

The Study of Garing Fish Physical Habitat (*Tor tambra* C.V.: Cyprinidae) in Anai River West Sumatera

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Abstract: Garing fish (Genus *Tor*) have high economic value. This fish include as the red list of threatened extinction. Thus, their conservations have to keep safe by using conservation and domestication effort. Furthermore, we need deep understanding about the criteria of physical habitat parameter (water depth, water velocity, the type of base substrate and the type of cover). The expectation of this research result is able to give the better picture of physic habitat parameter to every life stage of Garing fish. Hence, the researchers have done a field research toward the fish habitat. The data is analyzed by using PHAB-SIM's. The result of analysis shows; the appropriate water depth for Garing fish in the life stage of juvenile < 0.50 m, in the life stage of subadult > 0.25 m and in the life stage of adult > 0.50 m; the appropriate water velocity for juvenile stage < 0.76 m/s, subadult stage 0.26-1.00 m/s and adult stage > 0.50 m/s; the appropriate types of base subtract for juvenile stage are sand, pebble and small cobble, for subadult and adult stage are small cobble and big stone in flow, while the appropriate cover types for juvenile, subadult and adult stage are relatively resemble which are no cover, the tree shadow and big stone in flow.

Keywords: Cyprinidae, *Tor tambra*, Life stage, Habitat, PHAB-SIM'S, Anai River

1. Introduction

Garing fish (*Tor* Genus) is a sort of fish that includes as the red list of threatened extinction [1]. It is caused as the effect of over fishing and forest denudation [2, 3, 4]. The others reasons are the uncontrollable fishing technique such as by using tuba explosive and electricity [5], the habitat damage which is caused by the contamination in the land which estuaries through the public waters [6] and the building without environmental consideration such as a levee that can block water organism from downriver to upriver or vice versa [7,8, 9].

Garing fish is a kind of bream which has a thick meat, tasty taste and liked by the people, thus it has high economic value [10]. Likewise the Semah fish in Betuang Kerihun West Kalimantan national park is sold to Serawak-Malaysia within the price 80 Ringgit or as much Rp. 200.000/kg [11]. The body sized of this fish is very exotic because it can achieve more than 30 kg within the total length more than 1 m [12]. Hence, this kind of fish is dubbed as 'Kings of the Rivers' [13].

The fish as the nutfah-plasma within the waters ecosystem has important role in the chain-link of ecology. The effort to keep their conservation is a must [6]. The possible attempt that can be done is by conservation and domestication efforts [14]. To achieve this effort, the understanding of the study of all bio-ecology fish aspect is very determining [15].

The study of physical habitat is part of fish ecology aspect. The information that relates with this study is very limited and simplistic and also the report is descriptive and qualitative, likewise the habitat of Semah fish (*Tor*

douronensis) in the clear and strong waters flow [16]. The base subtract of Tambra fish habitat (*Tor tambroidess* Blkr.) is stone, pebble and sand, clear water color, slow until strong water flow [10]. The different condition of habitat either in qualitatively or quantitatively differentiates the species and the fish life stage (juvenile, subadult, and adult) that occupies it [17, 18, 19]. But in quantitatively, the study of physic habitat for the species and life stage of Garing fish in the tropical region such as in Anai River, west Sumatra is not yet reported.

The fishery research method is still developed and follows the technology development. The Physical Habitat Simulation System Method (PHAB-SIM's) is a method that is developed to learn and simulate the habitat condition in waters [20]. The benefit of this method is able to decide the optimum criteria and suitable within a physical habitat parameter (the depth of water, the velocity of water, the base substrate and the type of cover). By using this method, it is hoped that we can learn the physic habitat parameter characteristic which can support all the life stage of Garing fish in Anai River, west Sumatra.

2. Material and Method

2.1. The Research Time and Place

The research is carried out throughout Anai River - West Sumatra and starts on December 2012 until December 2013. The observation has been done throughout Anai River. It starts from the upriver until the downriver that passes through Padang Panjang city, Tanah Datar district, Padang Pariaman district and Padang city (Fig. 1).

2.2. Research Material

The research is carried out by using survey method which is done by diving in the estimation of Garing fish location in Anai River. In this location, the researchers observe and note the physical habitat parameter (water depth, water velocity, the base substrate and cover type), the species and size, the stage of life cycle (juvenile, subadult, or adult) and the fish amount. The research is done as many 200 times in the different physical habitat throughout Anai River.

2.3. Data Analysis

The data analyze by using PHAB-SIM'S program (Physical Habitat Simulation System). The PHAB-SIM'S program will determine the suitability index, the suitability index within percentage and the criteria of suitability index [21, 22, 23]. According to the criteria of suitability index, every research spot (location) can be classified as follows:

- a = The research spot which has the optimal physic habitat characteristic and occupied by the fish.
- b = The research spot which has the usable physic habitat characteristic and occupied by the fish.
- c = The research spot which has the optimal physic habitat characteristic and unoccupied by the fish.
- d = The research spot which has the usable physic habitat characteristic and unoccupied by the fish.
- a + b = The research spot which has the suitable physic habitat characteristic and occupied by the fish.
- c + d = The research spot which has the suitable physic habitat characteristic and unoccupied by the fish.
- e = The research spot which has the unsuitable physic habitat characteristic and occupied by the fish.
- f = The research spot which has the unsuitable physic habitat characteristic and unoccupied by the fish.

To differentiate the optimal physical habitat characteristic with the usable one, the researcher utilizes the formula of *Chi-square* equation 1, while for the suitable physical habitat characteristic with the unsuitable one, the researcher uses the formula of equation 2 [23, 24, 25, 26] :

$$\chi^2_{hitung} = \frac{(a \times d) - (b \times c) \times \sqrt{(a+b+c+d)}}{\sqrt{(a+b) \times (c+d) \times (a+c) \times (b+d)}} \dots \text{Equation 1}$$

$$\chi^2_{hitung} = \frac{\{(a+b) \times f\} - \{e \times (c+d)\} \times \sqrt{\{(a+b)+e+(c+d)+f\}}}{\sqrt{(a+b+e) \times (c+d+f) \times (a+b+c+d) \times (e+f)}} \dots \text{Equation 2}$$

3. Result

3.1 Observation point

The observation point of this research is the location where at the diving times the Garing fish is found. At this location (observation point) will be observed the fish physical habitat parameter. From 200 observation point, the researchers find out the water depth at the range of 0, 10-2, 50 m; water velocity 0,15-1,30 m/sc; the base substrates are sand, pebble, small cobble (Ø 5-15 cm) and big stone in flow (Ø

>15 cm) while the types of cover are no cover, tree shadow, rivarian vegetation, water vegetation, and big stone in flow.

3.2. Water Depth

The water depth which can be occupied by every Garing fish life stage has variation. The juvenile stage is more suitable in depth 0.26-0.50 m, the subadult 0.51-0.75 m, while the adult > 1.00 m. The subadult stage has wider water depth range than juvenile or adult (Fig. 2).

The optimal and/or suitable water depth is different in every Garing fish life stage. The subadult stage has the suitable water depth range wider than the juvenile and the adult one. (Table 1)

3.3. Water Velocity

The water velocity which can be occupied by every Garing fish life stage has variation. The juvenile life stage is more suitable in velocity 0.26-0.50 m/s, the subadult 0.51-0.75 m/s while the adult 0.76-1.00 m/s. The subadult stage is also has the wider water velocity range than the juvenile or the adult one (Fig. 3).

The optimal and/or the suitable water velocity are different in every Garing fish life stage. The adult stage cannot be determined the 'optimal' and 'usable' water velocity, but the suitable water depth is > 0.50 m/s (Table 2).

3.4. The type of base substrate

The base substrate type is mud that is not occupied by Garing fish. But, the other base substrate has variation for every Garing fish life stage. The base substrate for juvenile stage is match with pebble. The subadult and the adult one is match with cobble base substrate. (Ø 5-Ø 15 cm) (Fig. 4).

The optimal and/or suitable type of base substrate is quite different in every Garing fish life stage. The base substrate for adult stage cannot be determined, neither the optimal nor the useble one. But the suitable base water substrate is pebble, cobble and big stone in flow (Ø >15 cm) (Table 3).

3.5. The cover type

The cover type has variation for every Garing fish life stage. The juvenile stage prefers to no cover. The subadult and adult stage prefer to big stone cover type. (Fig. 5).

The optimal and/or suitable cover type is different among the Garing fish life stage either the juvenile, subadult or the adult one. The optimal cover type of subadult and adult stages is big stone in flow. While the suitable and unsuitable one is cannot be determined. (Table 4).

4. Discussion

The optimal and suitable water depth for every Garinf fish life stage is different (Table 1). The differential is caused by the difference of physical fish condition. The fish sized juvenile has the physical condition relatively weak, thus it tends to life at the shallow water depth that has minor water

mass pressure. Referring to Nybakken [27], the water depth has the big influence toward water biota. It connects with the pressure which is accepted by the biota within the water where the pressure within the water increases along with the raise of water depth. Adi [28] states that the larva/juvenile period is the most critical period of fish life cycle. At that time, the fish physical condition is still weak and should adapt the environs condition.

Beside the physic condition, the different is also caused by the physical habitat parameter interaction. The depth interaction through the intensity of sunlight causes the different light penetration which is accepted by the waters part. In the relatively shallow waters, the sunlight penetration reaches the base (littoral zone). Hence, it causes the high plankton fertility (phytoplankton and zooplankton). Plankton is the main woof resource for Garing fish at juvenile stage. According to Odum [29], the zone littoral waters is the shallow waters through the sunlight penetration which reaches the base. Furthermore, it claims that the photosynthesis zone in the aquatic habitat is bounded by the depth. Next, Sumantadinat [30] claims that in general, plankton (phytoplankton and zooplankton) is the main woof for juvenile fish.

The optimal or suitable water velocity for every Garing fish life stage is different (Table 2). The differential is caused by the different ability of fish to swim against the stream. The juvenile stage ability to swim against the stream is still weak, thus it tends to life in the relative stilling-water. Henceforth, Adi [28] states that at the larva/juvenile stage is the most crisis period of the fish life cycle. At that time, the fish physical condition is still weak and should adapt the environs condition.

The subadult and the adult Garing fish chronologically has the strong ability to swim against the stream, thus as bigger fish sized as stronger the water flow it prefers (Picture 3). This happens because the sort of Garing fish is one out of fish that lives in the torrential waters flow. According to Rupawan, *et al.* [16], generally, the adult Garing fish species (*Tor* sp.) lives in the torrential and clear water flow. Meanwhile Nontji [31]; Masrizal & Azhar [32] dan Kiat [13] claims generally the original habitat of Tamba fish (*Tor* sp.) is at the upper river in the hills area with the torrential and clear water flow.

The water velocity influences the woof resource. The waters that have weak velocity are the ideal type of plankton to fertilize as the woof for the juvenile stage. Ewusie [33] states that plankton cannot thrive within the flow water because it will drift through the water flow. Plankton is the main woof resource for juvenile [30]. Effendie [34] notes that habitat environment naturally will determine the woof type and the fish eating habit.

In the waters that have strong water velocity provide the woof resource such as; benthos, feriphiton and the seed that drifts through the water flow. The woof resource is main backer for the life of subadult and adult Garing fish. Ewusie [33] contends that the organism that can live in the torrential water flow is the adapting organism by the condition such as the organism that lives adhered in the water base (feriphiton

dan benthos). Lagler [35]; Ikusemiju and Olaniyan [36]; Saliu [37] and Mamun *et al.*, [38] contends that from one stadia individual to the others, the woof type and the fish eating habit is very varied. The variation connects with size, age, sex, life history, the obtainable feed type, season and feed time of the fish. Furthermore, Windell [39] states that the woof type variation and the fish eating habit is also depend on the habitat, the water temperature in lunch time and the others fish species as the competitor.

The base water substrate such as mud is disliked by Garing fish (Picture 4). The Garing fish is a sort of fish that prefers to live in clear water [13, 16, 31,32].

The optimal and the suitable base water substrate for every Garing fish life stage is relatively different (Picture 4 and Table 3). The sand substrate type is suitable for juvenile stage and the big stone substrate type is suitable for subadult and adult stage. The differentiation is caused by the depth and water velocity differential. The differential of depth interaction and water velocity will form the different type of base substrate. According to Odum [29], there are two zones in the river flow; they are 'torrential water zone' which refers to a shallow waters through high water velocity in order to make the river bottom clear from the mud deposit so the bottom river is solid and 'stilling water zone' refers to a depth waters where the velocity has been decrease so the mud tens to deposit in the bottom then the bottom becomes soft.

The optimal cover type for juvenile stage Garing fish is different with subadult and adult one (Table 4). Garing fish sized juvenile lives in the relatively shallow waters, weak water flow, and without cover. The Garing fish sized subadult and adult lives in the relatively depth waters and strong water flow. It needs cover types such as big stone in flow for protection after lose the power swim againts the strong water flow.

5. Conclusion

From the result of this research, the writer concludes that the optimal physical habitat parameter condition to support the life of Garing fish, juvenile stage: water depth, 0.26-0.50 m; water velocity, 0.26-0.50 m/s; the type of base waters substrate is sand; cover types are no cover and tree shadow. The Garing fish, subadult stage: water depth, 0.51-0.75 m; water velocity, 0.51-0.75 m/s; the type of base waters substrate is small cobble. The Garing fish, adult stage: water depth, > 1.00 m; cover type is big stone in flow.

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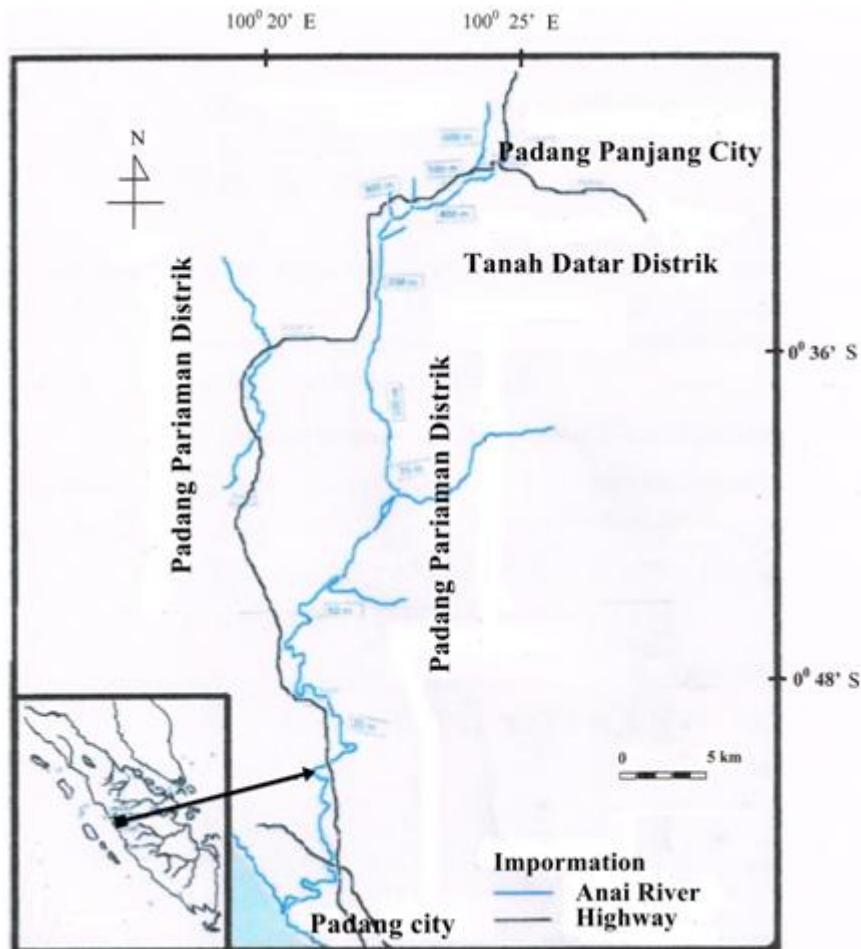


Figure 1: The sketch of Anai River waters flow and the altitude spot above the sea level (<http://maps.google.co.id>).

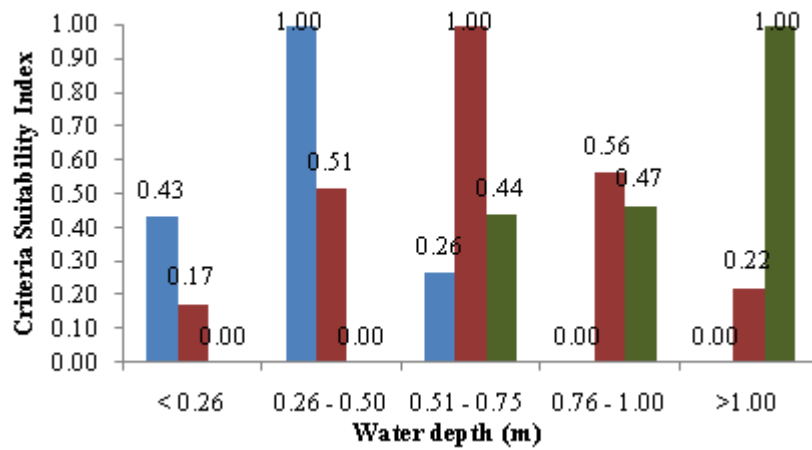


Figure 2: The histogram of index suitability criteria value bases on water depth and Garing fish life stage in Anai River West Sumatra. ■ = Juvenile stage, ■ = Subadult stage, ■ = adult stage.

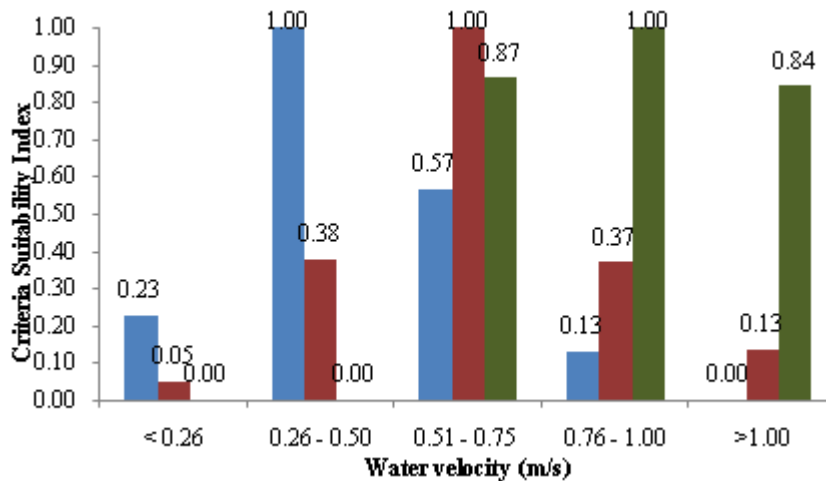


Figure 3: The histogram of suitability index criteria value bases on the water velocity and Garing fish life stage in Anai River West Sumatra. ■ = Juvenile stage, ■ = Subadult stage, ■ = adult stage

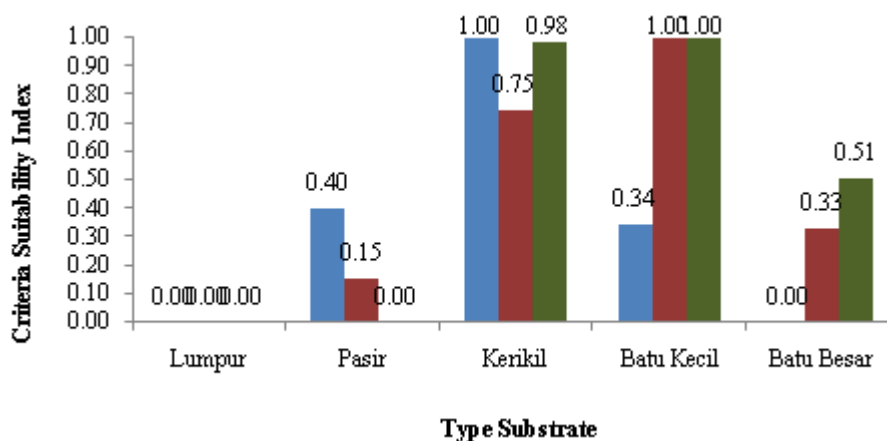


Figure 4: The histogram of suitability index criteria value bases on the type of base substrate and Garing fish life stage in Anai River, West Sumatra. ■ = Juvenile stage, ■ = Subadult stage, ■ = adult stage.

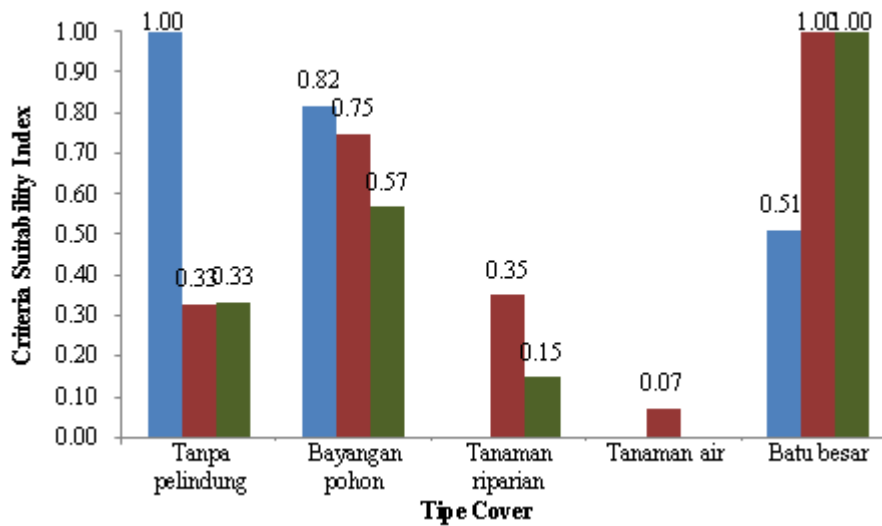


Figure 5: The histogram of suitability index criteria value bases on the cover type and Garing fish life stage in Anai River, West Sumatra. ■ = Juvenile stage, ■ = Subadult stage, ■ = adult stage.

Table 1: The result analyses of Chi-square water depth which is optimal and/or suitable for every Garing fish life stage in Anai River West Sumatra.

	Juvenile Stage		Subadult Stage		Adult Stage	
	$\chi^2_{\text{calculation}}$	Depth	$\chi^2_{\text{calculation}}$	Depth	$\chi^2_{\text{calculation}}$	Depth
Optimal	5.5566*	0.26 – 0.50	6.1243*	0.51 – 0.75	5.9771*	> 1.00
Usable	8.4917*	< 0.76	2.7911*	> 0.26	6.4486*	> 0.50

Information: * = the value of $\chi^2_{\text{calculation}} > \chi^2_{\text{table}} (1,6449)$.

Table 2: The result analyses of Chi-square water velocity which is optimal and/or suitable for every Garing fish life stage in Anai River, West Sumatra

	Juvenile Stage		Subadult Stage		Adult Stage	
	χ^2_{hitung}	Velocity	χ^2_{hitung}	Velocity	χ^2_{hitung}	Velocity
Optimal	7.2186*	0.26 – 0.50	4.3737*	0.51 – 0.75	-4.6611 ^{ns}	---
Layak	7.0571*	< 0.76	2.2388*	0.26 – 1.00	1.6449*	> 0.50

Information : * = the value of $\chi^2_{\text{calculation}} > \chi^2_{\text{table}} (1,6449)$, ^{ns} = the value of $\chi^2_{\text{calculation}} \leq \chi^2_{\text{table}} (1,6449)$, --- = The result cannot yet differentiate the velocity between the optimal with the usable one.

Table 3: The result analyses of Chi-square base substrate which is optimal and/or suitable for every Garing fish life stage in Anai River, West Sumatra

	Juvenile Stage		Subadult Stage		Adult Stage	
	$\chi^2_{\text{calculation}}$	Substrate	$\chi^2_{\text{calculation}}$	Substrate	$\chi^2_{\text{calculation}}$	Substrate
Optimal	3.3616*	Pebble	4.2269*	Small cobble	-1.9980 ^{ns}	---
suitable	4.9718*	sand, pebble & small cobble	3.6169*	pebble, small cobble & big stone	2.6279*	pebble, small cobble & big stone

Information : * = the value of $\chi^2_{\text{calculation}} > \chi^2_{\text{table}} (1,6449)$, ^{ns} = the value of $\chi^2_{\text{calculation}} \leq \chi^2_{\text{table}} (1,6449)$. --- = The result cannot yet differentiate the base substrate between the optimal with the usable one.

Table 4: The result analyses of Chi-square cover type which is optimal and/or suitable for every Garing fish life stage in Anai River, West Sumatra

	Juvenile Stage		Subadult Stage		Adult Stage	
	χ^2_{hitung}	Cover	χ^2_{hitung}	Cover	χ^2_{hitung}	Cover
Optimal	6.2042*	No cover and tree shadow	2.9945*	Big stone in flow	3.4835*	Big stone in flow
Layak	4.8439*	No cover, tree shadow and big stone in flow	-2.0508 ^{ns}	---	0.4098 ^{ns}	---

Information : * = the value of $\chi^2_{\text{calculation}} > \chi^2_{\text{table}} (1,6449)$, ^{ns} = the value of $\chi^2_{\text{calculation}} \leq \chi^2_{\text{table}} (1,6449)$, --- = The result cannot yet differentiate the cover between the suitable with the unsuitable one.