUP III CATCH	GROUP IV ENVIRONMENT
RESULTS	* Low richness index of the Java Sea * Relatively fast growth * Natural mortality relatively high	* Too few small and big sizes in the samples * Difficult to establish the growth curve	* High seasonal variations * No relationship cpue-environment * Surplus models do not fit well * Standardisation of effort	* Data too scarce and too old * High variability of the environment
RECOMMENDATIONS	* Age of the fish * Early life stages Spawning grounds Nursery grounds	* Sampling other fisheries in order to find small and big sizes * Analysis with more than one method * FL(fork length) TL (total length) relationship	* Characteristics of the fleet * Improvment fishing effort index * Use of GLM for standardisation of effort * Research of the beginning of year cycle	* Search for actual data * Use of climatic factors as rainfall, wind and rivers runoff * Satellite imagery
	* Bibliography * Stock limitations. Joint studies with Asean countries			

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