Viet Nam National University, Ha Noi (VNU)
Centre for Natural Resources and Environmental Studies (CRES)
Mangrove Ecosystem Research Division (MERD)

EVALUATING PRESENT STATUS AND SOCIO-ECONOMIC EFFECTS OF MANGROVE FORESTS IN COMMUNITIES OF TAN THANH, BANG LA AND DAI HOP – HAI PHONG CITY

Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

International Federation
of Red Cross and Red Crescent Societies

Ha Noi, 2015

Viet Nam National University, Ha Noi (VNU)
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MFF – VNRC - IFRC

Project

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Acknowledgements

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SUMMARY

This report presents additional evaluation findings on the present status of mangroves in communes/wards of Tan Thanh, Bang La and Dai Hop and socio-economic effects of mangroves on local communities in the project area. Study results show that the planted mangrove area in the 3 communes/wards of the study site has been rationally cared and protected, leading to a well developed forest stretch that helps bring about considerable livelihood sources for local communities.

Total planted mangroves were not great compared with the existing forest; however, in the context of not-quite-favorable environmental conditions combined with limited awareness of local community about protection and caring of forests in the early stage (before 2005), the remaining forest area was, to some extent, reflective of efforts of local authorities and communities in forest protection and guarding. Specifically, 100% of communes/wards formed voluntary forest protection groups under the limited financial support from the localities; no forest deforestation has been found… Nevertheless, to further protect and develop mangrove forests in those localities, it is vital to conduct communication activities, raising awareness to local communities and leaders of branches and sectors on the role and multi-sided values of mangrove forests.There is a need for actively implementing more campaigns related to mangroves to educate and disseminate information to young generations in those localities and neighboring areas in this regard.

Kandelia obovata is a key planted species in the area, gradually encroaching seaward over the past many years. The time to start mangrove planting varies in different localities; however, in general, the entire communes/wards in the study area have, so far, witnessed a closed canopy forest stretch outside seadykes. Notably, some locations in the study area saw a mangrove belt as long as 2.5 km. A large area of *K.obovata*, though planted several years ago, saw not very high trees. The average height of mature trees reached 3.5 – 4.0 m with the diameter of 7-16 cm. Density of mangrove trees in general and of *K.obovata* in particular was very high at 15,000 – 20,000 trees/ha. *Sonneratia caseolaris* was not high in individual quantity but the largest in coverage (38.6% on average); specially, in some places, the coverage was approximately 100%. *S. caseolaris* in the study area was fairly stable in density at around 1,300 trees/ha ; the species height and diameter averaged 7.14 to 7.32 m and 20cm respectively. Though these two values reached the climax, they were rather low compared with those of the same species in other locations of the area and in the world and lower than those of naturally regenerated mangroves of the same species. This can be explained by the environmental conditions in the coastal zone of Northern Viet Nam with prolonged cold winter. This factor limited the increase in height of mangrove species. Moreover, too high planting density in the study site, to some extent, affected diameter growth of floral vegetation.

Household survey results showed that the average income per hectare of mangroves was significant at 319-498 USD/ha/year from natural aquatic fishing and about 45 USD/ha/year from apiculture.The highest figure could be observed in Tan Thanh, followed by Dai Hop and

Bang La. However, in terms of the number of local people benefiting from mangroves, despite its second rank in mangrove area, Bang La saw the most manual aquatic fishermen (around 151 people/day).The local communities enjoyed remarkable economic benefits from mangroves ; nevertheless, this mangrove value could only be evaluated and recognized by Bang La Ward's People's Committee through the report on the implementation of tasks in 2013 and directions and solutions to task implementation in 2014. Dai Hop commune and Tan Thanh ward have reflected mangrove importance which, however, should be officially acknowledged to confirm the role of mangroves in their local socio-economic plans; this was aimed not only to attract attentions from local officials, leaders and different branches and sectors in forest protection and development work but also to get more consideration and contributions of communities to the common tasks.

The role of mangroves in coastal protection against extreme weather events has been assured by local authorities and communties in the study site. Though this value could not be quantified, the study team has obtained corroborative evidences. Annual final reports of localities covered assessment of the role, ensuring further directions for forest protection to defend local communities against natural disasters. Through interviews with local inhabitants, 75-99% of respondents were of the opinion that they felt safer against typhoons and floods with the presence of mangroves and 63-98% of respondents confirmed change in their viewpoints from the insignificance of forest protection to the crucial role of forest protection.

Mangrove vegetation in the study site brought about significant ecological effects. It was estimated that each hectare of planted mangroves in the study site accumulated about 1,204 tonnes of carbon equivalent to 44,535 USD/ha. In addition, landscape and environmental values of mangroves from which local people benefited contributed to different aspects of the social community life. These values have been highly appraised by local communities and therefore, they were more active in mangrove protection and development activities.

This evaluation report has not yet covered and quantified all the values of mangroves in localities. We, the study team, hope that data and analysis in this report will be used by local governments as a basis for evaluation of property values of mangroves in their localities, and therefore, enhance communication activities among community members for mangroves to be protected and developed forever.

1. INTRODUCTION

1.1.Introduction

A mangrove ecosystem is found at the interface between land and sea. Ecological factors influence the existence and distribution of mangrove forests (Hong, 1999). It can be noted that mangrove environment is changeable frequently under impacts of physio-chemical factors. Nevertheless, mangrove plants successfully colonize this environment thanks to their adaptive morphological, physiological and reproductive features.

The coastal region of Northern plain (from Do Son cape to Lach Truong cape) belongs to zone II of mangroves according to Phan Nguyen Hong's classification (1999). The mangroves in this region are distributed in four provinces of Hai Phong, Thai Binh, Nam Dinh, and Ninh Binh.This zone is accreted by alluvia from Red river and Thai Binh river systems and possesses a slightly-sloping and interwined system of rivers with a large volume of water, forming plenty of large tidal mud flats rich in alluvia, favorable for brackish water species. However, due to large open space, this area is affected directly by tropical depression and storms from East Sea and Northeast monsoon, leading to big waves. During stormy season with heavy rain combined with high tides, in natural conditions, mangroves in this zone include brackish water oreuryhaline species such as *Acanthus ilicifolius*, *K.obovata, Aegiceras corniculatum* distributed from river mouth inward.

Climate change over the past time has caused great damage to human life, assets, natural resources and environment; extreme weather events such as storms, superstorms, high tides, floods, and droughts have been more frequent and severe; therefore, urgent measures should be taken to respond to such natural calamities. Despite their important role in response to climate change impacts, mangroves have been being influenced by climate change (change in temperature, rain, sea level rise, ...) (Karen L. McKee, 2010; Sanders, C.J et al., 2010). In addition to climate change impacts, mangroves in Viet Nam as well as in many other areas in the world have been facing deterioration due to population pressure and economic development (Aksornkoae, 1993; Hong and San, 1993; Hong,1999).

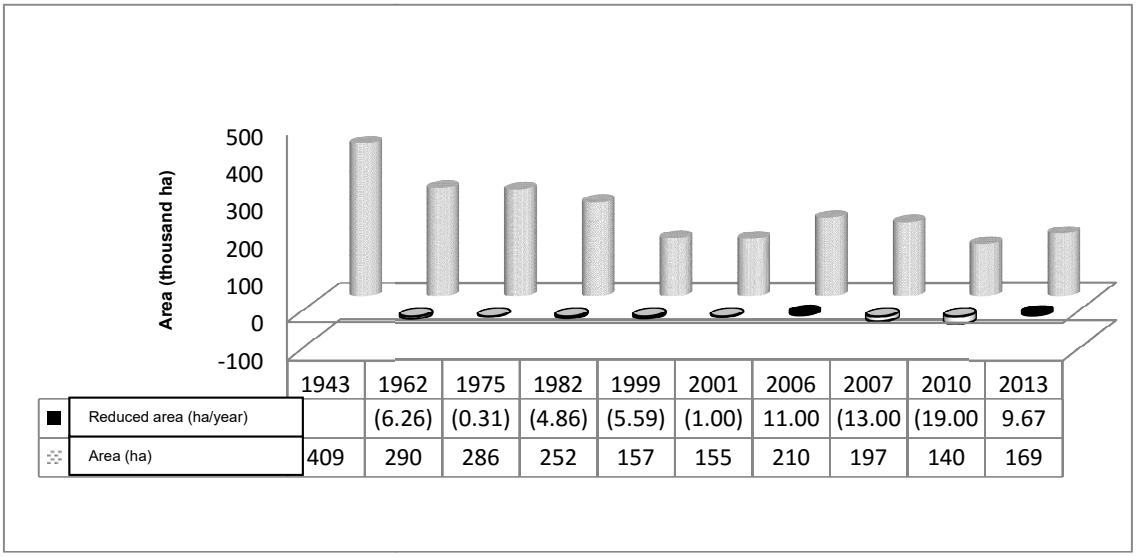
Mangroves are an ecosystem of great importance, which both meet the need of local community, especially the poor in coastal areas and act as a solid green wall against winds, storms, tsunami, erosion; in addition, mangroves contribute to cleaning coastal environment, controlling saline intrusion, groundwater protection, carbon accumulation, reduction of CO_2… and sustaining biodiversity during occurrence of natural hazards (Cuc and Erik Van der S., 2013). As a result, maintenance and development of mangrove ecosystems are considered one of the solutions to response to and minimization of climate change impacts (Cuc et al., 2015). Though mangroves are known as an ecosystem widely adaptive to climatic conditions, due attention should be paid to adaptibility of this crucial ecosystem and sea level rise as a consequence of climate change.

Rehabilitation and rational development of protection mangroves are responsibilities of the state, local governments, mass organizations and communities in coastal areas. This task has been increasingly confirmed at different management levels. Previously, mangroves were once mentioned as "wave buffering protection forests" to refer to protection forest type specified in the Law on Forest Protection and Development (issued on 12/Aug./1991). So far, there have been about 40 written documents at a central level directly or indirectly related to forest protection and development, 07 of which were issued by the Government and 19, 09 and 03 of which by the Prime Minister, MARD and MONRE respectively; Viet Nam Administration of Forestry alone has issued 4 documents; these documents have been mainly issued after 2001.

With a view to enhancing coastal forest protection and development work, contributing to proactive response to climate change, and mitigating damage caused by natural disasters and sea level rise, on 31/July/2014, the Prime Minister issued Decision No 1277/QĐ-TTg approving the policy framework of 2015 under Programme to support climate change response, in which MARD is assigned to research the building of the document and then submit it to Prime Minister for promulgating Decision on some policies on coastal forest management, protection and development.

On 22nd/January/2015, Prime Minister issued Decision No 120/QĐ-TTg approving "Program *Coastal forest protection and development in response to climate change -phase 2015 - 2020"*, in which MARD is assigned to research and build policies on management, protection and development of coastal forests to be submited to the Prime Minister for approval and promulgation to support the implementation of the Program. According to the Plan on building of the legal document by MARD, the draft Decision of the Prime Minister on some policies on coastal forest management, protection and development must be finalized for submision to the Prime Minister in June 2015.

After a long period of mangrove degradation in extent and quality, a large area of mangrove forests in many localities throughout the country have been restored and developed, especially the coastal zone of Northern Viet Nam; this has contributed remarkably to socio-economic life of local people in coastal areas. The country has experienced a rather big change in mangrove extent (Figure 1).



	1943	1962	1975	1982	1999	2001	2006	2007	2010	2013
Reduced area (ha/year)		(6.26)	(0.31)	(4.86)	(5.59)	(1.00)	11.00	(13.00	(19.00	9.67
Area (ha)	409	290	286	252	157	155	210	197	140	169

Figure 1. Change in mangrove area in Viet Nam over the past time (Maurand, 1943; Rollet, B., 1963; Hong P.N., H. T. San, 1993; FIPI, 2001; 2007; 2011, 2013)

Total area of mangroves in the whole country was on a continued decrease from 1943 to 2001; the average reduced area was 1-6.3 thousand ha/year. During 2001-2006 – the first phase after the mangrove-degradation-in-area period, mangroves tended to increase at an average rate of 11 thousand ha/year. However, right after that, mangroves continued to decline at a rate twice or three times higher – the highest reduction in the earlier period. However, coastal forest inventory results released by MARD, 2013 show that during 2010-2013, the mangrove area tended to be on a rise at a rate of 9.3 thousand ha/year (Figure 1). Therefore, mangrove area in the country has experienced a great change over different development phases. Additionally, forest quality should be taken into account and monitored as well. For management and sustainable development of mangrove ecosystems, further attentions from different levels and sectors through the issuance of legal documents and the number of mangrove projects and programs implemented, and involvement of all stakeholders.

The coastal Red river delta is not as rich in mangrove floral diversity as the other coastal zones of the country; the area is characterised by planted mangrove vegetation with 14 true mangrove species and over 90 associate mangrove species found (Phan Nguyen Hong, 1994). Trang (*Kandelia obovata*[1])is a main planted species at a fairly high planting density; the

[1] Trang - *Kandelia obovata,* planted in the study site used to be called as *Kandelia candel*becauseKandelia (Rhizophoraceae family) has been considered as a single-species genus for a long time. Recent research on chromosome number, physiological adaptation and leaf anatomy has determined two separate species of this genus: *Kandelia candel* (L.) Druce and*Kandelia obovata* Sheue, Yong Liu & sp. (Chiou-Rong Sheue, Ho Yih Liu and Jean W.H. Yong, 2003). Since then, the Kandelia species planted in the north of Viet Nam has been called *Kandelia obovata*. In some materials, audience can find the information of this species with the old name.

Chiou-Rong Sheue, Ho Yih Liu and Jean W.H. Yong, 2003. *Kandelia obovata* (Rhizophoraceae), a new mangroves species from Eastern Asia. Taxon 52. May 2003, 287-294.

species has been planted since 1997. *Sonneratia caseolaris*is mainly interplanted with *K.obovata*. Moreover, *Aegiceras corniculatum* is found to naturally regenerate under canopy of planted species. In addition to the above three species, the area sees some other true and associate species, which increase diversity of floral vegetation in this area and however, are at a low density.

Effects of mangrove planting and rehabilitation activities in many coastal areas of Viet Nam have been confirmed. Final evaluation reports of reforestation projects demonstrate that planted mangroves have greatly benefited socio-economic life and the environment (IFRC, 2010). However, the evaluation results are normally reflective of effects of forest planting right after the project end. More long-term evaluation will be a tool better supporting the assessment of reforestation work and especially the plan for rehabilitation, sustainable management and conservation of mangrove ecosystems and directions for planning and policy formulation.

Knowledge of local communities on multi-sided values of mangrove ecosystems is limited. Local people are unevenly aware of mangrove protection and development work. In some areas, mangrove deforestation for shrimp farming, or building of residential areas, seadyke construction etc. has been observed.

To promote mangrove rehabilitation and management of mangrove ecosystems and respond to climate change, in addition to technical solutions, awareness raising, capacity building, improved communication (connection, contact), education, etc. are prioritized in most of projects, programs, action plans and strategies.

Community based natural resource management or natural disaster risk mitigation is an effective approach and applied worldwide, especially in coastal areas. Community groups in coastal areas play a vital role in sustainable coastal development. A number of studies have shown that local people and students play a crucial role in the cause of mangrove restoration and development. That is a reason for the study team's proposal for a project to establish the club "*For the Green of Mangroves*" with an aim to disseminate information on socio-economic effects of mangroves and mangroves' function of climate change response and minimization to local communities. In this project, the study team has tried to improve communication approach, i.e implementing surveys on mangrove status and actual situation of mangrove protection in localities, evaluating socio-economic effects on local communities brought about by mangrove plantations and drawing lessons and experience in the study localities to serve communication work. Having applied such approach, the study team wish to provide the most updated information and data to local authorities, branches and sectors and communities in the localities; the information covers local mangrove status, their management and development work, based on which each official and each local people is aware of their working activities for management and sustainable development of mangrove ecosystems.

1.2.Objectives and methods of evaluation

Objectives

- To additionally evaluate present status of mangrove forests in communes/wards of Tan Thanh, Bang La and Dai Hop and socio-economic effects of mangroves on local community life in the project area;
- To use findings of the study and field survey in communication and awareness raising for local communities in the project area on mangrove importance with a view to encouraging community based protection and management of mangrovesin project communes[2].

Evaluation methods

Vegetation survey method

Setting standard plots

The survey site witnessed a mangrove stand 0.5-2.5 km wide stretching from dyke embankment seaward. As the survey is aimed to update and add data to the results of the study conducted in each commune/ward, the study team set up three survey bands on each of which there were 3 standard plots.

For *Kandelia obovata*, standard plots on each band were evenly established from dyke embankment seaward. They were 10 m x10 m in size. In the place where there was a mixture of *K. obovata* and *Sonneratia caseolaris*, the standard plots were sized 30 x 30 m.

In the standard plots No 1 of each band, mangroves were planted in 1998-1999. These plots had a thin humus layer of 0.5- 5cm; the mangroves were high with large closed canopies. Regeneration rate was low; Regenerative seedlings were less likely to develop and grow together with high tree populations.

Mangroves on standard plots No 2 were planted in 1999-2000. These plots had the thickest layer of humus of the three bands (20-40cm), and the regeneration rate was low.

Standard plots No3 had a thin layer of about 10-25cm. Plenty of young regenerative seedlings were found. The mangroves were low in height with large canopies and many branches. In many locations where high trees were found dead, young seedlings grew abundantly. On the surveyed standard plots, some young mangroves have grown and developed well, almost reaching the high layer and plenty of layers of young mangroves have been observed.

S.caseolaris standard plots were 30m x 30 m in size. The standard plots were set up from the expansion of standard plots of *K.obovata.* Like the establishment of *K.obovata* research band, the setting-up of band based *S.caseolaris* plots was based on stand (mangrove plantation) age.

* Determination of stem diameter

+ After the standard plots were set up, species number and individual tree number of each species were determined.

[2]Communication and awareness raising among communities in the project area has been implemented by VNRC in combination with local Red Cross. Contents and results of this activity are not presented in this report.

+ *K.obovata* diameter was determined by Caliper measure; diameter was measured at the first joint of the tree stem which was about 0.3 m high from the ground; the diameter was therefore called $D_{0.3}$.

S. caseolaris stem diameter was determined by measuring stem circumference with the use of tape measure at height of 1.3 m, the breast-height, based on which diameter was called $D_{1.3}$ and calculated.

* Determining tree height (H)

+ Tree height was measured. For *K.obovata,* tree height was determined from the point which was at a distance of about 30cm above the ground level up. *S.caseolaris* height was determined from the breast height level up.

Method of socio-economic survey

Three steps to evaluate socio-economic effects of mangroves on local communities in the project area: preparation, data collection and analysis. Preparation work for the evaluation started from early 2014 with such outputs as: household questionnaires, suggestions for group discussion and in-depth interviews with managers. Quantitative and qualitative study method was selected. Qualitatively, key informants (those who knew key information) were interviewed, in-depth interviews were conducted and the study team took a visit to the study site. Quantitatively, the study was based on household interviews, bringing about key findings of the study. In addition, related secondary materials of mangrove reforestation projects in the localities were also used and inheritted.
Floral vegetation was also studied through the survey on present status of mangrove silviculture in 3 study communes/wards.
The study group inherited published study findings on mangrove flora as well as values of socio-economic effects of mangroves on local communities in the study area to serve our analysis.

* Preparation work

Targeted people for the socio-economic survey in the study site were determined during the writing of the study proposal. During the preparation, the study team developed a set of questions. The questionnaire included 62 questions (most of which are multiple choice questions). The questionnaire covered contents of community awareness raising about present status of mangroves in their locality, evaluation of management work, importance ofmangroves to climate change response and socio-economic situation in the locality. In addition to the questionnaire, the study team developed a set of open questions for in-depth interviews with local managers as well.

* Data collection

In each commune/ward, the study team conducted about 20 interviews with some targeted people such as local authorities, Red Cross official, women, young people, some aquatic traders, and aquatic collectors in the area.

In each commune/ward, the study team started with group discussion with local authorities, Red Cross official, and related associations such as Women Association, school representative, official from Flood and Storm Control Board, Voluntary Group of Forest Protection.
Besides socio-economic survey data in study communes/wards, the study team carried out a survey on present status of floral vegetation.

Data collected from surveys were processed and analyzed by Excel software.

1.3.Study site and targeted objects

From 1998 to 2013, approximately 900 ha of mangroves were restored and planted in three communes/wards of Bang La, Tan Thanh and Dai Hop, protecting about 14 km of national seadykes (Bang La: 4 km, Dai Hop: 4 kmand Tan Thanh: 6 km), and local life and assets of over 22,000 people; These mangroves were mostly under the VNRC project of mangrove plantation and disaster risk reduction and partly planted by local forestry sub-department. However, these reforestation projects normally did not have regular budget for post-planting activities such as research on socio-economic effects of mangrove planting and rehabilitation. Evaluation of mangrove planting project impacts was done in Bang La and Dai Hop communes under VNRC project of mangrove plantation and disaster risk reduction in 2005. Since then, no evaluation of mangroves protection and development has been made in these communes except data on planting area, survival rate and effects of seadyke protection (IFRC, 2012). The evaluation implemented in 2005 in these communes/wards indicated that half of the respondents (50%) were aware of one effect of mangroves on seadyke protection while only 0.5% of the respondents understood 5 effects of mangroves and none of the respondents knew all the six effects; therefore, it is essential to disseminate information on the content of effects of mangroves through activities of clubs at the village cultural house, radio system, teachers and pupils of primary and secondary schools. As a result, after 8 years, it is appropriate to re-evaluate impacts of planted mangroves in these three communes/wards.

Some key figures of the project area are described in Figures 1,2 and 3 (IFRC, 2012).

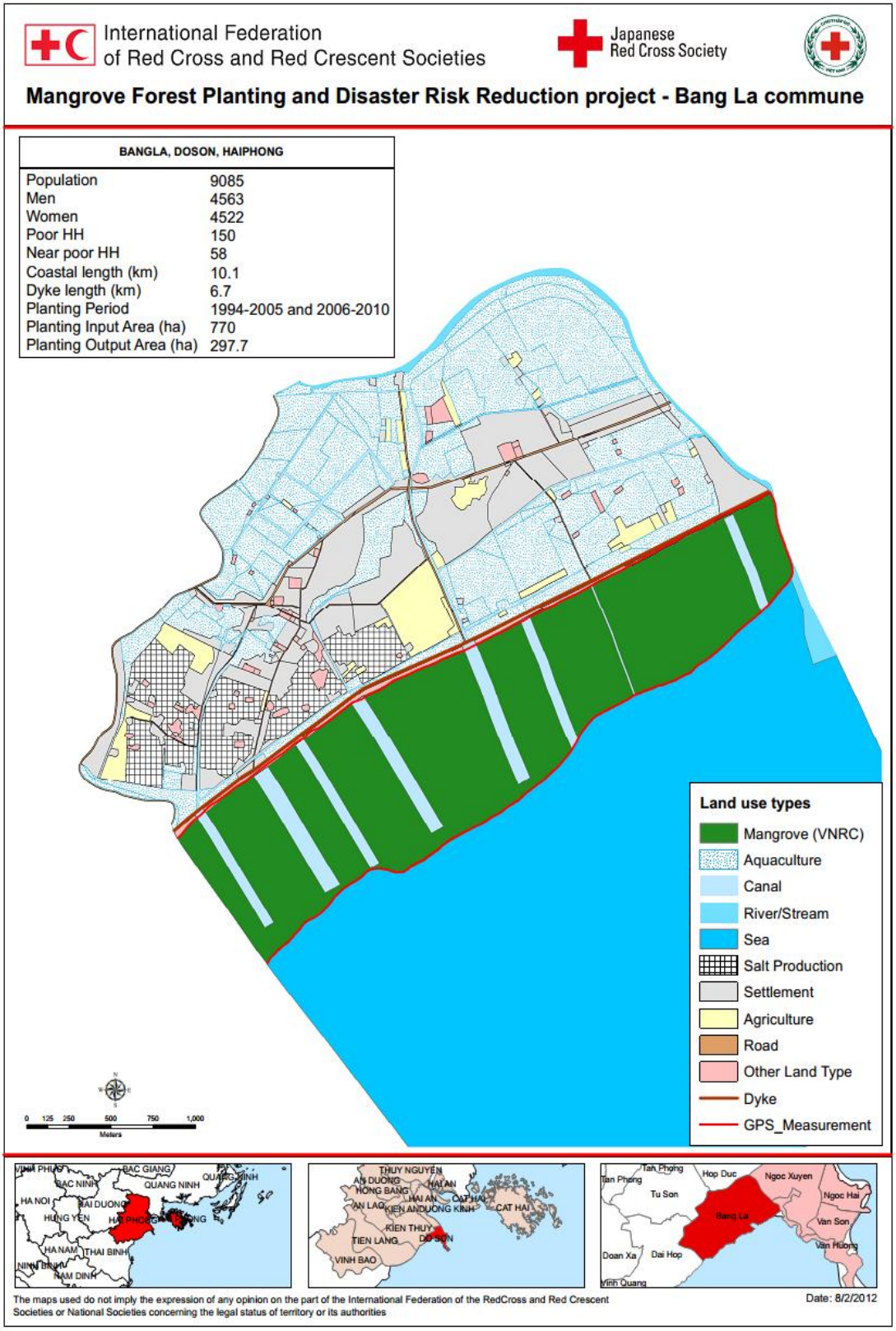


Figure 2. Map of the project area in Bang La commune (IFRC, 2012)

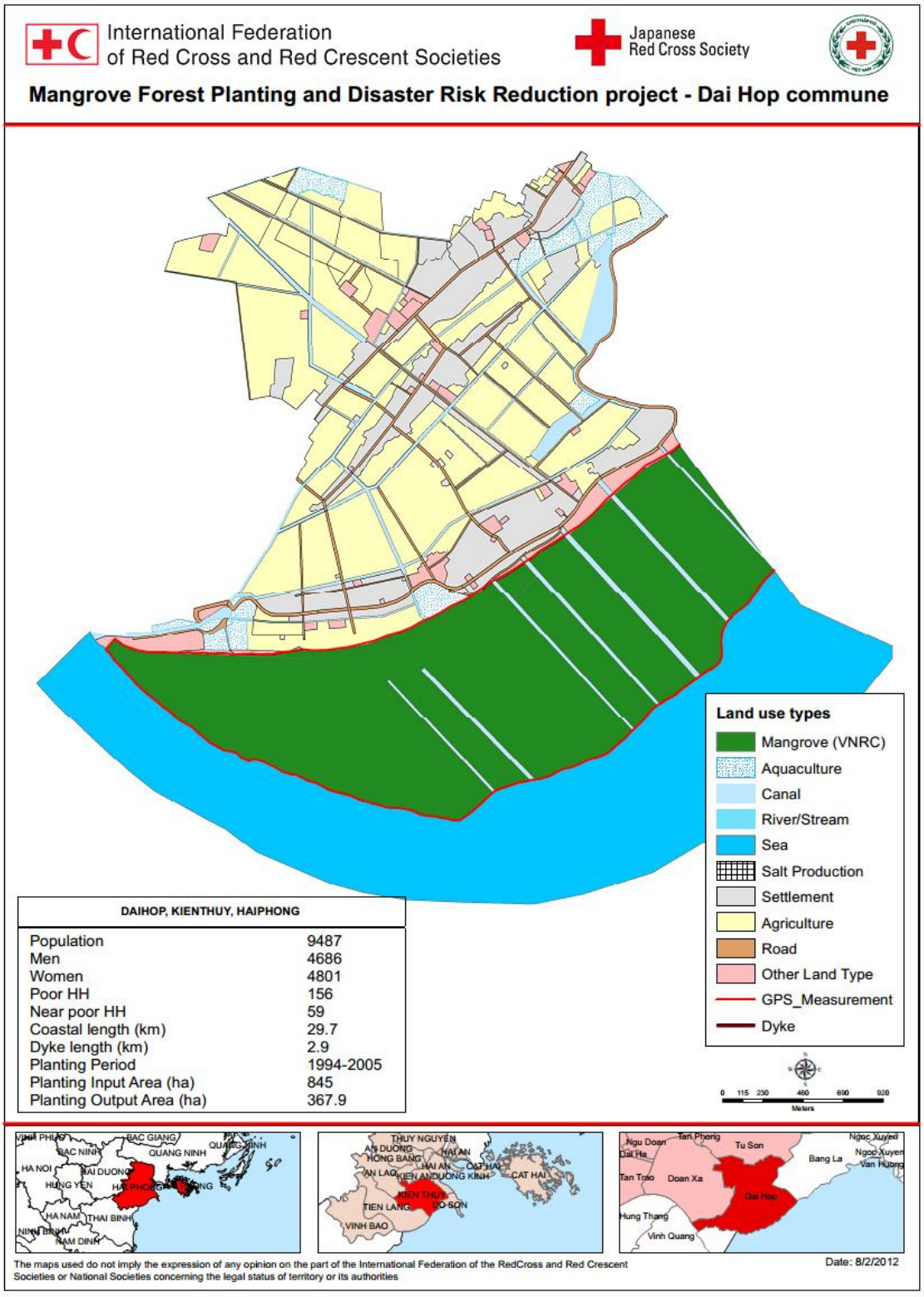


Figure 3. Map of the project area in Dai Hop commune (IFRC, 2012)

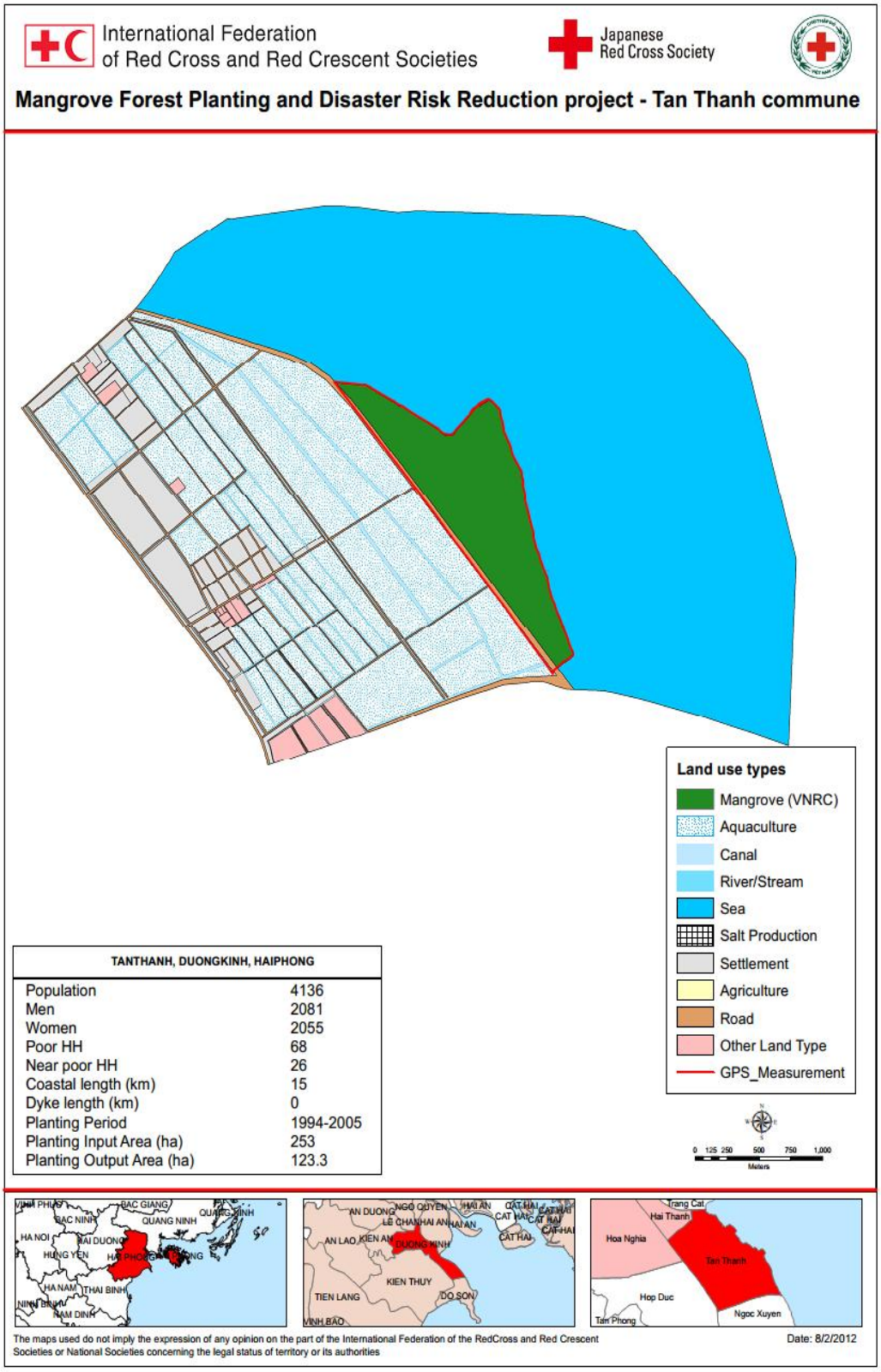


Figure 4. Map of the project area in Tan Thanh ward (IFRC, 2012)

2. PRESENT STATUS OF MANGROVES IN THE STUDY AREA

2.1. Mangrove area

With the use of data of VNRC and local authorities of communes/wards in the study area, Table 1 shows estimation of mangrove area in each commune/ward in 2005 and 2014.

Table 1. Mangrove area of communes/wards in the study site (ha)

communes/wards	2005	2014
Dai Hop	250	400
Bang La	250	300
Tan Thanh	130	200

2.2. Present status of mangrove vegetation

On the standard plots, one, two or three mangrove species could be found dependent on the location of the study plots. Floral coverage in the study site was 70 -80% on average. The mean density was 160 -182 trees/standard plot.

Based on the data on tree height measured, we could categorize the vegetation in this area into 3 layers: layer of trees >1.8m in height; layer of trees <0.5m (shrub layer); and layer of remaining trees. However, this study focused on true mangrove species which were mainly found here.

Figure 5. Some mangrove images of the study site

a. (left)Mangrove vegetation in Dai Hop ward

b. (right) Seedlings regenerating under mature mangroves at a very low rate despite a high germination rate of propagules

Survey results of present status of mangrove vegetation in the study area are presented in Table 2 and Table 3.

Table 2. Density, height and diameter of *K.obovata* planted in the study site

Age	Density (tree/ha)		Diameter (cm)		Height (cm)	
	Mean	Standard error	Mean	Standard error	Mean	Standard error
1	3,700	1,609	0.67	0.02	45.70	1.55
3	12,833	2,389	5.38	-	111.68	-
4	9,100	942	5.51	-	149.49	-
5	12,167	1,960	7.34	0.18	117.32	0.53
6	12,100	1,646	6.68	0.13	117.54	0.49
7	15,488	3,551	7.75	0.08	180.77	0.77
8	17,963	2,811	16.33	0.17	147.20	23.36
9	20,208	4,727	14.50	0.10	160.23	1.19
10	19,833	3,942	21.41	0.46	197.58	41.67
12	16,700	4,126	19.68	0.26	165.64	29.68
13	18,358	3,775	14.50	0.11	153.13	0.71
14	17,567	1,847	18.15	0.23	141.27	46.01

K. obovata is a mainly planted species in the area. This species has been planted seaward over the past many years. The starting time for mangrove planting varies in different localities; however, generally, so far, all the study communes/wards have had a closed canopy mangrove band stretching in front of seadykes. Typically, some places in the study site witness mangrove bands as long as 2.5 km. Though a large area of *K.obovata* mangroves have been planted for many years, they are not high on average. The average height of mature trees ranged from 3.5 to 4.0 m with stem diameter of 7-16 cm. Tree density in general and *K.obovata* density in particular was as high as 15,000 – 20,000 trees/ha (Table 2). In the areas with a too-high density, regeneration under the canopy of mother trees was very low at a rate of 3-10%. Depending on present status of mother trees (density, age), environmental conditions (substrate, tidal inundation…), regeneration rate (for mangrove area expansion) of mangrove flora in the study site varries from 3-76%. Especially, some mangrove bands have grown up close to sea edge, where mangroves have been observed to naturally regenerate

very well. Mangroves in Bang La and Dai Hop are considered to expand about 40-80 m seaward and at the same time, encroaching the bare paths left as shelters for boats and ships.

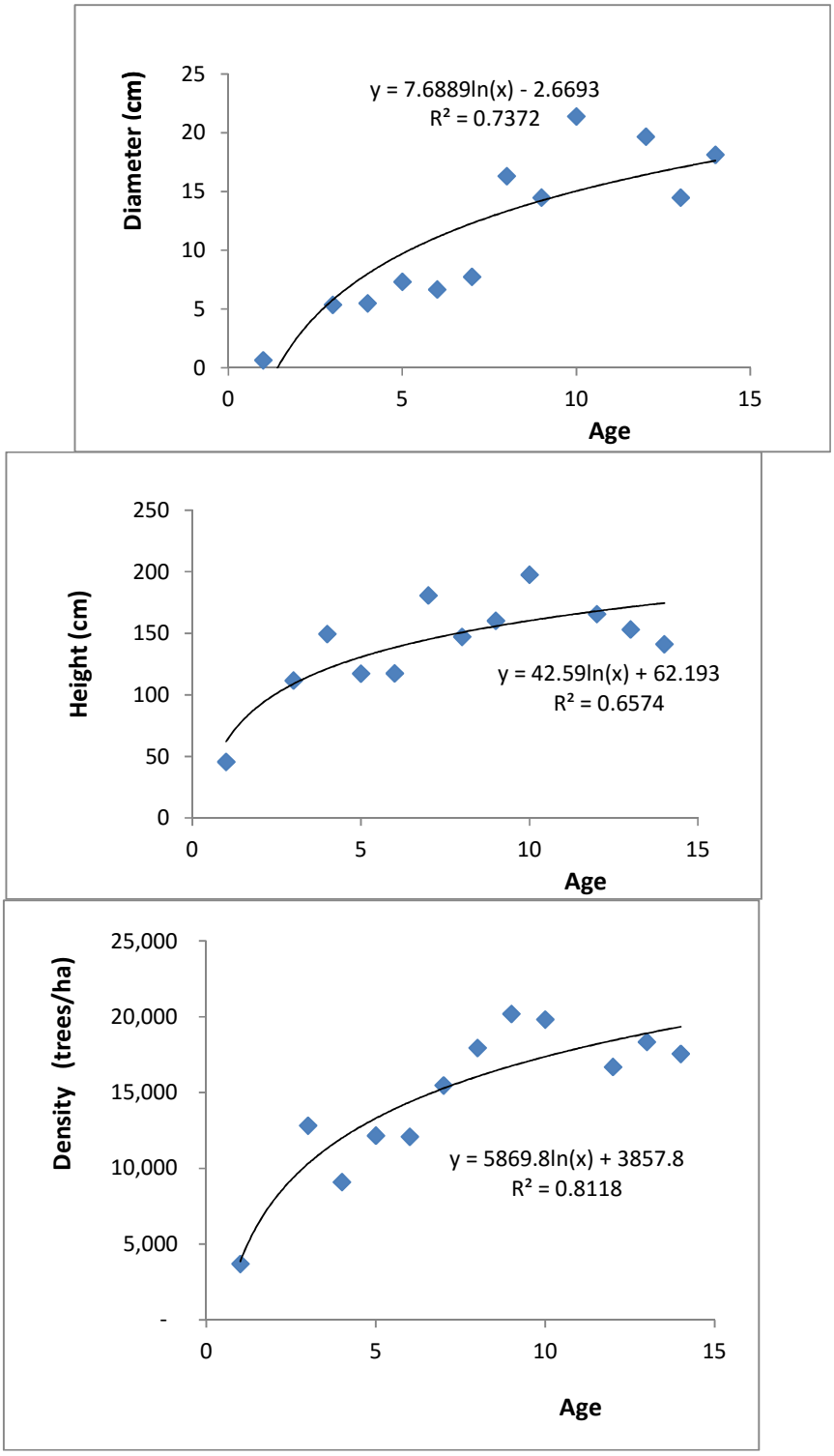


Figure 6. Correlation between density, diameter, height and age of planted *K.obovata*

Results of analysis of present status of mangrove flora in Figure 6 show that density of planted mangroves in the study site increased with tree age and seemed to reach the stable/balanced value (in terms of density). An explanation is that the density of planted mangroves from the first phase has been large and additionally, *K.obovata* mangroves planted in here have reached their maturity and regeneration started when they were 3-5 years of age.

The above figure indicates height and diameter of planted mangroves at height of 0.3 m from the ground. It can be seen that the values of these two parameters rose at older tree ages. Nevertheless, these values became stable when the planted trees reached the age of 8-9 years old. These values were mostly constant later.

Although the planted trees of these ages reached their peak in terms of height and diameter, these two values were rather smaller compared with those of the same species in the region and in the world and smaller compared to naturally regenerative forests of the same species. This can be explained by the fact that with regard to environmental conditions, generally, a prolonged winter is observed in the coastal zone of Northern Viet Nam – a factor limiting growth in height of mangroves in here. Moreover, the tree density was too high in the study site, influencing, to some extent, growth in diameter of the vegetation here.

S. caseolaris is not a species abundant in individual quantity, yet having the highest coverage of 38.6% on average; especially in some places, the value is up to approximately 100%. *S. caseolaris* planted in the study site was fairly even in density, being about 1,300 trees/ha with the average height of around 7.14-7.32 m and diameter of 20 cm on average (Table 3).

Table 3. Density, height and diameter of planted *S. caseolaris*in the study site

	Density (tree/ha)	Height (m)	Diameter (cm)
Standard plot 1	1,328±471	7.24±0.61	19.75±0.94
Standard plot2	1,291±536	7.32±0.64	20.29±0.82
Standard plot3	1,280±527	7.14±0.56	19.80±0.73

In addition to two main planted species found in the study site, Su (*A.corniculatum*) was seen to naturally regenerate under these two species. Regeneration rate of *A.corniculatum* was not the same, dependent on canopy closure of main planted species and environmental conditions. Besides, in some locations, coverage of timber layer and shrub layer that have slowly developed has been found; species of Cyperaceae namely *Phragmites karka*, *A. ilicifolius*…have developed here.

There were 3 mangrove vegetations which were the most commonly found here, including *K.obovata* plantation population and semi-natural mangrove vegetation (*S.caseolaris – K.obovata- A.corniculatum* formation and *K.obovata- A.corniculatum* vegetation.

3. MANGROVE FORESTS AND THEIR SOCIO-ECONOMIC EFFECTS

3.1. General information on surveyed respondents

The study team conducted a questionnaire survey on 430 households of 3 communes/wards (96% of the study plan). Moreover, the study team carried out an interview with 20 individual people in each commune/ward (achieving 100% of the targeted plan). Interviewees were composed of commune/ward managers (vice chairmen), Red Cross members at district and commune/ward levels, members of volunteer groups of forest protection, intermediate aquatic traders and aquaculture farmers in the study site.

General information on surveyed respondents through questionnaires in the three communes/wards is as follow:

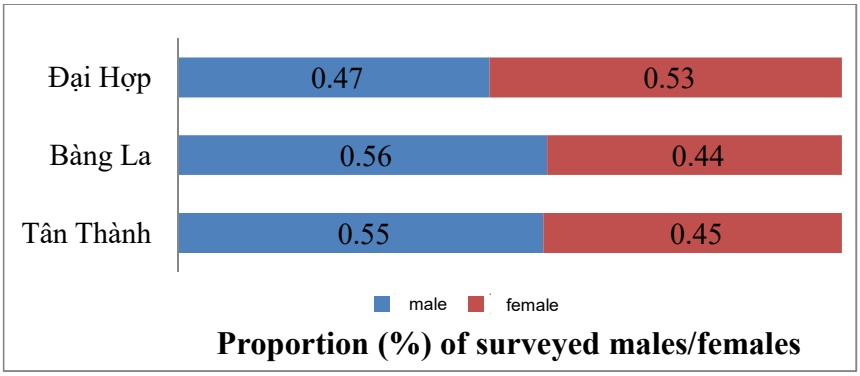


Figure 7.Proportion (%) of males/females involved in the interview

Figure 7 shows that the proportion of males/females involved in the survey is fairly equal, around 50%.

A large percentage of surveyed respondents in study communes/wards finished secondary schools. The figure was the highest in Dai Hop commune 73% and the lowest in Bang La 45%.The second largest percentage belonged to those graduating from high school; the figure was the highest in Tan Thanh, followed by Bang La and then Dai Hop being 38%, 25% and 18 % respectively. A small percentage of the surveyed respondents did not finish primary schools or graduate from a higher educational level (Figure 8). In general, there was a small difference (no big difference) in educational level of surveyed people among wards/communes in the study site.

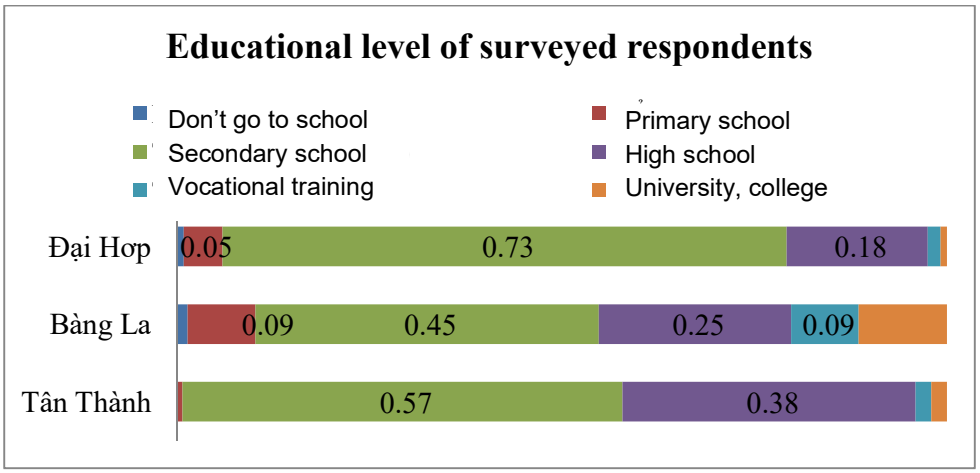


Figure 8.Educational level of surveyed respondents (%)

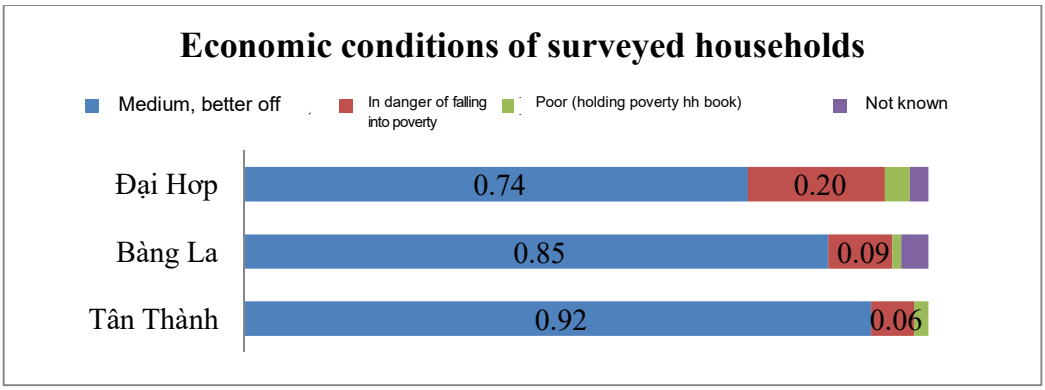


Figure 9.Economic conditions of surveyed households (%)

Economic conditions of about 74-92% of surveyed households were at a medium level. A small percentage belonged to households in danger of falling into poverty (near-poor households). Only a very small proportion of the surveyed households were poor ones and particularly, some surveyed households did not know which categories they fell into (Figure 9).

About 53-84% of surveyed households used to engage in forest planting in the area, over 40% of whom were involved in mangrove planting under the mangrove reforestation program of VNRC and the remaining households participated in mangrove restoration programs/projects of the government and other organizations in the locality. Over 70% of surveyed respondents joined in protection of mangroves most of which are planted mangroves under VNRC program.

3.2. Awareness of local community on mangrove importance to coastline protection

Study and evaluation of the role of mangroves in protection of coastline, seadykes and local

communities have been conducted in many areas in the world and in Viet Nam. Mangrove vegetation planted in the study site has been reported to contribute markedly to coastal protection in this area. Survey results show that as many as 331/430 (77%) people under interview were of the opinion that they felt safer against natural disasters (storms and winds) compared with the period before 2005 (Figure10) due to the development of mangrove plantations and solidity of seadykes and houses. However, from 73% to 97% of interviewed households in study communes/wards confirmed the significance of mangrove plantations in the locality to wave buffering, 65-87% confirmed the mangrove role in seadyke protection (Figure11).

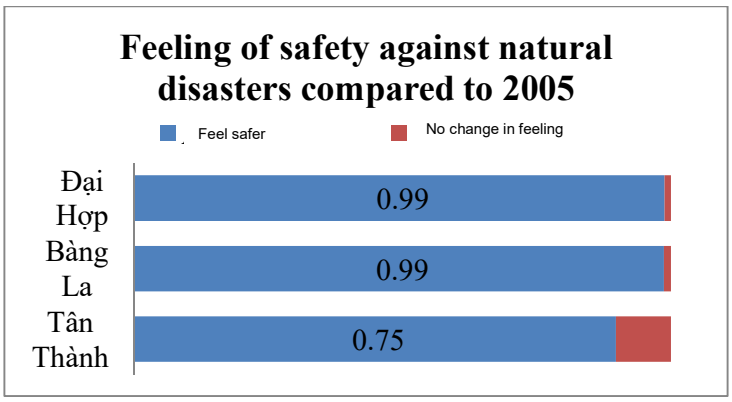


Figure 10.Feeling of safety (%)against natural disasters compared to 2005

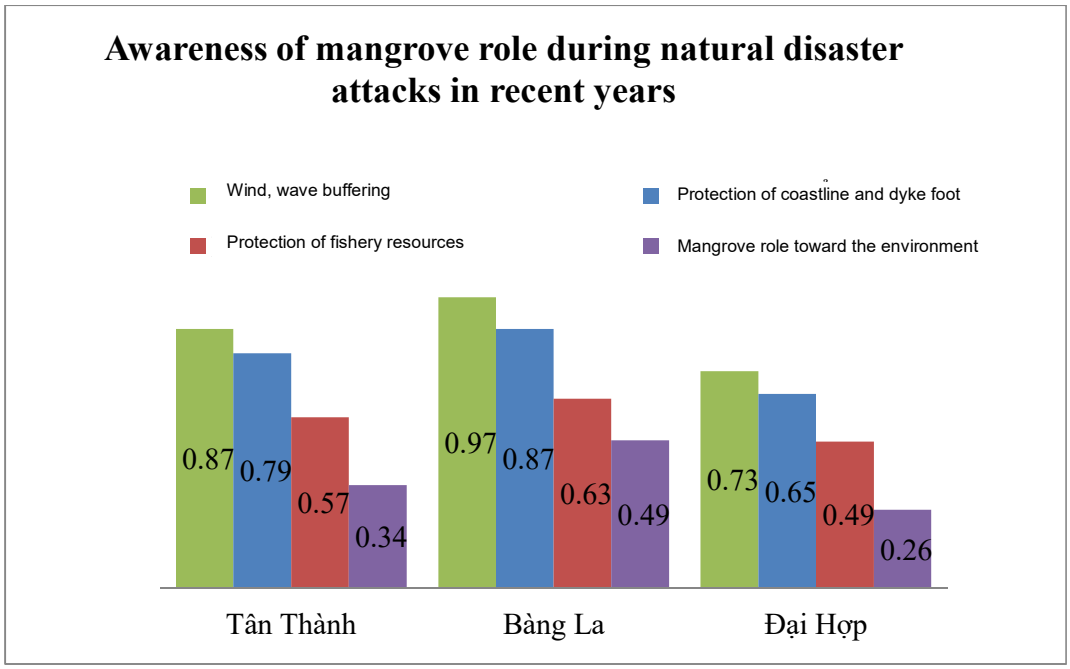


Figure 11.Community awareness upon mangrove role during recent attacks of natural disasters in study communes/wards (data in the figure show % of interviewed people)

Study findings in Dai Hop in 2011 (IFRC, 2011) provide statistical data as follows: in 1987, the storm caused serious damage to a seadyke section of 3 km which needed to be repaired at a cost of 6 billion VND (equivalent to 300,000 USD at present price).This dyke was entirely protected against the storm in 2005, and is now being defended by a mangrove belt over 1km wide. Nevertheless, a small dyke outside was damaged a little and the tidal level was almost the same during the two storms; the difference in dyke damage was estimated to be 5.9 billion VND (295,000 USD); the difference possibly resulted from good effects of mangroves planting.

Storm No 8, level 11 directly stroke the coastal northern zone on 28th October 2012. While some dyke sections in Hai Phong, in front of which there were no protective mangroves, were eroded (nearly 3km of stone covered section of Cai Vo dyke (Cat Hai island) from K1+100 to K3+094). The seadyke in Dai Hop commune directly facing the sea did not suffer from any direct damage (commune report on damage caused by Storm No 8 on 28/Oct./2012 in Dai Hop commune).

Protective significance of mangroves can also be realized through the hypothesis of storm caused damage level in case of absence of mangrove forests. Suppose that big storms occurred in Dai Hop commune every ten years, mangroves would help protect seadykes which are estimated to save about 676,800 USD. However, this picture would change remarkably when other loss can be prevented thanks to mangrove role in protection of shrimp ponds, agricultural land, assets and other public facilities: Total loss that can be avoided would amount to 37,818,000 USD (IFRC, 2011).

According to data of DARD of Hai Phong city, the cost for upgrading seadykes was around 16 billion VND (800,000 USD) per one km of dyke.This amount is paid for concretizing seadykes and increasing dyke height by 1m – a sea level rise predicted in the future. Moreover, the annual cost for dyke maintenance is also very high; suppose that only 25% of this cost is used for concretizing dykes, the figure would be equivalent to 200,000 USD/km of seadyke.

Effects and benefits of mangrove plantations on seadyke protection in study communes/wards have been highly appraised. However, such mangrove role has been recognized only in Bang La ward through the local report “implementation of tasks in 2013, and task implementation directions and solutions in 2014”. It is also suggested in the report that it be necessary to enhance instruction and leadership of the Party and authorities on mangrove caring and protection work in Bang La ward. Strengthening dissemination of information on effects and significance of mangroves to socio-economic life of local people.

Therefore, the combination of dyke upgradation and mangrove planting is considered a safe and sustainable solution for coastal communities in response to natural disaster risks, especially in context of climate change. According to Decision No 58/2006/QD-TTg dated 14 March 2006 concerning approval of the program on investment in solidification, protection and upgradation of existing seadykes in dyke-surrounded provinces from Quang Ninh to Quang Nam, technical solutions used in the dyke investment include: tree planting

along dyke route to form wave buffering mangrove belts in front of seadykes- a measure which must be taken in all areas under the program; restoration of ecosystems in coastal areas.

Decision No 1613/QĐ-BNN-KHCN on 9th July 2012 covers the issuance of technical standards applied to the above sea-dyke program also which are also stipulated in wave calculation techniques in presence of mangroves; it is also shown that mangroves are an constituent of seadyke works, help reduce wave height before waves hit dyke foot, increase alluvial deposition and support in protection of mud flats and ecological environment.

So far, Viet Nam has not, yet, issued any legal documents specifying minimum width of mangrove belt for protection of seadykes and on-dyke works (in Indonesia, the riverside and coastline green belts stipulated by the Government are 30 – 50m and 500 – 1,000m respectively). Directive No 85/2007/CT-BNN issued on 11th October 2007, which promotes reforestation and planting of coastal wave buffering trees shows that "Areas without dykes need to be covered with wave buffering trees and when a new dyke is built further inland to share places in front for wave buffering tree planting; minimum plantation width is 200m".

However, in this report the role of mangroves in dyke protection is valuated to be limited because local infrastructure (sea-dyke, other facilities) in the study site has been more solidified compared to 2005; such activities as early warning, capacity and skill building for communities have been conducted systematically before and during storms which enhance effectiveness of storm control and prevention.

3.3. Mangroves and livelihoods of coastal communities

Concerning economic benefits from mangroves, the study team has found that manual aquatic harvesting was the most common direct income source. Aquaculture brought about the highest direct income. Next comes some livelihoods such as bee keeping, intermediate aquatic trading … Yet, within this report, the study team only present analysis of economic benefits of forests from aquatic fishing and bee keeping (apiculture) which will be analyzed based on secondary data, not on direct survey. In this study, estimation is based on the value group bringing about direct livelihood benefits and other values (including direct values which are not specifically quantified such as generation of favorable conditions for aquaculture, beautiful landscape and indirect values such as dyke protection, carbon accumulation …).

3.3.1.Direct benefits

Aquatic fishing/harvesting

Results of household survey showed that average income per one hectare of mangroves in 2005 in the study area was about 2.7 to 5.7 million VND equivalent to 131 - 272 USD (*at 2013 price*).This figure for 2013 was around 6.7 -10.5 million VND or 319-498 USD. Survey results indicate that a considerable number of local people (at some time as many as 200 people involved in this activity/day in each locality)

engaged in this economic activity (table 3).This clearly demonstrated the significance of mangrove plantation to household economy. The results of this study could be compared with those of the calculation presented in the report of IFRC in 2011–around VND7.58million – equivalent to about 370 USD/ha. Economic benefits of natural aquatic fishing in the area have been remarkably increased since the presence of planted mangroves (5-8 times higher) compared with those of aquatic fishing on bare mud flats (75 USD).

Table 3.Information on manual aquatic fishing in study communes/wards in 2005 and 2013

		Dai Hop	**Bang La**	**Tan Thanh**
Aquatic fishing from mangrove area (2005)	Area (ha)	250	250	130
	Average income/day (VND) (according to 2013 price)	100,000	158,720	112,000
	Fishing days/month (day)	15	12	14
	Fishing months/year (month)	6	6	7
	Estimated aquatic collectors (people)	107	124	36
	Total earnings in the whole commune/ward (VND)	965,533,539	1,429,799,863	358,828,994
	Earning/ha (VND)	3,862,134	5,719,199	2,760,223
	Earning/ha(USD)	184	272	131
Aquatic fishing from mangrove area (2013)	Area (ha)	400	300	200
	Average income/day (VND)	403,514	182,982	214,086
	Fishing days/month (day)	15	12	16
	Fishing months/year (month)	6	6	7
	Estimated aquatic collectors (people)	112	151	83
	Total earnings in the whole commune/ward (VND)	4,096,750,188	2,010,877,202	2,092,722,632
	Earning/ha (VND)	10,241,875	6,702,924	10,463,613
	Earning/ha (USD)	488	319	498

In addition to the household survey on mangrove significance to community livelihood, the study team has analyzed secondary data collected from socio-economic reports of localities as well as conducted interviews with local authorities and officials in charge of related fields. Analysis findings showed that the figures from local authority were significantly greater than data of the survey results. Specifically, the

number of aquatic collectors provided by most of localities was 30-40% higher compared to the corresponding figure released by household surveys; fishing days were 25-35% higher as well; and fishing months in locality report were 12 months instead of 6-7 months/year revealed by household survey. The report from the local authority of Bang La on the value of aqua-product collection was 16.65 billion VND (USD756,818 or $2,643/ha/year) (2013). This value was higher than the value of the household survey, but it can be compared with the economic efficiency of mangrove forest in other countries of the world.

The incomes from livelihoods from restored mangroves of the local community in 2013 showed that local communities benefited from the increasing value of fishing activities compared with the year 2005. In the same commune/ward, the number of people collecting aquatic products in 2013 increased by 10-35% compared with the year 2005. The number of working days and working months in the year seemed stable. Regarding the output of aquatic products, feedbacks on the type of fishery products have changed and the figure was not the same. However, it is noteworthy that aquatic products in large size such as crabs in 2013 tended to be more limited than in 2005. Overall, the economic effect /labourer/ day increased from 5.9 - 9.3 USD/working day in 2005 to 8.7 - 19.2 USD/working day in 2013.

In addition to the comparison with the previous research in the same area (IFRC, 2011), comparison with other areas in the country has been done; the study findings in the planted mangroves in Giao Thuy, Nam Dinh in 2010 (Hawkins et al., 2010) provided the figure of 173-187 USD/ha/year from aquatic fishing. Nevertheless, the benefit from this activity was equal to only 1/30 of that of aquatic fishing in South Korea. Author Miguel et al. (1998)'s surveys in Hongbo, Kunchang, Daebu-do and Y ongchong-do (South Korea) showed the value of natural fisheries (including animals and plants - algae and sea grass) of $ 8,400 - 10,600. The results of the integrated data in the region of Asia (Patrik Ronnback, 1999) indicated results from fishing of from $ 750 USD - 1,128/ha of mangroves/year.

Bee keeping

Apiculture is a seasonal economic activity, benefiting only a small community group. In study communes/wards, on-site/local bee swarms were very small in number and even not present. As a result, normally, an outsider community group benefited from this activity. Bee haive stands varied from 200-500 in different communes/wards. Especially in 2013, in Dai Hop, Bang La and Tan Thanh, the respective figures were 500, 300 and 200. During mangrove flowering season, bee hive stands from bee raising outsiders were moved to mangrove sites in the study communes/wards. It was estimated that about five litres of honey/hive stand/year were collected and one litre cost 150,000 – 200,000 VND. Total bee hive stands in 3 study communes/wards amounted to 1,000, bringing about earnings of about 40,500 USD on the whole 900 ha of mangroves, equivalent to 45 USD/ha/year. The figure was 6-7 times higher than that of survey findings

Figure 12 . Bee keeping in mangroves

by Hawkins et al. in Nam Dinh (2010). This can be explained by the fact that mangrove vegetation in the study site was close to seadyke, more favorable for bee raising for honey harvesting.

Aquatic trading

A group of local people in the community earn their livelihood as aquatic traders. About 10-20 households in each commune/ward had their main income from this economic activity. *Therefore*, direct livelihood sources from mangroves in the study site in this study include aquatic fishing and bee keeping, bringing earnings of 435 USD/ha/year[3]–2,643 USD/ha/year[4] and about 45 USD/ha/year respectively.

3.3.2.Other values

Carbon accumulation

Table 4. Carbon accumulation in mangrove soil and trees in communes/wards till 2013

Stand age (year)	**Forest area in Dai Hop (ha)**	**Carbon (Ton)**	**Forest area in Bang La (ha)**	**Carbon (Ton)**	**Forest area in Tan Thanh (ha)**	**Carbon (Ton)**
6	8	660	6	495	4	330
7	8	783	6	587	4	391
8	8	928	6	696	4	464
9	8	1,100	6	825	4	550
10	16	2,607	12	1,955	8	1,304
11	16	3,090	12	2,318	8	1,545
12	16	3,663	12	2,747	8	1,831
13	40	10,854	30	8,140	20	5,427
14	80	25,729	60	19,297	40	12,865
15	120	45,746	90	34,309	60	22,873
16	80	36,149	60	27,111	40	18,074
Total	***400***	***131,308***	***300***	***98,481***	***200***	***65,654***
Total (ton of carbon)						**295,443**

[3]Mean value in 3 communes/wards collected from household survey

[4]Data estimated by Bang La People's Committee

The surveyed vegetation aged from 6 to 10 years old, which had been planted during 1998-2007. Due to limited conditions, it is impossible to conduct a survey on mangroves of each forest age; as a result, based on mangrove planting and development history in localities, the study team grouped the mangrove area according to forest stand age. The collected data would help in quantifying relatively the amount of carbon accumulated in mangrove soil and trees planted in study communes/wards (Table 4).
Carbon accumulation in the mangroves was estimated using the research results of Nguyen Thi Kim Cuc et al. (2007) on mangrove plantations in the Red river delta. The amount of carbon accumulated was calculated using the formula: y = 29,766e0,17x.

Where: y is the cumulative amount of carbon (carbon ton/ha) and x is the stand age of planted mangrove trees (year old).

Accumulated carbon estimation is shown in table 4.
In terms of the ecological benefits, up to 2013, the amount of carbon sequestration by mangroves in the study area was estimated to be 295,433 tons of carbon - equivalent to 1,083,291 tonnes of CO2 (1,204 tons/ha). Therefore, restored mangroves in the areas can generate $ 40,081,768 for their value of carbon storage for the entire region or $ 44,535/ha (the price of 37 USD/ton of CO2) (World Bank, 2014).

Consequently, in the context of climate change response, mangroves act both as climate change mitigation and adaptation measure and as the place for carbon accumulation and coastal protection.

Other benefits

Mangroves provide food source for aquaculture, which was not valuated by the study team. However, this value of mangroves has been shown in some other localities as in Hawkins' (2010) report valuating mangroves in Giao Thuy, Nam Dinh to be 882 – 980 USD/ha/year.

Mangroves generate clean air for the whole area, which has been considered by local communities to be one of direct values. Most of local people interviewed have confirmed that recently, people doing physical exercises along dyke routes have increased considerably. A possible reason for this is that the mangrove plantations here have closed canopies, creating clean air. Every morning and evening, hundreds of local people take a walk or go cycpling on the dykes (no body was found to do this activity when there was no mangroves). Doing physical exercises acts as a part of community daily life in the study site.

Some mangroves are used as herbal medicine. Some local people confirmed this use value of mangroves when they used some mangrove species as herbal medicine for treating some common diseases for family members. Mangrove usage as herbal medicine is not much valued economically (1-2 USD/ha/year, Hawkins, 2010) but is of spiritual value to the community.

3.4. Mangroves and viewpoints of forest management and development

Through discussion with local managers, 3/3 communes/wards under the study confirmed the important role of mangroves in protection of the coastlines and communities against natural disasters. All the three localities have shown their great concern about forest protection and development and ensured the continued and regular implementation of communication activities on the role and function of mangrove ecosystems among communities. In addition, the maintenance of budget for forest protection and volunteer group for forest protection in each locality assure the great determination of Hai Phong in general and 3 study communes/wards in particular.

Localities have unanimously agreed to do their best to protect and develop mangrove forests by confirming the absence of mangrove invasion cases for the past many years. Mangrove invasion used to be commonly found (mainly mangrove exploitation for fuelwood) in early years of implementation of the mangrove restoration program in the communes/wards. Survey findings indicated that 78-95% of interviewed households were ready to take over the caring and protection of mangroves even when there was no budget for forest protection from the local authorities of Hai Phong city. As many as 80-90% of the interviewed households confirmed that they would voluntarily plant additional mangroves in the area where mangroves were lost due to natural factors (storms, winds…) (Figures 13 and 14).

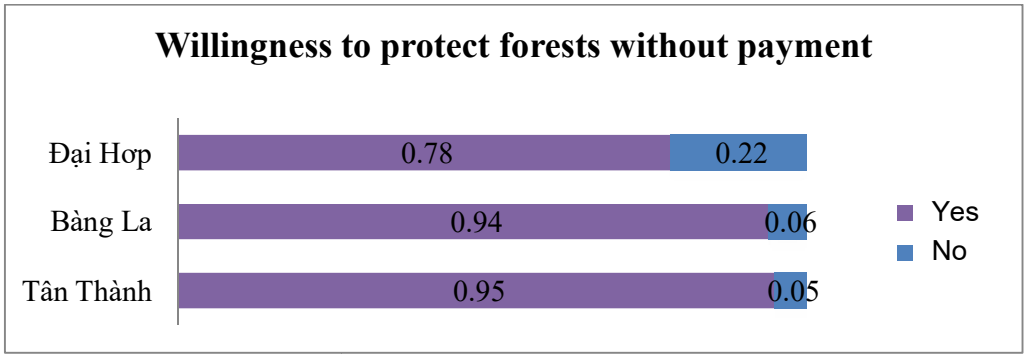


Figure 13. Willingness to join in forest protection in absence of forest protection fee (% of interviewees)

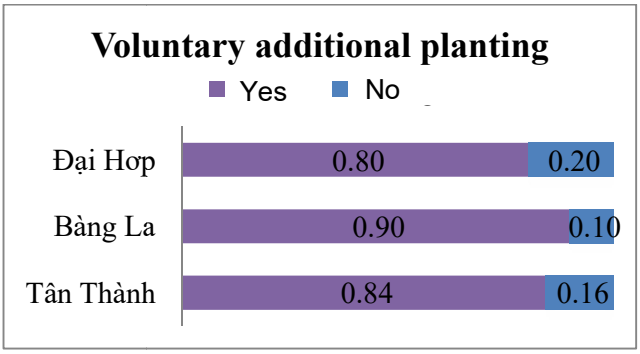


Figure 14. Willingness to plant additional mangroves in places udner impacts of natural calamities (% of interviewees).

With regard to evaluation of mangrove status, as many as 89-100% of interviewed households stated that mangrove area in the localities have increasingly been on a rise compared with the year 2005 (Figure 15). The mangrove area has changed thanks to additional plantation by humans or natural regeneration of planted mangrove vegetation in the study site. The highest percentage can be found in Tan Thanh and Bang La 93% and 85% respectively. Natural regeneration and additional planting were confirmed in Dai Hop; however, the figures were lower at 37% and 44% for respective natural regeneration and planting work. Besides, a small number of respondents were of the opinion that mangrove area in the localities was reduced more or less due to impacts of natural disasters or conversion of land use purposes. Particularly, 1% of respondents (or 2 respondents) said that in Bang La, forest cutting was still observed (Figure 16).

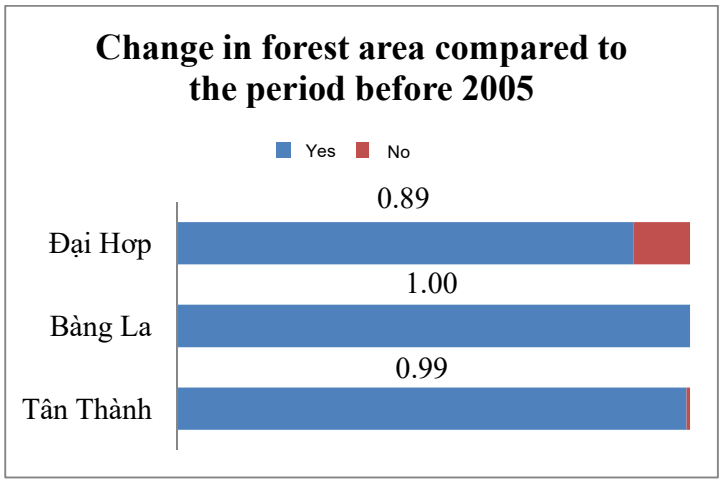


Figure 15. Evaluation of change in mangrove area in different localities (% of respondents)

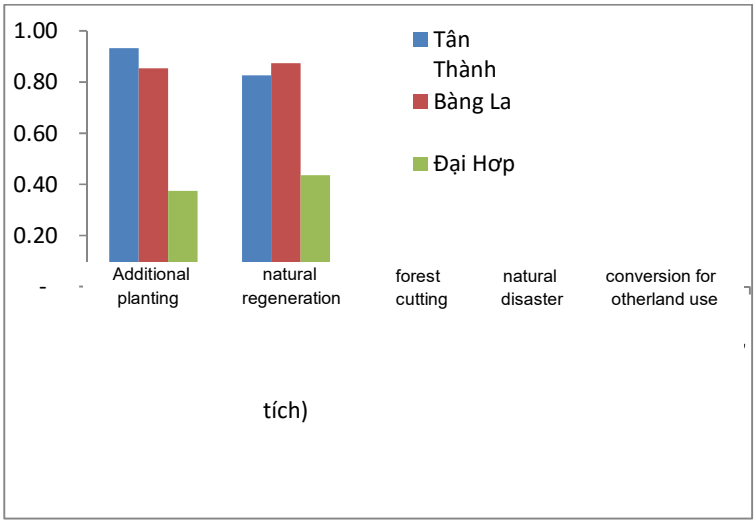


Figure 16. Causes of changes in mangrove area in study localities from 2005 to now (% of respondents)

Concerning the assessment of the role of mangroves and the necessity to protect and develop mangroves in localities, over 80% of surveyed households stated that mangroves protection and development were of great significance. Over 90% of interviewed households highly appraised (special to very special) consideration of local authorities about forest management and protection.

When asked about the change in viewpoint of local people about the necessity to protect mangroves at present time compared to the period before 2005, about 63-98% showed their change in viewpoint and the need for forest protection and 2%-29% did not change their viewpoints.

As a consequence, survey results displayed that compared to 2005, mangrove area of localities in the study site has been on an increase. In addition to the increased area thanks to reforestation programs, mangrove rise resulted from natural regenration. Local authorities demonstrated their concern about the existance and development of mangrove forests. Local communities in the study site showed their clear direction for forest protection and development in context of social change as well. Nevertheless, according to the survey results, despite a small percentage, human activities adversely influencing mangroves have been still seen. Additionally, extreme weather conditions have also exerted impacts on the vegetation. Therefore, in the future, specific actions to further strengthen community protection of mangrove vegetation should be taken and at the same time attention should be paid to research on restoration of mangroves under impacts of natural disasters.

It can also be found from survey results that most of local people were aware of mangrove protection and development, which confirmed marked effects of communication activities implemented in the localities over the past time. However, a part of local people have not yet realised and properly appraised role and values of mangroves. As a result, it is suggested that local authorities should consider continued implementation of communication to further raise awareness of community on mangrove forests.

4. CONCLUSIONS

Mangrove plantation in three communes/wards in the study site have been properly cared and protected, bringing about livelihood sources for local communities.

Findings from the retrospective research showed that the proportion of total planted mangrove area to the remaining (alive) planted mangroves was not high. However, in the context of environmental conditions that are not quite favorable as well as limited community awareness upon forest protection and caring at the early stage (before 2005), the remaining planted mangrove area has, to some extent, reflected the spirit of forest protection and management of local authorities and communities. Specifically, 100% of study communes/wards had voluntary forest protection groups with limited budget support from localities; no violation cases have been observed ….

K. obovata is a main species planted in the area. A large area of *K.obovata*, though planted several years ago, saw not very high trees. The average height of mature trees

reached 3.5 – 4.0 m with the diameter of 7-16 cm. Density of mangrove trees in general and of *K.obovata* in particular was very high at 15,000 – 20,000 trees/ha. *Sonneratia caseolaris*is not high in individual quantity but the largest in coverage (38.6% on average); specially, in some places, the coverage was approximately 100%. *S. caseolaris* in the study area was fairly stable in density at around 1,300 trees/ha ; the species height and diameter average 7.14 to 7.32 m and 20cm respectively. Though these two values reached the climax, they were rather low compared with those of the same species in other locations of the area and in the world and lower than those of naturally regenerated mangroves of the same species. This can be explained by the environmental conditions in the coastal zone of Northern Viet Nam with prolonged cold winter. This factor limited the increase in height of mangrove species. Moreover, too high planting density in the study site, to some extent, affected diameter growth of floral vegetation.

Results of household survey show that average income per one hectare of planted mangroves in 2013 was around 319-498 USD/ha/year from aquatic fishing and about 45USD/ha/year from bee keeping. The highest figure can be found in Tan Thanh followed by Dai Hop and the lowest in Bang La. However, in terms of the number of benefitiaries, Bang La, ranking the second in mangrove area, saw the most manual aquatic collectors (151 people/day). The role of mangroves in coastal protection against extreme weather phenomena has been confirmed by local authorities and communities through local reports and interview results of the study team. Interviews with local people show that 75-99% of interviewees stated that they feel safer with presence of mangroves during storms and floods and 63-98% confirmed they changed their viewpoint from the unimportance of forest protection to the great significance of forest protection.

Planted mangrove vegetation in the study site has brought about significant ecological benefits. Each hectare of planted mangroves here accumulated about 1,204 ton carbon, equivalent to 6, 44.535 USD/ha. In addition, mangroves bring about landscape and environmental values that benefit local communities, thereby beautifying their social life. These values have been highly appraised by communities and consequently, they have been increasingly active in mangrove protection and development activities.

The direct economic benefits brought by mangroves were significant. However, this value was only officially assessed and recognized by Bang La Ward People's Committee through the report on implementation of tasks of 2013 and directions and solutions to task implementation in 2014. The two localities, Dai Hop commune and Tan Thanh ward have realized the value which, however, should be officially recognized to confirm the role of mangroves in local socio-economy. As a consequence, not only local officials, leaders, sectors and branches consider and involve in forest protection and development but communities are encouraged to pay attention and contribute to the common tasks as well. Therefore, to continue the protection and development of mangroves in localities, it is essential to conduct communication, awareness raising activities among communities and leaders of branches and sectors on the role and multi-sided values of mangroves and to

actively perform movement activities related to mangroves to educate and communicate this value to young generations in the localities nad neighboring areas.

The evaluation in this report has not yet reflected the quantification of mangrove values in the localities. We – the study team – hope that data and analysis of this report will be received and used by local authorities as a basis for assessing values of mangrove assets in their localities based on which communication activities will be enhanced among communities for mangroves to be protected and developed forever.

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APPENDIX. Some images of the survey in study localities

Meetings with officials from Tan Thanh ward (left) and Bang La (right) on the role and values of mangroves in the localities

Meeting with officials from Dai Hop on the role and values of mangroves in the locality