THE CORRELATION OF WATER LEVEL FLUCTUATION TO FISH PRODUCTION DYNAMICS AND PHYSICO-CHEMICAL FEATURES OF LUBUK LAMPAM FLOODPLAIN IN SOUTH SUMATERA

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ABSTRACTS

Lubuk lampam is a floodpalin sytem that seasonally inundated in the rainy season and be come dried up at the dry season. The fishing activities at Lubuk Lampam floodplain are very intensive and comproses of various fishing gear and methods, started with small simple pot traps to large active barrier that can catch a large amount of fish. A study to reveal the pattern of relationship of water level fluctuation to fish production dynamics and water quality was conducted from 1989 to 2003. Water quality parameters observed are water level level fluctuation, temperature, pH, dissolved oxygen and dissolved carbon dioxide. Fish production dynamics parameters observed fishing activities, fishing gears, yield. The result showed tahat the values of water quality parameters and the amount of fish production are fluctuating in accordance with water level fluctuation.

Keywords: floodplain, water level fluctuation, water quality, dynamics, fish production.

INTRODUCTION

Lubuk Lampam is a floodplain system refer locally (South Sumatra) as *lebak lebung*. The condition of this water body is fluctuating according to season, fully inundated during the rainy season but most of its part is completely dried during dry season. The area of Lubuk Lampam as one of the floodplain system of Lempuing River reach up to 1200 ha during inundation period, but contracted down to about 120 hectares during the dry season (Arifin, 1978). At this time only the floodplain pools, main river segments and tributary channel still containing some water.

During the rainy season, the water inundated the aquatic vegetation resulted in the decaying of the plant. When the level decreasing many of organic material deposited in river segments and floodplain pools the decaying process have an impact to water quality of the floodplain system, characterized by low pH, high level of carbon dioxide and low dissolved oxygen. The fishes that live in the floodplain system have to adapt to this extreme condition. Some of the fishes developed additional breathing organs that were capable to take oxygen directly from the air (Welcome, 1979).

The abundant organic materials in the floodplain system function among the others as natural food for fishes that also feeds directly upon the submerged aquatic vegetation. The submerged organs of aquatic vegetation provide substrate for the growth of periphyton, insects, worms and small shrimp that in its turn also provide rich food sources for fishes. Inundated vegetation in the floodplain at high water time function as spawning and nursery ground for fishes (Utomo dan Asyari 1999). Water level fluctuation in floodplain system at the end will also influence the dynamics movement of fishes and food availability. This study was aimed to reveal

the relation of water level fluctuation to some water quality parameter in Lubuk Lampam floodplain.

Fishing activities in inland water have been done for many years using simple or sophisticated fishing gear. Floodplain is one of inland water type where the fishing activities are practiced intensively by the human population living nearby. Fishing activities of this kind also being practiced until now in Lubuk Lampam floodplain (1200 ha) Ogan Komering District, South Sumatra until now .

The fishing gear operated in Lubuk Lampam floodplain, among the other includes Active Seine (*Ngesar*), Filtering device (*Tuguk*), Operating Cash Net at the river pools during the Drought period (*Ngubak Lubuk*), active barrier (*Ngesek*), barrier traps (*Empang lulung*), filtering device (*Tuguk*), set long line (*Rawai*), hook and line (*Tajur*), pot traps (*Sengkirai*) and others. The type of fishing gears operated in Lubuk Lampam floodplain is influenced by the seasonal condition of the ecosystem. During high water time (December-March), the fishing gear that was operated are Sengkirai, Tajur, Tuguk and others, but in during the periods of decreasing water s (April-June) the empang, tuguk, sengkirai and others are operated. During the drought period (July to September) the main fishing activities is the operation are seining (Ngesar), active barrier and cash netting in the river pools (Arifin 1978; Hoggarth dan Utomo 1994).

The main production periods in Lubuk Lampam are concentrated from April - June to July-September during the operation of big fishing gear at the periods where the fishes started to migrate and concentrated. During high water periods the fishes usually tend to disperse to the entire ecosystem resulted in low production of capture fishery (Utomo dan Arifin, 1991). Seasonal water level fluctuation in Lubuk Lampam floodplain is also influenced by water utilization for irrigation of paddy rice field or crop field. For irrigation purposes canals that change the ecological connectivity of the floodplain system resulted in sedimentation and decreasing depths of the river segment. (James 1991).

MATERIALS AND METHODS

Data collection

The study was conducted in Lubuk Lampam floodplain, South Sumatra from 1989 to 2003. The data on water level fluctuation was recorded from water level gauge that was set up near the bank s the Lempuing River segment at the centre of Lubuk Lampam floodplain. The water level data were taken daily around noon together with transparency data that were taken using Secchi Disk.

The other water quality collected includes temperature, pH, carbon dioxide and dissolved oxygen. For this group of water quality data, the data collection were conducted for four periods in year represents four periods of water level condition. Those periods include (a) period of high water level (December -February); (b) period of decreasing to bank overflow level (April-June); (c) period of low water level (July-September and (d) period of increasing to bank overflow level (October-November). The methods of water quality parameter monitoring is following APHA (1986) that was described in Table 1.Beside measurement of water quality parameter, direct field observation of habitat condition is also conducted during the four above periods. The habitat under observation includes river segments, flooded grass land, swamp forest and dry land forest.

Fisher catch, fishing activities and type of fishing gear used were calculated from the daily record of all 30 fishers' folk of Lubuk Lampam floodplain. Water level and production data were analyzed pictorially to observe the relationship of water level and production.

Table 1. Parameter and methods of analysis of water samples

Parameter	Units	Methods and Instrument
1. Temperature	°C	Direct measurement, thermometer
2. Transparency	cm	Direct measurement, Secchi Disk
3. pH		Direct measurement, universal pH indicator
4. Carbon dioxide	mg/L	Direct analysis, titrimetry, NaOH as titrant
5. Dissolved oxygen	mg/L	Direct analysis, titrimetry, Winkler methods, NaS_2O_3 as titrant
6. Alkalinity	mg/L	Direct analysis, titrimetry, H_2SO_4 solution as titrant

Data Analysis

The data collected were analyzed pictorially and tabulated so the difference of the parameter values for each month or season that represent the water level fluctuation in the floodplain. The difference of values between parameters was analyzed using the randomization methods (Manly 1997). Randomization test was performed 10,000 times (9,999 randomized data plus original data) and repeated for six times. The R-statistical program (R Development Core Team 2005) was used for the present statistical analyses and the significant level was set to 5 %.

RESULTS AND DISCUSSION

Water level fluctuation

According to fluctuation of average water level fluctuation from 1989 to 2001 (Fig. 1), it is shown that highest water level was observed in the period of December - April that coincidence with the rainy season. In May to June, water level started to decrease because it is near the end of rainy season. In the dry season (August to September), lowest water level was observed bit in October to November water level started to increase again early in rainy season.

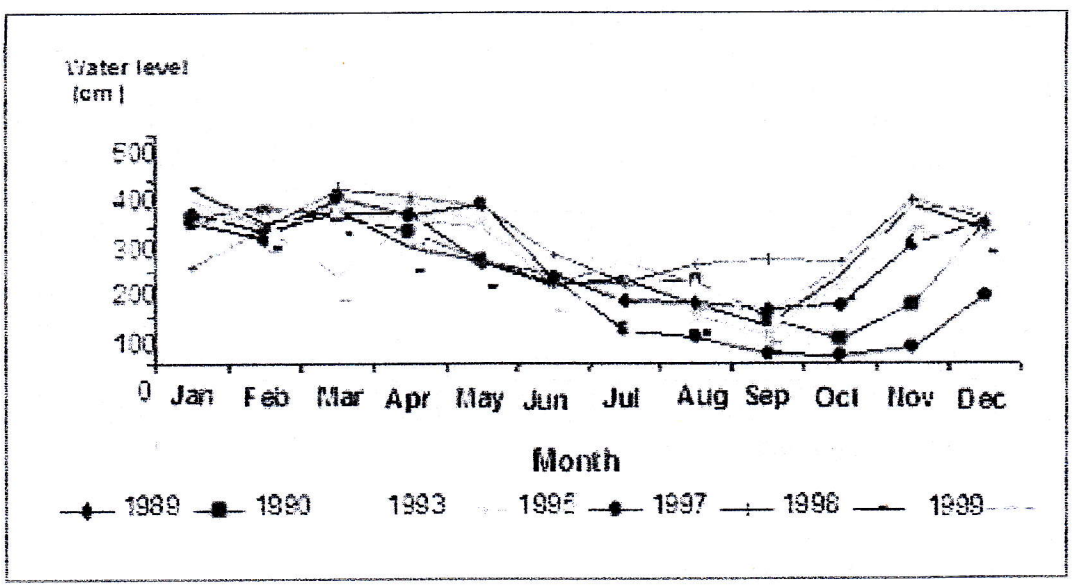

Figure 1. Water level fluctuation at Lubuk Lampam floodplain

Transparency

Figure 2 showed that, started from January (high water level period) the transparency level is relatively high but tend to decrease to the minimum in concordance with decreasing water to the lowest water level in October. This

pattern probably due to the level of suspended organic matter is not to large at high water level, but oppositely, the suspended organic level , increasing when the water level becoming contracted at the dry season, causing low level of transparency.

pH

In general, a floodplain tend to showed a low pH, except at its river segment habitat in especially when in the dry season (August-September) the pH the reach up to 6.5-7.0 because this river segment do not connected to flooded grass land and swamp forest. The water in the river segment mainly consisted of water mass that originated from the upstream part of the watershed. The riparian part of the floodplain usually characterized by low pH (< 7). This riparian part of the floodplain ecologically connected to the adjacent river segment started in early rainy season (October to November) to the high water level periods in the middle of rainy season in December to March. The phenomenon of decreasing pH in river segment to 5.5-6.0 probably due to the input of decaying organic matter from flooded grassland habitat (Table 2.2).

Flooded grassland area that lies on the riparian part of Lempuing River as the connected river segment usually shows a low pH (< 6). The pH at the flooded grassland during period of high water level (December-March) relatively still high (5.5-6.0) because of the large water volume at this expansion period where the river water flows into this habitat. When the water level started to decreased the pH reach down to 5.0-6.0, because of higher concentration of organic matter due decreasing water volume. In the dry season

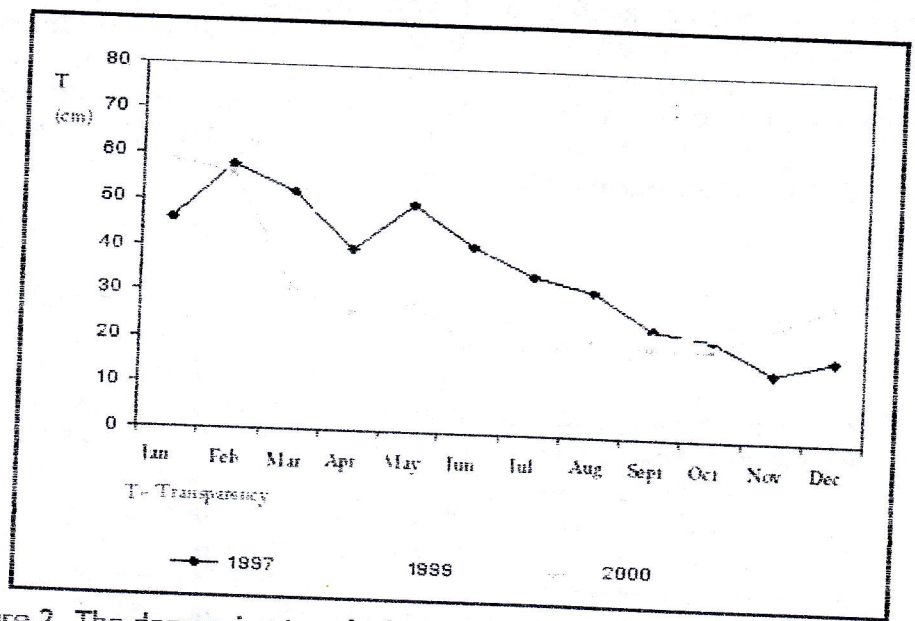

Figure 2. The decreasing trend of transparency at Lubuk Lampam floodplain, South Sumatera

Table 2. Range of values of water quality parameter in Lubuk Lampam floodplain

No.	Habitat type	Periods	Parameters			
			Water Temperature (°C)	pH	Dissolved oxygen (mg/L)	CO_2 (mg/L)
1.	Flooded riparian system	High water level (Dec-March)	27.0-28.0	5.5-6.0	2.0-2.7	12.0-16.4
		Decreasing water level (Apr-June)	27.0-29.0	5.0-6.0	2.0-2.5	14.0-20.7
		Low water level (July-Sept)	29.0-31.0	4.5-5.5	1.4-2.0	18.0-30.0
		Increasing water level (Oct-Nov)	28.0-29.0	5.0-6.0	1.5-2.0	15.0-20.0
2.	River segment	High water level (Dec.-March)	27.0-28.0	5.5-6.5	2.0-3.0	11.0-17.5
		Decreasing water level (Apr-June)	27.0-28.0	5.5-6.0	3.5-6.4	11.0-14.5
		Low water level (July-Sept.)	28.0-29.0	6.5-7.0	5.5-6.7	8.0-12.0
		Increasing water level (Oct.-Nov)	28.0-29.0	6.0-6.5	2.5-3.5	13.5-17.5

(August-September), flooded grassland habitat becomes dried up leaving a small volume of water at the bottom of natural floodplain pools (*lebung*), where a large amount organic matter accumulated and made the pH range from 4.5 to 5.5 (Table 2).

Dissolved oxygen.

Dissolved oxygen levels in the flooded grassland and swamp forest generally shows a low level (<7 mg/L) because decaying processes of organic matter required a lot of oxygen . At the river segment, oxygen level relatively higher (5.5-6.7) in the dry season (August-September) because the connection with the riparian part of floodplain is disconnected and the water column predominantly showing the character of upper river segment. In the periods where the water level started to increase (October-November) to high water level period in rainy season (December-February) the river segment laterally connected to flooded grassland and swamp forest causing the oxygen level reach down to 2.5-5.5 mg/L. When the water level started to decrease in April to June, the oxygen level in the river segment seemed to be higher (3.5-6.4 mg/L) because the influence of water originated from flooded grassland and swamp forest started to diminished. In the dry season (August-September), flooded grassland habitat experience drought that accumulates organic matter in the bottom of floodplain pools creates a low dissolved water and reducing condition (Effendi 2000).

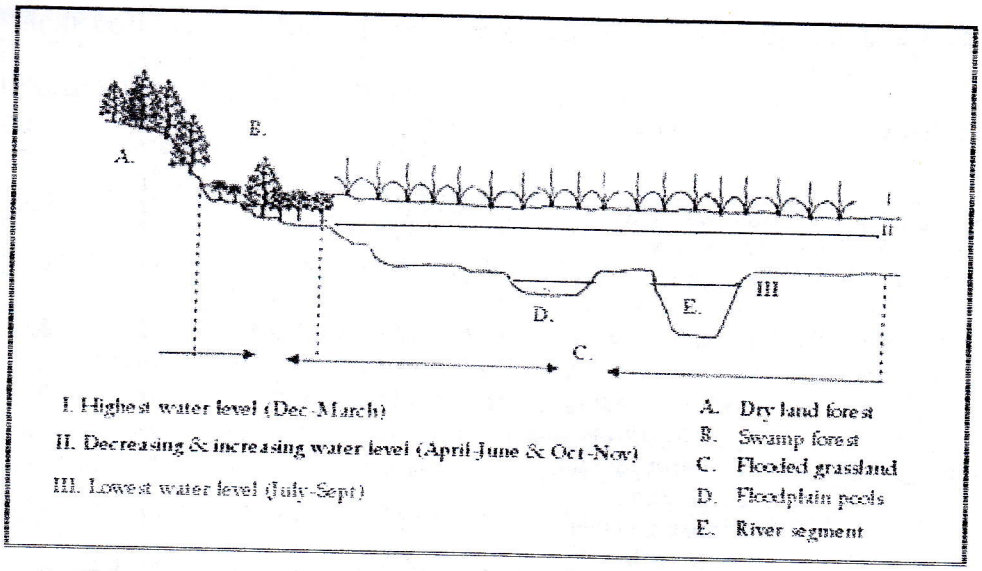

Figure 3. Cross sectional diagram of Lubuk Lampam floodplain

Carbon dioxide

Carbon dioxide is one of the products of decaying process of organic matter in aquatic system. In general, the level of carbon dioxide at the floodplain ecosystem is relatively high (>8 mg/L). At the river segment in the dry season, the level of dissolved carbon dioxide reach its minimum (8.0-12.0 mg/L) due to disconnection of this habitat with organic rich habitat such as the riparian part of floodplain. Early rainy season (December-March) to the middle rainy season (December -March) the level of carbon dioxide are 11.0-17.5 mg/L because the influence of decaying processes in the flooded area of the riparian system. On the other hand, when the water level started to decrease (April -July) the carbon dioxide also decreasing to 11.0 -14.5 mg/L since at that time probably the decaying process already reach to advance level and the influence of flooded grassland also decreasing.

On the floodplain ecosystem during rainy season (December to March), the dissolved carbon dioxide level range 12.0-16.5 mg/L, and when the water level started to decrease (April-July), carbon dioxide level started to increase to 18.0-20.0 mg/L and reach to its maximum during the dry season at around 18.0-30.0 mg/L. This pattern probably due to the contraction of water volume that cause significant increase of organic level.

Although the range data indicated that there is a difference of water quality parameter between periods, randomization test to complete data showed different results. Randomization test (Fig 4 and Fig.5) show that only CO_2 level differ significantly between high water level with decreasing water periods. The carbon dioxide concentration is increasing at decreasing water level period.

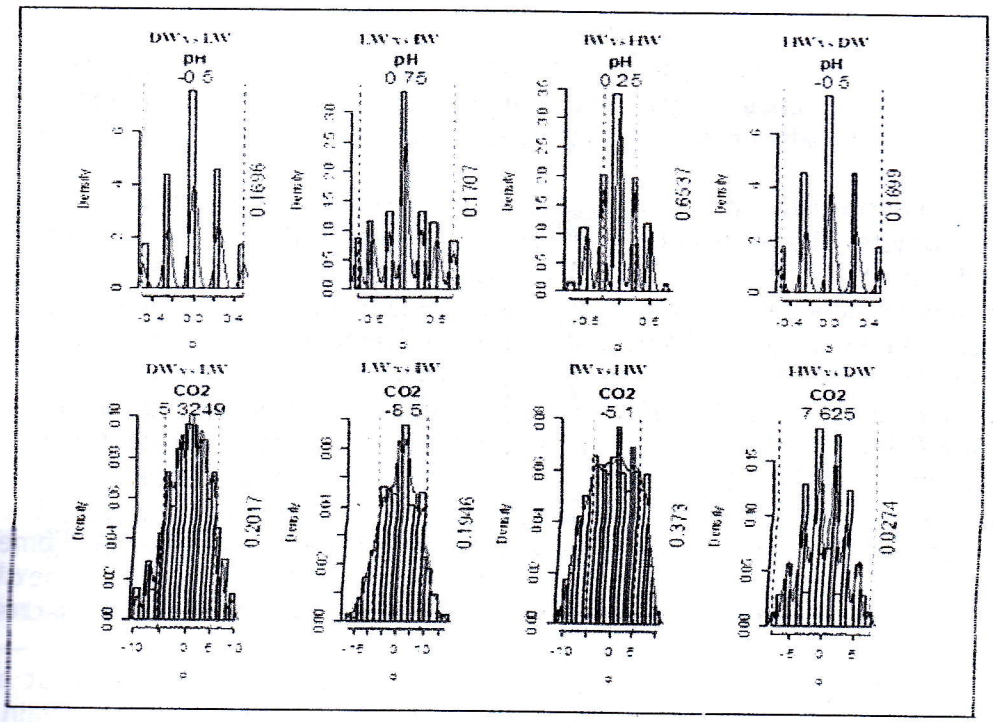

Figure .4. Histograms showing the distribution of differences of pH and dissolved CO2 between periods obtained by 9,999 times of randomization plus original of parameter values in Lubuk Lampam. DW= Decreasing water level period (Apr-June); LW= low water level period (July-Sept); IW= Increasing water level period (Oct-Nov); HW= High water level period (Dec-Mar)

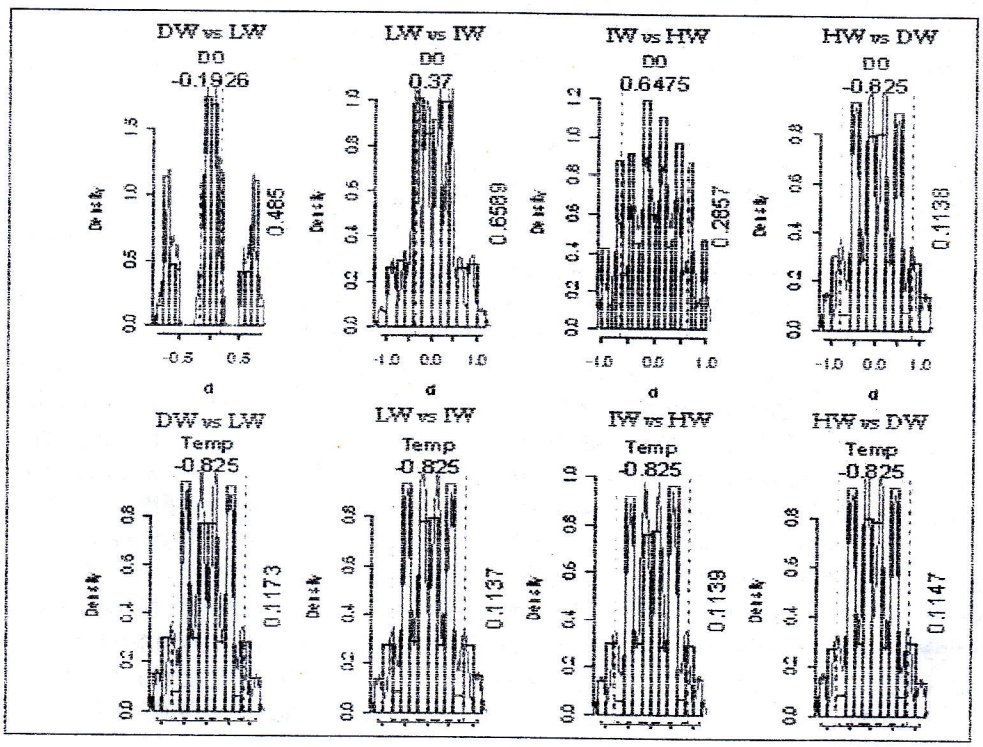

Figure 5. Histograms showing the distribution of differences of dissolved oxygen and water temperature between periods obtained by 9,999 times of randomization plus original of parameter values in Lubuk Lampam. DW= Decreasing water level period (Apr-June); LW= low water level period (July-Sept); IW= Increasing water level period (Oct-Nov); HW= High water level period (Dec-Mar)

Change of Habitat

To understand the dynamics change of Lubuk Lampam floodplain system according to season could be trace back in Fig. 3. Dryland forest (*Talang*) is a habitat type belongs to floodplain system that do not inundated by water even at the middle of rainy season.

This dry land consisted of rubber trees, rengas trees (*Gluta renghas*), Dipterocarp trees and others. The trees in this habitat type are very tall (>10 m). Even though the dry land forest do not inundated by water at the rainy season, but it is still ecologically influenced the aquatic part of floodplain ecosystem because the detritus is still carried away by surface run off into the floodplain system and influence the water quality in the floodplain system.

Swamp forest (*Rawang*) is a forest of trees that can withstand inundation and them usually not to tall (4-7 m). Swamp forest has important ecological function such as spawning, nursery and feeding sites. Flooded grassland (*lebak*) is a part of floodplain ecosystem dominated by aquatic macrophytes (Graminae), water hyacinth (*Eichhornia crassipes*) and others. The aquatic macrophytes consisted of submerged, floating and rooted species. Flooded grassland is inundated longer than the swamp forest, since it is started to be flooded by water when the water initially increasing, reaching its maximum then started to decrease.

Floodplain pools are depression at the land of flooded grassland that always filled with water even though in the normal dry season. The size of floodplain pools varied between one to several hectares and ecologically functions as the refuge site for several fish species in the dry season, when the other part of floodplain becoming dry.

The river segment as the part of floodplain ecosystem is always filled with flowing water even in the long dry season. River segments in the floodplain is a life line of the system since it the source of water supply. There is deeper part at the bend of meandering parts of floodplain system. This deeper part of the river segment refer as to river pool (or *lubuk*) that function as refuge site for big size fishes at the dry season such as *Tapa* (*Wallago sp*), *Patin* (*Pangasius sp*), *Baung* (*Mystus nemurus*) and other.

Fishing period

Traps are predominant among various fishing gears operated in the floodplain. Intensive fishing activities were done by the fishers at the period water level decreasing to bank over flow level at the end of rainy season (April to June) to the dry season (July-September). When the water level approaching the bank over flow level, the fishes are easily caught by traps, but during the dry season many of water body in the floodplain significantly contracted resulting in high efficiency in operation of active fishing gear such as *Ngesar* (active seine) and *Ngesek* (active barrier) an others (Table 3). Non selective fishing gear that also can catch the fishes in large quantities is barrier traps (*Empang*), filtering device (*Tuguk/Corong*), active seine (Ngesar) (*Active Seine*), active barrier *or Ngesek* (Hoggarth and Utomo, 1994). Tuguk have a more serious impact for the sustainability of the stock since it also cutting the migration route of migratory fishes (Utomo, 2001). Based on this situation, it seems that protection management tools in the form of introduction of fishery reserve is urgently needed, in order to guarantee the availability of spatial resource that can sustain the brood stock and fingerling. Hartoto (2000) defined fishery resource as a body of water whether it is inland or marine that fishes is prohibited to be caught at any time, by any methods by anyone.

Table 3. The time of fishing activities in Lubuk Lampam Floodplain

Fishing gear used	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Simple fishing gear												
Hook & line												
Pot traps				■	■	■						
Cast net												
Large fishing gear												
Barrier traps					■	■	■					
Fyke net												
Filtering device A					■	■	■	■				
Filtering device B					■	■	■	■				
Active seine								■	■	■		
Active barrier								■	■	■		

Note: ■ Medium to high fishing intensity, ▒ = low to medium fishing intensity

Filtering device A: *Empang*; Filtering Device B: *Tuguk*

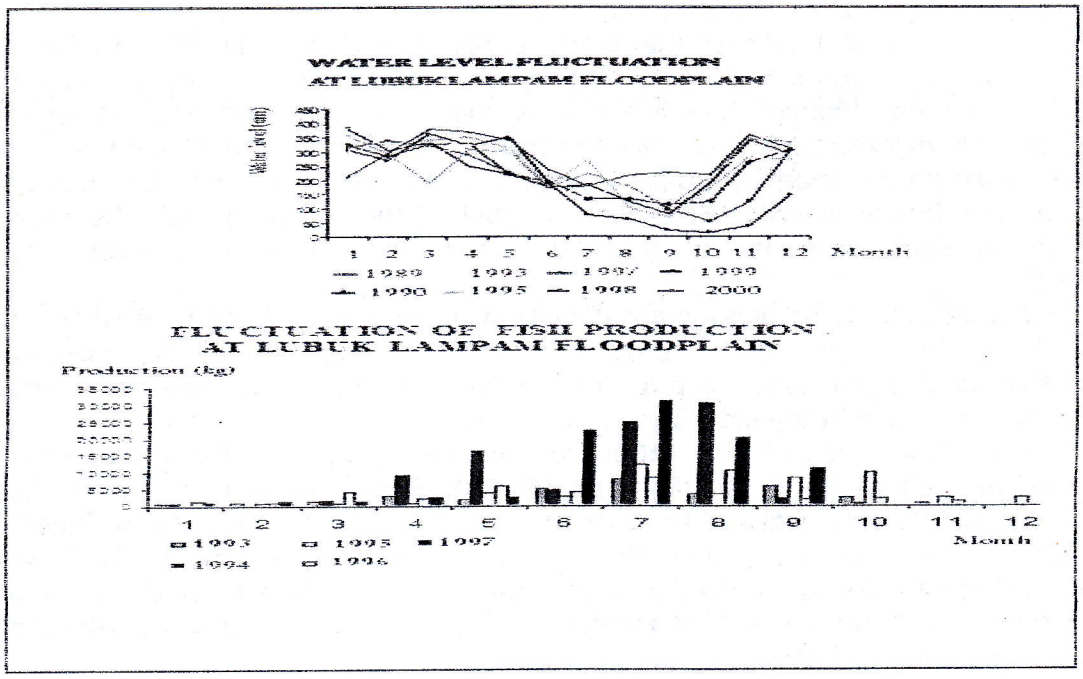

Figure 6. Water level and fish production of Lubuk Lampam floodplain South Sumatra

Relationship of water level to fish yield

Figure 6 showed the low fish yield from Lubuk Lampam floodplain during high water period (December-March), because the fishes in this floodplain are widely distributed resulting in low fishing success. When the water level started to decrease (April-June), the fish yield tends to decrease because the fishes started to move following decreasing water movement. During this time, the migrating fishes are easily to be capture using barrier traps, filtering device or Fyke net. Fishing yield reach its maximum during the drought period, when the water body in the floodplain contracted to its minimum where only the deepest parts of the floodplain such as floodplain pool (or lebung) and river segment still containing some water. During this period the fishes are effectively catch using active barrier (*Ngesek*) and active seine (*Ngesar*)

Catch composition

Appendix 1 showed that *Tuguk* is the main fishing gear that was used in the river segment of the floodplain and it can catch the fishes affectively from April to July when the water started to decrease. During this time the fishing shows rheotaxis response following the water current that flows down stream and the fisher operating the tuguk perpendicular to river bank cross cutting the fish migration path of the fishes. At the start of the dry season (August), cash netting was done in the river pools (*Lubuk*) and the activities refer to as *Ngubek Lubuk*. When the water level reach its minimum in September-October, fishing were done by guiding the fishes into the traps or fish picking site using seine (*Kerakat*). This fishing activity refers to as *Ngesar*.

Fish catch composition of fishing activities in the river segment dominated by white fishes such as Lais (*Kryptopterus* spp.), Baung (*Mystus nemurus*), Tapa (*Wallago* spp.), various small member of Cyprinidae family and others. One species of black fish that is the Toman (*Channa micropeltes*) also could be catch in the river segment. The white water fishes during the high water period migrate to the floodplain for feeding and spawning but return back to river segment when the water quality in the flooded grassland started to deteriorated (Welcomme 1979; Utomo dan Asyari 1999).

Appendix 2 to 4 indicate that *Empang* started to show some fish catch in June to July, when the water level started to decrease and the fishes move to deeper part of the floodplain habitat (floodplain pools and river pools). Empang was set cross cutting the migrating paths to trap the fishes. On the other hand when the water level reach its minimum, only the floodplain pools and river pools still containing water, the fishing activity were done by guiding the fishes towards the traps or picking up sites using bamboo fences (Empang). This fishing activity refers to as *Ngesek*.

Fishing activity using pot traps (Sengkirai) in general could be done whole years but the significant yield usually observed in April to June, In September, many parts of the flooded grassland already dried up so the yield from Sengkirai operation relatively very small (Appendix 3)

The composition of fish catch from flooded grass land mostly consisted of black-fish such as Betok (*Anabas testudineus*), Sepat (*Trichogaster* spp.), Gabus (*Channa striata*), Tambakang (*Helostoma temminckii*) and others. Black fishes can adapt to water quality condition characterized by low pH and low dissolved oxygen such as usually found in flooded grass land or swamp forest. Black fishes have additional respiratory organ that facilitate them to take oxygen directly from the air (Rankin & Jensen, 19993)

CONCLUSION

1. Floodplain ecosystem is influenced by seasonal water level fluctuation, that is inundated in rainy season and experiencing drought in the dry season. The water quality of floodplain system is characterized by acidic, low dissolved oxygen and high level of carbon dioxide because decaying process in the flooded grassland. Water level fluctuation are strongly influenced the physico-chemico water quality of floodplain water.

2. Fish production from Lubuk Lampam floodplain is strongly influence by the seasonal water level fluctuation. The peak of fishing season occurs during the dry season. To sustain the stock, introduction of no take zone is recommended at the floodplain habitat such as floodplain pools or river segment

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Appendix 1 (continued)

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Appendix 1. Species composition of fishing yield of a fisher group from river segment habitat of Lubuk Lampam Floodplain in 1997

Fishing gear	Species	Month)										Total kg
		Jan kg	Feb kg	Mar kg	Apr kg	May kg	Jun kg	Jul kg	Aug kg	Sept kg	Oct kg	
Tuguk/Corong (Filtering Device)	*Baung (Mystus nemurus)*	58.0	40.0	54.0	70.0	85.0	79.0	107.0	-	-	-	493.0
	Patin (Pangasius hypopthalmus)	4.0	-	-	9.0	10.0	-	-	-	-	-	23.0
	Lais (Kryptopterus spp.)	41.0	21.0	36.0	35.0	50.0	94.5	94.0	-	-	-	371.5
	Udang (Macrobrachium rosenbergii)	10.0	5.0	4.0	-	4.0	-	-	-	-	-	23.0
	Tembakang (Helostoma temminckii)	10.0	10.0	-	10.0	-	139.0	116.5	-	-	-	285.5
	Putak (Notopterus notopterus)	14.0	11.0	-	-	-	82.0	160.0	-	-	-	267.0
	Juaro (Pangasius polyuranodon)	6.0	-	-	5.0	10.0	-	-	-	-	-	21.0
	Belut Tulang (Kryptopterus apogon)	9.0	-	-	-	13.0	-	-	-	-	-	22.0
	Beringit (Mystus nigriceps)	24.0	10.0	14.0	-	20.0	91.0	24.0	-	-	-	183.0
	Palau (Osteochilus hasselti)	63.0	40.0	34.0	60.0	60.0	131.0	170.0	-	-	-	558.0
	Mentilan (Mastachembelus unicolor)	10.0	-	-	-	-	-	-	-	-	-	10.0
	Rucah (Mix small fishes)	25.0	50.0	35.0	85.0	90.0	-	130.0	-	-	-	415.0
	Betutu (Oxyeleotris marmorata)	-	1.0	-	2.0	-	-	-	-	-	-	3.0
	Damai	-	-	-	30.0	-	-	-	-	-	-	30.0
	Tawes (Barbodes gonionotus)	-	-	-	20.0	10.0	-	-	-	-	-	30.0
	Sepat Siam (Trichogaster pectoralis)	-	-	-	-	-	36.0	460.0	-	-	-	496.0
	Gabus (Channa striata)	-	-	-	-	-	44.5	157	-	-	-	201.5
	Toman (Channa micropeltes)	-	-	-	-	-	67.0	95.5	-	-	-	162.5
	Sebarau (Hampala ampalong)	-	-	-	-	-	-	10.0	-	-	-	10.0
	Belida (Notopterus chitala)	-	-	-	-	-	-	3.5	-	-	-	3.5
	Sepat Merah Mato (Trichogaster sp.)	-	-	-	-	-	-	163.0	-	-	-	163.0
SUB TOTAL		274.0	188.0	177.0	326.0	352.0	625.0	1475.0	-	-	-	2747.0

Appendix 1 (continued)

Fishing gear	Species	Jan kg	Feb kg	Mar kg	Apr kg	May kg	Jun kg	Jul kg	Aug kg	Sep kg	Oct kg	Total kg
Ngubek Lubuk (Cast net)	*Lais (Cryptopterus spp)*	-	-	-	-	-	-	-	319.5	-	-	319.5
	Belut Tulang (Cryptopterus apogon)	-	-	-	-	-	-	-	212.0	-	-	212.0
	Tapah (Wallago leeri)	-	-	-	-	-	-	-	79.5	-	-	79.5
	Baung Bino	-	-	-	-	-	-	-	21.5	-	-	21.5
	Sampah (Mix Cyprinidae)	-	-	-	-	-	-	-	38.0	-	-	38.0
	Patin (Pangasius hypopthalmus)	-	-	-	-	-	-	-	13.0	-	-	13.0
	Putak (Notopterus notopterus)	-	-	-	-	-	-	-	50.5	-	-	50.5
	Toman (Channa micropeltes)	-	-	-	-	-	-	-	14.9	-	-	14.9
	Belida (Notopterus chitala)	-	-	-	-	-	-	-	6.0	-	-	6.0
	Mentilan (Mastachembelus unicolor)	-	-	-	-	-	-	-	10.0	-	-	10.0
	Baung Bino	-	-	-	-	-	-	-	6.0	-	-	6.0
	Gabus (Channa striata)	-	-	-	-	-	-	-	7.0	-	-	7.0
	Palau (Osteochilus hasselti)	-	-	-	-	-	-	-	21.0	-	-	21.0
SUB TOTAL		-	-	-	-	-	-	-	313.0	-	-	313.0

Fishing gear	Species	Jan kg	Feb kg	Mar kg	Apr kg	May kg	Jun kg	Jul kg	Aug kg	Sept kg	Oct kg	Total kg
Ngesar (Active seine)	*Belut Tulang (Kryptopterus apogon)*	-	-	-	-	-	-	-	214.0	20.0	-	234.0
	Belida (Notopterus chitala)	-	-	-	-	-	-	-	75.0	24.0	42.5	141.5
	Tapa (Wallago leeri)	-	-	-	-	-	-	-	613.0	216.0	216.0	1045.0
	Baung (Mystus nemurus)	-	-	-	-	-	-	-	2043.0	1264.0	61.2	3368.2
	Toman (Osteochilus hasselti)	-	-	-	-	-	-	-	1375.0	595.0	47.6	2017.6
	Lais (Kryptopterus spp.)	-	-	-	-	-	-	-	510.0	271.0	6.5	787.5
	Juaro (Pangasius polyuranodon)	-	-	-	-	-	-	-	416.0	-	-	416.0
	Sampah (Mixed small Cyprinidae)	-	-	-	-	-	-	-	763.0	341.0	22.0	1126.0
	Sihitam (Labeo sp.)	-	-	-	-	-	-	-	67.0	64.0	-	131.0
	Putak (Notopterus notopterus)	-	-	-	-	-	-	-	443.0	146.0	87.0	676.0
	Tembakang (Helostoma temminckii)	-	-	-	-	-	-	-	291.0	396.0	308.0	995.0
	Palau (Osteochilus hasselti)	-	-	-	-	-	-	-	306.0	311.0	138.0	755.0
	Gabus/Bujuk (Channa spp.)	-	-	-	-	-	-	-	209.0	73.0	10.3	292.3
	Mentilan (Mystus sp.)	-	-	-	-	-	-	-	24.0	-	-	24.0
	Beringit (Mystus nigriceps)	-	-	-	-	-	-	-	64.0	-	-	64.0
	Sepat Siam (Trichogaster pectoralis)	-	-	-	-	-	-	-	53.0	-	-	53.0
	Kalui (Osphronemus gouramy)	-	-	-	-	-	-	-	213.0	116.0	-	329.0
	Lampam (Barbodes schwanefeldii)	-	-	-	-	-	-	-	54.0	213.0	-	267.0
	Tengkeleso (Scleropages formosus)	-	-	-	-	-	-	-	3.0	-	-	3.0
	Rucah lalang (Mixed small fishes)	-	-	-	-	-	-	-	293.0	211.0	50.5	554.5
	Betutu (Oxyeleotris marmorata)	-	-	-	-	-	-	-	-	4.0	1.0	5.0
	Aro	-	-	-	-	-	-	-	-	54.0	-	54.0
	Kelemak (*Leptobarbus hoeveni*)	-	-	-	-	-	-	-	-	59.0	-	59.0
	Sebarau (*Hampala* spp.)	-	-	-	-	-	-	-	-	163.0	-	163.0
SUB TOTAL		-	-	-	-	-	-	-	8029.0	4378.0	929.4	6399.0
TOTAL		274.0	188.0	177.0	326.0	352.0	625.0	1475.0	8827.6	5530.6	929.4	18129.7

Note: The number of the fishers within the groups is six

Appendix 2. Species composition of fishing yield of a fisher group from flooded grassland (*Lebak kumpai*) of Lubuk Lampam Floodplain in 1997

Fishing gear	Species	Month							Total kg
		Apr kg	May kg	Jun kg	Jul kg	Aug kg	Sep kg	Oct kg	
Empang (Barrier traps)	*Lais (Cryptopterus spp)*	-	-	42.0	-	-	-	-	42.0
	Sampah (Mix Cyprinidae)	-	-	119.0	-	-	-	-	119.0
	Tambakang (Helostoma temmincki)	-	-	221.6	-	-	-	-	221.6
	Putak (Notopterus notopterus)	-	-	45.0	-	-	-	-	45.0
	Keli (Clarias spp.)	-	-	22.6	-	-	-	-	22.6
Ngesek 1 (Active barrier 1)	*Tambakang (Helostoma temminckii)*	-	-	61.2	-	-	-	-	61.2
	Gabus (Channa striata)	-	-	3.7	-	-	-	-	3.7
Ngesek 2 (Active barrier)	*Gabus (Channa striata)*	-	-	123.3	-	-	-	-	123.3
	Tembakang (Helostoma temmincki)	-	-	297.5	-	-	-	-	297.5
	Serandang (Channa sp)	-	-	55.5	-	-	-	-	55.5
	Betok (Anabas testudineus)	-	-	31.5	-	-	-	-	31.5
	Selincah	-	-	116.0	-	-	-	-	116.0
	Sepat mato merah (Trichogaster sp.)	-	-	118.5	-	-	-	-	118.5
Ngesek 3 (Active barrier 3)	*Tembakang (Helostoma temmincki)*	-	-	61.2	78.0	-	-	-	139.2
	Gabus (Channa striata)	-	-	3.7	22.5	-	-	-	26.2
	Putak (Notopterus notopterus)	-	-	-	22.0	-	-	-	22.0
	Sepat siam (Trichogaster pectoralis)	-	-	181.5	150.0	-	-	-	331.5
Sub Total		-	-			-	-	-	

Note: The number of fishers within the groups is five

Appendix 3. Species composition of fishing yield of individual fishers from flooded grassland habitat of Lubuk Lampam Floodplain in 1997

Fishing gear	Species	Jan kg	Feb kg	Mar kg	Apr kg	May kg	Jun kg	Jul kg	Aug kg	Sep kg	Total kg
Sengkirai (Pot Traps).	*Gabus (Channa striatus)*	517.1	352.0	1.236.6	539.5	360.4	940.6	55.0	112.2	-	3380.7
	Tembakang (Helostoma temminckii)	10.4	14.9	1.1	10.5	0.5	1185.9	139.0	56.8	-	1419.1
	Palau (Osteochilus hasselti)	3.8	-	-	-	-	-	-	-	-	3,8
	Lele (Clarias spp.)	60.0	31.1	6.2	9.3	-	425.5	58.2	-	-	590.3
	Betok (Anabas testudineus)	-	-	4.9	-	-	12.7	199.0	95.8	-	311.9
	Lais (Kryptopterus spp.)	86.1	21.4	20.7	16.6	-	-	-	-	-	144.8
	Baung (Mystus nemurus)	5.6	17.7	23.2	4.3	6.8	23.6	-	-	-	74.4
	Sampah (Mix Cyprinidae)	6.7	0.8	1.2	-	-	0.5	-	-	-	9.2
	Sepat siam (Trichogaster pectoralis)	-	2.1	164.7	-	24.5	385.8	517.0	448.0	-	1541.8
	Toman (Channa micropeltes)	8.9	7.3	40.4	-	3.0	0.7	-	-	-	60.3
	Putak (Notopterus notopterus)	67.9	21.0	-	-	5.6	26.1	-	-	-	120.6
	Sebarau (Hampala ampalong)	0.7	0.5	-	-	-	-	-	-	-	11.8
	Belut (Fluta alba)	9.4	21.2	-	-	81.2	-	-	-	-	111.8
	Sepatung (Pristolepis fasciatus)	1.9	0.8	-	-	-	-	-	-	-	2.7
	Tapah (Wallago leeri)	-	-	24.0	-	-	-	-	-	-	24
	Selincah	-	-	50.6	-	-	2.7	-	-	-	53.3
	Sepat Siam (Trichogaster pectoralis)	-	-	-	-	-	7000.0	5500.0	-	-	12500.0
	Sepat (Trichogaster)	-	-	-	-	-	3,500.0	50.0	-	-	7500.0
	Total	778.5	490.8	337.0	580.2	475.2	10007.6	7021.0	712.8		27856.7

Note: The numbers of fishers are 24 individuals, each with 50-80 pot traps/person

Appendix .4. Species composition of fishing yield of individual fishers from floodplain pools habitat of Lubuk Lampam Floodplain in 1997

Fishing activity	Species	Months							Total kg
		Jan kg	Feb kg	Mar kg	Apr kg	May kg	Jun kg	Jul kg	
Ngesek at Artificial floodplain pool (*Lebung Project*) (Active barrier 1)	*Gabus (Channa striata)*	-	-	123.5	40.7	-	-	-	164.2
	Tembakang (Helostoma temminckii)	-	-	297.5	42.7	-	-	-	340.2
	Serandang (Channa sp)	-	-	55.5	8.0	-	-	-	63.5
	Betok (Anabas testudineus)	-	-	31.5	142.5	-	-	-	174.0
	Selincah	-	-	113.1	14.8	-	-	-	127.9
	Sepat mato merah (Trichogaster sp.)	-	-	118.5	-	-	-	-	118.5
	Sepat siam (Trichogaster pectoralis)	-	-	4000.0	5000.0	-	-	-	9000.0
Ngesek at natural floodplain pool 1 (Active barrier 2)	*Gabus (Channa striata)*	-	-	-	194.5	-	-	-	194.5
	Tembakang (Helostoma temminckii)	-	-	-	296.0	-	-	-	296.0
	Betok (Anabas testudineus)	-	-	-	141.5	-	-	-	141.5
	Putak (Notopterus notopterus)	-	-	-	103.1	-	-	-	103.1
	Selincah	-	-	-	42.5	-	-	-	42.5
	Sepat siam (Trichogaster pectoralis)	-	-	-	5500.0	-	-	-	5500.0
	Lele (Clarias spp.)	-	-	-	6.0	-	-	-	6.0
Ngesek at natural floodplain pool 2 (Active barrier 3)	*Gabus (Channa striata)*	-	-	-	235.7	267.6	-	-	503.3
	Tembakang (Helostoma temminckii)	-	-	-	78.3	23.7	-	-	102.0
	Putak (Notopterus notopterus)	-	-	-	120.3	-	-	-	120.3
	Lele (Clarias spp.)	-	-	-	45.1	6.2	-	-	51/3
	Betok (Anabas testudineus)	-	-	-	348.0	329.3	-	-	677.3
	Salted Sepat siam (Trichogaster pectoralis)	-	-	-	2000.0	4000.0	-	-	6000.0
	Rucah (Mix small fishes)	-	-	-	-	17.0	-	-	17.0
Total				6243.0	14632.0	4643.8			25551.8

Appendix 5. Species composition of fishing yield of individual fishers from swamp forest habitat of Lubuk Lampam Floodplain in 1997

Fishing activity	Species	Months								Total kg
		Mar kg	Apr kg	May kg	Jun kg	Jul kg	Aug kg	Sep kg	Oct kg	
Empang (Barrier traps	*Udang (Macrobrachium rosenbergii)*	-	-	9.0	8.0	-	-	-	-	17.0
	Lais (Kryptopterus spp.)	-	-	-	3.5	-	-	-	-	3.5
	Rucah (Mixed small fishes)	-	-	2.0	12.0	-	-	-	-	14.0
	Gabus (Channa striata)	-	-	2.0	235.3	-	-	-	-	237.2
	Putak (Notopterus notopterus)	-	-	1.0	62.0	-	-	-	-	63.0
	Sampah (Mixed Cyprinidae)	-	-	-	29.9	-	-	-	-	29.9
	Sepatung (Pristolepis fasciatus)	-	-	-	28.7	-	-	-	-	28.7
	Baung (Mystus nemurus)	-	-	-	27.1	-	-	-	-	27.1
	Betutu (Oxyeleotris marmorata)	-	-	-	13.2	-	-	-	-	13.2
	Lele (Clarias spp.)	-	-	-	177.0	-	-	-	-	177.0
	Betok (Anabas testudineus)	-	-	-	2.5	-	-	-	-	2.5
	Lais (Kryptopterus spp.)	-	-	-	2200.0	-	-	-	-	2200.0
Ngesek 1 (Active barrier 1)	*Gabus (Channa striata)*	-	-	-	259.9	1388.0	1461.9	498,0	-	3607.8
	Sepat Siam (Trichogaster pectoralis)	-	-	-	124.5	227.5	1037.5	141.5	-	1531.0
	Baung (Mystus nemurus)	-	-	-	22.2	1011.5	315.2	379.0	-	1727.9
	Putak (Notopterus notopterus)	-	-	-	247.5	526.5	950.5	17.0	-	1741.5
	Tembakang (Helostoma temminckii)	-	-	-	23.5	859.0	808.0	545.0	-	2235.5
	Sepatung (Pristolepis fasciatus)	-	-	-	-	329.5	436.8	324.5	-	10.90.8
	Sampah (Mixed Cyprinidae)	-	-	-	-	152.0	25.0	23.5	-	200.5
	Betutu (Oxyeleotris marmorata)	-	-	-	-	11.7	-	-	-	11.7
	Lele (Clarias spp.)	-	-	-	-	298.5	96.5	9.5	-	404.5
	Rucah (Mixed small fishes)	-	-	-	-	16.5	-	-	-	16.5
	Lais (Kryptopterus spp.)	-	-	-	-	1365.0	-	-	-	1365.0
	Rucah (Mix small fishes)	-	-	-	-	1281.3	-	-	-	1281.3
	Toman (Channa micropeltes)	-	-	-	-	-	88.0	-	-	88.0
Ngesek 2 (Active barrier 2)	*Sampah (Mixed Cyprinidae)*	-	-	-	-	-	-	2766.7	-	2766.7
	Beringit (Mystus nigriceps)	-	-	-	-	-	-	183.7	-	183.7
	Sepat Siam (Trichogaster pectoralis)	-	-	-	-	-	-	363.7	-	363.7
	Sepat Merah (Trichogaster sp.)	-	-	-	-	-	-	171.2	-	171.2
	Rucah (Mixed small fishes)	-	-	-	-	-	-	165.7	-	165.7
Total		-	-	-	3476.8	7467.0	5219.4	5589.0	-	21766.

Note: The number of fishers within the group is five persons