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EXPECTATION OF FLOATING BUILDING IN JAVA INDONESIA, CASE STUDY IN SEMARANG CITY

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Many delta cities worldwide are dealing with the same kind of problems: rising of the sea level, land subsidence, scarcity of land and illegal housing. Multiple land use is one of these solutions that will help to reduce flooding and scarcity of land. An example of multiple land use is a floating community. This research used Semarang as location for the research into the social acceptance of floating houses. The data in this study were obtained through literature study and survey among inhabitants. The social acceptance of the inhabitants is determined with 35 respondents that have been done in the area of Kemijen, Semarang. In order to determine the social acceptance of floating houses, there are elements used, namely: knowledge of floating houses, perception of risk, urgency, implementation, chose for a floating house, requirements, positive and negative elements, self-sufficient system. According to the result of research, the social acceptance of the inhabitants is quite low, but there is potential because they see positive elements in a floating house. Low social acceptance is caused by the fact that the concept of floating houses is not well known in this community. With raising awareness on the challenges and informing the community on the possibilities on floating infrastructure will result in higher social acceptance.

Keywords Floating Building, Expectation, Flooding, Polder Area

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1 Introduction

Dealing with water related issues has always been a challenge in many parts of the world [1] and [1a]. Especially in high density areas along rivers near the coast: The Delta Cities. With the rising of the sea level, climate change and land subsidence delta cities have to adapt to the changing conditions in order to keep the city safe from flooding. Only heighten the embankments is in most situations not enough. A combination of different solutions must be applied [2]. Climate change causes more heavy rainfall in a shorter period of time. Therefore, city planners should organize the city in a way that it can adapt to the extra water. This requires extra storage zones and demands more space and more flexible management [3].

Besides water related issues there is another problem where city planners have to deal with: limited space. In many cities there is an urgent need for urban development [4]. The number of city dwellers is expanding and this requires an increase of space for housing area.

The demand for extra water storage and space for housing are in conflict with each other. This conflict will increase in the future when the demands are growing through climate change and growth of the population [5]. City planners should therefore search for other possibilities; multiple use of space seems the solution for this problem. Floating houses are an example of multiple land use [6]. Combining different functions in a city can help to reduce the water problems and provides more space for living areas.

1.1 Case Semarang

The study case of this research is Semarang, a city with 1.7 million inhabitants in Central Java, Indonesia [8]. The delta city is one of the locations that is facing floods on a daily base. Through climate change rises the sea water level with 6 mm a year [2]. Nevertheless, the relative sea level rise is way higher. Through large-scale groundwater extraction and oxidation subsides the land in Semarang with average 9 cm per year [9]. The current water system (city rivers and sewerage system) are not dimensioned for this rapidly changing situation and resulting in flooding. Improper maintenance and a poor drainage system worsen this situation [10]. In order to deal with these problems, the government of Semarang and the Dutch government, started a cooperation in 2003 [9]. The purpose of this cooperation is to set up a water authority similar to the Dutch model and construct Banger polder system (figure 1) with embankments, a pumping station and dredging schedule to reduce the water level of the river. This project should be finished in 2020 and will make Semarang less vulnerable for flooding.

Fig. 1 The Banger Polder

1.2 Problem Analysis

The Banger Polder contains 2 retention basins in the Kemijen area (one of the sub districts in Semarang) which can be used to store water during heavy rainfall (see figure 2). The others retention basins are in Semarang Polder System, Tenggang Polder System and Sringin Polder System. Around these basins people build illegal houses. By making an electricity connection people are protected for replacement by the law that says that people who are connected to electricity aren't illegal anymore [11]. Through this people get in unsafe situations and the storage volume of the basin is being

affected. Besides this, the current retention basins do not have the required capacity yet. The basins must be extended so that they can store more water when needed and lower the risk of flooding. When the polder system and the extension of the basins is completed, the polder will deal with floodings with a returning period of every 8 years [12]. Without the extension of the basins, floods will occur every 2 years (which is already an improvement to the current situation). When the basins will be extended, the inhabitants who live around the basins should be replaced.

Floating houses can be a solution for the problems in Semarang. In this context floating houses could be an adaptive solution with several positive effects [7]:

- The application of multiple land use will reduce flooding problems and lack of space.
- Floating houses are not or nearly affected by land subsidence
- Instead of replacing inhabitants for a possible expansion of the retention basins, inhabitants can continue living in the same area.
- Provide security of tenure and make inhabitants live on a legal basis.
- Floating houses are a positive addition to the pilot project the Banger Polder and can serve as a showcase for other vulnerable areas in Indonesia.

This research focus on the social elements that are required by technical improvements. Research into the social acceptance of a new technology of the target market is important for the development of the product. In this context the new technology is a floating house.

2 Research Method

In this research several methods are applied, such as literature study, field research and survey amongst inhabitants. These methods are based on scientific resources and implemented to the situation in Semarang. In order to determine the social acceptance of floating houses in Kemijen, Semarang, the elements that are necessary for the social acceptance for floating should be determined first. These elements are set up by using the literature resources and experience: a) knowledge of floating houses, b) perception of risk, c) urgency, d) Implementation, e) chose for a floating house, f) Requirements, g) Positive and negative elements, h) Self-sufficient system. These elements form the basis for the questionnaire to determine the social acceptance of the inhabitants of Kemijen, Semarang. Every element represents one theme, wherein every theme consists of several questions. With this questionnaire it is possible to determine the social acceptance for floating houses. The participants for the survey were selected according to the following criteria:

- They should be living in Kemijen, Semarang. Because Kemijen lies around the retention basin and is most vulnerable for flooding.
- They should be living in a lower laying house than sea level and street level. In Kemijen there are different kinds of houses. Some of them are higher than the streets, some are at the same level and some houses are even below the street level. The houses which are lower than the street level are most vulnerable for flooding. Therefore, these people are most interesting for this research. For this research the most vulnerable people are most interesting to do a survey because for them the utility is the highest.
- For this research it is impossible to interview the whole community. There-fore this research is making use of a sample. For a sample it is important that the participants represent the community. In order to do this the participants are selected on a variety of age and gender.

The results of the survey will be shown in graphics and tables with explanations. Methods derived from several literature resources will be used in order to make a clear overview.

3 Results and Discussion

The social acceptance of the inhabitants is determined with 35 surveys that have been done in the area of Kemijen, Semarang. This is only a small amount of the total population of Kemijen (13.000). But because this research is making use of a sample these surveys can represent the population and give a first impression of the acceptance of new technologies. Besides during the selection of the participants the variety of the inhabitants is taken into account. The surveys were hold in many different streets and areas in Kemijen. There is also a good balance between male and female; age; kind of house and income around IDR 1500 or 100 USD. The questionnaire consists of 2 parts: the first 4 themes based on the theory of Von Wartburg & Liew. [13]. and a second part with additional information to determine the social acceptance. The results of the first four themes can be shown in diagrams that show the answers that have been given.

3.1 Knowledge about the concept of floating houses

The first element is 'knowledge about the concept'. This is an important element because ignorance of a technology is mostly a negative factor for the social acceptance. Diagram 1 shows that almost 80% of the participants don't know what a floating house is. The 20% who said that they know what it means was wrong or couldn't explain what a floating house is exactly.

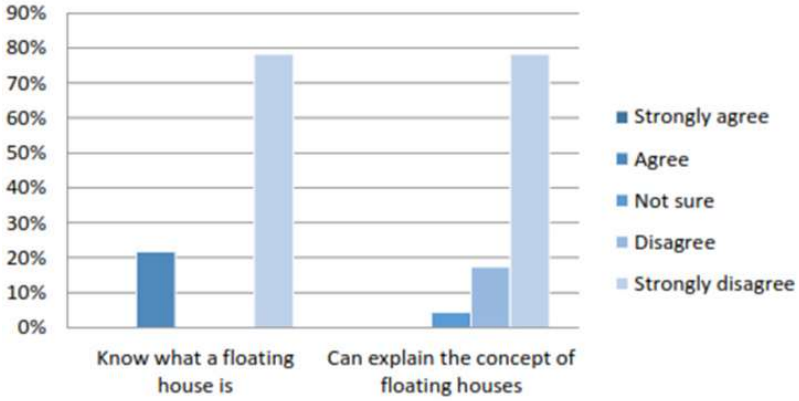

Fig. 2 Knowledge about the concept

Every theme can be valued with a number. With these numbers it is possible to compare the social acceptance with other researches of social acceptance. If this research will be done in another area or in the same area in a few years, the numbers can qualify what the social acceptance is comparing other researches. The value of the number can vary from 1 to 5. Where in 5 is most positive for the social acceptance and 1 negative concerning the social acceptance.

The knowledge of the concept gets a 1,46 which is very low on the range of 1 to 5. For improving the social acceptance, this value should be higher by giving information or starting a pilot.

Table 1. Score of knowledge about the concept

No	Statement	Score
1	Know what a floating house is	1.65
2	Can explain the concept of floating house	1.26
	Average Score	1.46

After this question the concept of floating houses is explained. It is explained what a floating house is and how it can contribute to their lives. Besides the current situation is drawn wherein the inhabitants are being told about the flooding problems, the banger polder and the extension of the retention basins. Thereafter the next questions were asked.

3.2 Perception of risk

Perception of risk is the second element. The perception of risk is important because it gives an indication of inhabitants will accept a floating house. According to Von Wartburg & Liew (1999) most people will probably accept the risk of doing something if the risk or not doing it is even greater. The risk of not doing anything is that people have flooding. A floating house will only be accepted if people see the risks of a floating house smaller than the risks of flooding that they have now. Analyzing the results shows that about half of the participants think a floating house is totally safe. But only 37% think that a floating house is more safe than living in a normal house. Less than 30% think they can live with their family safely on a floating platform. This question is a control question for question 1 because the form of the question is different, but the meaning is the same.

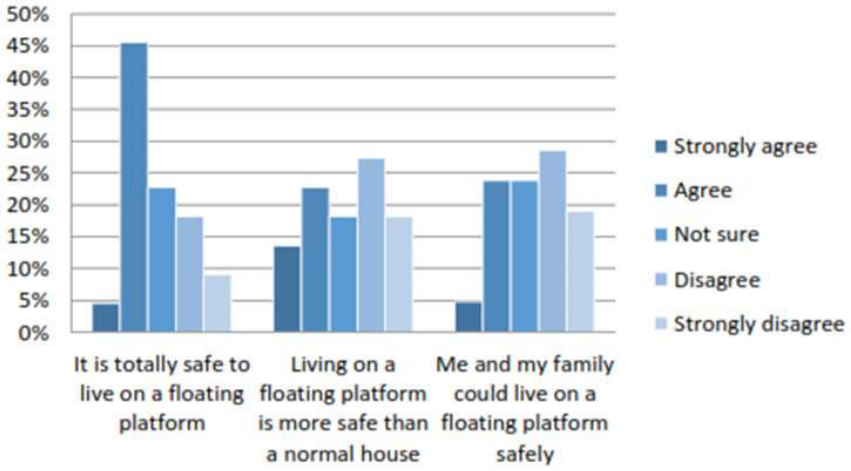

Fig. 3 Perception of Risk

The table below shows the values for the perception of risk. A high number indicates that people see low risks in the new concept. The perception is risk gets a score of 2.90. This is quite a low number and should be increased. The perception of risk is strongly linked with the knowledge about the concept. Because inhabitants don't know the concept, the anxiety for floating houses is also quite high. More information and a pilot can raise this number.

Table 2 Score of perception of risk

No	Statement	Score
1	It is totally safe to live on the floating platform	3.18
2	Living on a floating platform is more safe than a normal house	2.86
3	Me and family could live on a floating platform safely	2.67
	Average Score	2.90

3.3 Urgency

According to the Dutch standards, flooding on a daily basis is far from accepted. If Dutch people would be living in a situation like in Kemijen where floods are very common, the perception of urgency would probably be very high. But the outcomes of the survey in Kemijen show that the urgency of Indonesians is not that high for an area where floods occur almost daily. 57% of the participants see the utility of floating houses and 58% thinks floating houses are necessary in their neighborhood. The inhabitants who see the utility and who think it is necessary are mainly the ones who live in lower houses that are more vulnerable for flooding. The urgency is less by inhabitants with a higher house or in streets where there is less flooding.

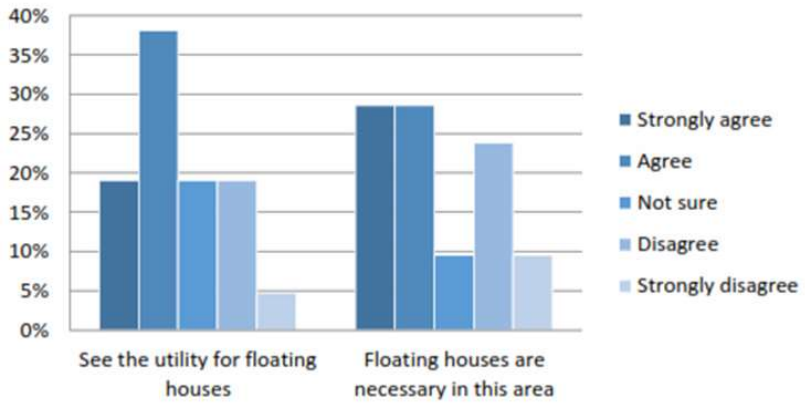

Fig. 4 Urgency

Urgency has scored 3.46. This is the highest score of this survey. This score is quite positive for the social acceptance. It shows that many people see that there is a need for a solution for the current situation.

Table 3 Score of knowledge about the concept

No	Statement	Score
1	See the utility for floating house	3.48
2	Floating house are necessary in this area	3.43
	Average Score	3.46

3.4 Implementation

When inhabitants are asked about the implementation, they are quite reluctant. About 1/3 of the participants think that floating houses can be implemented in their area. But if they are asked where they rather want to live, more than 80% give 'a normal house on the ground' as answer. 14% is willing to pay some extra money for a floating house. For a possible implementation of floating houses, this 14% should be the focus group.

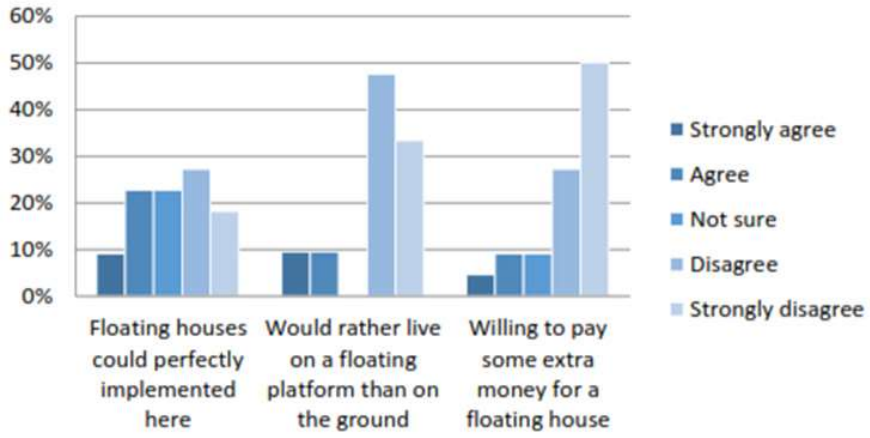

Fig. 4 Implementation

The most important score of the survey is the value for implementation. The score for this is a 2.27 which is low. Most inhabitants think the concept is good, but in they still rather live in a normal house.

Table 4. Score of knowledge about the concept

No	Statement	Score
1	Floating houses could perfectly implemented	2.77
2	Would rather live on a floating platform than on the ground	2.14
3	Willing to pay some extra money for a floating house	1.91
	Average Score	2.27

3.5 Choosing a floating house

Participants are asked in a different way (see theme 4) if they would choose a floating house instead of a normal house. Since this is an important question of the research, it is worthy to validate the answers given by the participants. The results are shown in the table below.

Table 5 Choosing a Floating House

No	How likely	Amount
1	Very likely	4.3%
2	Likely	4.3%
3	Maybe	13.0%
4	Not likely	52.2%
5	Totally not likely	26.1%

These answers are in line with the answers given at theme four where about 80% would choose their current house above a floating house. The validation is checked and gives the same result. For the participants who give “not likely” or “totally not likely” as answer, these are their main reasons:

Table 6 Reason for no Floating House

No	Main Reason	Amount
1	Don’t need a floating house	25.0%
2	Don’t want a floating house	25.0%
3	Satisfied with the current house	35.0%
4	Can’t afford a floating house	5.0%
5	Don’t want to pay for a floating house	5.0%
6	Don’t know the concept	5.0%

The participants who were not likely to choose a floating house were asked what their main reason was. It turns out that most participants were satisfied with their current house and didn’t need or want a floating house. These reasons where according to the inhabitants more important than financial reasons.

3.6 Requirements

In order to make a floating house more attractive it is important what the most concerning elements of a floating house are according to the participants. The table below shows what inhabitants concern most.

Table 7 Main Concern

No	Main concern	Amount
1	Price	31.8%
2	Maintenance	0.0%
3	Safety	27.3%
4	Material	36.4%
5	Information	4.5%

The main concerns of the inhabitants are price, safety, and material. Safety is especially for women and important issue. Many are concerned about their children who can fall into the water from the floating platform. Men are more thinking about the materials. Bamboo and wood are less accepted as building material for the house. Besides many are wondering if the materials are suitable for the salt in the water of the basins.

3.7 Positive and negative elements

It's important to review the positive and negative elements mentioned during this study. The positive elements can be highlighted and improvements can be made to the concept in response to the negative feedback on wooden floating houses.

3.7.1 Positive elements that are given by the inhabitants:

- They don't have to heighten their house anymore.
- They are safe from flooding.
- It is good that the house can fluctuate with the water level.

3.7.2 Negative elements:

- People don't want to live in houses made of wood and bamboo. The house should be made of concrete because the quality of wood and bamboo is not as good as a concrete house. Besides wood of good quality is more expensive than concrete.
- People want to build their own house so that they can build and adjust it how they want to.
- The salty water can affect the materials.
- It should be safe for children.
- Inhabitants are not familiar with floating houses, so they don't want to live in a floating house. For most inhabitants the house they are currently living in is fine for them.
- The price of a floating house is too much.

3.8 Self-sufficient system

Participants are asked what they think of the self-sufficient system. The response to this question *is not very high*. A floating is for most people already hard to imagine, the self-sufficient system is even harder to understand. Therefore, people didn't give much comment. The comments that have been given are listed below:

- It's a good system.
- I would spend some extra time and money in the system, but only if we don't get problems with it and the maintenance is low.
- People required that the toilet should be inside the house.

3.9 Results recapitulation

The table below gives the outcomes of the social acceptance derived from the inhabitants of Kemi-jen.

Table 8 Results recapitulation of Theme

Theme	Conclusion
Knowledge of floating houses	The knowledge about the concept is very low. Almost no one could explain what a floating house is.
Perception of risk	People see relative much risk in the floating concept. This is negative for the social acceptance. This can be explained be-cause people have never seen the concept.
Urgency	About 60% of the participants see the urgency for floating houses.
Implementation	Most inhabitants do not want to live in a floating house. Even less people want to invest some extra money in the concept.
Choosing a floating house	Almost all participants chose a normal house above a floating house because they don't want or need a floating house and are satisfied with the house they are currently living in.
Requirements	People consider price, material and safety as most important is-sues for a floating house.
Positive and negative elements	Most people see the positive elements of a floating house: they are less vulnerable for flooding. But people also see negative points such as the used material, safety and the price.
Self-sufficient system	Most inhabitants think it is a good system, but they say that they have insufficient knowledge about the system to judge about it.

4 Conclusions and Recommendation

4.1 Conclusions

According to the results of research, the conclusions can be drawn as follows:

- In order to determine the social acceptance of floating houses in Semarang, the *elements* that are necessary for the social acceptance for floating should be determined first. These elements are setup by using the literature resources and experience: Knowledge of floating houses, Perception of risk, Urgency, Implementation, Choosing a floating house, Requirements, Positive and negative elements, Self-sufficient system
- To determine the social acceptance, the *themes* that are described above are used. This has been brought into practice. The outcomes can be divided into the acceptance of the inhabitants and the perception of the other stakeholders and experts.
- It can be concluded that the social acceptance of the inhabitants is quite low, but there is potential because they see positive elements in a floating house. The main criteria why the social acceptance is low is because they don't know the concept. By improving this, the social acceptance will probably also become higher. In order to understand the circumstances, it is withal important to interview stakeholders and experts who can explain and clarify the context. Besides they can give their opinion about the project which gives a more nuanced view on the topic.

4.2 Recommendation

- Overall there are several recommendations concerning the improvement of the social acceptance of floating houses in Semarang:
- Start a pilot project so that people can see how the concept is working
- Providing more information about floating houses and its advantages and disadvantages. Start a project of floating houses without a self-sufficient concept because the step is too far

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