Sustainability of the floating house at Tempe Lake, Sulawesi Island

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ABSTRACT: The floating house in Tempe Lake is one of the Buginese’s traditional settlements in South Sulawesi. However, the characteristic of Tempe Lake is a cistern lake, causing the lake’s water to overflow during the rainy season and dry out during the dry season. The extreme climate condition, inconsistent wind direction and waves cause constant movement of the floating house. Nevertheless, the fisherfolk community have learned to adapt to these conditions as their livelihood is largely dependent on the floating house. The aim of this research is to improve the design concept of the floating house so that it can adapt to the seasonal changes in the Tempe Lake, and determine the most suitable location and layout that will ensure the safety and durability of the floating houses, hence the sustainability of the use for the livelihood of the fisherfolk community. The research findings showed that the concept of the floating house on a raft adapts well to the seasonal changes. During high tide, the floating houses will be moved to the lake side to avoid the waves and strong winds, and also to simplify the fisherfolks’ activities. During the dry season, the floating houses will be moved afloat to the centre of the lake. The arrangement of the floating houses depends on the minimum crash distance considering the waves and the change of wind directions. The fishing boats are positioned alongside the houses to allow the house to freely move about a tether pole. The open building concept is used so that each room can be used for various purposes, including fish drying.

Conference theme: Architecture
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INTRODUCTION

A house is a physical culture which in traditional context is an expression that strongly related to the personality of its society. Its physical term is strongly influenced by cultural social factor and environment where it grows and develops. The difference of area, cultural background, and its natural condition has also caused its different culture.

The floating house in Tempe Lake is an interesting phenomena which needed to be analysed in term of the settlement concept and its architecture context. The settlement and the form of the house has existed because the moving of the settlement place from ground to the lake as the effect of economics dependence as fishermen in Tempe Lake. The floating settlement has evolved and incrementally formed a new environment image in this area by creating a new housing concept which is suitable with its function and its nature condition.

The important factor which is the intention in this research was the settlement adaptation process conducted by the fishermen on the water in facing the nature characteristic and climate in Tempe Lake so it forms a kind of settlement which is functioned to various activities, anticipates nature condition and maintaining settlement characteristic that illustrates Buginese traditional culture. Which factor dominates the sustainability of the house and settlement pattern so that the life of the floating house will be sustained.

1. THE ARCHITECTURE CHARACTERISTIC OF FLOATING HOUSE IN TEMPE LAKE

1.1. The History of Floating House
In South East Asia, almost traditional people built their house on stilts, except in Java Island, Bali, Lombok, Buru, and Vietnam. Among these traditional communities, there were tribes which did not use the ground as a place to build, such as seamen who built a stilt house on the water and sailors living in the ship (Bier,1990, in Frick, 2006). The history of the settlement on the water was begun when the groups of a certain ethnic arrived on the water area. These groups has lived and developed generation to generation and then formed a clan. The existence of the people (community) on the water tends to be homogeneous and developed a tradition and certain value in their lives. This character becomes a character and specific characteristic of the settlement. The next condition, the settlement’s characteristic tends to improve spontaneously and organically to a spontaneous settlement (Suprijanto, 2000).

The settlement on the water has existed in several places in Indonesia. Some of them lived permanently by using stilt house architecture or raft house architecture, and some of them continuously moved by using floating house. The settlement on the water which used permanent raft house on the water existed in Barito River and Mahakam in Kalimantan, Musi River in Palembang, and along the Baliem River in Papua (Rigg,2002). The settlement which used permanent stilt were also existed in Bajo tribe settlement in Bone (Soesangobeng in Salipu,2000), whereas settlement on the water which used moving floating house only existed in Tempe Lake in Wajo Regency of South Sulawesi (Suprijanto,2000).
The floating settlement has existed in Tempe Lake for decades. At first, this fishermen community only dwelled in the coastal area of the lake, since the people of this area earned their living as fishermen on the lake, they also work as a farmer on the ground. However, since the characteristic of Tempe Lake is always experience the condition of the rise and the fall of the water annually, so when the water is narrowed, the distance of the location to catch the fish is far from the ground. The condition has made the community to make a temporary settlement in the lake as commonly called *kalampang* (Bugis: A small shelter, to carry 3 – 4 people, made of bamboo) At first the people built *kalampang* just for shelter from the heat and the rain, places for storing fishing equipments such as *belle* (bamboo laths used for catching fish) and fishing net (as *belle*, jala)) and the roof for taking a rest in nap on fishing activities. This *kalampang* is built permanently on the water by embedded the bamboo poles to the almost dry water. This shelter is furnished with the floor and the wall made of bamboo piles and the roof is made of palm leaves.

Along with the development level of fishermen community needs, *kalampang* on the water which is built permanently on the water is considered inappropriate and inflexible toward the climate’s condition of the lake. On the time when the lake water is on the rise and the fall, this house can not be used again, so it must be reconstructed and be moved again to follow the water’s direction. The far distance from the catching place on the centre of the lake has made the fishermen to think to make temporary shelter and the place for keeping *belle*. The place is in the form of bunch of bamboo poles which tied to make a raft which floats on the water permanently, so the raft can be moved to follow the location of the fishing areas. The raft is tied to a pole embedded to the bottom of the lake.

The raft made of bamboo initially just equipped by four poles from the cylindrical bamboo poles by spreading the tent made of fabric on its top. Every day the fishermen take a rest by eating and drinking which is taken from the house or repairing the fishing tool on the raft. Afterwards, the fishermen tried to supply the raft by replacing the fabric roof with palm leaves and iron sheet and adding the wall made of bamboo. Along with the growth of the community and the growing activities has to be done by the fishermen on the lake, so the simple shelter raft has changed into a simple house on the floating raft.

Fishermen community of Tempe lake and its surrounding people used to call the house on the raft as *bola mawang* (*bola= house, and *mawang=*floating), and it is so-called floating house. The floating house in the past and now has experienced a morphology in its shape which is suitable to its function. The potency of Tempe Lake as the fresh water production has made the local community depend on its economic activities on the lake, so Tempe Lake is chosen as an alternative to be an effective settlement place.

The floating settlement in Tempe Lake is a moving settlement adapting to the rise and the fall of the water, without replacing part of the house but just by pushing them to other places on the water level, by at least 3 boats. The length of stay in one location on the water depends on the water condition. Generally it lasts 1 week and maximally lasts for 3 months. In a long dry season, the lake water decrease every day, this meant that the length of stay in one location is shorter. The settlement have to be pushed to the other location which still have flooded water. On the other hand, on the continuous rainy season, the floating settlement will be moved to the possible nearest place of the ground.

The adaptation process towards the extreme climates and its severe environment on the water for years, has made the community sustains their settlement with its unique culture and its traditional law. This condition has attracted the foreign visitors who visit this settlement and increasing every year.

### 1.2. Location, Geographical Sites and the Climate of Floating house in Tempe Lake

The location of this floating settlement is lie on the floating on the water level of Tempe Lake in Wajo regency of South Sulawesi, on the coordinate of 119º53’ -120º04’ BT and 4º -09ºLS. This settlement consists of approximately 115 floating house in the area of relatively dry and average monthly rainfall less than 100 mm. This area belongs to changing areas between west climate and east climate in South Sulawesi. The dry season happens twice that is on January ,February and August, September, and October. The average degree on the day time is approximately 34-35ºC and the humidity is approximately 85-90 %. So this area can be considered as an area which relatively dry with high humidity. The lake water elevation varies from 3 meters high in dry season until 10 meters high when the flood occurs. Due to the location and climate like this, makes the floating houses can be moved at any time which with low-high-tide of the lake’s water and the macro and micro climate around the settlement (Naing, 2008).

### 1.3. The Lay Out of Floating house in Tempe Lake.

The floating house in Tempe Lake tends to gather in a group with irregular pattern which were formed from a single house system. The distance between one house to other house is twice of the length of the house, so it is possible for the wind to blow freely. Since the floating houses always move continuously, the pattern of the house-position changes every time and also does the view of the house. The floating house is tied on a pole located on the front of the house, so that the view of the house is strongly depends on the wind’s direction as seen on Figure 1 below.
2. CONCEPT AND ARCHITECTURE FUNCTION OF THE FLOATING HOUSE

2.1. Concept of the Floating House
To Buginese tribe, a house is not only a comfortable dwelling place or material object. A House is a sacred space where people born, get married, and die and in this place also social activities and those rituals were conducted (Robinson, 2005). According to Pelras (2006), the traditional Buginese house is a house model of Southeast Asian- Type House in the form of still house made of wood and the framework is in ‘H’ letter consist of poles and beams which were constructed without nails. The poles support the floor and the top, while the wall just tied up on the outer poles. The physical characteristic of the Buginese house as described above has made the house easy to be reconstructed or to be moved. This is one of the factors that caused the Buginese settlement always moved and not focused on a permanent settlement.

A house according to Buginese is always be related to macro cosmos and micro cosmos so that a house is related to a belief system and rituals. A house with its yard is a space which limit to a world surrounded by important powers (Waterson, 1993:223), and a space for supra-natural creatures. To the Moslems believers in Buginese’ tribe, the ritual practice were choosing the location, stocking the materials or house materials, on the day of building and occupying the house. This indicated that human beings followed the cosmos, as other living creatures.

The inclusion of human beings in the cosmos can also be found in traditional community in floating settlement. The rituals in choosing the location did not include in the ritual since the location of building the house is on the water with a moving and temporary places. In the process of building the floating house the good day will be chosen according to Islamic casts or geomancy which mostly acknowledged by the Buginese’ fortune tellers or by Panre Bola (a skilled-person in making Buginese’ house). Before building a house, the owner of the house will ask about the good days and good times to build the house or poles in the main house (posi bola). The good chosen time is important to make sure the positive things as an effort to build a house.

Floating house in Tempe Lake is a house which consists of two parts that is traditional stilt house made of wood with short poles (space underneath) and the lower part in the form of a raft made of bamboos. The combination of Buginese traditional house with the lower part structure from a raft is a form in adapting with the nature condition of Tempe Lake which has rise and fall of the water. The use of the raft on the lower structure is aimed that the house is easy to be moved/ changed on the water without reconstruct the other parts of the house. The moving of the floating house is different with the moving of the house on the ground which must be demolished on its certain parts to reconstruct them.

The manuscript (lontara) which was kept in National Archives of Makassar on building the house, in general consisted of the lists of months in Islamic calendar, with its notes on whether the times are good for the activity to build the house. Building the house and wedding is commonly be related, that is good month for a wedding ceremony is usually good also for building the house. Some examples of good days in building the floating house according to the knowledge of the community of the floating house is: mapongngi arabaE that is a first Wednesday of the month; cappu kammisis that is last Thursday of the month. Whereas the bad days to start to build a house is mula kammisis that is first day of the month; cappu araba that is the last Wednesday of the month; Monday in the middle of each month that is on the 13,14,15 and 16; uleng maharrang means the Muharram’s month. This meant for the Buginese people as hot month meaning that the month has many dangerous things such as illness and house burns. Uleng
Taccipi meaning that sandwich between months of two big Islamic big days such as Idul Fitri and Idul Adha. The taccipi month is Zulkaidah (Hijriah year).

Besides good months, in a day, as Buginese people belief, there were good times and bad times. The good times to start to build a house is in the time of enrekenna matanna essoE  that is on the time when the sun starts to rise that is between 8 to 12 o’clock, while the evening is considered bad to start the work. The concept to use the good and the bad times is connected to the religion believed and the calculation of the year and ritual experiences which inherited for generations to generations.

The concept of good months, days and times to the floating community is considered to influence their lives in dwelling and doing the activities of catching the fish on the lake. Since the people of this areas believed that each space on this world has its ‘guardian’ or creature which appointed by God the Almighty. Hence, in every ritual of building the house, the process of honouring the creatures is highly considered by conducting sacred rituals according to its need. The success of the business and the safety and health is depended on how big is the effort and honour the other surrounded creatures.

Moreover, the building of the floating house in Tempe Lake is in the source on the culture, traditional system and Buginese people’s belief. The cosmology belief is used as basic concept in building the floating house on the water. This meant that the Buginese people in dwelling on the water always keep their balance with natural environment and the universe, to create the balance and sustainability of life.

2.2. The Function of Floating House

The lay out concept of the floating house followed an open building concept that is a lay out concept which used spaces for multi functions. That is function for dwelling place and space for doing the economics activities. Both functions will decide the floating house’s architecture form for its sustainability.

- Economic Function

The economic activities which are conducted by the community at floating house are mostly informal activities in the economic sector as fishermen, fish breeders, fish processors, and fish sellers. Besides that, doing the activities such as opening a stall in the house, be a travelling vendors and renting the house. The equipments used to catch fishes are casting-nets and Jabba (iron made snare fish) which is to be put at the back of the floating house. The kind of fish in the lake are fresh water fish, such as Nila fish (Oreochomis niloticus), Gurami fish (Trichogaster pestoralis), Kandea fish (Pantius goneonotus), Gabus fish (Channa Striata), Betak/Oseng fish (Anabas testudinens), Golden fish (Cyprinus carpio), and many other kinds (Dinas Pengairan Wajo, 2006). The harvested fish from the Tempe Lake, besides to be used for local consumption, the rest are also be distributed to the other areas.

The role of the head of the family in the floating house is to catch fish in Tempe Lake from morning to night time. The fish then be selected from the fresh fish which directly be sold to the dealers, or be brought home for the dried. The role of the housewife is helping their husband to process the caught fish. The production process are cleaning the fish, drying the fish, and helping selling the fish to the dealers or the nearest market on the ground. All the activities of processing the fresh fish were done in the floating house. For the activities of cleaning the fish and drying the fish were done in the house. While the process of drying the fish is done at the back of the house, which is the roofless open area on the boat. The purpose is that the fish drying process will get enough sun rays maximally.

Besides as fishermen, the income of the community is also obtained by doing the traveling as vendors to sell secondary needs such as cloths, sarung or other house appliances. Besides that, the housewives also open a small stall in the house to sell various kinds of basic need food for the fishermen in the area. The existence and the unique of the floating houses also as attractive recreational places, so the floating house can also be rented to the visitors.

To facilitate the activities, the floating house is designed based on its economics activities with open building concept. The concept will ease the fishermen’s accessibility and productivity in the house, so that the room spaces of the house can be functioned suitable with its need.

Figure 2. process of drying the fish at the back of the house,

Figure 3. activities of processing the fresh fish in the floating house

Source : (Primary data,2009)
Dwelling Function

The open building concept with open lay-out which is applied to floating house has no massive partition. It will facilitate the dweller to do a variety of activities everyday. The division of the room spaces in the floating house is done based on the need of the time used between the dwelling function and economics function. Each room can be doubled function so the lay out will be more flexible. The lay out of the floating house in horizontal way consists of outer terrace, multi function room, bedroom, and kitchen. The open building concept applied makes every room be functioned maximally. There is no limitation of function in every room. For the outer terrace usually used for sitting place, storing place to store fishing equipments, and drying the cloths. On the inner part of the house, there is multi function room usually lies near the door or near the side door which oriented to the nearness of the boat’s tether. The multi function room is a spacious room without wall limitation with the wide almost half of the house’s wide. The function of the multi function room depends on the activity and the inhabitant’s need. Some used it for welcoming the guess, bedroom and opening a small stall for daily needs. Near the multi function room usually lies a bedroom which was given a wooden wood, bamboo, or fabrics as the limitation without the door. This small room is used for the head of the family or children, while the rest of the family members can use the multi function room.

In the back of the house there is a kitchen and a place to do the dried fish processing. The form of the kitchen of the floating house is a traditional kitchen which still used firewood as the fire and a kerosene stove. The kitchen which used firewood is in rectangular desk with the height from the floor approximately 20 cm. The place for cooking is a stove made of clay with firewood. Besides a cooking place, the kitchen is also be used for processing the fresh fish to a dry fish. In the kitchen, the fish is cleaned, preserved with salts, then be left for a night, and in the morning be dried on the special drying place at the back of the floating house. Besides that, the kitchen is also be used for eating place. There is no eating chair or eating table in this room. The different of the room function is in its floor’s height. The kitchen’s floor is built lower that other floors.

3. THE SUSTAINABLE FLOATING HOUSE FORM

The floating house on the fishermen settlement in Tempe Lake is different with Buginese people’s stilt house in general. Though, in general the existed house is described as rectangular base, with the triangle roof. In order not to carried by the wind and flow, the house is tied with a rope embed to a pole to the bottom of the lake. So the house only turned on its pole when the wind blows or the waves. The rectangular concept refers to a cosmologic sight of the Bugisnese, which commonly called Sulapa Eppana Ogie. Sulapa eppa meant rectangular, while Ogie meant the Buginese people. The meaning of this philosophy is everything is supposed to be perfect if in the form of rectangular (four-sided). To avoid the humidity from the lower part as the cause from the water’s degree influence, so a pole is made in a distance between the floor and the raft for 40-50 cm. The use of the short pole is for the moving of the free air on the floor to make the air on inside the house cooler, besides it is not easy to be carried and blew by the wind. As the base of the pole, a raft is made from the whole bamboo which tied by rattan or nylon rope. The wide of the raft should be wider than the wide of the floating house. This is used for the activities on the area in the right, left and the back of the floating house.

![Figure 4: Lay-out of the floating house in Tempe Lake](source: Primary data, 2009)

The area above the raft besides to be used for storing the poles of the floating house, is also be used as an area for storing fishing tools such as fishing net (jabba, jala, belle, lanra) also be used for storing the firewood, drying the fish and raising chicken and storing the boats. Each house is equipped with front terrace or side as a room before entering the room, and as the changing room between area of the house and embedded boat’s area. Besides that the terrace is also be used for taking a rest while sitting in the evening. Not so many houses are equipped with window since the wind blows freely and there is no need for the house to have them. Only few made small windows on the side of front wall. To make a cross ventilation, a wall made of bamboo with plaited style technique. The way to make the bamboo plait is to clip it with vertical bamboo piles or diagonally which made with certain distance to keep the air to blow in and out through the bamboo’s gap. The other material of the wall is a board which stored horizontally at certain distance, so that the air is still obtained through the wall’s gap.
The floating house has a roof in the form of saddle (triangle) made of wood or bamboo with or without ornament on its ridge-pole. The leaning of the roof is between 30º to 45º to anticipate the climate with strong rainfall and relatively hot degree. For that purpose, the material used for the roof should be made from material which easily absorbed the heat available from the areas such as palm leaves and coarse grass, although some has made of zinc material. The use of the saddle roof on floating house is real adaptation towards humid tropical climate on the lake.

The setting of the main entrance on the floating house differs from Buginese house on the ground which lies on the front wall. The setting of the main entrance on the floating house lies on the side, on both sides of the wall side. Whereas the side entrance lies on the front wall. The setting is based on an easy accessibility orientation thinking to the boat. The fishermen’s boat is always tied on the raft on the side and in line with the length of the floating house. This is aimed for the house to turn easily from the influence of the wind and the wave’s current.

For the clean water supply, the fishermen community took the water from the rivers which flow near the lake by using the boat and jerry can as the water’s saving. The water then be kept for one night and be added an alum/purifier, before it be used for drinking and cooking. Whereas for solid household disposal or the water closet used the direct spray system to the lake. On the floating settlement in Tempe Lake, the sanitation or the toilet is generally called *jambangeng* which existed in every raft house and is built unitedly with the master house. Although it lied separately from the back of the house, it is a unity in the raft house system in the water. Every house has its own *jambangeng*, with the direct spray system from the gaps of the raft to the water place. There is no channel pipes to connect the toilet to the septic tank as the toilet system in the ground, so that all the wide of the lake water surface is a reservoir of the toilet disposal of the toilet and from other household disposals as well. This has formed a natural sanitation by rely on natural biological process system from the nature for its strand process.

The sanitation/toilet is in topless rectangular form with the walls made of zinc materials, bamboo piles, or just a fabric. According to the local residents, the sanitation system like this is an effective model to anticipate the settlement condition which always moving on the water.
from the clean water used of the area (Tchobanoglous, 1991). Hence the quantity of disposal water in one settlement can be detected by two ways, that is from the average use of clean water per person in disposing the waste. However, this area of floating settlement has out of PDAM (Local Government of Air Supply) piping service or other source such as shallow well, drilled well, or surface water, so that the used clean water is difficult to detect accurately, since this floating settlement used the clean water source from the nearest river banks of the settlement. Besides that, the location of the floating settlement which can be moved far from the ground on the dry season, has caused the settlement difficult to find clean water on the certain period in a year. For the total of disposal water, in each settlement the flow of the household waste will vary all the day or all the year depends on the location and the culture of the local people (Lisnley and friends, 1986).

The created floating house architecture with its shape and its architecture elements which is adapted with the nature condition and climate, made the fishermen community to sustainable living on the water comfortably. Besides, the activities which its economic oriented has influenced the shape of the floating house. The economic activities as fishermen and fish sellers create inner room form and outer room which adapted with its activity functions.

4. CONCLUSION

The adaptation method carried out by the fishermen community in order to sustain living on the water is to create a floating house with the open concept building. This concept allows a house to be functional for house activities and for production processes (economics activities) as well. The Buginese house concept with the lower structure in the form of a raft simplifies the house's adaptation by moving according to the fall and the tide of the water, so that the household can continue activities and production at anytime unhindered by the flood conditions. The use of the structure made of bamboo and the wood, which is flexible with a bundle and pin system, allows the house to be elastically moved against the strong winds and strong water flow. The cross-ventilation system through the hole system on the wall is a developed knowledge adaptation system in anticipating the strong winds on the wide water. The form concept, room lay out, function and structure of the floating house which developed based on the nature experience in adapting with the natural environment of Tempe Lake, has made the floating house became an adaptive and sustainable dwelling. As a result, this has affected the economics and improved the living standards of the fishermen community in Tempe Lake.

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