

Local Institution to Utilize the Water Resources of The Giam Siak Kecil-Bukit Batu Biosphere Reserve in Riau

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Abstract. The Giam Siak Kecil - Bukit Batu (GSKBB) Biosphere Reserve in Riau Province has flood swamp forest ecosystem, which is served as the primary fisheries resource for the local community. This research is aimed to determine the characteristics of resources and fishing communities, as well as the local institution in utilizing of water resources using Ostrom's principles (1990). This research uses qualitative methods. The data are collected and validated through three techniques which are in-depth interviews, participant observation, and documents study. Analysis was conducted by descriptive-qualitative. The results show that most of fishing communities were Siak Malay ethnic, who still used traditional fishing gear. Water resources of GSKBB are classified as Common Pool Resources (CPRs), which make it difficult to cope for free riders. Fishing communities have local institutions, namely: the boundary of technology, property rights, supervision, social sanctions, and the conflict resolution mechanism. There are no boundary of time and fishing in the area because fishermen wisely adapted to a natural condition such as water fluctuations in water level of rivers and lakes. There are also no limitation of users and the number of unit resources that should be applied because fish resources are still abundant.

Keywords: biosphere reserve, local institution, water resources.

Introduction

The Giam Siak Kecil - Bukit Batu (GSKBB) is a Biosphere Reserve declared by UNESCO on 2009 with total area ±705 271 ha, and located in Bengkalis, Siak, and Dumai Regencies (Indonesia MAB National Committee, 2008) in Riau Province, Indonesia. The core area of The GSKBB Biosphere Reserve has unique wetland ecosystems with the two complexes of lakes which connected by the main rivers, namely Siak Kecil and Bukit Batu rivers. In South Sumatra, this type of ecosystem known as lebak lebung (Ditya *et al.*, 2013) or a flood swamps (Husnah *et al.*, 2010) because periodically it receives an overflowing water from rivers and rainwater that make the water level fluctuates.

Rivers and lakes have great potential of fishery resources. For generations,

communities have utilized the fisheries resources in the GSKBB water area (LIPI, 2008). Legally, the use of fish in this region is limited by external formal regulations, related to the management of wildlife and biosphere reserves. Since 1986, rivers and lakes were designated as part of The Giam Siak Kecil and Bukit Batu Wildlife Reserves, based on Forest Land Use Agreement (Tata Guna Hutan Kesepakatan/TGHK) of Riau Province. Since 2009, both the wildlife reserve areas designated as part of the core areas of The GSKBB Biosphere Reserve. Therefore, biographies of local communities and their interaction with the fishery resources in The GSKBB Biosphere Reserve need to be explored in depth.

Characteristics of resources and user groups affected the action of situation

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of GSKBB water resources utilizing. The action of situation is a social space where individuals interact, to exchange goods and services, supply and utilization activities, as well as problem solving (Ostrom *et al.*, 1994). In order to avoid excessive utilization of the common pool resources and conflict among beneficiaries can be controlled, needs institutions that can protect resources and adjust the allocation of the efficient and sustainable utilization. Institution arranged to direct human behavior according to expectations of community members (Ostrom, 1990), to limit the possibility of aberrant human behavior such as opportunistic behavior by providing the structure of daily life which guide human interaction (Kasper & Streit, 1998; North, 1990)

This research aims to determine the characteristics of resources, characteristics of the fishing communities, and to discover the local institution that developed by community in the use of water resources in The GSKBB Biosphere Reserve. This knowledge is important in order to find out whether the local institution can support the sustainability of GSKBB water resources utilization, and

provide input for the local institutional to strengthening the sustainability. It is due to the fact that water resources is located in the area of wildlife reserve that should be protected by Law No. 5 of 1990 concerning Conservation of Living Resources and Their Ecosystems (Konservasi Sumber Dalam Hayati dan Ekosistemnya), and Government Regulation No. 28 of 2011, concerning Sanctuary Reserve and Nature Conservation Area Management (Pengelolaan Kawasan Suaka Alam dan Kawasan Pelestarian Alam).

Research Methods

The study was conducted in September 2014 - November 2015 in public water within the core areas of The GSKBB Biosphere Reserve (Figure 1). The data was collected using three techniques, namely: participant observation, in-depth interviews, and document study. Participant observation was held during fishing on the Siak Kecil and Bukit Batu rivers, as well as in Tasik Serai and Tasik Betung lakes. In-depth interview related to local institutions in the utilization of water resources was carried out to fishermen and community leaders in the Tasik Betung village

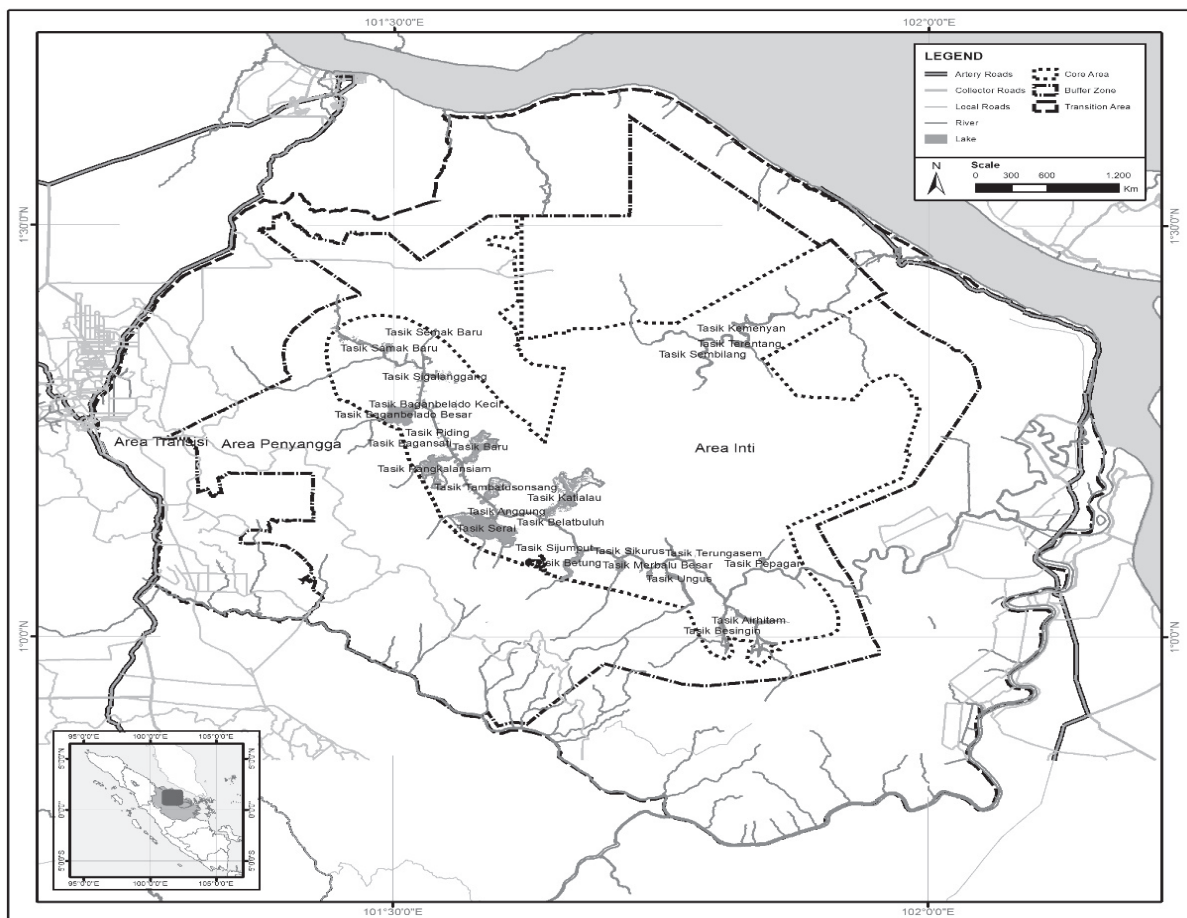


Figure 1. Map of The GSKBB Biosphere Reserve Water Area

Table 1
Species of Commercial Fish in the GSKBB Water Area

No.	Local Name	Latin Name	Category	Catching Intensity
1	Mengkait	<i>Barbus fasciatus</i> Volz.	consumption fish	+
2	Kepar	<i>Belontia hasselti</i> Cuv.	consumption fish	++
3	Bujuk	<i>Channa lucius</i> Cuv.	consumption fish	+++
4	Toman	<i>Channa micropeltes</i> Cuv.	consumption fish	+++
5	Serandang	<i>Channa pleurophthalmus</i>	consumption fish	+++
6	Lompong	<i>Channa</i> sp.	consumption fish	+++
7	Bocek	<i>Channa striata</i> Bloch.	consumption fish	++
8	Keli/Limbat	<i>Clarias batrachus</i> Linn.	consumption fish	++
9	Sipaku	<i>Cyclocheilichthys repasson</i> Bleeker	consumption fish	+
10	Tuakang	<i>Helostoma temminckii</i> Cuv.	consumption fish	+++
11	Cucut	<i>Hemirhamphodon</i> sp.	ornamental fish	+
12	Selais	<i>Kryptopterus macrocephalus</i> Bleeker	consumption fish	+++
13	Bulan-bulan	<i>Megalops cyprinoides</i> Broussonet	consumption fish	+++
14	Baung	<i>Mystus nemurus</i> Cuv. & Val.	consumption fish	+++
15	Kelabau	<i>Osteochilus melanopleurus</i> Bleeker	consumption fish	+
17	Selais	<i>Ompok hypophthalmus</i> Bleeker	consumption fish	+++
18	Juaro	<i>Pangasius polyuranodon</i> Bleeker	consumption fish	+
19	Sepimping	<i>Parachela</i> sp.	consumption fish	+
20	Batung	<i>Pristolepis fasciata</i> Bleeker	consumption fish	+
21	Peperut	<i>Rasbora kotochroma</i> Bleeker	ornamental fish	+
22	Pantau	<i>Rasbora cephalotenia</i> Bleeker	ornamental fish	+
23	Sepat rawa	<i>Trichogaster tricopterus</i> Pall.	consumption fish	+
24	Tapah	<i>Wallago attu</i> Bloch & Schneider	consumption fish	++

Description: + a little, ++ medium +++ many

at Siak District; in the village of Tasik Serai, Tasik Serai Timur, Tasik Tebing Serai, and Temiang, at Bengkalis District. Documents study was conducted by tracing the previous studies in the GSKBB Biosphere Reserve and other relevant documents. The assessment of the local institutions used the eight principles of sustainable institutional design of Ostrom (1990). The data and information analyzed using descriptive-qualitative, simultaneous and cyclical with data collecting and processing activities.

Biophysical Characteristics of the Water Area of The GSKBB Biosphere Reserve

Most of the GSKBB Biosphere Reserve area was a peat swamp forest (Gunawan *et al.*, 2012), and have a high conservation value (Jarvie *et al.*, 2003). Siak Kecil and Bukit

Batu rivers were the main rivers in this area, each of them was connected to surrounding of lake ±26 areas (Hutomo, 2012) (Figure 1). Fluctuations in water levels in the flood swamps were quite high, of ± 5 m, even though some lakes dry for several months. The seasonal water depth change affects water quality conditions (Hartoto, 2000) and as main factor to determine the structure of fish communities in the flood swamps (Hoeinghais *et al.*, 2003).

Water GSKBB has an organic matter content and high acidity level so that it is only suitable as a habitat for species of swamp fish (blackfish), detritus feeders and predators (Husnah *et al.*, 2010). Although it has a pH value of <4, the abundance and diversity of fish species in the GSKBB water area relatively high (Marini and Husnah, 2011). Husnah *et al.* (2010) found the number of fish species in the GSKBB water area as many as 37 species

of 12 families.

Aside from being a source of protein for household consumption, fish was also a source of income for people in GSKBB because it has economic value. Most of the fish was a consumption fish, and very few it used for ornamental fish (Table 1). There were 10 species that mostly collected because they were expensive and easy in processing, but each has a peak fishing season and it was indicated by water level conditions. Although these fishes were expensive, some species were rarely caught because it is already suffered declining population, such as a fish called tapah (*Wallago attu*).

Characteristics of the GSKBB Water Resources

The GSKBB water area was categorized as *Common Pool Resources* (CPRs) because it was subtractable and attract rivalness in utilization (Ostrom, 1990; 1999). It was due to the vast size of the water area and the benefits of these resources can't be divided (undivisible). This condition also occurs in large forest ecosystems, as described by Gibson *et al.*, (2000). The indirect benefits of forest ecosystems, such as flood control services, carbon services, travel services, and clean air regulator, can not be divided, and they are even out of the physical boundaries of the forest (Kartodihardjo, 2006).

The water resources were subtractable because each utilization by a person will reduce availability for others. It leads to rivalness because it restricts the access of others who want to take advantage of the same resources. This second characteristic is causing trouble to ban or restrict other parties to utilize such resources (non-excludable)

(Ostrom *et al.*, 1994). Since it's having low excludability and high sub tractability, there was a tendency of overuse and hard to cope with the presence of free rider, the parties who take benefit from the resources but refuse to contribute to the costs to be incurred to provide, maintained and managed its utilization. Therefore, if the level of management and supervision were still low, the flood swamp ecosystem of GSKBB was vulnerable to damage and fisheries resources in it could be decreased.

According to Schmid (1987), common pool resources had several inherent characteristics that a source of interdependency between individuals or groups of people, among others: the high cost of exclusion and incompatibility. High exclusion costs occurred because the cost to prevent others from utilizing resources was greater than the value (Pakpahan, 1989). Incompatibility occurs because of limited resources so that if there was utilization by one party will reduce the choice or the opportunity of others, and this condition was often triggered a conflict between one person with others. This condition was trigger the public tragedy (Hardin, 1968), when the number of natural resources was limited and claimed many people, everyone has the rationality to utilize it intensively and resulted in the depletion of natural resources and all parties would be at lost.

To set the dependence on resources among individuals in the community a reliable institution is needed to set (Pakpahan, 1989; Basuni, 2003). The institution was rule of the game in society, the restriction was designed to establish a human interaction, whether in the political, economic and social

Table 2
The Number of Fishermen in the GSKBB Water Area

No.	Origin of Fishermen/ Village	Sub District	District	Total (Family)	Proportion from Citizen (%)
1	Temiang	Bukit Batu	Bengkalis	12	2,87
2	Lubuk Gaung	Siak Kecil	Bengkalis	50	8,98
3	Langkat	Siak Kecil	Bengkalis	30	6,77
4	Bukit Kerikil	Bukit Batu	Bengkalis	5	0,35
5	Tasik Tebing Serai	Pinggir	Bengkalis	6	0,92
6	Tasik Serai Timur	Pinggir	Bengkalis	51	5,82
7	Tasik Serai	Pinggir	Bengkalis	102	6,80
8	Tasik Betung	Sungai Mandau	Siak	6	3,45
Total				262	



(a)



b)

Figure 2. Huts of Fishermen; (a) at Tasik Kemenyan when It Receded, (b) at Estuary of Tasik Ketialau

(North, 1990). Institution was a set of work rules used to determine who was entitled to make decisions about what, what action was allowed or restricted, what rules to be used, what procedures should be followed, what information should or should not be provided, and what sanctions will be given to someone who violates the rules (Ostrom, 1990).

Characteristics of Fishermen Community in The GSKBB Biosphere Reserve

A number of fishermen families in each village that has the main livelihood of fishing in the GSKBB water area can be seen in Table 2. The number of fishermen was fairly low compared to the population of the village because the fish catches were likely to decline so that most of them switched to the plantation of rubber and palm oil. Some of them were the tribe Siak Malays, term for the Malay groups that were spread in the eastern coastal areas of Riau which was part of the territory of Siak Kingdom. However, high migration of people who came into The GSKBB Biosphere Reserve affected heterogeneity of fishermen in the region. Some Javanese became fishermen in Tasik Serai Timur village, and seasonally catching the fish its population increase in Tasik Betung and Tasik Serai villages.

Most of the fishermen live in several hut groups (*bagan*), which spread out on the edge of the main river that was adjacent to a lake estuary or tributaries estuary (Figure 2). This strategy applied to shorten the distance and more efficiently in reaching the location of resources from the main settlement. In a year, this fisherman's huts were inhabited

within a period of 6-9 months. In the flood season, most fishermen return to the main settlement in the village because the catch of fishing is drastically reduced. At the time when the water level began to recede, they returned to the huts because catches began to increase. Huts just as a place to rest and to process the fish, and it is not a symbol of ownership over water resources, because all water area were public property. Each fisherman may install fishing gear in one place together with other fishermen. There were no individual ownership of the area.

Fishermen settlements were relatively large in the Siak Kecil River located at estuary of Tasik Pepagar, estuary of Pesingin River, estuary of Tasik Ungus, estuary of Tasik Ketialau, estuary of Tasik Serai, Bagan Benio, and Pulau Bungkuk (Table 3). Most of the fishermen who live in several huts in the downstream to estuary of Tasik Ketialau from the people of the villages in the downstream of the Siak Kecil River, from the village of Lubuk Gaung and Langkat, Siak Kecil sub-district, Bengkalis. Meanwhile, fishermen who settled in Kuala Tasik Serai, Bagan Siam and some settlements on the upstream side of the river were mostly local villagers and inhabitants of the villages in the downstream of the Siak Kecil River. Most of the fishermen live in main settlements in the village of Tasik Betung and Tasik Serai because the locations can be reached easily from their home every day.

Fisherman's huts in the Siak Kecil River were semi-permanent, except in Bagan Benio and Pulau Bungkuk. Both of these settlements were permanent settlements on the banks of the Siak Kecil River, developed since 1942, as the oldest village in Tasik Serai, there has

Tabel 3
Distribution and Number of Fisherman’s Huts on the Siak Kecil River and the Surrounding Lake Complex (from downstream to upstream)

No.	Location	Village Area	Number	Origin of Fishermen
1	Muara Sungai Pesimsim	Tasik Betung	5	Langkat, Lubuk Gaung
2	Kuala Sungai Antan	Tasik Betung	9	Langkat, Lubuk Gaung
3	Kuala Tasik Peparar	Tasik Betung	15	Langkat, Lubuk Gaung
4	Kuala Tasik Pesingin	Tasik Betung	15	Langkat, Lubuk Gaung
5	Kuala Tasik Ungus	Tasik Betung	16	Langkat, Lubuk Gaung, Tasik Betung
6	Kuala Tasik Membalu	Tasik Betung	5	Lubuk Gaung, Tasik Betung
7	Kuala Tasik Betung	Tasik Betung	1	Tasik Betung
8	Kuala Tasik Ketialau	Tasik Tebing Serai	18	Langkat, Lubuk Gaung, Tasik Betung
9	Kuala Tasik Serai	Tasik Serai Timur	13	Tasik Serai Timur
10	Kuala Tasik Mato Songsang	Tasik Serai Timur	6	Tasik Serai Timur, Lubuk Gaung
11	Pangkalan Siam	Tasik Serai	7	Tasik Serai, Langkat
12	Bagan Benio	Tasik Serai	50	Tasik Serai
13	Pulai Bungkok	Tasik Serai	24	Tasik Serai
14	Bagan Belado	Tasik Serai	9	Tasik Serai
14	Kuala Sungai Mengkuang	Tasik Serai Barat	2	Lubuk Gaung
15	Empang Dusun	Tasik Serai Barat	10	Tasik Serai, Bukit Kerikil, Lubuk Gaung
Total			205	

been a Primary School that was built 1978. Both of these settlements were located in near area, on a bed of mineral soil surrounded by swamp forests. Beside as fishermen, the villagers also do rubber gardening, but they have not be able to do the expansion because of the land of its surrounding is peaty. It was because the rubber plant could not grow on deep peat, then some residents have moved them to other areas that have mineral soil types and choose a location that was easily accessible by road.

The number of fisherman’s huts in Bukit Batu River was less than those in Siak Kecil River (Table 4). It was due to the length of the Bukit Batu River was shorter and the trend of catching fish was decreased. According to the recognition of Temiang villagers, the number of fishermen in Bukit Batu River has declined drastically since 2005 in line with the decrease in catches caused by water pollution due to forest plantation development around the canals to drain the peat swamp water into the Bukit Batu River.



Figure 3. Trap Fishing Gear Used by Fishermen; a) Lukah Tali to Close the Estuary of the Small Size Lake, B) Fishermen were being Held Up Hambat in Tasik Serai

Table 4
Distribution and Number of Fishermen's Huts in Bukit Batu River and the Surrounding Lake Complex (from downstream to upstream)

No.	Location	Village Area	Number	Origin of Fishermen
1	Tasik Baru	Temiang	1	Temiang
2	Tasik Kemenyan	Temiang	2	Temiang
3	Tasik Terentang	Temiang	1	Temiang
4	Tasik Anggung	Temiang	2	Temiang
5	Tasik Rantau Panjang	Temiang	1	Temiang
6	Tasik Pangkalan	Temiang	1	Temiang
Total			8	

Table 5
The Number of Hambat in Some Lakes in the Surrounding of the Siak Kecil River

No.	Lake/River	Number	Origin of Fishermen
1	Tasik Betung	1	Tasik Betung
2	Tasik Baru	1	Tasik Serai
3	Tasik Serai	9	Tasik Serai Timur
4	Pangkalan Siam	3	Tasik Serai
5	Bagan Samak	1	Tasik Serai
6	Sungai Mengkuang	1	Tasik Serai
7	Sungai Sigeronggang	3	Tasik Serai
8	Empang Dusun	1	Langkat
9	Puang Sembilan	4	Tasik Serai, Tasik Serai Timur, Tasik Serai Barat
Total		24	

Table 6
The Catch of Fish based on Type of Tools and Water Level in the Siak Kecil River

No.	The Fishing Gear	The Height of Water Level	
		High	Low
1	Lukah	5-25 kg/day/Fisherman	3-6 kg/day/Fisherman
2	Gill net	5-16 kg/day/Fisherman	4-8 kg/day/Fisherman

Source: Husnah *et al.* (2010), Marini and Husnah (2011)

Most of fishermen in Bukit Batu and Siak Kecil rivers have used a motor boat to cross the river and lake. The use of rowboats was limited only to catch fish around huts. Motor boats owners have a cruising range catch >5 km from huts to reach locations that rarely visited by other fishermen, while the distance range owner rowboat <2 km. Locations visited was usually close to the plant rasau (*Pandanus helicopus*) growing on the riverbanks and lakes, a place where many fish gathered. Furthermore, they will install the fishing gear

in the vicinity.

Fishing gear that was used were traditional, ie: *lukah*, fishing rods, nets, gill nets, *belat* and *hambat*. *Lukah* was a tool fish trap such as *bubu* (pot traps), equipped with a narrow mouth on the inside so the fish that have been caught in a trap could not get out back. A variety of *lukah* distinguished by shape and materials to make. *Lukah baring* oval shaped, mounted horizontally, made from bamboo and rattan to catch all of the

medium size fish. *Lukah tali* (fish trap rope) cube-shaped, mounted stand, made from netting fabric, has many variants depending on the frame size and density cavities rope used, according to the species and size of fish to be caught. *Lukah tali* which large-sized with rarely density of rope cavity used to catch *tapah* fish (*Wallago attu*), *lukah tali* which medium-size with a high density of rope cavity to catch *baung* fish (*Mystus nemurus*), and which the cavity very dense to catch a *selais* fish (*Ompok hypophthalmus*) and other small fish. *Lukah tali* was more widely used than *lukah baring* because it was easier to obtain raw materials and workmanship.

Especially in the lake, the fishermen usually use a *belat*, *lukah*, and *hambat* to catch fish. *Belat* was a type of wood or bamboo fences and netting fabric mounted stretches in the river or estuary and estuary of lakes to fish in order to steer through the hallway provided with a deep groove. In the small lake, the hallway closed with a *lukah* (Figure 3a), while in the large lake which was usually installed as a *hambat* (Figure 3b). *Hambat* was a kind of netted door such as *jermal* that can be pressed and removed from the stage. Besides installed the estuary of the lake, *hambat* was also installed on some deep tributaries. Distribution of *hambat* in the GSKBB water area can be seen in Table 5.

The catch of fish in the GSKBB water area was fluctuated, affected by water level and fishing gear used. In the Siak Kecil River, the water began to recede in February and reached its lowest ebb in July-August. The water level began to rise in September and reached the peak in December-January. Research of Husnah *et al.* (2010) in 14 observation points scattered in the river and some lakes connected by the Siak Kecil River showed that the use of *lukah* in the water high level was more effective than the gill net, and on the contrary, when the water level was low, *Lukah* was more effective than gill net (Table 6).

According to the fishermen of Tasik Betung and Tasik Serai, the catch of fish in the lake occurred twice, usually at the beginning and end of the rainy season. At the time of high water levels, fish spread out to distant marshes of the rivers and lakes. When the water level gradually declining, many fish were formerly trapped in the swamp back into the rivers and lakes. At the beginning of the rainy season and water level began to rise, *hambat* installed in the hallway of *belat* to

catch fish that will come into lake, it usually takes place in October-November. At the end of the rainy season and the water level of the swamp began to recede, *lukah* and *hambat* installed in the opposite direction to catch fish that will come out of the lake to the river, usually occurs in May-June.

Fishermen of the Siak Kecil River claimed that the catch of fish was declining because the duration of the flood on the lake and the surrounding area was getting shorter, which was less than 3 months. They suspect that it was because of the influence of the construction of the drainage canal in the Langkat village, in the lower of the Siak Kecil river, established in 1978 to prevent flooding in transmigration areas of Sungai Linau. Land use changes in around the lake, from natural forest to plantations and estates, accompanied by the manufacture of drainage canals has also altered the hydrology of this region.

The catch of fish in the Siak Kecil River mostly sold to merchant-traders who come directly to the fisherman's huts on a regular basis once a week using a wooden ship (*pompong*). There was no fishing auction in Siak Kecil (Tempat Pelelangan Ikan/TPI) as illustrated by Amiruddin (2014a) and described it as clearinghouses and providers of public services. Traders usually carry essential goods and materials or fishing equipment needed by fishermen. Traders also serve as *Toke* which provide loans to fishermen, both for household and fishing purposes. A marketing social network involves *Toke* like this also happen in traditional fishing communities in Banten commonly referred *Langgan* (Amiruddin, 2014b). It is happened because the fishermen do not have access to financial services. It happened due to the distance of the service center, as well as the fact that they generally do not have assets that can be used as collaterals for a loan application. In addition, relationships with *Toke* was still carried out by fishermen as a safety strategy at the time reduced when catching fish at the peak of floods and long droughts.

Institutional Sustainability Analysis in the Utilizing of the GSKBB Water Resources

People in local fishing communities within the GSKBB water area generally know each other and most have family ties, so that the opportunity to act in collective was

Table 7
Characteristics of Local Institutions in the Utilization of GSKBB Water Resources

No	The principles of sustainable institutions design (Ostrom, 1990)	The condition of local institutions in GSKBB	Conformity with the principles
1	Clearly defined boundaries in resources utilization:		
	- Technology	There were technology boundaries that prohibit the use of stun and poison.	√
	- Territory	There was not territory of fishing boundaries.	x
	- Time	There was not time of fishing boundaries.	x
	- Number of resources units	There was not boundaries of the number of resources units that may be utilized.	x
	- Users	There were not users boundaries.	x
	- Property Rights	Fish that have been caught in fishing gear was privately owned.	√
2	Congruence between appropriation and provision rules and local conditions	Rules were arranged by the hydrological conditions, the knowledge and practice of community that lasts from generation to generation.	√
3	Collective-choice arrangements	Rules drafted by the ancestral community leaders, and if it requires modifications to be carried out community deliberation	√
4	Monitoring	There was a social internal monitoring, in case of deviant behavior of users will be reported to the community leaders and village head.	√
5	Graduated sanctions	Social sanctions from other users was severe enough to realize a high level of adherence.	√
6	Conflict-resolution mechanisms	The mechanism of conflict resolution through community deliberation led by community leaders.	√
7	Minimal recognition of rights to organize	BBKSDA of Riau as a wildlife reserve managers recognize the local rules and do not forbid the practice of the GSKBB water resources utilization by local communities.	√
8	Nested enterprises	Local rules were already in line with the rules of the village, but not yet in line with the rules of the upper level related to the management of conservation areas designated by the government.	√

independently and to manage resources is based on local institutions (Uphoff, 1986). Identification of the application of the principles of sustainable institutional design (Ostrom, 1990) was performed in the local institution in the GSKBB water area. The results of identification of each of the principles were briefly presented in Table 7.

To Clearly defined boundaries in resources utilization

In the use of common pool resources (CPRs), there should be clearly defined the rules about the time, location, technology, and a number of units of resources that can be utilized. GSKBB fishing communities

have been set and enforce boundaries on technology, which was not allowed to use poisons and electrical current carrying fishing gear (stun) with the reason that can it kill all of the species and sizes of fish and disrupt the continuity of the fishing catch. In Bukit Batu fishing communities, they also prohibited the use of net and gill net to catch fish in the lake and Bukit Batu River because they think these two tools are sea fishing gear that were believed to disrupt the lives of freshwater fish. This reasonable myths can help restricted the competition among sea fishermen so there would be no overfishing.

All the GSKBB water area may be used and there was no mastery of the territorial

water by an individual or groups. Fishing can be done throughout the year because nature has set the intensity of the arrests followed the fluctuations in water level of a flood swamps. That condition was also not encouraging them to determine the boundaries of certain areas which prohibited their arrest. It is different from the rules of *Lubuk Larangan* that mostly found in the highlands of Sumatra, as in Mandailing Natal, North Sumatra (Nuraini, 2015) and in Lima Puluh City, West Sumatra (Kurniasari, 2014; Yuliaty *et al.*, 2014). The boundaries of a number of units of fishery resources that may be arrested also not regulated. All the species and size of the fish caught can be consumed or sold, where in small fish that unsold were usually released again or used as bait to catch baung fish. It was because GSKBB flood swamp area was very spacious ($\pm 16,620$ ha) and fish resources in it were still abundant.

According to Ostrom (1990), individuals or households who have the right to withdraw resource units from the CPRs must be clearly defined, as to the boundaries of the CPRs itself (Ostrom, 1990). However, fishing communities within the GSKBB water area not set boundaries of individual or catcher groups, allowing anyone right to exploit the fish in the river or lake, both locals and visitors, without specific requirements. Residents of an area were also allowed to catch fish in other regions. It was because the number of fishing communities was still small and relatively uniform in culture background as Siak Malays were always open to welcome others.

The congruence between appropriation and provision rules and local conditions

Utilization rules must congruence to local conditions, and in accordance with the rules of supply (energy needs, material, or money), and the distribution of benefits should be proportional to the costs incurred (Ostrom, 1990). Although fishing communities within the GSKBB water area have not set the boundaries of time, place, and the number of units of fishery resources that can be captured, but they have set and enforced boundaries on technology, where fishermen were not allowed to use poisons and fishing gear that equipped with electricity (stun) with the reason that can it kill all species and size of the fish. The rules that were complied with for generations have already noticed specific hydrologic conditions for both of them will kill

all of the species and sizes of fish to disrupt the continuity of the fish catch. The fishermen community was already getting benefits in accordance with the fishing gear and the costs they incur in fishing activities. This rule was efficient because the cost of enforcement was low, while the catch using other equipment were still comparable to the costs incurred.

Collective choice arrangements

Most individuals affected by operational rules can participate in modifying operational rules (Ostrom, 1990). Utilization of GSKBB water resources ancestral figures compiled by the society passed from generation to generation, and until now there has not been a changing to the rules. If they require modifications, a consultation with the societies will be done. This indicates that the rule has survived a long time because it was according to the aspirations of the wider community and to keep opening the chance of any involvement of the fishing communities (if necessary) to change the rule. These rules developed based on the practice and experience of their ancestors from generation to generation which was a cognitive-cultural dimension, and become one of the pillars of the institution (Scott, 2008).

Monitoring the Activity

Ideally, there were monitoring who actively audit the resource conditions and appropriator behavior, and they were also responsible for those appropriators (Ostrom, 1990). In the fishing communities of GSKBB no officials appointed to be the monitor. They develop participatory social monitoring in fishing. If there were people who misbehave will be reported to the community leaders or village head. Local communities still adhere to the norms should not take away the rights of others, they even are not allowed to look at the fish trap and other gear that other people have installed. The community believes that the presence of fish in rivers and lakes were unseen because they can not be seen from above the water, so the fish were caught as the fortune of God to be grateful regardless of the outcome. The community still believes that God governing a sustainability of resources and monitor appropriator behavior. It showed that the social capital of people trust can reduce the cost of monitoring. Adequate monitoring through community participation greatly contributed to the realization of sustainability of CPRs and reduce conflicts between appropriators (Ostrom, 1990;

Dutton, 1996).

Dividing Sanctions

Appropriators who violate the operational rules must be given graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by accountable officials to these appropriators, or by both (Ostrom, 1990). The institutional need sanctions to enforce and punish the act of violating because the institutional without sanctions was no use (Kasper & Streit, 1998). The sanction was a means of coercion in order to obey the norms in force (Susetyo, 2014). At the operational level, in addition to the existing rules in the appropriation, provision, and monitoring, also need rules of enforcement (Ostrom, 1990). Fishing communities within the GSKBB water area put more emphasis on social sanctions, for those breaking the rules a ban on the use of poison and stun would be ostracized from the community. The fishing communities consider that these penalties as unwritten rules that must be followed in order to preserve their resources and so far no one has ever break the rules. Unwritten social sanctions like these were also more respected by the community Rumahkay in West Seram, Maluku in protecting their forest resources (Ohorella *et al.*, 2011). According to Kasper and Streit (1998), sanctions on informal institutions usually given spontaneously from social interaction. It was form of accountability inwardly from the perpetrators of the offense (Susetyo, 2014). However, the presence of migrants outside the Malays who work as fishermen was necessary to formulate clear sanctions to prevent the violation in the future.

Conflict-resolution mechanisms

Sustainable institutions need to have rapid access to low-cost local arenas to resolve conflicts between appropriators, or between appropriators and officials (Ostrom, 1990). The institution should have a purpose to limit and resolve conflicts (Kasper & Streit, 1998). In the GSKBB water area has never been open conflicts among appropriators because usually a group of fishermen in an area still have family relationship. Apart from that, they were also upholding the values of harmony, mutual respect, and common prosperity.

Conflict is a clash that occurred between two or more parties due to the differences

in interests, perspectives, values, and the scarcity of resources (Fisher *et al.*, 2001; Malik *et al.*, 2003). Conflict among fishermen in the GSKBB water area began to emerge when the number of fishermen has multiplied in numbers and heterogeneous due to the arrival of migrants from outside the Malays, as in the Tasik Serai Timur village, where began to occur in the case of illegal fishing in the fish trap. To prevent the conflict continues to expand, they hold deliberations, facilitated by community leaders so that the theft of the fish does not happen again. It showed that the rules at the operational level have been underway to resolve the conflict at a low cost. Low conflict in this area was the establishment of tenure security indicator (Agarwal & Elbow, 2006), since the restriction of property rights was clear and recognized by the public that the fish was caught belonged to an individual of the fishing gear installer.

Minimum recognition of right to organize

Ideally, the right of appropriators to device their own institution were not challenged by the external governmental authorities (Ostrom, 1990). In the GSKBB water area, Conservation of Natural Resources Agency of Riau (BBKSDA of Riau) who manage the Giam Siak Kecil and Bukit Batu Wildlife Reserves do not prohibit fishermen to catch the fish in the GSKBB water area. BBKSDA of Riau recognizes the right of local people to establish sensible rules. Water area in the reserve will be allocated as a Utilization Block, although until now has not become the structuring area. It was because BBKSDA of Riau still believe that the local institutions developed by fishing communities based on habit (tradition) from generation to generation and it was not caused a huge negative impact on fish populations.

Local institutions were usually more effective to control the behavior of people who were relatively the same and the number of fishermen were still limited. Research by Nursidah *et al.* (2012) showed that institutional development based on customary norms in West Sumatra was superior compared to institutional designated by the government. Based on the research in Lore Lindu National Park, Central Sulawesi, Mehring *et al.* (2011) suggested that the government's recognition need to be poured in conservation agreement between community and conservation area managers by considering cultural diversity and flexibility in the area management

process. A form of community conservation agreement was an example of collaborative management in the conservation area (Massiri *et al.*, 2015) which need to be developed in the GSKBB Biosphere Reserve.

Nested enterprises

For CPRs that were parts of larger system, appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities were organized in multiple layers of nested enterprises (Ostrom, 1990). Ideally, there was linkage rules at the operational level, the collective, and the local constitution. The rules in appropriation of water resources that developed by fishermen of GSKBB already aligned with the government regulation of the village, and the village government was also ready to assist in enforcement. However, this rule has not been yet in line with the rules of the upper level related to the management of forest conservation developed formally by the government. It was very important given the fisheries resources were located in the area of wildlife that should be protected by Law No. 5 of 1990 concerning Conservation of Living Resources and Their Ecosystems, and Government Regulation No. 28 of 2011, concerning Sanctuary Reserve and Nature Conservation Area Management.

Until now, there has not been spatial planning in two wildlife reserves that allows granting access rights to local communities in the Utilization Block. The Bukit Batu Wildlife Reserve has been establishment based on Decree of Minister of Forestry No. 482/Kpts-II/1999, but spacial structuring of this area not yet. Meanwhile, The Giam Siak Kecil Wildlife Reserve that designated in 1983 by Decree of the Governor of Riau No. 324/XI/1983 has not been completed boundary marking so can not be conducted yet the establishment and structuring of this area. This has become tough task for BBKSDA of Riau who managed two of the wildlife reserves.

Conclusions

Fishing communities in The GSKBB Biosphere Reserve were relatively uniform, mostly from the ethnic Siak Malay, and still using a traditional fishing gear, ie: *lukah*, fishing rods, nets, gill nets, *belat* and *hambat*, settled in several hut groups (*bagan*) spread out on the main riverbank. Water resources of The GSKBB Biosphere Reserve had low excludability and high sub tractability so that it was difficult to overcome the presence of

free riders and most likely to occur excessive utilization. To maintain the sustainability of water resources and control conflicts among users, the fishing communities had developed local institution, namely: the technology boundaries, the right of ownership, monitoring, social sanctions, and the conflict resolution mechanism, which had adapted to the hydrological conditions. There were no time and fishing area boundaries because fishermen wisely adapted to natural conditions such as fluctuations in water level of rivers and lakes; as well as there was no limitation of users and the number of unit resources that should be applied because fish resources were still abundant. BBKSDA of Riau needed to integrate these local institutions into the management plan of The Giam Siak Kecil and Bukit Batu Wildlife Reserves to ensure sustainability.

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