COMMUNITY-BASED ANALYSIS ON MANGROVE FOREST CHANGES IN REMBANG DISTRICT, CENTRAL JAVA PROVINCE, INDONESIA

(ANALISIS KOMUNITAS PADA PERUBAHAN HUTAN MANGROVE DI KABUPATEN REMBANG, PROVINSI JAWA TENGAH, INDONESIA)

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Abstrak

Hutan mangrove secara luas dikenal sebagai sumber daya berharga yang menyediakan jasa lingkungan, serta fungsinya untuk melindungi kawasan pesisir dari erosi pantai dan mempromosikan sedimentasi. Penelitian ini bertujuan untuk mengetahui perspektif masyarakat terhadap perubahan dinamis dari hutan mangrove akibat perubahan garis pantai. Penelitian ini menyoroti dua hal, yaitu 1) deteksi garis pantai menggunakan interpretasi visual; 2) pengamatan masyarakat terhadap hutan mangrove serta menganalisis pengaruh perubahan hutan mangrove terhadap masyarakat termasuk aksi adaptasi mereka. Kuesioner semi-terstruktur digunakan sebagai instrumen pengumpulan data melalui survei. Pengambilan sampel dilakukan secara proporsional random sampling untuk menentukan 81 responden dari Desa Pasarbanggi, Tasikharjo dan Tunggulsari. Penelitian ini mengungkapkan bahwa terdapat perubahan garis pantai di daerah penelitian, yang menginduksi hutan mangrove yang dinamis. Hutan mangrove yang dinamis memengaruhi strategi adaptasi lokal, dan itu sesuai dengan intervensi pemerintah dalam program mangrove. Desa Pasarbanggi yang menerima berbagai program, baik dari pemerintah maupun pihak-pihak lainnya, dikombinasikan dengan partisipasi aktif masyarakat setempat dalam membangun mangrove, memiliki peningkatan area mangrove yang stabil dan tanpa mengalami gangguan signifikan dibandingkan dengan Tasikharjo dan Tunggulsari. Sejalan dengan situasi ini, responden memiliki respon yang berbeda terhadap perubahan hutan mangrove di daerah mereka. Tanggapan responden terhadap perubahan hutan mangrove berkorelasi dengan partisipasi mereka dalam program bakau dari pemerintah. Responden di Desa Pasarbanggi tampaknya lebih diuntungkan oleh perubahan hutan mangrove termasuk manfaat langsung dan tidak langsung dari hutan, dibandingkan dengan responden lain di Tasikharjo dan Tunggulsari.

Kata Kunci: *Perubahan Hutan Mangrove, Perubahan Garispantai, Persepsi Masyarakat, Penyesuaian Masyarakat*

Abstract

Mangrove forest is widely known as valuable resources, which provide goods and services as well as its function to protect coastal area from coastal erosion and promote sedimentation. This study aims to investigate community perspective towards dynamic change of mangrove forest due to coastline change. The research highlights two observations, i.e. 1) coastline detection using visual interpretation; 2) community observation towards mangrove forest. Semi-structured questionnaire was applied to analyze the influence of mangrove forest changes to community as well as their adjustment. A proportional random sampling protocol was performed to determine 81 respondents from the village of Pasarbanggi, Tasikharjo and Tunggulsari. The research reveals that the research area exposes to coastline change, which induces mangrove forest dynamic. The dynamic mangrove forest influences local adaptation strategies, and it corresponds to government intervention within mangroves program. Pasarbanggi Village, which received various programs, both from government and other parties, combined with active participation of local people in establishing mangrove, has a stable increase of mangroves area between periods without significant disturbances compared to Tasikharjo Village and Tunggulsari Village. In line with this situation, respondents have different response toward the changes of mangrove forest in their area. Respondents' response toward mangrove forest changes correlates to their participation in government mangroves program. Respondents in Pasarbanggi Village are apparently more benefited by the changes of mangroves forest including the direct and indirect benefit from the forest, as well as from mangroves program, compared to another respondent in Tasikharjo Village and Tunggulsari Village.

Keywords: Mangrove Forest Changes, Coastline Changes, Community's Perception, Community's Adjustment

INTRODUCTION

Coastline dynamic which represented by the occurrence of coastal erosion and sedimentation is highly corresponded to the dynamic of mangrove forest. Mangrove forest is believed could promote the sedimentation through its mechanism to trap sediments (Furukawa & Wolanski, 1996). On the other hand, Woodroffe (1992) proposed different perspective that mangroves are not the cause of sedimentation but only accelerate the sedimentation process which also depends on the other factors in surrounding areas.

Human intervention such as disruption of sediments supply, coastal sand mining, removal of vegetation and natural protection (Mujabar & Chandrasekar, 2011) and construction of aquaculture pond (Thampanya et al., 2006) is another factor which affects the rate of coastal erosion and sedimentation. Mangrove establishment through natural and artificial regeneration is considered as one effort to enhance coastline protection. Local people-initiated plantation, government-initiated plantation, or combination between these efforts have resulted in both failure and successful in mangrove forest establishment (Amri, 2005).

Rembang District has been facing with these issues for recent years. Sedimentation and coastal erosion have been recognized as natural phenomenon along the coastline of Central Java Province (Wahyudi et al., 2012). Marine and Fishery Office (DKP, 2011) of Central Java Province described that North Coast area of Rembang District is affected by sedimentation and coastal erosion. Sunarto (1999) and Setiady & Usman (2008) in their research also explained that parts of Rembang District were affected by sedimentation process.

The changes of mangrove forest are considered could influence the surrounding community. For instance, the progression of forest due to the successful of mangrove plantation program could give advantages to local community (Auliyani et al., 2013; Gamayanti, 2013; Amri, 2005). In line with the progression of mangrove forest area, local community also made a special adjustment to adapt to the situation (Gamayanti, 2013).

This study aims to provide community-based analysis on mangrove forest dynamic. To ensure, there are two method employs to investigate mangrove dynamics. Historical topographic maps, multi-temporal images of Landsat and Google Earth images were used as sources the investigate the dynamic of mangroves and coastline. The map and images provide different details analysis to be compared since the research area covers reasonably wide research area.

This study highlights the presence of community who live nearby mangrove forest by investigating their perception toward the influence of mangrove forest changes into their daily life, as well as benefit obtained. Government intervention in managing mangrove forest also plays an important role in the dynamic of mangrove forest. The deployment of various mangroves program is expected to increase mangroves extent as well as to promote an additional benefit for the community.

The study area was located in north coast of Rembang District, Central Java Province, Indonesia. The study focused on mangroves area which exists in the two sub-districts, Kaliori and Rembang.

The research employed quantitative and qualitative method/There are two types of data acquired. Secondary data consist of:

− Landsat 8 path/row 119/65 acquisition date 20 June 2014

− Landsat 7 ETM+ path/row 119/65 acquisition date 14 August 2002

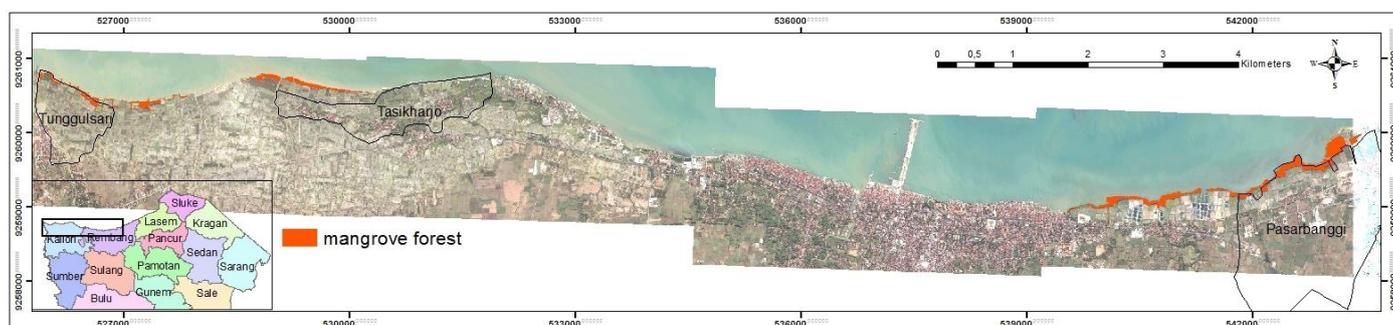− Landsat 5 path/row 119/65 acquisition date 28 May

Figure 1. Map of the north coast of Kaliori Sub-District and Rembang Sub-District, and the surveyed villages of Pasarbanggi, Tasikharjo and Tunggulsari (UTM WGS 1984 Zone 49 S in projection and datum).

1994(all landsat images downloaded from http://earthexplorer.usgs.gov)

- Topographic map year 1881 (downloaded from http://maps.library.leiden.edu)

- Topographic map year 1943 (downloaded from http://maps.library.leiden.edu for Kaliori Sub-District and http://www.lib.utexas.edu for Rembang Sub-District

- Tidal table (from Meteorological, Climatology and Geophysic Board (BMKG) of Semarang)

- Google Earth images, imagery date 18 March 2009 and 15 July 2014

- Topography map scale 1:25,000 included Sheet 1509-132 Year 1999 Juwana, Sheet 1509-141 Year 2000 Rembang, and Sheet 1509-142 Year 1998 Lasem as reference maps

Furthermore, field wok also conduct to collect primary data. Data collected as follows:
- Coast slope

- Respondents perception toward mangroves changes which encompasses knowledge, influence, adjustment/response, benefit from mangroves non-timber forest products (ntfp), acceptance on government program

- Socio-economic characteristics of respondents

A proportional random sampling was applied to determine the 81 respondents distributed in the three surveyed villages, those are Pasarbanggi, Tasikharjo and Tunggulsari. Semi-structured interview using open and closed questions was utilized to collect information from respondents.

Descriptive statistic was used to observe respondents perception toward the changes of mangrove forest, which included their knowledge on mangrove species, sedimentation, and coastal erosion. While chi-square test ($p < 0.05$) was applied to analyse if there was any significance difference between villages in: (a) perception toward the influence of mangrove forest changes (b) adjustment/response toward the changes of mangroves (c) benefit from mangroves ntfp, and (d) acceptance of government mangrove programs. Furthermore, multiple linear regression was executed to analyze factors which may contribute to (a) respondents' perception of the influence of mangrove forest changes (b) respondents' adjustment/response toward the changes of mangrove forest. Correlation test in form of contingency test was used to analyse the correlation between respondents' perception toward

the influence and response due to the changes of mangrove forest, respondents' response toward the mangrove changes and their perception on benefit from mangroves ntfp, and respondents' response toward the changes of mangrove forest and their acceptance on government mangrove program.

GEOGRAPHICAL DESCRIPTION OF THE AREA

There are at least three section surveyed thoroughly during the research. Profile 1 located near the estuarine of Randugunting River, Kaliori Sub-District. The dominant landuse is fishpond/saltpan with scatered mangrove forest near the estuarine and pond, as well as along the dike. Profile 2 located near the estuarine of Tasikharjo River, Kaliori Sub-District. The dominant landuse is fishpond/saltpan with thin man-made mangrove forest along the coastline. Profile 3 located near the estuarine of Banggi River, Rembang Sub-District. Fishpond/saltpan also the dominant landuse in present days, covered with man-made mangrove forest along outside the pond embankment on seaward direction.

According to the spatial temporal analysis via topographic maps, the research reveals that the mangroves area cannot be easily identified. However, there are significant coastal changes detected using the topographic maps. As sedimentation was the dominant process in Profile 1 and Profile 2 during the last century, in profile 3, the coastline also shifted into seaward direction in small part of western area. Slightly different from the previous profile, coastal erosion was the dominant process during the same period in profile 3. The average of coastline changes in Profile 1, Profile 2 and Profile 3 during 1881 and 1943 were about +179 m, +106 m and -47 m, respectively.

COASTAL DYNAMICS AND SOCIO ECONOMIC CHANGE

A supervised image classification using band composite resulted there was a decreases of 31 ha mangrove in 1994 into 27.9 ha in 2002. During this period, mangrove forest in Kaliori Sub-District decreased from 6.7 ha to 2.4 ha. The development of saltpan/fishpond contributed to the changes as much as 3.8 ha. Meanwhile, in Rembang Sub-District, the mangroves area increased from 24.3 ha to 25.5 ha.

A total of 6 ha mangrove forest in 1994 has changed into saltpan/fishpond in 2002. The new establishment of mangrove area into seaward direction also occurred as amount of 3 ha and 5.9 ha in saltpan/fishpond area.
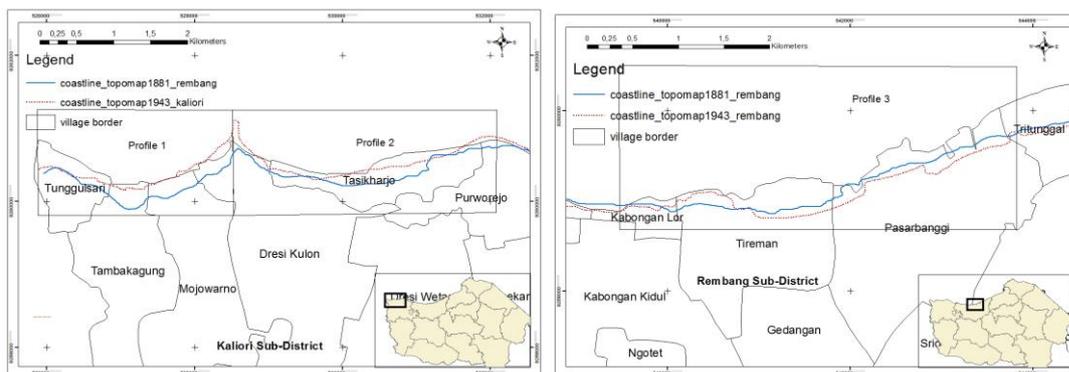
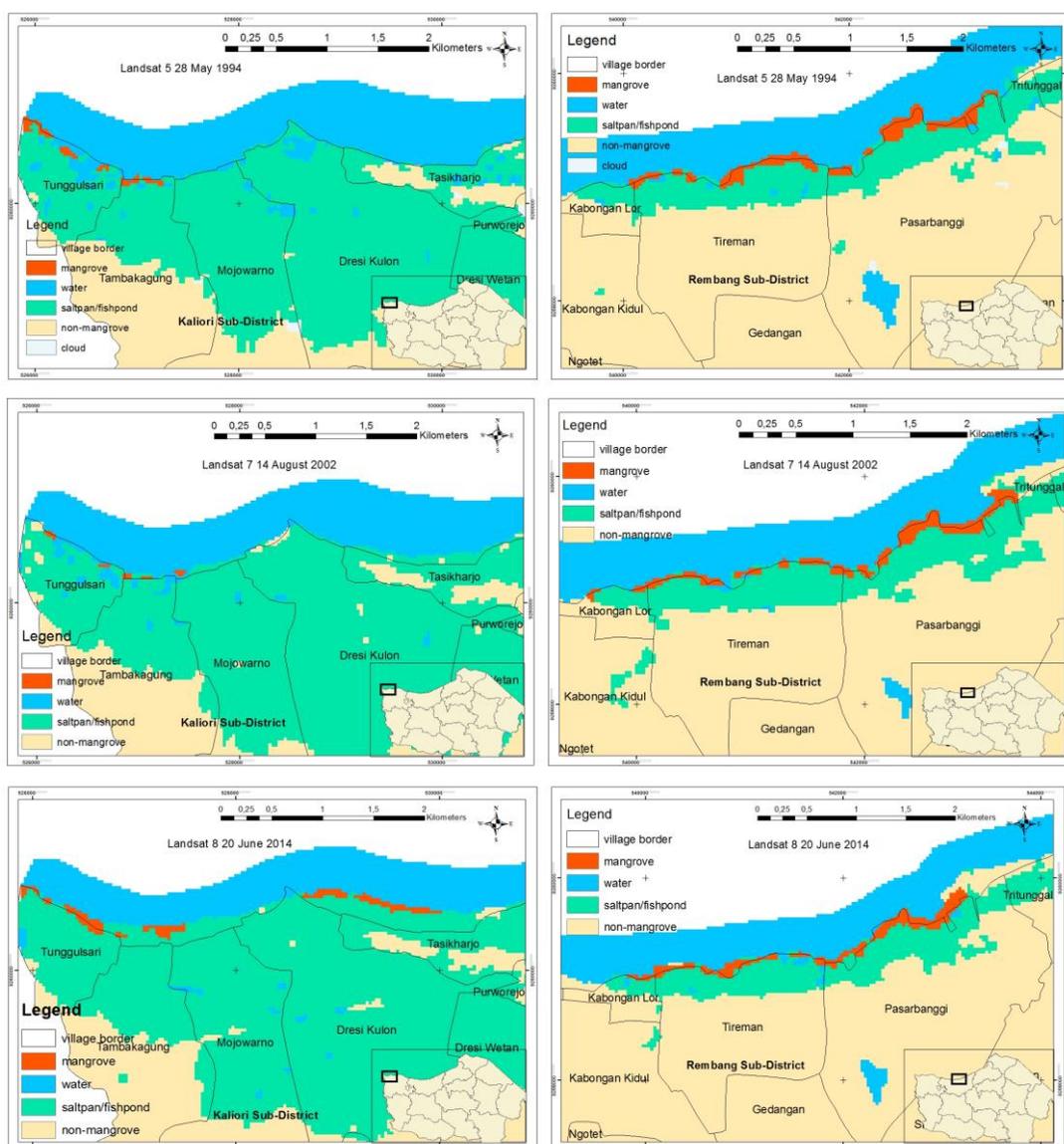Figure 2. Coastline maps from topography maps year 1881 and 1943

Figure 3. The classified images of supervised classification using band composite

In general, it can be observed that the shiftness of coastline into seaward direction followed by the increases of mangroves area. For instance in Profile 1, during period 2002-2014, coastline change as much 82 m (using band composite) or 90 m (using binary slicing) followed by the increases of mangroves area as much 7.1 ha (supervised image classification using band composite) or 6.4 ha (supervised image classification using band indices and band ratio).

Meanwhile, the coastline in all profiles had a tendency to shift into seaward direction. In Profile 1, the coastline of the outer edge of mangroves shifted into seaward direction with an average of changes about 26 m. In line with this situation, the coastline inner edge of mangroves also shifted into seaward direction with an average of changes was about 18 m. Its mean that the movement of coastline into seaward direction also followed by the removal of mangroves area on landward margin.

Table 2. The changes of mangroves and coastline extracted from multi-temporal images of Landsat

Profile	Period 1994-2002				Period 2002-2014			
	Mangroves changes (ha)		Coastline changes (m)		Mangroves changes (ha)		Coastline changes (m)	
	1	2	3	4	1	2	3	4
1	-4.3	-3.5	+44	+28	+7.1	+6.4	+82	+90
2	0	0	+17	+14	+7.6	+7.3	+80	+70
3	+1.2	+2.0	+20	+13	+1.4	+1.3	+13	+20

Remark:
1. Supervised image classification using band composite
2. Supervised image classification using the image composite of difference between NDWI-NDVI, band ratio SWIR/NIR, and NIR band
3. Visual delineation of coastline using band composite
4. Visual delineation of coastline using binary slicing

A total of 26.59 ha of mangroves area can be identified in 2009. This extent distributed 5.90 ha in Kaliori Sub-District and 20.69 ha in Rembang Sub-District. The extent of mangroves in Profile 1 increased from 5.25 ha in 2009 to 6.88 ha in 2014. In 2009, mangroves area in Profile 1 mainly distributed along the pond dike, as well as inside the pond and along outside the dike on seaward direction. The average of mangroves width was increased from 14 m in 2009 into 18 m in 2014. While in Profile 2, the extent of mangroves area was increased from 0.66 ha in 2009 to 5.22 ha in 2014. In 2009, the mangroves area was scattered on muddy flat along the outside of pond dike on seaward direction. The width of mangroves area was vary from 4-18 m, with average about 8 m. In 2014, the mangroves area expanded into a seaward direction along outside the pond dike on seaward direction. The width of mangroves area is vary from 9-60 m, with an average of width around 34 m. Unfortunately, the mangroves area in 2009 was replaced by the pond in 2014.

Furthermore, in Profile 3, there was an increases of mangroves area during 2009-2014. The extent has increased from 20.69 ha into 26.84 ha. The average on mangroves width was increased from 48 m to 66 m. There was also mangroves removal due to new establishment of new pond and river normalization on the eastern part of the area.

While in Profile 2, the coastline has shifted into landward direction with a range 2-37 m during period 2009-2014. On the eastern part, the coastline also has shifted into landward direction with the range of changes about 5-27 m. In average, the coastline has shifted into a seaward direction about 25 m during this period. In Profile 3, there were no much changes of coastline between period 2009-2014. In average, the coastline of outer mangroves has moved into seaward direction as far as 4 m during 2009-2014. The coastline of the inner edge of mangroves also shifted into a seaward direction about 2 m.

According to the extracted mangrove forest and coastline year 2009 and 2014, in general, it can be observed that the dominant process in both three profiles was sedimentation followed by the expansion of mangrove forest into seaward direction. In profile 1, the average of coastline changes during this period was 26 m, then followed by the expansion of mangroves area as much 1.64 ha. While in Profile 2, the changes of 25 m of coastline followed by the increases of 4.57 ha of mangrove. Then in Profile 3, a slight 4 m changes of coastline followed by 6.15 ha increases of mangroves area.
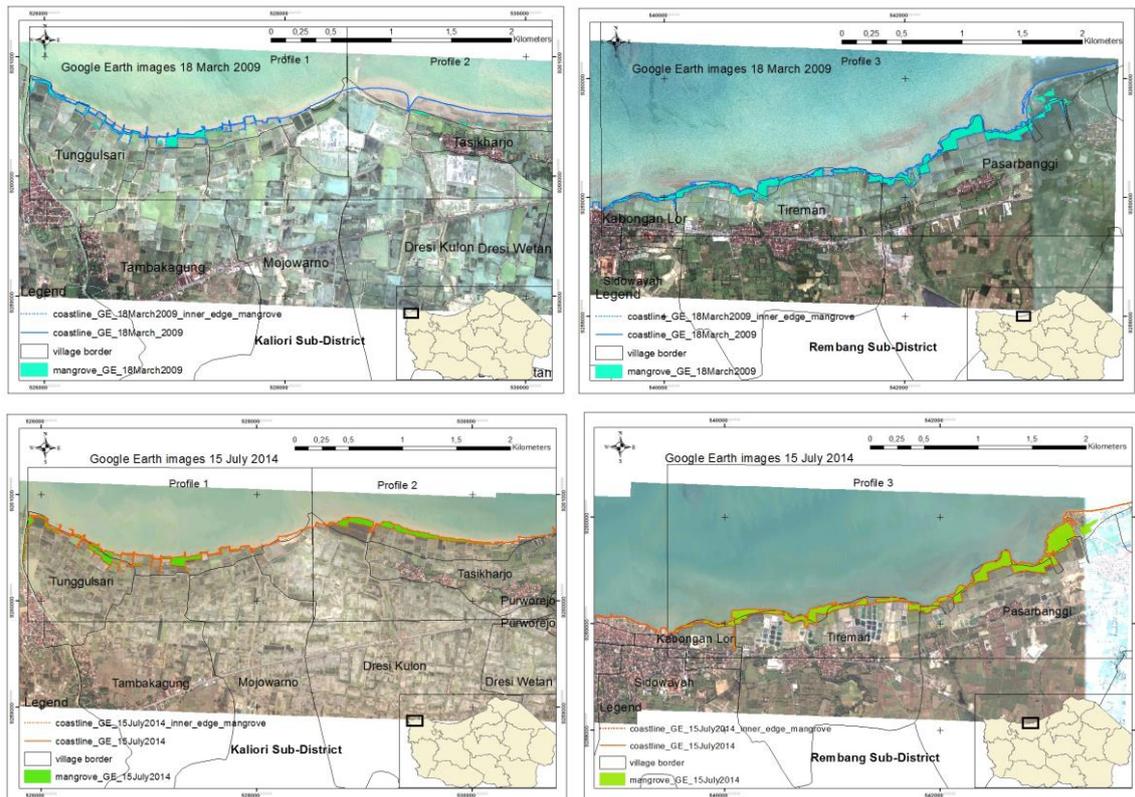
Figure 4. Mangrove forest and coastline extracted from Google Earth images

Table 3. The changes of mangroves and coastline extracted from Google Earth period 2009-2014

Profile	Mangroves (ha)	Coastline outer mangroves (m)	Coastline inner mangroves (m)
1	+1.64 ha	+26 m	+18
2	+4.57 ha	+25 m	-
3	+6.15 ha	+4 m	+2

As the research comprehended with characteristics of the coastal dynamics using spatial-temporal approach, the mangrove change is identified thoroughly. Based upon the finding the research look through details on how community perception towards this changes. Predominantly, respondents indicated that mangrove forest near their villages had increased compare to 10 years ago. Mangrove plantation by local people and government were assumed as the main reason due to the increases (67 respondents) while some other interviewees (14 respondents) argued that mangrove plantation and natural regeneration as the main factor of the increases.

About sedimentation, the majority of respondents explained that sedimentation has taken place in their village for the last ten years. Some 14 respondents and 67 respondents described that sedimentation has taken place in their village since 5-10 years and > 10 years ago, respectively. The majority of respondents explained that sedimentation is not an adverse condition, with the assumption that sedimentation provides new land which can be used for some purposes such as mangrove plantation, land extension into sea direction and pond expansion.

Furthermore, there was 7 respondents who indicated that coastal area in their village has been affected by coastal erosion since 5-10 years ago. These 7 respondents argued that strong wave, particularly at peak season of west monsoon (locally known as musim barat) that usually takes place every January-February, as the main factor of this condition. Six respondents described that coastal erosion has negatively affected pond bank and mangroves stand. A number of 34 respondents (42%) indicated their agreement when they requested to indicate their perception wheter the changes of mangrove forest extent can affect their daily life. While 47 respondents (58%) disagree if the changes can affect their everyday lives. Out of 33 respondents in Pasarbanggi, 19 respondents explained that the changes of mangrove

extent have influenced their daily lives. The same impression also showed by eight respondents in Tasikharjo and seven respondents in Tunggulsari. Overall, most of the respondents (47 respondents) argued that their daily life has never affected by the changes. Respondents' perception toward the influences of mangrove forest change is not significantly different between the three villages (p-value 0.056 > 0.05).

Amongs the socio-economic factors which included gender, age, education, income, occupation, length of stay, distance between house-mangrove forest, and involvement in government program, only the factor of respondents' participation in government mangrove program has the significance influence to those surveyed' perception of the effects of mangrove forest changes to their life (significant value 0.001 < 0.05).

The amount of 48 respondents described that they never made any particular adjustment related to the changes. While 33 respondents exclaimed that they have made adjustment toward the changes of mangrove forest. There is two type of adjustment which made by respondents, structural and economic. Amongst 33 respondents who made an adjustment, 12 of them generated structural adjustment in the form of planting mangrove. While 21 respondents have generated side job, as an economic adjustment to the changes of mangrove forest. There is some side job which owned by those interviewed, such as collecting and selling Avicennia fruit; collecting and selling crabs, shell, and oyster; establishing an own nursery and selling mangrove seedlings, and managing the parking area of mangrove park. Respondents' adjustment/response toward the changes of mangrove forest is significantly different between the three villages (p-value 0.03 < 0.05).

Amongst the socio-economic factors of respondents, the factor of those surveyed' participation in government mangrove program considered has a significant influence on those surveyed' adjustment toward the changes of mangrove forest (significant value 0.000 < 0.05).

A total of 33 respondents experienced on utilizing mangroves ntfp in their daily life, mainly in utilizing the fruits of Avicennia. They collected the Avicennia fruits for some purposes, such as food (snack), seedlings and side income (selling into the market). Some respondents also explained that they are accustomed to collect propagules of Rhizophora as materials for seedlings in the nursery. Respondents' perception of benefit obtained from mangroves top is

significantly different between three villages (p-value 0.000 < 0.05).

A total of 42 respondents indicated that mangrove programs can deliver benefit for them. While the other 39 respondents exclaimed that there are no significant advantages they can obtain from mangrove programs. Out of 33 respondents in Pasarbanggi Village, 27 of them expressed that they obtain advantages from mangrove programs. While only 13 respondents in Tasikharjo Village and two respondents in Tunggulsari stated the same impression. The respondents' perception of benefit from government mangrove program is significantly different between villages (p-value 0.000 < 0.05).

Correlation between community's perception toward the influences of mangrove forest changes and community's adjustment/response toward mangrove forest changes is directly proportional and statistically significant (p-value 0.000 < 0.05 and contingency coefficient 0.698).

While the correlation between community's adjustment/response toward mangrove forest changes and community's perception of benefit from mangroves non-timber forest products is directly proportional and not statistically significant (p-value 0.656 > 0.05; contingency coefficient 0.054).

Furthermore, the correlation between community's adjustment/response toward mangrove forest changes and community's acceptance on government mangroves program is directly proportional and statistically significant (p-value 0.041 < 0.05; contingency coefficient 0.239).

COMMUNITY PERSPECTIVE TOWARDS DYNAMIC CHANGE OF MANGROVE FOREST

According to the extraction mangroves area and coastline using Landsat data and Google Earth images, in general, it can be observed that sedimentation was the dominant phenomenon along the study area, in line with previous study by Sunarto (1999), then followed by the increases of mangroves area. The utilisation of historical topography map year 1881 and 1943, tough could not presented the area of mangroves, at least could provide information on sedimentation and coastal erosion.

Sedimentation process in Profile 1 corresponds to the deposition of sediment materials from Randugunting Rivers in the western part of the area. While in Profile 2, the coastline has changed into seaward direction

correspond with the deposition of sedimentation materials from Tasikharjo River. The wave during west monsoon which moves from northwest to southeast direction, will bring the materials into east direction and deposit the materials in Profile 1. On the other hand, the coastline was not much change between periods in Profile 3. The waves during the peak season of east monsoon bring the sediments from east to west and deposit the materials in the form of sandspit in some parts in front of mangroves forest. Thus, the progression of mangroves area in all profiles corresponds to the deposition of sedimentation materials.

Furthermore, the anthropogenic factor might also contribute a significant role in progression or decreases of mangroves area, as well as the coastline dynamic. Mangrove plantation by local people with their initiative and government's intervention through various programs are considered as the main contributor of the dynamic of mangroves area.

Local citizens in Pasarbanggi Village have started to establish mangrove plantation by their efforts around the 1970s. The government then started to assist local people to expand the forest through plantation program. Various government institutions have actively conducted mangrove plantation in this village, such as The Ministry of Forestry, The Ministry of Environment, Agriculture and Forestry Office (Distanhut), Environment Office (BLH) and Marine and Fishery Office (DKP). The Ministry of Environment has started to run a program called Rehabilitasi Pantai Entaskan Masyarakat Setempat/Rantai Emas (coastal rehabilitation to elevate local people) collaborated with female group of Kartini I and Kartini II. The pioneering stage of tourism activity also has been started in Pasarbanggi Village by BLH Rembang District which called rintisan taman mangrove (pioneering program on mangrove park). The succesfull of local people on establishing mangrove forest in Pasarbanggi Village apparently has attracted various parties to conduct mangroves program in this village. As the direct results, protection of the existing forest is getting better. There has been an increases of forest extent between periods without significant human disturbances.

Meanwhile, government-supported mangrove plantation program is the main contributor at the initial stage of mangrove forest establishment in Tasikharjo Village. The Ministry of Forestry, Distanhut, BLH and DKP have carried out mangrove plantation in this village. Another parties have also conducted plantation

which involving local people, such as BLH of Central Java Province, DKP of Central Java Province, army, NGOs and students. However, the intervention of local people on newly planted areas of mangroves has played an important role in mangroves dynamic in Tasikharjo Village. During 2009-2014, the newly planted areas of mangroves which resulted by government-supported program from previous period, was cleared by local people to be converted into ponds. However, the establishment of Kelompok Pelestari Mangrove (farmer group) is a prominent evidence to show their commitment to protecting the remaining forest. The village government which also supported by this group, has issued informal prohibition on mangrove disruption, includes collecting of Avicennia fruits.

A different condition might occur in Tunggulsari Village. Locally initiated of mangrove plantation by local people was the main factor of mangroves establishment in Tunggulsari Village. The pond farmers in Tunggulsari Village and surrounding area are accustomed to planting the wild seedlings of Avicennia marina and Rhizophora mucronata along the pond dyke at seaward margin to protect the earthen dykes and along the new water channel which built accross the coastline to trap the sediments. Unfortunately, the establishment of new mangroves area at seaward margin often followed by mangrove felling at the landward margin to be converted into a new pond. Mangrove plantation program as government intervention has introduced in Tunggulsari Village and its surrounding area. The Ministry of Forestry and local institutions such as Distanhut, DKP and BLH have initiated mangrove plantation program in this village. Mangroves dynamic in Tunggulsari Village and its surrounding area was higher compare to another villages in the study area which can be observed by the fluctuation of mangroves extent and the shiftness of coastline inner-edge mangrove into seaward direction.

The majority of respondents in Pasarbanggi Village exclaimed that they have been affected by the increases of mangrove forest. In contrary, the majority respondents in Tasikharjo Village and Tunggulsari Village argued that the increases of mangrove forest does not influence their daily life. Furthermore, respondents perception toward the influence of mangrove forest changes is highly correspond to their adjustment toward the changes of mangrove forest. In line with the previous statement, the majority respondents in Pasarbanggi Village explained that they have created certain adjustments toward the changes of mangrove forest. Respondents' adjustment can be

grouped into two type. First, structural adjustment in form of own initiative mangrove plantation. Second, economic adjustment in form of sided-income generation.

Meanwhile, respondents' adjustment toward the changes of mangrove forest corresponds to their participation or involvement in government mangroves program. The respondents from the surveyed villages also conveyed different reason if their villages require government program. In fact, the majority of respondents argued that government mangroves program is still need to be conducted in their villages due to some reasons such as generation of additional income, lacking of own budget and environment protection. In contrary, some respondents in Tunggulsari Village exclaimed that mangrove plantation is no need to be conducted in their village because the local people can do the plantation by their own iniative. They emphasized that protection and preservation the existing forest is more important.

The existence of government intervention and local community's participation in establishing mangrove forest has showed different effects on the dynamic of the forest itself, as well as their influence to community. Various programs in Pasarbanggi Village and active participation of local people in mangrove plantation have delivered the stable increases of mangrove forest and benefit from the forest for local people.

CONCLUSION

This study has utilised different dataset to investigate spatial-temporal changes of mangrove forest in relation to coastline dynamic. The findings have provided usefull information on the dynamic of mangrove forest, as well as coastline, and community's response toward the changes of forest.

Mangrove forest dynamic and coastline changes in Rembang District are mainly affected by natural and antropogenic factors. The deposited materials from sedimentation process, followed by man-made regeneration of mangrove and establishment of saltpan/fishpond into seaward direction are the main driver for the dynamic of mangroves area, as well as coastline changes. Unfortunately, the progression of mangroves area into seaward direction often followed by removal of mangrove vegetation on backward margin. Meanwhile, there was a different response given by community toward the changes of forest. Only small portion of community who benefited by the changes and create adjustment. Their adjustment is

correspond to their participation in government program.

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