

## THE COASTAL CHANGES AND ITS INFLUENCE ON THE SPATIAL CONFIGURATION OF MARISO SETTLEMENT, INDONESIA

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### ABSTRACT :

*This paper discusses the coastal changes in relation to the spatial configuration development of Mariso settlement. Mariso settlement is located on the waterfront of Makassar city, Indonesia, and it is develops due to reclamation. It is causes the spatial configuration changes of Mariso settlement. Method of space syntax was used to analysis. It is an imaging technique, quantification and interpretation of the spatial configuration. This analysis will be interpreted the spatial configuration and spatial integration of Mariso settlement. This research is focused to explain the development of settlement formed in 1980 and 2013. Result of this research showed that the spatial configuration of Mariso settlement has been developing from non-distributed to distributed, and it is forming the spaces more integrated. The coastal changes to be settlement has formed the spatial configuration more integrated. This integration concept could be the basis for the waterfront settlement development.*

**Keywords :** *Mariso, space syntax, spatial configuration, integration.*

### 1. INTRODUCTION

The sea has an important role in human life. It is as the workplace, transport, recreation, commerce and housing. The presence of beach and communities' dependence on the beach are aspects which influence the land use patterns and coastal settlement forms (Sairinen and Kumpulainen, 2006). The phenomenon of water presence is determines the settlement form and the city development. The phenomenon of water presence has affected on the morphological transformation of the waterfront city (Cakaric, 2010). Furthermore, the effect of the water presence causes the three types of cities formed, namely are longitudinal, concentric and irregular (Cakaric, 2010). It's clear that the water presence and the dependence on the beach are affects the spatial configuration of the waterfront settlement.

Hassan (2010) explains that there are five types of waterfront settlement development patterns, which are: development of inland water, outward water, parallel water, on the water and river mouth water. These patterns are influenced by topographical of the waters. The coastal settlements tend to forming spreaded and clustered patterns (Hassan, 2010). These patterns are the most appropriate for the communities related with water activities. Darjosanjoto (2007) explains that the coastal settlements tend to forming linear pattern following the shoreline. This is influenced by the movement pattern of the fishing community. It's clear that the layout and the development

pattern of the coastal settlement are influenced by topographical and the socio-cultural community conditions.

According Darjosanjoto (2007) that the movement to the beach has affected the spatial configuration of coastal settlement, and it is form a high level of permeability. The most integrated spaces is the main street of the settlement, it is as an access to workplace (Darjosanjoto, 2007). It is clear that the community livelihood is one of the factors had influenced the spatial configuration of the waterfront settlement. Li dan Dai (2012) explains that the waterfront settlement development have relationships with a network of water. The water network has affected to land use and spatial configuration. The most integrated spaces is the street along water area, it is formed by the movement flow. This describes that the relationship between the water, movement pattern, land use and spatial configuration.

Feng, et al (2012) explains that the reclamation due to the social society changes will be forming the global integration spaces. The reclamation had caused the spatial structure into shallower and the streets become interconnected. It is showed an improvement on the relationship between the local and global structures (Feng, et al, 2012). This is describes that the physical changes in the waterfront area due to the reclamation process shows the relationship of the social, the movement patterns and the spatial configuration. The spatial configuration in unplanned dense settlements shows the spaces are has a small depth value. It is causes accessibility can easily be achieved, so that the spaces are more integrated (Kustianingrum, 2010).

Phenomena that occurred in Makassar waterfront area showed that Mariso area was forming unplanned settlement, and it is develop to be dense settlement. Initially Mariso waterfront settlement formed by the local community, in this the fishing communities. The dependence on the sea causes the spatial order settlement described the social community conditions. Mariso settlement was developing to the sea, and it is changes the coastal into settlement. This was followed by the reclamation process. Reclamation causes the communities livelihood changes, from the water orientation to be land orientation. It causes the changes of settlement layout, form and the building function. On the other side, reclamation causes the changes of the land use and the movement pattern. It is has influence on the spatial configuration of Mariso settlement.

Based on the phenomenon, this paper aims to describe the Mariso settlement development in terms of its spatial configuration. The results of this study can be used as a reference for spatial planning in the waterfront settlement accordance with the social and environment transformation.

## **2. MATERIALS & METHODS**

This research will describe the changes of the sea to be settlement in relation to its influence on the development of spatial configuration. To analyze the spatial configuration development, space syntax method is used (Hillier and Hanson, 1984). It is as an imaging technique, quantification and interpretation of the settlement spatial configuration. The spatial pattern was described diagrammatically in justified permeability map. This analysis will be interpreted the spatial hierarchy of Mariso waterfront settlement. The study of the morphology of space by using the techniques of presentation and space syntax analysis can show the influence of social to the spatial order (Hillier and Hanson, 1984). Through this study it can be seen how the spatial patterns can bring social information. This indicates that the spatial configuration of settlements formed is influenced by social conditions.

The configuration is understood as a the relationships posed by the co-presence simultaneously and possibly also posed by other elements are interconnected (Hillier, 2007). Furthermore, the meaning of the configuration as a concept that refers to all things that are more complex than just a part (Hillier, 2007). Intuitively, configuration means a set of relations among

things which are mutually interdependent and related to one another. In relation to the spatial configuration, the pattern of connectivity between space and all forms of configuration is called integration. In spatial configuration there is the permeability nature between spaces. The configuration gives of another interpretation about the spatial system that has relevance to the function of the space.

Hillier and Hanson (1984) explains that the influence of social aspect in terms of the spatial configuration settlement was analyzed by using space syntax method. This method will be outline the spatial model, and it is describe in numerical and graphical form, then interpreted through a scientific basis. It is aimed to describe the relationships between spaces and the social aspect. The inter-related space called connectivity. The movement pattern from origin to destination called permeability (Hillier and Hanson, 1984). In the spatial configuration, the connectivity and configuration form is called integration.

According Hiller and Hanson (1984) and Kustianingrum (2010) that analysis of the influence of social aspect to the spatial configuration through space syntax method was conducted by several stages, namely:

1. The first stage is to define the space meaning in accordance with the function based on the social activities. Understanding of space meaning is a communication tool to the reader.
2. The second stage is to modeling the space meaning representation in the form of the spatial settlement structure. Hillier and Hanson (1984) uses several symbols to represent the elements of the settlement. (X) symbol for buildings, the symbol (x) for the boundary courtyard building such park boundary and terrace boundary. Symbol (y) for open space in settlements and (Y) symbol for space around the outside of the settlement. These symbols are interpretation the meaning of spatial structure formed. This structure describes the configuration of outer space settlements in accordance with its function.
3. The third stage is to model the meaning of a spatial settlement in the form of axial line or convex space or isovist space.
4. The next stage is analyzed by using access graph. It is to explain the spatial inter connectivity, the depth of space and the spatial configuration. Connectivity can be identified as the number of lines is only one step of each line in the system. In other words, the connectivity is the number of lines that intersect directly with each line. Depth space measurement is defined as the number of steps needed to reach one space from outer space. Hillier and Hanson (1984) explains that the spatial configuration will be forming distributed and non-distributed. Distributed form is when there is the option to move to another place.
5. After a description of the spatial patterns in access graph is found, the next step is to calculate the Relative Asymmetry (RA) or the value of the settlement integration based on the justified permeability map, so that it can be seen as a space settlement hierarchy to know what spaces are integrated or segregated. Integration is a measurement of justification of a configuration. Spatial integration value expresses the relative depth of all the available spaces in the graph. Integration value calculation is using the formula as follows :

$$RA = \frac{2(MD-1)}{k-2}$$

RA = integration value (relative asymmetry)

MD = depth of the center (mean depth)  
space to be counted.

k = number of spaces.

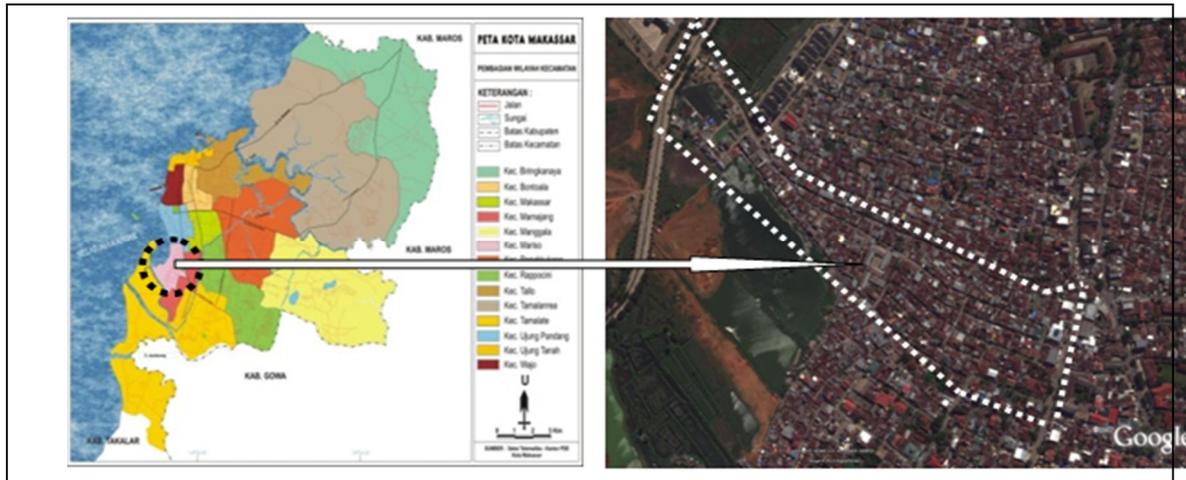
This calculation gives the value of R varies between 0 and 1. The value of 0 indicates the maximum integration condition. The value R a lower value, indicates spaces from the shallow system and tends to be integrated in the system. On the contrary, the value of R=1 indicates that

space is segregated from the system, and provides the maximum depth. The increase in the value of the space integration causes the decrease of depth.

Based on the space syntax analysis, the data collection through field observations about the spaces and the community activities formed. Besides, used the previous maps and supported by interviews of local community. Based on these data, the space syntax analysis is carried out, so it the Mariso spatial settlement hierarchy will be found.

The research was conducted at Mariso waterfront settlement in Makassar City, South Sulawesi Province. This study is focused to explain the spatial configuration of Mariso settlements that were formed in 1980 and 2013. Both periods, it can be explained the spatial configuration development of Mariso waterfront settlement.

The location of the research is illustrated in figure 1 :



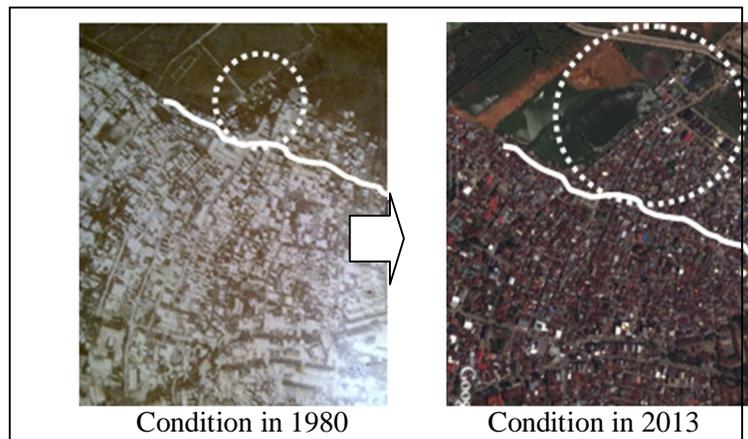
**Fig 1. Research Location**  
Source: MDA and Google Earth 2012

### 3. RESULTS AND DISCUSSION

#### 3.1. The Physical Changes of Mariso Waterfront

Mariso settlement is initially located on the waterfront. Then it is developing directly to the sea, and it is forming the new settlement. This is followed with reclamation process done by the local community. It causes to physical changes of Mariso area, and it is changing the sea area to be settlement. The development of Mariso settlement is forming elongated from inland to the sea. The waterfront settlement form theory from Hassan (2010), explains that the development of Mariso settlement is forming the outward water village.

The development of Mariso area is described in figure 2:



**Fig 2. The Development of Mariso Area, 1980 and 2013**

Sources : Google Earth and Museum Makassar

Figure 2 explains that initially the Mariso settlements were formed on the waterfront, then evolved into the sea. The reclamation on the Mariso area has caused : 1) changes of the sea function from a source of livelihood area in to settlements, 2) occurs building density, and 3) forming the unplanned settlements. The establishment of new settlements in the Mariso area has caused physical changes of Makassar waterfront.

Mariso settlement is beginning formed by community related on the beach, in this case by the fishing communities. So that the spatial order is describe the social condition of coastal society. It is showed the houses layout is spread on the water. Reclamation leads to reduced catchment area and further away access to the sea. This has an impact on people’s livelihood changes, so that the fishing communities turned to other works.

The Mariso area development, building number and the changes of society related on the beach in 1980 and 2012 are described in table 1 :

**Table 1 : The Development of Mariso Settlement**

In Year	Area (Ha)	Population	Number of Building	Number of Fishing Household
1980	13,50	7.507	715	123
2012	18,00	7.820	1324	11

Sources : MDA 1983 and 2012, Field Observation and Interview

Table 1 explains that the development of Mariso area is correlated with the number of buildings. Besides, the increase in Mariso land area causes a reduction the fishing community. It is clear that reclamation has changed Mariso people's livelihood.

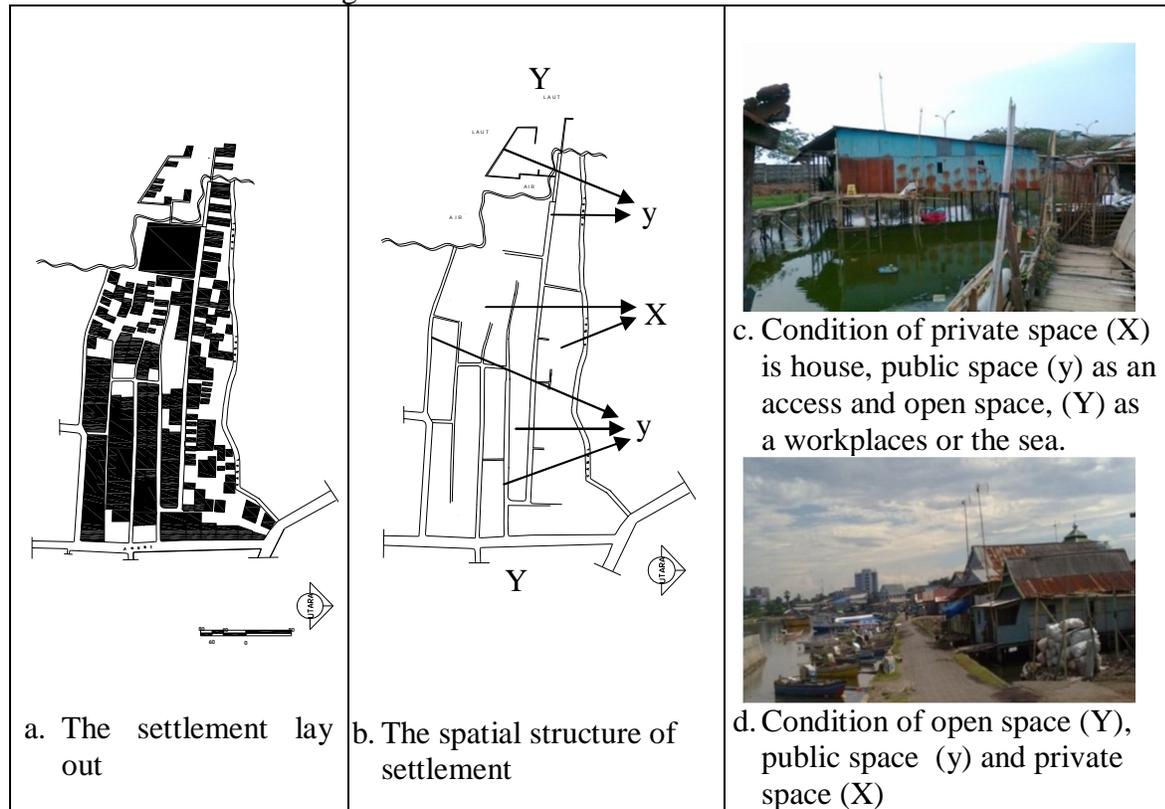
Reclamation and changes of livelihood had influenced the changes of building form and movement pattern in Mariso settlement. Initially it is water oriented then turned into mainland orientation. This has an impact on spatial structure changes of Mariso settlement.

**3.2. The Spatial Structure Development of Mariso Settlement**

Mariso settlement is beginning formed by the fishing communities. The value of solidarity in fishing communities is shown by giving space for other communities to live together. This is to facilitate interactions of the work relationship. It is causes the formation of the houses are spread around the waters which is connected directly to the workplace on the beach. The formation of the houses on the water has change the sea into settlement.

The houses of fishing communities are interconnected and it's forming the open space. It is serves as an access and as a common space. Besides, it is used as a workplace related to fishing livelihoods, such as fishing equipment repair and drying fish. The spaces are connecting the home and the beach. Therefore, the space meaning when Mariso settlement located on the waterfront is the space as a workplace.

The basic principles structure of the Mariso settlement in 1980, when it is located on the waterfront is described in figure 2 :

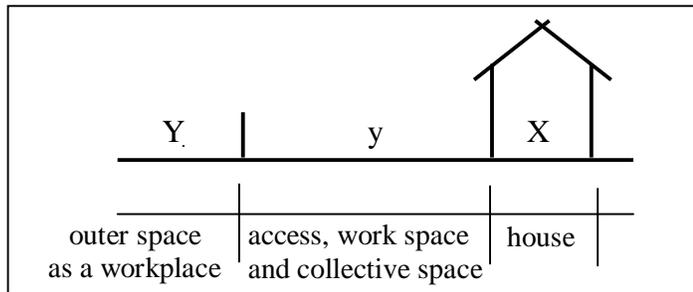


**Fig. 3. The Basic Principles of the Mariso Spatial Settlement at 1980**

Based on the space function, the spatial structure of Mariso settlement in 1980 is interpreted into some of space meaning, namely:

- The space as a workplace (Y) is the outer space boundary settlement. The (Y) space is the main access to enter into the settlement and from the beach. The (Y) space is a workplace for fishermen communities.
- The space as a public space (y) is the space connecting the outer space with the residences. The (y) space is the main access in settlement. For fishing community, the (y) space is used as a work space for drying fish, repairing their work equipment and the social interaction space.
- The space as a private space (X) is a space that is more personal. The (X) space is a residence and it is located at the end of the settlement.

The spatial structure of Mariso settlement in 1980 is explain in figure 4 :



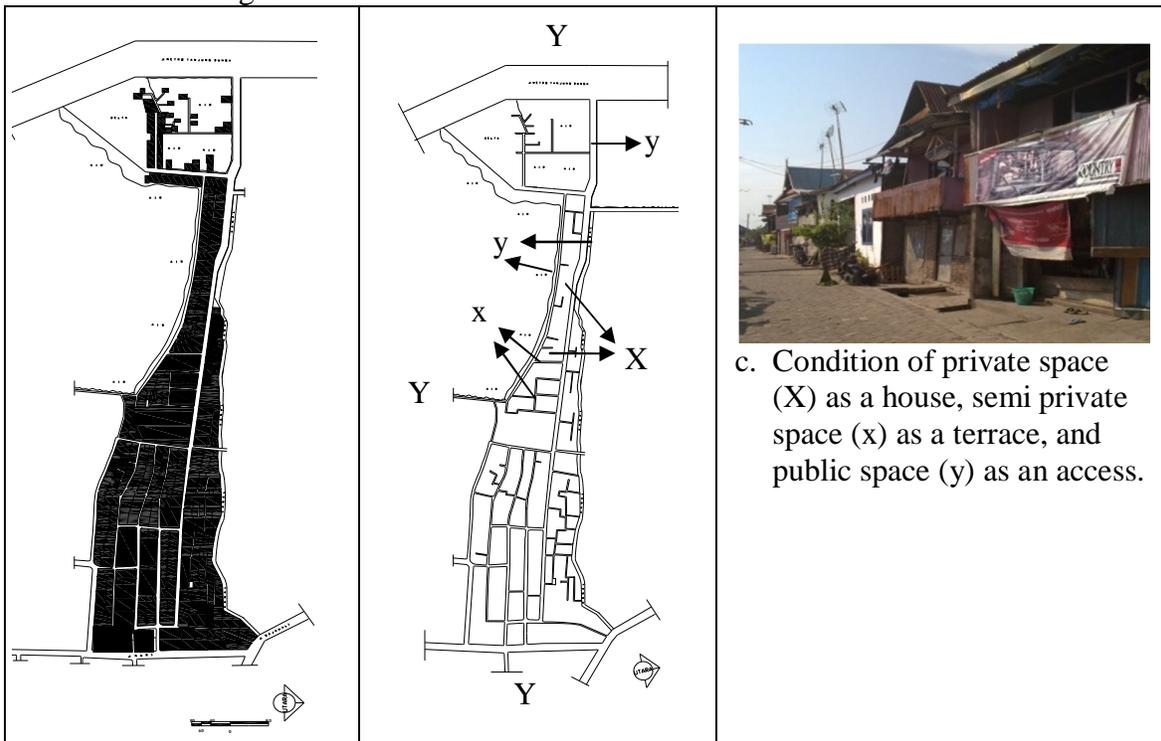
**Fig. 4. The spatial structure of Mariso settlement at 1980**

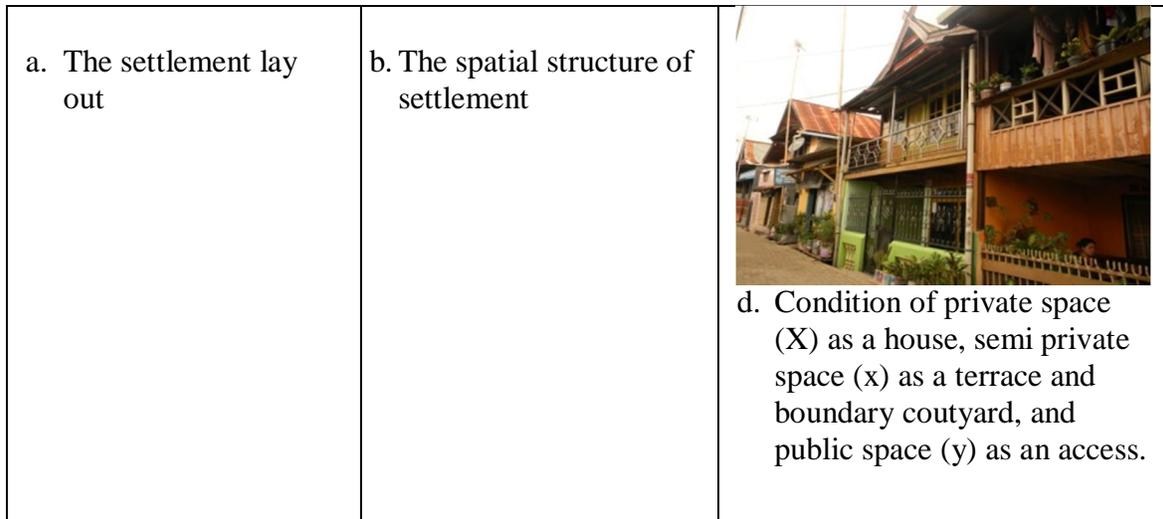
Figure 4 explains that when the Mariso settlement located on the waterfront, the classification of spatial structure settlement is consisting of 3 categories. It is ranging from the most public space that is outer space of settlements (Y) to the most private space that is residence (X).

Reclamation has caused the changes of the dependence on the beach, so that the fishing communities turned to other works. It is impact to changes of Mariso society livelihood. On the other side, reclamation caused to changes of the form and the buildings function. Initially the house as a dwell, and then it is developed into a business place. This causes the changes of space function. The houses as a private space and then developed into the workplace. So that the workplaces formed are connected directly to the collective space.

Reclamation causes the clustered settlement pattern formed. It causes the new open spaces are formed as a connector between the cluster houses. It is impact to changes of the movement pattern. On the other side, the open spaces are function as a collective space in the group houses. It is as a social interaction spaces in settlement. Therefore, the space meaning when the Mariso settlement located on the land is the space as a collective space.

The basic principle of spatial structure of Mariso settlement in 2013, when it is located on the land described in figure 5 :



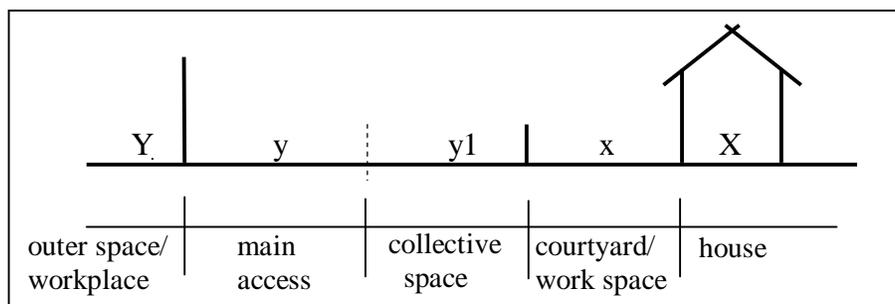


**Fig. 5. The Basic Principles of the Mariso Spatial Settlement at 2013**

Based on the space function, the spatial structure of Mariso settlement in 2013 is interpreted into some of space meaning, namely:

- a. The space as an outer space of settlement (Y) is a space located on outside boundary main gate. The (Y) space is access from the outer settlement and from the beach. The (Y) space is a workplace for fishermen communities and also for the communities which work outside the settlement.
- b. The space as a public space (y) is the space connecting the workplace with the settlement, and it's the main access of settlement. The (y) space is the closest reach to outside space.
- c. The space as a semi-public space (y1) is a space connecting main access settlement with access to the house. In some groups of houses, the (y1) space is directly connected with the house (X). For the fishing community the (y1) space is used as a work space for drying fish, repairing their work equipment and the social interaction space.
- d. The space as a semi private space (x) is a courtyard residence that had a boundary or fence. The (x) space is used as a work space for the communities which work in the settlement.
- e. The space as a private space (X) is a space that is more personal. The (X) space is a residence space and located at the end of the settlement.

Mariso spatial settlement structure at 2013 when it is located on the land is explain in figure 6 :



**Fig. 6. The Mariso spatial settlement structure at 2013**

Figure 6 explains that the Mariso settlement located on the land, the classification of spatial settlement is consisting of 5 categories, ranging from the outer space of settlements (Y) to the most private space that is residence (X).

Based on the space meaning analysis above, the spatial structure of Mariso settlement develops from of 3 categories to be 5 categories. It is caused by the sea changes become settlement. Reclamation and changes of livelihood are causing (y) space develops to be 2 categories, and (X) space develops to be 2 categories also. Initially the spaces formed as a workplace, but the reclamation causes the spaces meaning changes as a common space. It's clear that reclamation and changes of livelihood causes the development of the space meaning in Mariso settlement.

**3.2. The Spatial Configuration of Mariso Settlement**

The spatial configuration analysis is done by the space syntax method. It is illustrated with access graph or justified permeability map based on the movement pattern. The results of the justified permeability map will explain the spatial configuration hierarchy, the space depth and the space inter-connectivity. This analysis described based on movement pattern, ranging from the outer space of the settlement boundary (Y) to the building (X). The results of access graph can interpret the social influences to spatial configuration.

To explain the Mariso spatial configuration changes, then two periods of settlement development analysis were conducted in 1980 and 2013. Of this analysis, the changes of spatial configuration settlement will be described.

The analysis of spatial configuration in 1980 when the Mariso settlement is located on the waterfront described in table 2 :

**Table 2 : Justified Permeability Map of Mariso Settlement in 1980**

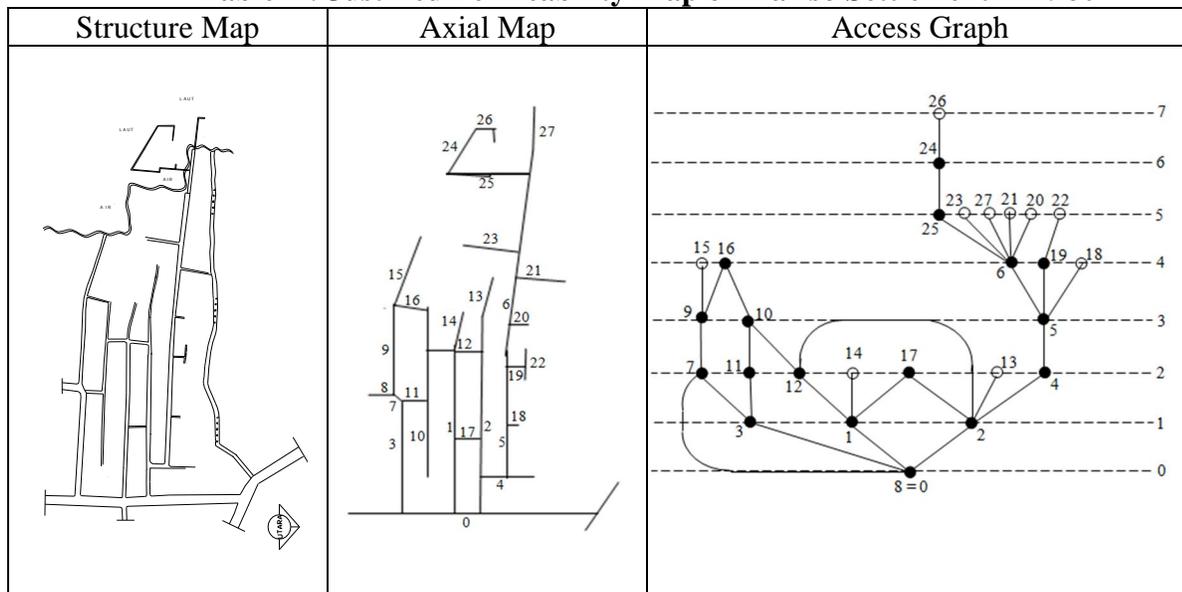


Table 2 explains that the spatial configuration of Mariso settlement at 1980. Access graph showed that the spatial configuration is non-distributed formed, because there is not route choice for moving from one space to another space. The closed settlement formed, because of this period the access can be reached from the main street and from the next village only (R 0 and R 8). There are 16 connectivity spaces formed as a common space in settlement. The spatial depth from outside the settlement amounted to 7 steps, so as to reach the inner side from outside the settlement takes 7

displacement or movement steps from one space to another space. Private space formed, it is near the workplace (R 26, R 24, R 23 and R 27) in this case for fishing community. It's clear that the dependence on the beach causes the closed settlement formed.

The reclamation has caused the sea changes become settlement. It is impact to the spatial settlement development. Reclamation causes the movement pattern changes. It is impact to formation the connector spaces to reach the outside space of settlement. On the other side, reclamation had forming the house groups, so that the spaces are develops in the settlement. It is impact to formation an open spaces as a connecting to reach the cluster houses.

The analysis of spatial configuration in 2013 when the Mariso settlement is located on the land described in table 3:

**Table 3 : Justified Permeability Map of Mariso Settlement in 2013**

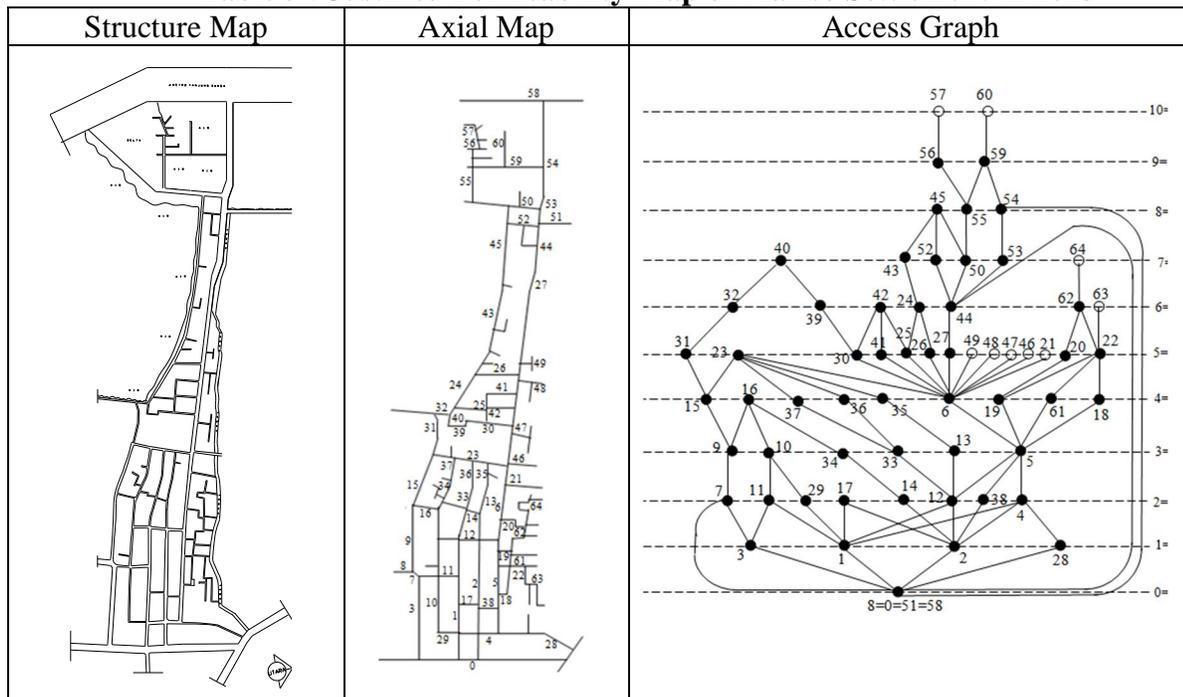


Table 3 described that this period formed a new access is Metro Tanjung Bunga street on the sea area due to reclamation. It is impact to the development of Mariso area. The entry access to settlement can be passed from 4 directions, namely are from the main street of settlement, from the new street and two access from the next village (R 0, R 8, R 51 and R 58). The settlement patterns are open because of the access around the settlements. The spatial configuration is distributed, so there is a route choice for moving from one place to another place. There are 52 connectivity spaces formed as a common space in settlement. The spatial depth from outer the settlement amounted to 10 steps, so as to reach the inner side from outside the settlement which takes 10 displacement or movement steps from one space to another space. Semi public space formed that serves as a collective space to workplace (R 6). The private space formed that far from the workplace and that is closed (R 57 and R 60).

From both justified permeability map above, it explains that some changes of spatial configuration in Mariso settlement occur. Initially the spatial configuration forming non-distributed and then turned into distributed form, so there is a route choice for moving from one place to another place. It's clear that the sea changes into land causes the open settlement formation. On the

other side, the depth level of spatial settlement developed from 7 steps to 10 steps from outer settlement. This condition informs that in the period of 2013 the space is deeper in system than the period of 1980.

The next analysis is calculating of the relative asymmetry. It is needed to determine the spatial integration of settlement and space depth. The result of the relative asymmetry calculation can be described the interconnectivity spaces. On the other side, the result of the relative asymmetry calculation can be described what spaces are integrated or segregated in settlement. The result of relative asymmetry calculation in Mariso settlement in 1980 and 2013 based on justified permeability map can be seen in table 4.

**Table 4. The Space Relative Asymmetry (RA) Calculation of Mariso Settlement**

CONDITION in 1980			CONDITION in 2013		
Space	R A	MD	Space	R A	MD
26	0,44	6,67	62	0,22	7,87
15	0,39	6,19	64	0,21	7,60
16	0,37	5,81	50	0,19	6,94
24	0,36	5,67	60	0,19	6,83
8	0,35	5,59	61	0,18	6,70
22	0,35	5,59	63	0,18	6,60
10	0,33	5,26	8	0,17	6,27
9	0,32	5,22	49	0,16	5,88
14	0,32	5,19	32	0,15	5,86
20	0,31	5,04	48	0,15	5,79
21	0,31	5,04	53	0,15	5,70
23	0,30	4,96	45	0,15	5,70
27	0,30	4,93	10	0,15	5,70
25	0,29	4,85	34	0,15	5,68
11	0,29	4,81	59	0,15	5,60
12	0,29	4,78	40	0,15	5,52
7	0,28	4,63	7	0,14	5,29
18	0,28	4,59	16	0,14	5,25
19	0,27	4,52	17	0,14	5,19
13	0,26	4,44	51	0,13	5,16
1	0,24	4,15	20	0,13	5,13
17	0,24	4,07	14	0,13	5,06
3	0,23	4,00	19	0,13	5,06
6	0,23	3,96	43	0,13	5,03
5	0,20	3,59	11	0,13	4,97
0	0,19	3,59	22	0,13	4,97
4	0,19	3,44	0	0,13	4,89
2	0,18	3,37	3	0,12	4,86
			39	0,12	4,71
			54	0,12	4,70
			58	0,12	4,70
			42	0,12	4,68
			9	0,12	4,67
			28	0,12	4,61
			13	0,12	4,60
			31	0,12	4,60
			24	0,11	4,58
			33	0,11	4,44
			1	0,11	4,35
			2	0,10	4,27
			35	0,10	4,24
			36	0,10	4,24
			37	0,10	4,24
			18	0,10	4,17
			19	0,10	4,08
			44	0,10	4,08
			47	0,10	4,08
			38	0,10	4,06
			4	0,10	4,05
			21	0,10	4,03
			46	0,10	4,03
			55	0,10	4,03
			56	0,10	4,03
			57	0,10	4,03
			15	0,10	3,98
			25	0,09	3,89
			26	0,09	3,89
			41	0,09	3,89
			30	0,09	3,79
			12	0,09	3,68
			27	0,08	3,59
			23	0,08	3,54
			5	0,08	3,38
			6	0,07	3,24
<ul style="list-style-type: none"> <li>- The spatial integration value is 0,18 –0,44.</li> <li>- Space R 26 is the largest value space and it is difficult to be integrated due to the uneasy achievement from the other spaces.</li> <li>- Space R 2 is the smallest value and it is most integration space because it is easily passed to other space. It is as a public space so that easily integrate with other spaces.</li> </ul>			<ul style="list-style-type: none"> <li>- The spatial integration value is 0,07- 0,22.</li> <li>- Space R 57 is the largest value space and it is difficult to be integrated due to the uneasy achievement from other spaces.</li> <li>- Space R 6 is the smallest value and it is most integration space because it is easily passed to any space. It is a public space so that easily integrate with other spaces.</li> </ul>		

From table 4, it can be explained that the development of Mariso settlement in 2013 caused the space settlement more integrated than 1980’s conditions. The sea changes become settlement causes the spaces formation is more integrated, because of the spaces are easily reached and easily

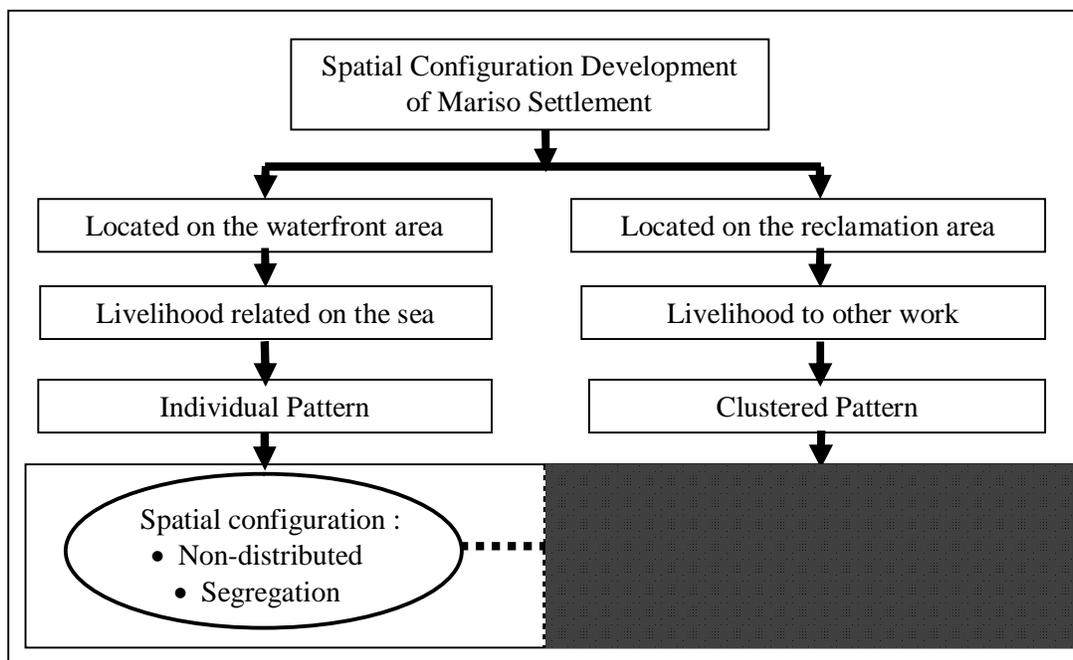
passed to other spaces. It's clear that reclamation and changes of livelihood are causing the more integrated spaces formed.

#### 4. CONCLUSION

Mariso settlement is developing due to the sea changes become settlement. Reclamation causes the changes of Mariso society livelihood, so that it is impact to changes of the movement pattern and the buildings form. The changes of livelihood is causing to the spatial order of settlement, from the spread to be clustered pattern. It is causing to the development of space meaning. Initially the spaces formed as a workplace, but the reclamation causes the changes of spaces meaning as a common space. Reclamation causes the interconnected spaces formed in the settlement.

The sea changes become settlement impact to the spatial configuration of Mariso settlement. It is changes form non-distributed turned into distributed. The closer to the sea increasingly the non-distributed formed, and getting close to the land increasingly the distributed formed. It is clear that the non-distributed spaces formed are located on the waterfront, while the distributed spaces formed are located on the reclamation area. Mariso spatial settlement hierarchy showed that the spaces are located on the reclamation land can be easily integrated. While the spaces difficult to integrated with other space is the spaces are located on the waterfront area. It is clear that reclamation and the changes of livelihood will be forming the integrated spaces in the waterfront settlement. This is explains that the society social interaction which is done when the settlement located on the reclamation land is better than to the located on the waterfront area.

The influence of the sea changes become settlement in terms of the spatial configuration development of Mariso settlement can be seen in figure 7 :



**Fig. 7. Spatial Configuration Development of Mariso Settlement**

The result of this research described that the coastal changes to be settlement will be forming the more integrated spaces. On the other side, the denser a settlement will be forming the more integrated spaces. The more integrated spaces are the spaces formed by society collective

need. Therefore, the planning of the waterfront settlement should be attention to the environment and the social conditions that exist in community.

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