Part I

The Results of the Joint Research

by Viet Nam Research Team

Chapter 1

Introduction

1. Background and Context

Effective land use management and agricultural land use in particular is considered as one of important elements in the context of climate change which contribute to the sustainable rural and agriculture development, and poverty reduction in Viet Nam for the time being as well as Viet Nam's MDGs in the year ahead.

Recognizing that the effectiveness of the cooperation and collaboration between 2 countries, Viet Nam and Korea in the field of sustainable rural development that the Korean partner agencies are exchanging and sharing valuable experiences, and providing necessary assistance to the Vietnamese ones. Accordingly, the Korean Agricultural Policy Experiences for Food Security (KAPEX) aims to ehance agricultural and rural development capabilities, thereby improving food security and other related issues in Viet Nam by sharing Korea's successful lessons. Therefore, the KAPEX Joint Research on Adminstration of Agricultural Land System for Sustainable

Agriculture and Rural Development in the context of Climate Change in Viet Nam is carried out in Viet Nam for serving for the aforementioned.

2. Objectives and Scope of the study

2.1. Scope

The Project forms a Joint Research Team (hereinafter referred to as the "Team"), which include experts and coordinators from Korea and Viet Nam. This Team is implementing the following activities:

○ To collect and analyze the exisiting data relate to a typical area in Viet Nam.

○ To review and analyze the current national policies and trategies, relevant international projects/programs which relate to the topic.

○ To conduct field survey to gather data and information which relate to the topic.

○ To provide a report that will be submitted to the related governmental organizations as a document for possible ODA proposal.

2.2. Objective

○ To collect data on the field of agriculture, climate, kand system, and suitability to analyze the situations and circumstances in Viet Nam.

○ To review the long and short-term agricultural policies and to make practical recommendations to the related governmental agencies of Viet Nam

for the future development of agriculture in Viet Nam.

2.3. Approach

Important features of sustainable agriculture in majority of the developing countries are predominance of effective land use management and rural development for the purposes of food security and climate change adaptability, especially in case of Viet Nam. Therefore, the Korean Implementation Survey Team organized by KREI visited MARD on 4 March 2014, for the purpose of working out the details of the Project titled "Administration of Agricultural Land System for Sustainable Agriculture and Rural Development in the Context of Climate Changein Viet Nam" (hereinafter referred as "Project"). The Project is then be conducted throughout the application of methods of data collection, document review, analysis and consultation for providing recommendations in the final report.

2.4. Duration

The duration of the Team is 4 months starting from March 2014 the moment when the official contract for the Team has been signed by between both Parties and specified by mutual agreement between the Korea Rural Economic Institute (hereinafter referred to as "KREI") and the Viet Nam's Ministry of Agriculture and Rural Development (hereinafter referred to as "MARD") in which the MARD's International Cooperation Department (hereinafter referred to as "MARD's ICD") is on behalf.

2.5. Data Collection

Data collection includes 2 main parts, (1) Desk study and (2) Field survey. The collected data/information are consolidated, analyzed and integrated into report, which truly reflects the situation and impact of climate change on agriculture development and the administration of agricultural land use in Viet Nam in general and RRD in particular.

2.5.1. Desk study

Desk study is help to capture overall view, key achievement and possible limitations. By the end of this stage, the Team will have primarily general opinions on the Project. The Team reviews all of the related documents including independent studies and reports of the related sectors, poliices, strategies, plans and programs related to agricultural land use at central and local levels.

2.5.2. Field study

Field study is help to collect full set of primary data and related secondary information at local levels. The Team additionally collects the secondary data at local (Thai Binh and Quang Ninh provinces). The following methods are applied for field study:

- ○ Focus group discussion with Thai Binh and Quang Ninh provinces to obtain opinions of the land use administration.
- ○ In-depth interview with key stakeholders at provincial, district and commune levels. The key informants include local Departments of Agriculture and Rural Development (DARD) and Natural Resources

and Environment (DONRE), districts, etc. in order to further identify the impact of climate change on agricultural land use.

○ Observation, during field study, of local climate change adaptation, achievement, crosschecking all data gathered by focus group discussion and in-depth interviews.

2.5.3. Limitations and Challenges

Additional and spatially disaggregated data were collected for this study to improve the land use data for Vietnam and RRD. However, a major problem is the inconsistency in the classifications and methods between the two sources of land use information between two related-land use agencies, MARD on the one way and MONRE on the other way, in terms of land cover map and land use map respectively. Both MONRE and MARD have acknowledged the need to create one integrated national land classification system but progress has been limited.

Chapter 2

Survey Findings

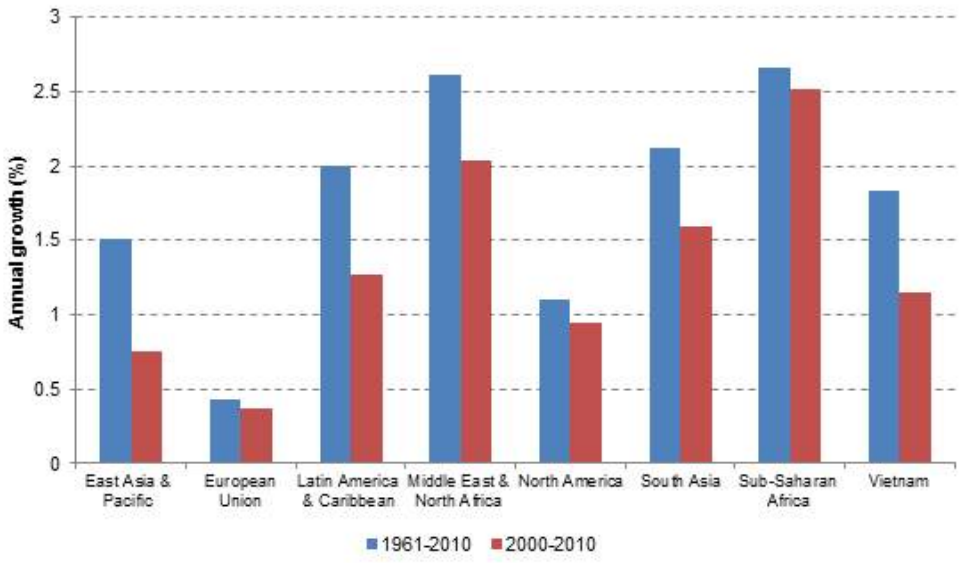
1. Global and Local Drivers of Land Use in Viet Nam

1.1. Global Land Use Drivers and Trends

1.1.1. Population Growth

According to UN, the world population is expected to reach 9.3 billion by the middle of the century (2011). To feed all these people, the FAO (Bruinsma 2009) has estimated that overall food production needs to be increased by at least 70 percent over the period 2005-2050. The figure below indicates historical trends for population growth for selected regions, including Viet Nam, during the period 1961-2010. In all regions, population growth has been slowing over the last decade. The decrease was particularly pronounced in Viet Nam where population growth decreased from an average of 1.8 percent during 1061-2010 to 1.2 percent in 2000-2010.

Figure 2-1. Population growth (1961-2010)



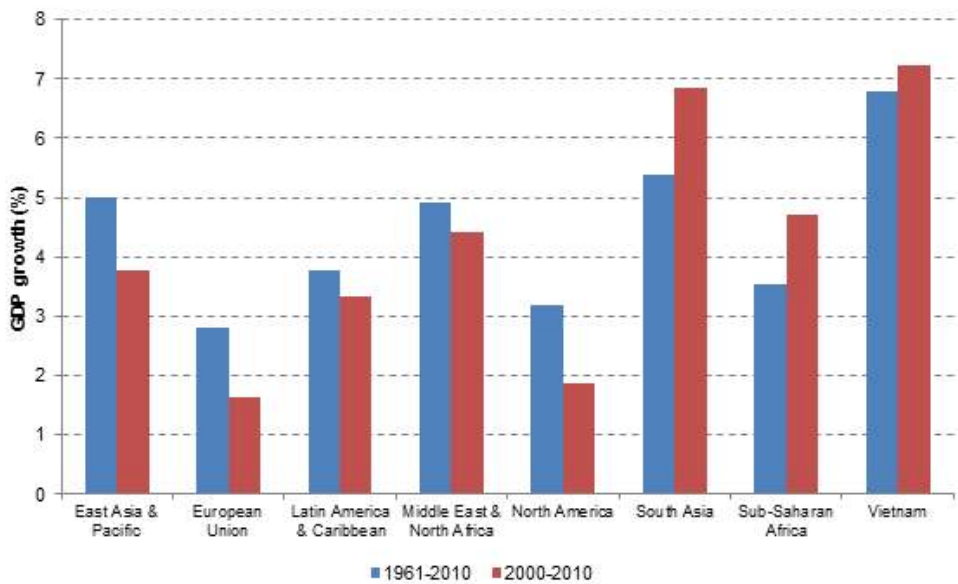
Source: World Bank

Among 3 countries, Viet Nam, Indonesia and Philippines, while Viet Nam' population will growth by 17 percent (from 89 million to 104 million) and Indonesia's by 20 percent (242 million to 290 million), the Philippines' population will jump up by nearly 50 percent (95 million to 142 million) due to its much higher birth rate. Within this totals, there will be 2 additional developments affecting labor supply for agriculture as well as food consumption patterns. First, in all 3 countries, the majority of people will live in urban areas. Second, a steady and significant rise in rural wages as a result of 3 mutually reinforcing factors: (i) rural to urban migration and the gradual ageing of the rural population; (ii) availability of higher paying off-farm jobs (services, agribusiness) in rural areas; and (iii) overall higher income and wage levels in the countries as a result of higher economic growth and higher productivity.

1.1.2. Macro-economic Growth

In addition to population growth, macro-economic growth is another key driving force of demand for agricultural production and resulting land use change. The development process is characterized by a rise in income, changing diets, and a process of structural transformation from agricultural towards manufacturing and services which together result in a greater demand for food, feed, fuel, etc. In addition, the recent awareness that the supply of fossil fuels is limited has led to an increasing global demand for feedstock, mainly maize and sugarcane, to produce biofuels.

Figure 2-2. GDP growth (1960-2010)



Source: World Bank

The above figure shows figures for historical trends of GDP growth. Global economic growth has been unequally distributed between regions

of the last five decades. High and middle income regions such as European Union, North America and Latin America and the Caribbean have experienced relative low rates of growth of around 3-5 percent while developing countries, have achieved rates in the region of 5 percent. Viet Nam is among the fastest growth countries in the world with GDP growth of near 7 percent. The economic growth pattern for the coming 30 years is expected to be similar as in the past decade. Rich economies will grow much slower than emerging economies, particularly India, China and Viet Nam. Already more than half of the world's population is living in urban areas and this is expected to increase to two-thirds in the future. It is projected that half of the population of Asia will live in urban areas by 2020, while Africa is likely to reach this level of urbanization only in 2035.

1.1.3. Consumer Food Preferences

Urbanization and rising incomes worldwide are accompanied by changing dietary patterns, also called the nutrition transition. Specifically, diets are observed to change towards increased intake of high energy-dense and low nutrient-dense foods. This transition is accompanied by a trend towards decreased physical activity due to the increasingly sedentary nature of jobs, changing forms of transportation, and increasing urbanization. The nutrition transition has given rise to a shift in the disease pattern from infectious to chronic diseases, not only in developed countries but increasingly so in developing countries.

Table 2-1. Meat Consumption (kg/person/year) by Region (2000-2050)

Region	2000	2050
Central and West Asia and North Africa	20	33
East and South Asia and the Pacific	29	51
Latin America and the Caribbean	58	77
North America and Europe	83	89
Sub-Saharan Africa	11	22

Source: Rosegrant and Thornton (2008)

The dietary importance of rice and other staple foods has been declining in all ASEAN countries. This trend is expected to accelerate with rising affluence in ASEAN as more consumers enter middle class status. They will move toward a more balanced and nutritious diet – with less rice and greater amounts of protein (meats, fish, and poultry), fruits and vegetables, and processed foods.

1.1.4. Yield Growth

Table 2-2 below shows the average annual yield growth of various crops between 1961-2010 for selected regions. For almost all regions and crops, yield has been increasing over time but considerable differences remain across countries. Viet Nam has achieved high yield growth rates, in particular for rice, the main staple and export crop, but also for maize, sugarcane and cotton. Overall, developing countries experienced a sharp increase in yield growth during the Green Revolution period the late 1960s but exhibit a decline from the mid-1980s to the most recent decade. This trend is expected to continue in the future due to decreasing availability of arable land and constraints in reaching attainable yields in each country and agro-ecological zone.

On average, global annual yield growth for major crops in the future is expected to be half from the historical rate of 1.7 percent (2.1 percent for developing countries) to 0.8 percent (0.9 for developing countries) for the period 2005/07-2050 (Bruinsma 2011).

Table 2-2. Average Annual Yield Growth (%), Various Crops (1961-2010)

	Paddy rice		**Wheat**		**Maize**		**Potatoes**	
	1961 -2010	2000 -2010	1961 -2010	2000 -2010	1961 -2010	2000 -2010	1961 -2010	2000 -2010
Africa	1.09	0.98	3.20	3.56	2.33	1.46	1.06	2.22
Asia	1.83	1.21	2.92	1.09	3.05	2.59	1.20	1.06
European Union	0.93	0.93	2.47	0.98	3.05	3.46	1.62	1.36
Northern America	1.50	0.77	2.05	1.65	2.85	1.42	1.43	0.45
Oceania	3.66	7.58	6.71	9.46	2.99	1.65	2.04	1.67
South America	2.09	2.32	2.90	3.89	2.96	4.79	1.73	1.56
South-Eastern Asia	1.97	1.58	6.25	5.51	3.10	4.08	2.51	1.31
Vietnam	2.31	2.42	-	-	3.26	4.96	0.75	0.34
	Soybeans		**Sugar cane**		**Seed cotton**		**Roots and Tubers, nec**	
	1961 -2010	2000 -2010	1961 -2010	2000 -2010	1961 -2010	2000 -2010	1961 -2010	2000 -2010
Africa	3.17	2.66	-0.16	-1.37	1.33	0.63	2.54	3.67
Asia	1.96	0.77	0.76	0.43	3.24	3.05	0.93	-0.49
European Union	6.14	3.02	1.61	-1.19	2.39	-1.37	2.14	-0.45
Northern America	1.67	1.71	-0.53	-1.80	1.87	2.18	-	-
Oceania	5.36	2.53	0.95	-1.11	10.07	1.99	-0.26	-0.38
South America	2.55	2.98	1.02	1.46	3.18	3.63	0.82	2.70
South-Eastern Asia	1.57	1.43	0.14	1.77	1.86	1.07	0.79	0.78
Vietnam	2.82	2.60	1.47	1.39	6.74	4.37	-	-

Source: FAO (2012).

1.1.5. Climate Change

CC will certainly have a substantial impact on future food and crop production, in turn affecting land use. At the same time, land use change, in particularly deforestation, will result in the emission of GHG and is therefore regarded as one of the major causes of CC. Changes in temperature and rainfall will impact on agricultural productivity resulting increase of extreme weather events, pests and diseases might force farmers to re-allocate or change crops. There is evidence that Viet Nam will also be seriously affected by CC, and Viet Nam is very vulnerable to sea level rise due to its long coast line and delta structure, especially MRD and RRD. The country ranks first in terms of impact on population, GDP, urban extent and wet land areas, and ranks second in terms of impact on land area (behind Bahamas) and agriculture (behind Egypt).

Table 2-3. Impact of CC in Viet Nam (2020-2100)

	2020	2060	2100
Annual average temperature change relative to 1980-99 (C0)	0.4	1.4	2.3
Annual average rainfall change relative to 1980-99 (%)	1.2	3.7	5.8
Sea level rise (m)	12	37	75

Source: MONRE (2009)

In long term of 2050 CC already underway is unlikely to adversely affect global food security. But, even before 2050, it will certainly lead to an adverse impact on many countries, including Viet Nam. Three important points must be kept in mind. First, the need transformation would not happen suddenly, but would be a gradual process. Countries

will need to adopt carefully designed transitional steps. Second, given the very large gains to both farmers and consumers of realizing the visions, countries should adopt policies and strategies needed as soon as possible. And third, the exact nature, scope and timing of the medium and long-term strategies will have to be country specific, taking into account country circumstances.

Trade policy can have major consequences on economic growth, in turn influencing the direct and indirect demand for land (Van Meijl et al. 2006; Laborde 2011). Even as total populations and size of GDP grow, the basic factors of agricultural production (land, water, and labor) would remain constrained or even decline due to completion from urbanization, industrialization, and higher living standards of consumers. As a result, resource costs are expected to continue to rise. Agriculture producers will thus have to pay higher costs for most inputs, increasing the premium on productivity improvement.

1.1.6. Technological Changes

On the positive side, technological changes (crop intensification; mechanization; hybrid seeds; more efficient use of water, energy, fertilizer; and crops capable of withstanding CCs, etc.) would present new opportunities to improve productivity and offset higher input costs (including labor and energy), while producing higher-value products demanded by consumers.

1.2. Viet Nam Land Use Drivers and Trends

1.2.1. Viet Nam and Special Features

Viet Nam is a large country of approximately 85 million inhabitants divided in 64 provinces. The country covers about 331,668 km2. It borders the Gulf of Thailand, Gulf of Tonkin, and south China, alongside China, Laos, and Cambodia. The country has a north-to-south distance of 1650 kilometers and is about 50 kilometers wide at the narrowest point.

In the context of trade integration, Viet Nam is facing the impacts of CC and declination of water resources to social and economic development in areas especially agriculture and social welfare. Viet Nam has a coastline of 3,260 kilometers which is one of the most vulnerable areas being affected by CC. Though accounting for only 12% of territory of Viet Nam is the home of 23 % population, which would be largely inundated by the sea level rise of 1m in the future as an effect of CC.

According to IPCC scenarios and recent studies, Vietnam is one of the most affected areas by CC impacts in the world. Viet Nam's initial National Communication to the UNFCC (United Nations Framework Convention on Climate Change) provides detailed predictions regarding climate change in Viet Nam of which the most important are summarized as follows:

- The average temperature is estimated to increase in 2070. The average temperature of coastal area may increase and spread quickly along the length of the country amongst other serious effects.

- The north and the south regions are affected by the southwest monsoon but the seasonal rainfall amount decreases in July and August and increases in September, October and November.
- Sea Level in Viet Nam has increased 5cm within the past 30 years. Sea level is expected to rise up to 9cm in 2010; 33cm in 2050; 45cm in 2070; and 1m in 2100.

Land use planning system in Viet Nam: According to the Land Law 2013, this system covers:

- Planning system, land-use planning (planning, land use planning at national, provincial and district levels; National defense and security land use planning and plan).
- Period of land use planning and plan (Land use planning period is 10 years; Period of land-use plan at national, provincial levell and land-use plan for national defense, security is 05 years. Land use plan at district level is developed annually).
- Principles of land use (comply with land-use planning and plan and land-use purposes; economization and efficiency, environmental protection and without prejudice to the legitimate interests of the surrounding land users, and Land users exercise their rights, obligations within the land use term under the provisions of this Law and other provisions of the relevant legislation).
- Land classification (used for agricultural purposes): (i) land for annual crops including paddy land and other annual crops land; (ii) perennial cropsl and; (iii) production forest land; (iv) protection forest land; (v) special use forest land; (vi) Aquaculture land; (vii) Land for salt production; and (viii) other agricultural land(land used to build green houses and academic purposes, research, experiments, etc.).

1.2.2. Role of Land Use Planning

The role is reflected in 4 aspects of (1) Land use planning is a state**'s** management tool of land; (2) Land use planning has orientation role for entrepreneurs to effectively invest in land; (3) Land use planning is the basis for the implementation of the examination, evaluation of the land use and land use management situation; and (4) The land use planning serves as a basis for governmental agencies at all levels to develop land use plans in stages.

For land management purposes, there are two official land use classifications in Viet Nam. One is mainly used by the General Department of Forestry (GDOF) and Forest Inventory and Planning Institute (FIPI), both under MARD to manage forest resources. The other belongs to the General Department of Land Administration (GDLA) that is part of MONRE and focuses on land use planning and management. GDLA/MONRE does not use remote sensing information but conducts land-use inventories every five years based on the National Land Registration System, ground surveys and annual land use statistics to prepare a land use map. In line with their objectives, the GDOF classification provides a lot of detail with respect to types of forestry cover (14 types) while the GDLA classification is more extensive on broader land use purposes, distinguishing for example between production and protected forest and various categories for built up land.

1.2.3. Country Specific Visions

By 2040 Viet Nam will have a bigger population than 2012, but about 104 million not much bigger because the population growth rate has declined. As result of the decline in population growth rate, (and better health and nutrition), the age distribution "pyramid" is substantially different in shape from that in the year 2000, with an ageing population

leading to a closer balance between young and old. In the rural areas, the labor force being dominated by the older generation as younger people move to the urban areas. Ninety-six percent of the Vietnamese population would be classified as middle class, and absolute poverty would have been practically eradicated. The country's population growth rate would slow down to 0.1 percent, leading to selective signs of agricultural labor shortage.

Under the optimistic scenario, Viet Nam would continue its rapid growth, with per capita income in 2040 of around US$7,800, a more than six-fold increase over the 2011 figures. The share of agriculture in national GDP would drop from 21 percent in 2011 to only 7 percent in 2040, similar to agriculture's share in developed economies. By 2040, over 90 percent of the population of Viet Nam will have reached middle class status. Food security has remained robust because of the high level of technology adapted by Viet Nam from international and national sources. Sector exports continue to growth as farmer diversify into higher value crops, while also maintaining significant rice exports to ASEAN and other destinations.

Agriculture and fisheries have transformed into a more dynamic sector of the economy due to improved productivity arising from the use of advanced technologies, more robust because of the technology adapted from both national and international sources. Agriculture exports would continue to be significant as farmers diversify into higher-value crops, while maintaining rice and fish exports.

Farms have become bigger on average than they are today as commercial farming has become more important and many farmers will have taken advantage of government land consolidation programs. With more efficient farming units, farm incomes have improved, allowing rural wages to more closely match urban levels. A considerable numbers

of old farmers are resorting to part-time farming as a food security endeavor.

Other key changes in the agriculture include: *(i) Shift to animal feed-crops:* Some 1.5-2.0 million ha of farmland is producing crops used as feed-grains (mainly maize) in response to the substantial increase in animal feed needed to support the growth in demand for meat; *(ii) Aquaculture development:* The high rate of growth of aquaculture has been maintained by a shift towards marine aquaculture; *(iii) Value chains:* The private sector has greatly expanded investments in the different elements of the value chain (storage, warehousing, refrigeration, transport, packaging, branding supermarkets, advertising and so on), processing a greater percentage of domestic production thereby adding value to Vietnamese agriculture; *(iv) Industrial crops:* Rubber and coffee remain popular industrial crops, adding to farmer incomes. A major investment in replanting rubber and coffee plantations with high quality cultivars would successfully upgrade production and safeguard Viet Nam's export prospects; *(v) Research:* Major reforms in the national agricultural research system have stabilized and upgraded staffing and technical capacity and redirected the focus of research so that it is more geared towards solving technical and financial problems at the farm level; *(vi) Disease control:* while crop and livestock diseases remain a concern, the upgrading of research and of the capacity of veterinary and technical services has greatly improved early disease identification and management and reduced losses; and *(vii) Food safety:* An effective first class food safety agency (and associated mechanism) is in place, with modern laboratories and a strong professional cadre capable of ensuring quality and consistency for all agricultural products – both for the domestic market and exports.

Diets have changed and the demand for rice has diminished. With rising incomes, Vietnamese consumers will eat less rice, and farmers will

adapt cropping patterns to better meet the changing consumption patterns and industrial demands for higher-value crops. There is greater consumption of higher priced foods such as fish and meat.

1.2.4. Historical Patterns of Land Use Change

Currently, agricultural land in Viet Nam is considered to be owned by the people as a whole and "the State is the representative of the people's ownership of land". In Viet Nam, there are ceiling on land holdings, and agricultural land tax must generally be paid on land held over the land limit. The agricultural land use tax in Viet Nam was based on Decree 031/SL (1951). This has changed to be a tax on both land and land use benefits since the Ordinance on Agricultural Tax (1983) and the Tax on Agricultural Land Use Law (1993) were issued. In 2003, the exemptions and reductions to the agricultural land use tax were announced under Resolution 15/2003/QH11(17 June 2003) and Ordinance 129/2003/ND-CP (3 November 2003).

The Table 2-4 below presents land use data for Viet Nam over the period 2000-2010, indicating five main land use categories: (i) agricultural land; (ii) forest land; (iii) built up land; (iv) other land; and (v) unused land as well as several sub-categories that are used in the GDLA classification. It shows an increase in agricultural land which is mainly caused by an increase in perennial crop land. Land use change is particularly pronounced in the forest land class. The increase in forest area is a relative recent phenomenon that started around 1995 and has been stimulated by several large scale national afforestation and reforestation programs to promote forest protection and development. Despite of this improvement, it has been found that the quality of the overall forest is still low. The share of rich and medium forest has been reduced while regenerated and plantation forest increased.

Table 2-4. Land Use Data (2000-2010)

	Km2			%			%
	2000	2005	2010	2000	2005	2010	2000 -2010
Agricultural land	95,700	94,310	101,522	29	28	31	6
Paddy rice	44,678	41,653	41,202	13	13	12	-8
Other annual crops1	22,918	22,356	23,697	7	7	7	3
Land for cultivation of perennial crops	28,104	30,455	36,885	8	9	11	31
Forest land	115,754	146,774	153,665	35	44	46	33
Production forest	47,341	54,349	74,318	14	16	22	57
Protection forest	53,982	71,737	57,955	16	22	18	7
Special use forest	14,432	20,689	21,392	4	6	6	48
Built up land	16,091	20,920	26,551	5	6	8	54
Land with rivers, canals and streams2	21,493	22,347	20,831	7	7	6	-3
Unused land3	82,174	46,860	28,744	25	14	9	-65
Unused flat land	7,397	3,717	2,377	2	1	1	-68
Unused hill-upland	73,796	43,111	26,327	22	13	8	-64
Total land	331,212	331,212	330,957	100	100	100	0

Source: Ministry of Agriculture and Rural Development

Note: 1. Includes other land for agriculture; 2. Includes land for aquatic farming; 3. Includes Rocky mountain without tree.

Table 2-5 presents a comparison between the various sources of land cover and land use data in Vietnam Roughly the distribution of major land use groups: agriculture (paddy rice plus other agriculture), forest (production forest, non-production forest and special use forest) and

other land (shrub and grass land, built up land and other land) are similar in the Vietnamese data sources.

Table 2-5. Comparison of Land Cover and Land Use Sources (%)

Land use class	FIPI-map (2007)	MONRE-map (2010)	MONRE-survey (2010)	GTAP (2007)
Paddy rice	16	7	12	-2
Other agriculture	16	26	18	28
Production forest	22	18	22	35
Non-production forest	13	16	18	21
Special use forest1	6	5	6	-3
Shrub and grass land	19	8	9	14
Built up land	3	12	8	1
Other land	6	8	6	0
Total	100	100	100	100
Total land area (km2)	332,910	321,231	330,957	332,910

Note: 1. Special use forest refers to forest that is located within protected parks and nature reserves. 2. Part of other agriculture; 3. Part of Non-production forest. GTAP does not provide information on the non-production forest area. This has been estimated using information on the total land area from the GDOF digital map.

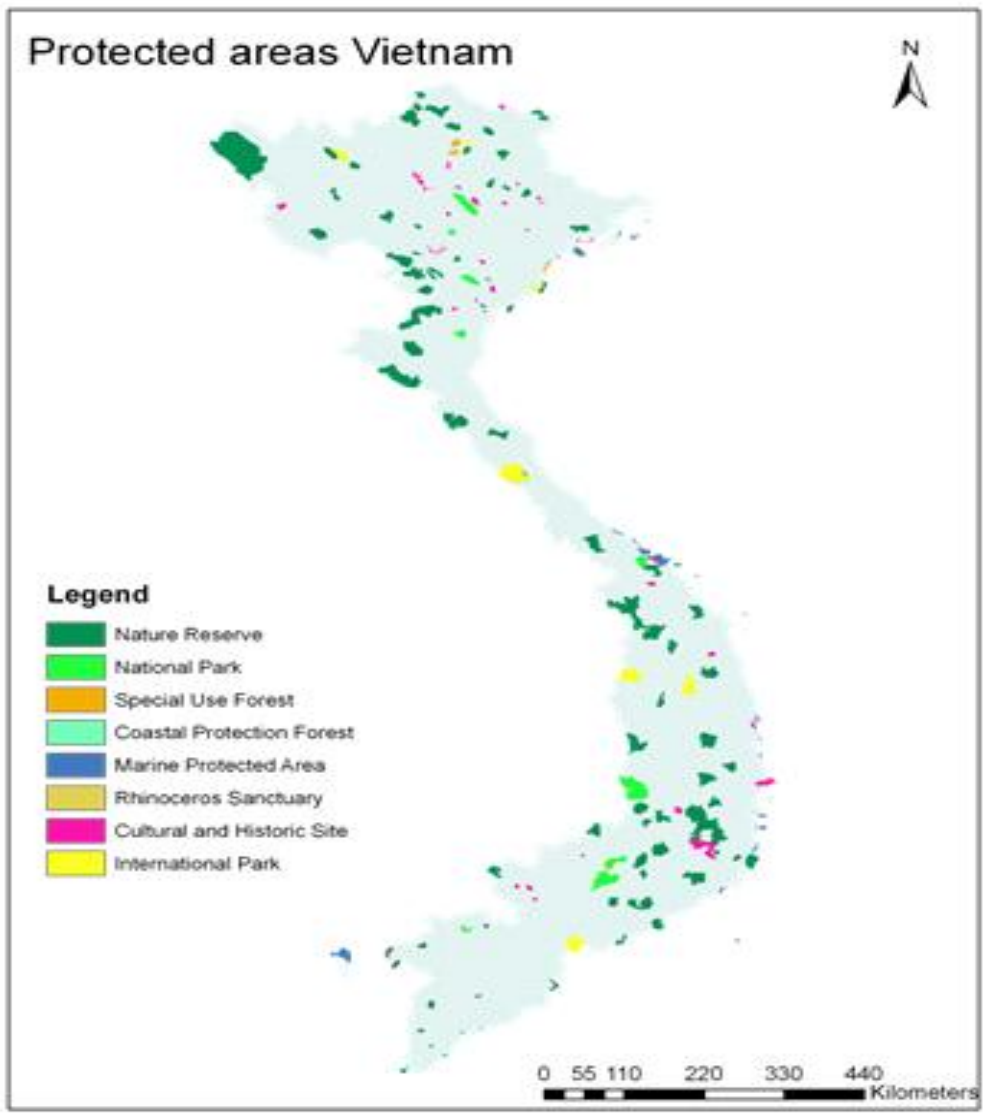
Source: Hoang et al. (2010), GIS and survey data from MARD and MONRE, GTAP database.

According to the Agricultural Development Plan to 2020 and Vision to 2030 (NIAPP 2011) not all unused land is suitable for expansion due to different soil types and slope. The projections on growth of land for agricultural production in the analysis and the spatial analysis account for the limitation of total available unused land and location specific conditions (e.g. slope, rainfall and soil quality).

1.2.5. Protected Areas

There are different types of protected areas, MARD is responsible for the management of special use forests, which consists of National Parks, Nature Reserves and Cultural Historic Sites. In addition, there are also a number of Marine Protected Areas (under responsibility of MARD), Ramsar Site, Man and Biosphere Reserves (both under responsibility of MONRE) and World Heritage Sites (under responsibility of the Ministry of Culture and Information). Most of the national protected areas in Viet Nam are special-use forests, which are mainly comprised of terrestrial but also may include a small number of wetland sites and marine areas. Given the large size vis-à-vis total land area, the allocation of and treatment of protected areas are an important element of spatial policy in Viet Nam. In two out of the three scenarios, it is assumed that the size and number of protected areas remains constant and that conversion of protected forest and shrub and grass land to land for agricultural production is not possible. In the third scenario, it is assumed that the protection of national parks and nature reserves is completely lifted and all land located in protected areas can be converted to other land classes such as paddy rice, agriculture, production forest and built up land.

Figure 2-3. Protected Areas in Viet Nam

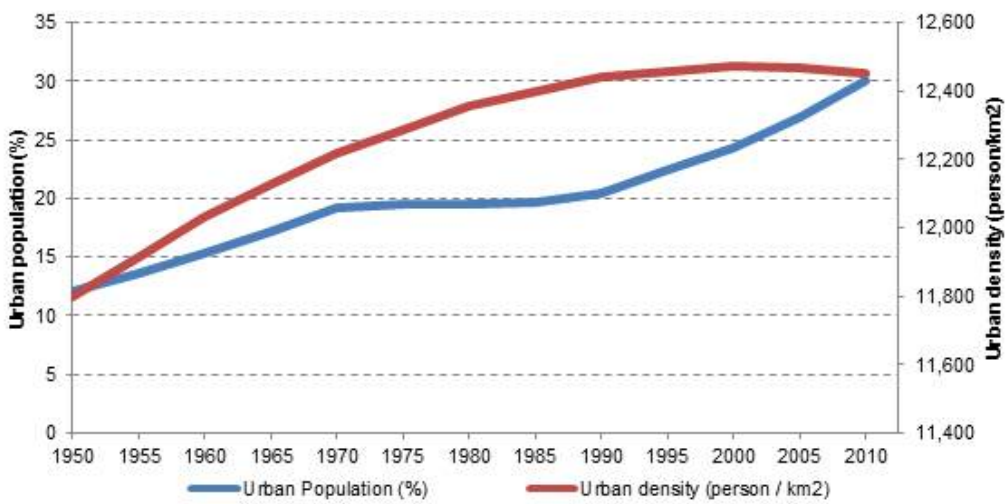


Source: ASEAN Declaration on Heritage Parks and Reserves, ASEAN Heritage Park list, Birdlife International Sourcebook of Existing & Proposed Protected Areas in Vietnam, UNESCO and World Heritage Site List.

1.2.6. Urbanization

Urbanization is an important driver of land use change. As a result of economic development and modernization, a growing share of the population is migrating from the countryside to urban areas. This results in rapidly growing cities and the establishment of industrial zones that encroach on rural land. In Viet Nam the share of people living in urban areas is relatively low in comparison to other Asian countries. In Viet Nam the four biggest cities (Ha Noi, Ho Chi Minh city, Da Nang and Hai Phong) make up already almost 12 million persons which presents 44 percent of the whole urban population. Of these cities, Ho Chi Minh city is with more than 6 million persons by far the biggest, though Ha Noi is growing fastest at a pace of more than 4 percent per year (UNDESA 2012). In the coming decades, the smaller urban centers are expected to grow faster than these cities.

Figure 2-4. Urban Population and Urban Density in Viet Nam (1950-2010)



Source: Klein Goldewijk et al (2010) and UNDESA (2012).

From a regional perspective, population growth in the Southeast and in the Central Highlands was above the national average, and slower in MRD, RRD and the Central Coast Regions. In the North, the mountain areas would just about maintain their level of the population. Urbanization in the intervening years has progressed rapidly and some 50 percent of the citizens are living in urban conglomerations compared with 30 percent today. The rural population will have declined as the rural labor force migrated in search of work in industry and services close to the urban areas.

1.3. Short description about the Study Area – Red River Delta (RRD)

1.3.1. Justification of the Study Area - Red River Delta

In the context of the Kapex Join Research the Red River Delta (RRD) is selected for study for the number of reasons as follow:

- The Red River basin is an international one, shared by China, Laos and Viet Nam. Many issues arisen from the socio-economic development in different parts of the Basin belonging to all three countries, including the reservoir building and waste discharging from the upstream area, belonging to China, effect more and more severely the downstream areas of Viet Nam.

- The RRD is the second largest river basin and rice production area in Viet Nam after the Mekong River Delta with the total catchment of 15,000 km2 which plays a significant role in the national food

security. The delta is also the political and economic capital of the country (Ha Noi city) with the population of 20 million people.

- The Government of Viet Nam (GoV) priorities for the area include the goal of attaining food security in the RRD through agricultural development (including diversification, intensification and specialisation), large-scale afforestation, and expanded fisheries production including aquaculture, the intensification of rice production and the expansion of exports (MARD & LNV, 2009), which has led to the conversion of large amounts of land to agriculture and transformation of traditional agro-ecosystems into intensified production systems (e.g. 2-3 crops per year, rice-shrimp systems).

- To date, climate change vulnerability assessment and adaptation initiatives have focused on the Mekong River Delta rather than other vulnerable areas of Viet Nam. In addition, those policies and programs targeted at responding to climate change in the RRD area have been local to provincial scale, without consideration of the whole area as a complex, integrated functioning ecosystem, specifically the watershed of the RRD. On the other hand, efforts to manage the area and its ecosystem services at the river basin level have not considered CC impacts and adaptation. Both the Mekong River Delta and RRD are considered highly vulnerable and priority areas for responding to CC by the GoV (for example, see: GoV, 2011; MARD, 2011). Ericson et al (2006, in IPCC, 2007) found that the RRD has a medium level of vulnerability based on an estimated 5,000-50,000 displaced people as a result of decreased delta building and sea level rise. The delta has been seriously affected by coastal erosion in recent years. However, Woodroffe (2010) notes that anthropogenic impacts have had and will likely continue to have as far-reaching effects as that of CC.

- The RRD is suitable for travelling, communication and logistic arrangement of a field survey during a short time (4 months) and under budget limit allocated to the research.

The RRD divides into its two main distributaries, the southern Song Hong (Red River) and the northern Song Duong (Duong River). The delta is highly protected by variety of structures including a dense network of levees, dikes, submerged dams and big reservoirs. Most of these structures serve for flood protection purpose. However, a significant portion of structures were also designed for irrigation purpose, mostly gravitational one.The delta is about 140km wide, and is expanding an astonishing 100 million a year. The entire delta region is very low lying - no more than three meters above sea level and much of it is one meter or less. The Red river system includes three major tributaries which are Da River, Thao River and Lo- Gam River with the total catchments area at the junction of Viet Tri is 143,000 km^2. Three major tributaries met each other at Viet-Tri and went to downstream. The catchments area from Viet Tri to the river mouth is about 15,000 km^2.

Almost the entire outer edge of the delta is protected by a high sea wall, beyond which there is only a narrow zone of intertidal sand or mud flats. The maximum tidal range along the coast of the delta is approximately 4m. Salinity increases from about 0.5 p.p.t. in the rivers to 30.0 p.p.t. offshore, and fluctuate widely depending on the flow in the river and state of the tide. The pH varies from 8.0 to 8.4, reaching its highest levels in November and its lowest level in May and June. Water temperatures vary over seasons and distance from the coast: in summer the surface temperature of the rivers is 27-30°C (somewhat higher than the temperature of the adjacent sea), while in winter the temperature is 24-26°C (somewhat lower than that of the sea). The subtropical climate in this region is characterized by a cool winter

season and a hot and humid summer. Rainfall averages about 1,700 mm per year.

The economic structure in the region tends to increase the proportion of industry - construction, reducing the proportion of agricultural, forestry and fishery sector, the share of the service sector reach nearly 50%.

1.3.2. RRD Specific Vision

- Strive to achieve higher GDP level in the RRD than the national average rate, RRD's average economic growth is 10.5%/year for the period 2011 to 2020, including: (i) agricultural GDP growth increase by 3.2%/year; (ii) Construction and industry increase by 11%/year; (iii) Services increase by 11.5%/year for the period 2011-2020; (iv) Expected GDP/persont hroughout the region by 2020 range USD 3600-4000; (v) The natural population growth in period2011 - 2020to reach 0.8 to 1%/year; and (vi) The poverty rate decrease to 3% under the current standard by 2020; etc.

- Restructure the economy in a positive direction, the share of agriculture decreased, the proportion of industry and construction increased, service share increased.

- Urban population will increase rapidly, while the rural population will decrease due to the impact of the process of urbanization, industrialization. Expected urban population will increase from 28% at present to over 40% in 2020, 50% in 2030 and 60% in 2050.

By 2020 agricultural land projected to decrease 23,262 ha compared with the current status (agricultural production land decreased 74,636 ha and forest land increases 33,462 ha); non-agricultural land increased by 96,141 ha (increase in residential land area in rural, urban and

especially the increase in non-agriculturalland: 42 914 ha); unused land decreased 72,880 ha compared with the current, which suggests land use purposes are clearer by 2020.

a. Industry

RRD is one of the regions having the earliest development of the industry. There are many leading industrial enterprises of the country locating in the region, especially in mechanical engineering, consumer goods manufacturing and food processing. Industrial production value increased from 214,134.4 billion (2005) to 709,973.3 billion (2010), accounting for 24% of the country's industrial GDP. So far in the area have formed a number of industrial parks, clusters, which plays great significance for the socio-economic development of the region as the industrial zones in Hai Phong, Ha Noi, Bac Ninh, Hai Duong, Vinh Phuc, etc.

However, the development level of the industry is much low compared with the level of industrial development of the South East and the MRD. Most of the industrial bases in RRD are small and medium scale, low investment, lack of capital and access to capital is limited, outdated technology, low productivity, poor competitiveness, not build brands and reputation in the market both at domestic and abroad. The growth rate of industrial production value is high but implicit several unstable factors due to mainly depend on the foreign investment-based economic sector, accounting for over 40% of the total industrial output value of the region.

b. Agriculture

The RRD is one of two biggest rice granaries of Vietnam, which is responsible for food assistance to the Northern provinces and partly for export. Rice production increased from 6762.6 thousand tons (2000) to 6872.5 thousand tons (2012). In terms of area and total food production, RRD ranks behind the MRD, but the region has high intensive farming qualification, the rice yield gained very high. Most provinces in the RRD have developed a number of cold-weather plants, which generate great economic efficiency as corn, potatoes, kohlrabi, cabbage, tomato and intercropping flowers. Currently, winter crop is becoming the main crop of a number of localities in the region. The households are typically small-scale, less than 0.3 ha in the RRD in comparison with those 0.7 ha in the Mekong River Delta (*Dao The Anh, 2003*)

In the structure of the agricultural sector, food crop cultivation ranks first. Food crop area is about 1225.8 thousand hectares, accounting for about 14% of the country's food crops area. Food production is 7,277 thousand tons, accounting for 15% of national food production (2012).

Among food crops, rice has the most significance in terms of area and production. Rice is available in most places, but most focus and reach the highest yield in Thai Binh, Nam Dinh, Hai Duong, Hung Yen, Ninh Binh provinces. Thai Binh is the leading province in entire the country in term of rice yield (65.4 quintals/ha - 2012). Annually, the RRD has more than 1 million hectares of rice cultivation. With this figure, rice is accounting for 92% of the food crop cultivated area of the region and accounts for about 14% of the rice sown area of the country (2012).

Box 2-1. Debate on Future Prospects for Rice Production in Viet Nam

The debate on future prospects for rice production had been reactivated by the 2008 world food crisis which showed a very high volatility of international processes, particular rice. In Viet Nam, the defenders of local food systems have supported the Resolution 63 (enacted in 2009). One of its main measures is to define a protected area of 3.8 million ha of rice field by government planning. The designated areas must be maintained as paddy land, although not necessarily cultivated in paddies. In 2011, a WB-coordinated study (Jaffee et al., 2011) observed that regions most concentrated in rice production in Viet Nam are also frequently the less developed localities. Considering that the growth of rice production and the potential for exports actually concentrates for 2/3 on 5 provinces from the South Viet Nam and on 280,000 producers, the study concludes that national food security is ensured, that efforts can be concentrated on the core of what is called by them a "rice belt", and that the objective to maintain 3.0 to 3.3 million ha paddy land is justified. Therefore, the debate exists between "concentration" vs. "decentralization" of rice production. Yet on all accounts, a large part of Viet Nam rice production and rice producers will maintain their orientation for self production or local markets – especially in the RRD in the North where production units are smaller and producers have already developed a high level of pluri-activity. Finally, the Vietnamese example may provide a good illustration that local food systems and exporting food systems may coexist. (Dao The Anh, Denis Sautier)

Currently, the entire region has 124.6 thousand ha of water surface area for aquaculture, accounting for 11.9% of the water surface for aquaculture in the country.

In recent years, the economic structure is moving to reduction of cultivation proportion, increased proportion of livestock and fishery, particularly among the cultivation itself, reduction of food proportion, increased proportion of industrial crops and food-stuff crops.

Agriculture and rice development in Viet Nam are based on the delta exploitation. This consists of the use of different modes of cultivating adapting to different ecological conditions. Y. Coyaud (1950) distinguished the following types of cultivation with different elevations:

○ Summer crop, non-stable;
○ Summer crop, stable;
○ Winter crop, non-stable, summer crop, stable;

- Winter crop, non-stable;
- Winter and summer crop, stable;
- Winter crop stable, summer crop non-stable;
- Winter crop, stable;
- Flooded area, no rice cultivation.

The flood in the RRD flows abruptly without regular time like in the MRD, so it is impossible to plant floating rice just like what they do in the south. It is possible only to plant rice during the dry season when water is scare. This crop is called Chiem (in Vietnamese) or winter rice. In this delta, the air is relative fresh so the crop needs to have cold tolerant varieties. These varieties are also tolerant to drought, to acid and saline soils. They are early duration varieties but the vegetation period lasts to 6-7 months due to low temperature (Dao The Anh).

1.3.3. The Red River Delta - Transboundary issue

Much of China's fresh water in its rivers, lakes, streams, and wells is just too polluted to use in irrigation, much less for drinking. This horrific water pollution is thus exacerbrating a water-scarcity problem that is already the worst among any of the larger economies of the world. China most severe water-scarcity problems are being felt in its heavily populated North China Plain. This extremely fertile bread-basket possesses a little more than 20% of China arable land but less than 4% of its water resources. It is not just Chinese farmers suffering from an extreme lack of water. Almost half of China's 660 cities face water shortages, more than a hundred of which face extreme water shortages. Water-scarce areas include the key industrial provinces of Jiangsu, Hebei, Shanxi, Shandong, Tianjin, Henan and Ningxia. These cities and provinces provide a lion's share of China's GDP; (*The Coming China Wars, Peter Navarro).*

The Red River basin is an international one, shared by China, Laos and Vietnam. Its area is about 169,020 km2 of which (i) 81,240 km2 in China (48%); (ii) 1,100 km2 in Laos (0.65%); and (iii) 86,660 km2 in Vietnam (51,35%). Many issues arisen from the socio-economic development in different parts of the Basin belonging to all three countries, including the reservoir building and waste discharging from the upstream area, belonging to China, effect more and more severely the downstream areas of Vietnam.

2. Climate Change Impacts

Current CC mainly rely on the green house gaz (GHG), i.e. on the level of socio-economic development as whole. Thereof, CC scenarios are developed on the basis of global socio-economic development scenarios.

There are numerous activities such as industry, agriculture, transport, de-forestation, etc. are causing the rampant GHG. Nowadays, GHG scenarios are based on (1) Global economic development; (2) Wold's population and consumption; (3) Living condition standards; (4) Energy consumption and its resources; (5) Technology transfer; (6) Land use change, etc.

CC and sea water level raise scenarios for Viet Nam which developed and released in 2009 cover low level GHG scenario (B1), medium (B2) and high (A2, A1F1), in which the medium B2 was recommended as an initial orientation for line Ministries, sector and localities to conduct

CC impact assessment and set up action plans, accordingly. In this Report, the low level scenario B1, medium one B2 and A1B, high one A2 and A1F1, are presented.

2.1. Sea Level Rise and Flooding

2.1.1. Scenario of Changing Temperature

a. Mean Temperature

○ Winter (December-February)

- Low emission scenario (LES): until the end of 21st century, temperature of winter increases from 1.6 to 2.2°C from level of 1980-1999;

- Mean emission scenario (MES): at the middle of 21st century, temperature increases from 1.4 to 1.8°C on most of area in the North. At the end of 21st century, temperature increases from 2.5 to 3.1°C;

- High emission scenario (HES): at the end of 21st century, temperature of winter increases from 2.8 to 3.7°C.

○ Spring (March – May)

- LES: at the end of 21st century ,temperature increases from 1.6 to 2.2°C from 1980-1999 level. Some areas within Northern provinces, temperature is low increase, from 1.0 to 1.6°C;

- MES: at the middle of 21st century, temperature increases from 1.2 to 1.6°C. At the end of 21st century, temperature increases from 2.2 to 3.1°C;

- HES: at the end of 21st century, temperature increases from 2.8 to 3.7°C.

○ Summer (June-August)

- LES: at the end of 21stcentury, temperature increases 1.0 to 1.6°C;

- MES: at the middle of 21st century, temperature increases 1.0 to 1.4°C. At the end of 21st century, temperature increases from 1.6 to3.1°C;

- HES: at the end of 21st century, temperature increases 2.2 to 3.7°C.

○ Autumn (September - November)

- LES: by the end of the 21st century, temperature in autumn increases from 1.3 to 2.2°C;

- MES: in the middle of the 21st century, temperature in fall increases from 1.0 to 1.6°C.

- HES: At the end of the 21st century, temperature increases from 1.6 to 2.8°C.

○ Annual average

- LES: by the end of the 21st century, the annual average temperature increases from 1.6 to 2.2°C in the majority of the northern area

- MES: in mid-21st century, the annual average temperature increases from 1.2 to 1.6°C. By the end of the 21st century, temperature increases from 1.9 to 3.1°C.

b. Extreme Temperature

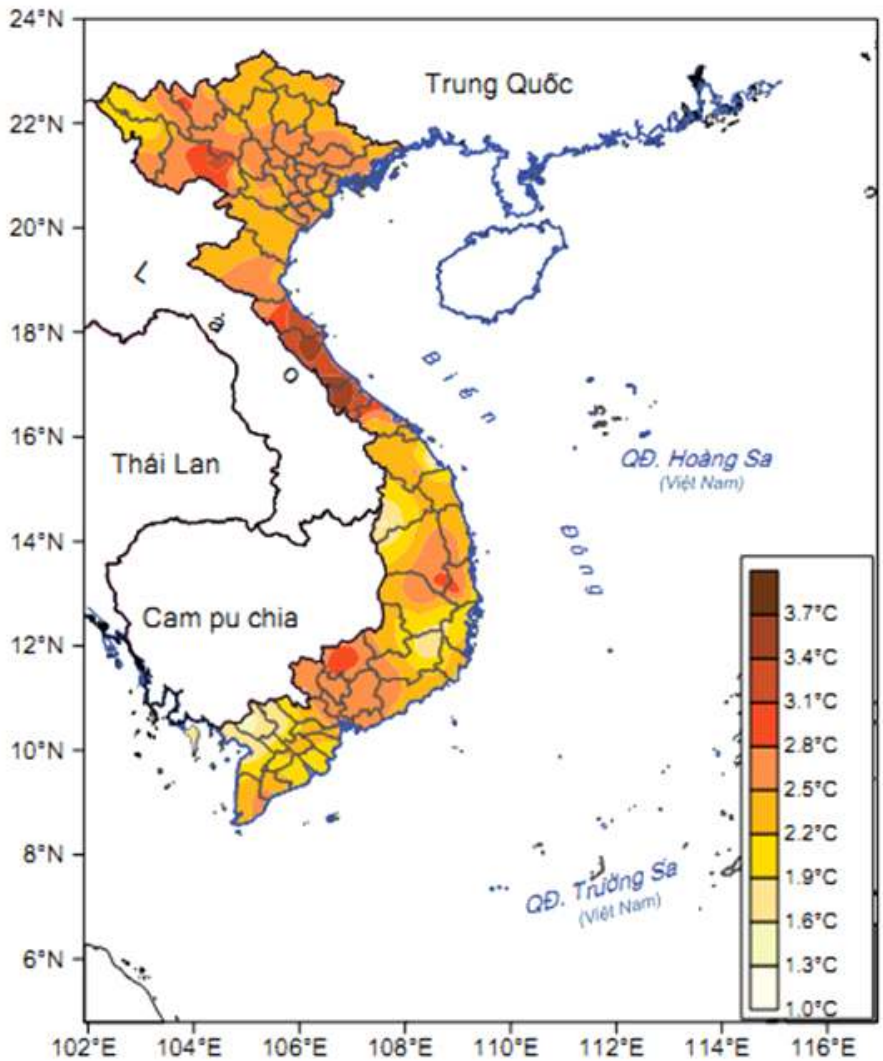
○ Extreme winter temperature (December - February): MES: in the middle of the 21st century, the average low temperature in winter increases from 1.0 to 1.2°C on over most of the area from Khanh Hoa to the northern part. The highest average temperature increase of 1.2 to 2.2°C over most of the northern area. At the end of the 21st century, the majority of the area from the North of Phu Yen to the northern part, the lowest average temperature in the winter increase from 2.0 to 2.2°C. The highest average temperature increase of 2.2 to 3.2°C over most of the area from Nghe An to the northern part.

○ Extreme summer temperature (June - August): MES: in the middle of the 21st century, the average lowest temperature in summer time could increase from 1.7 to 2.0°C in the East Tonkin. The average highest temperature in summer mainly increases from 1.2 to 2.0°C in the North East. At the end of the 21st century, the average lowest temperature in summer increases from 2.7 to 3.2°C in the Northeast. The highest average temperature increase of 2.2 to 3.2°C in the North East.

○ Extreme annual temperature: MES: in the middle of the 21st century, the average lowest annual temperature increases from 1.0 to 1.7°C in most of area of the country. The highest annual temperature increases from 1.0 to 1.7°C over most of the territory; increased from 1.7 to 2.2°C in the North East. At the end of the 21st century, the average lowest annual temperature increased from 2.2 years to 3.0°C. The highest average annual temperature increases of 2.0 to 3.2°C. At the

end of the 21st century, the number of hot days (maximum temperature above 35°C) increased from 15 to 30 days in the most of area of the country.

Figure 2-5. The Average Increase in Temperature (°C) at the end of 21st Century under the Medium Emissions Scenario (B2)



1.1.2. Precipitation Change Scenario

a. Winter precipitation (December-February): Winter precipitation tends to increase in most of the northern area of Viet Nam.

- LES: in the middle of the 21st century, winter precipitation increases to 2% in most of the Northeast area. At the end of the 21st century, the increase of winter precipitation ranged from 0 to 6% on the majority of the northern area;

- MES: in the middle of the 21st century, rainfall in most of the Northeast area increases less than 2%. By the end of the 21st century, the increase in rainfall over most of the northern area ranged from 0 to 6%;

- HES: average winter rainfall across most of the northern area increased to over 4% (in the mid-21st century) and to over 6% (at the end of the 21st century).

b. Spring precipitation (March-May)

- LES: spring rainfall tends to decrease in most areas of the country, with the possible reduction of 6% in the mid-21st century and to over 10% by the end of the 21st century. Rainfall increases only in a few parts of the North with an increase only less than 2%;

- MES: in the middle of the 21st century, the spring rain fell in most of the territory of the country; the common decline in northern area

is less than 2%. By the end of the 21st century, spring rainfall on the northern part fell by 4%;

- HES: spring rainfall in northern areas decreased by about 2% (by mid-21st century) and 4% (at the end of the 21st century).

c. Summer precipitation (June-August)

- LES: summer rainfall tends to increase over the whole territory. The common increase in the north (from Thua Thien Hue to the northern part) is from 4 to 6% (in the mid-21st century) and from 4 to 10% (at the end of the 21st century);

- MES: in the middle of the 21st century, the summer rainfall over the whole territory of Vietnam increased, the highest growth rate may reach over 6%. The increase in northern areas is higher than the southern region. At the end of the 21st century, summer precipitation increases to over 14%. In particular, the highest increase occurs in the northern area (commonly 6 to 14%);

- HES: summer rainfall increased over 6% in the mid-21st century and to over 18% by the end of the 21st century. The highest increase occurs in the northern region.

d. Autumn precipitation (September-November)

Similar to summer rainfall, autumn rainfall also tends to increase over the whole territory. However, the rainfall in the North is predicted with lower increase than other areas of the country.

- LES: the increase of average autumn rainfall in mid-21st century in the North is less than 2%. By the end of the 21st century, rainfall increased to 4% in the North;

- MES: in the mid-21st century, the highest growth rate of autumn rainfall in the northern region (from Quang Binh to the northern part) may reach 4%. At the end of the 21st century, in the territory of Vietnam, autumn rainfall increases to 14%. In particular, the northern region has the lowest growth rate (below 4%);

- HES: autumn rainfall increases to nearly 10% by mid-21st century, and 18% at the end of the 21st century.

e. Annual precipitation

- LES: annual rainfall increases to 5% in the mid-21st century, and over 6% at the end of the 21st century.

- MES: the common increase of annual rainfall in the territory of Vietnam is from 1 to 4% (mid-century) and from 2 to 7% (at the end of the century).

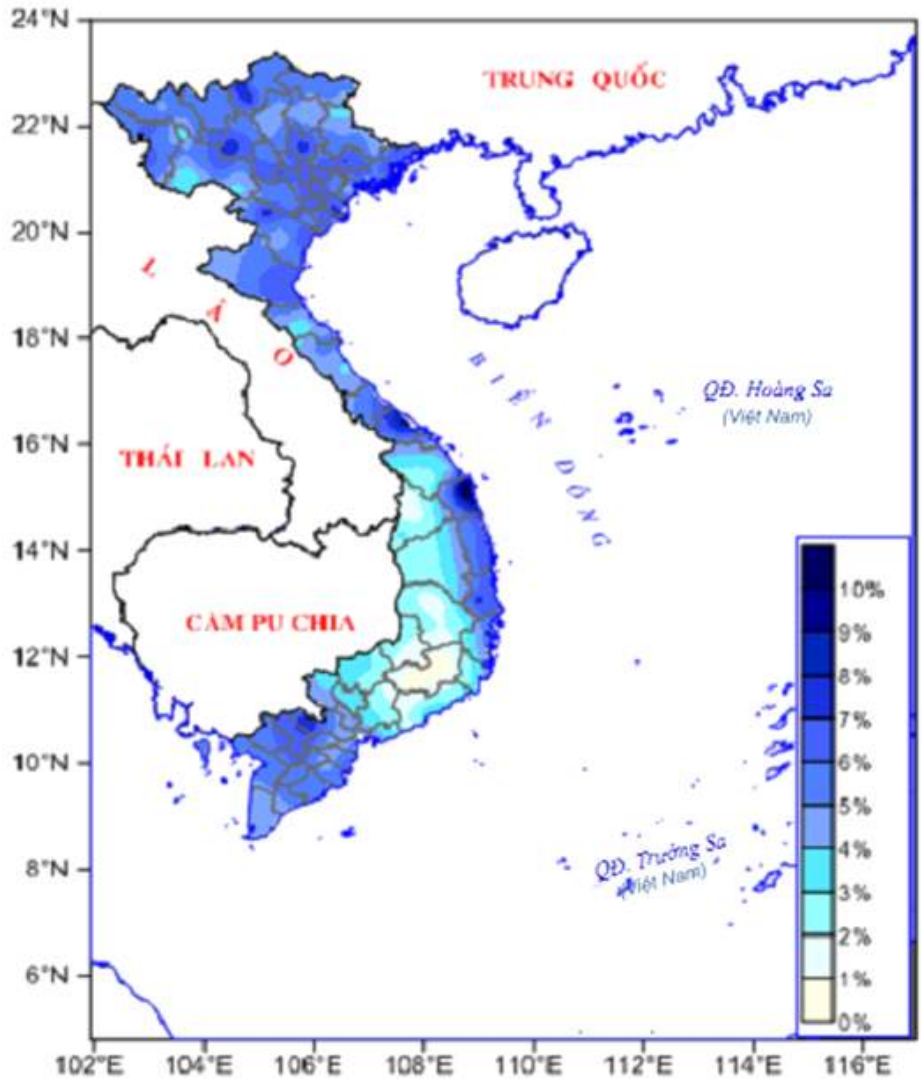
- HES: annual rainfall in mid-century increase from 1 to 4% and by the end of the century it could rise from 2 to over 10%.

f. The Trend of Climate Change for the Largest Daily Rainfall, Barometric Pressure and Humidity

At the end of the 21st century, the highest daily rainfall in the northern could increase by 50% over the period 1980-1999. However, in the

different regions could appear abnormal daily rainfall with double rainfall as compared to the current record.

Figure 2-6. Change rate (%) of rainfall at the end of 21st century according to average emission scenario (B2) in RRD



2.2. Sea level rise scenarios and inundation risk for Viet Nam and RRD

The GHG scenarios are selected to develop sea-level rise scenarios for Vietnam including low emissions scenario (B1 scenario), medium emissions scenario of the group of average emission scenarios (B2 scenario) and the highest emission scenario of group of high emissions scenarios (A1F1 scenario). The sea level rise scenarios were developed for seven coastal areas of Vietnam, including: (1) The coastal area from Mong Cai to Hon Dau (2) Coastal Zone from Hon Dau to Deo Ngang; (3) the coastal area from Deo Ngang Pass to Hai Van Pass (4) coastal zone from Hai Van Pass to Dai Lanh Cape; (5) the coastal area from the Dai Lanh Cape to Ke Ga Cape; (6) the coastal area from Ke Ga Cape to Ca Mau Cape, and (7) the coastal area from Ca Mau Cape to Ha Tien.

2.2.1. Sea Level Rise Scenario

- LES (B1): In the mid-21st century, across Viet Nam's territory, the average sea-level rise ranges 18 to 25cm. By the end of the 21st century, sea level rise in the area from Mong Cai to Hon Dau is in the range of 42 to 57cm. Average sea level rise in entire Vietnamese territory is in the range of 49 to 64cm.

- MES (B2): In the mid-21st century, across Viet Nam's territory, the average sea-level rise ranges 24 to 27cm. By the end of the 21st century, sea level rise in the area from Mong Cai to Hon Dau is in the range of 49 to 64cm. Average sea level rise in entire Vietnamese territory is in the range of 57 to 73cm.

- HES (A1F1): In the mid-21st century, across Viet Nam's territory, the average sea-level rise ranges 26 to 29cm. By the end of the 21st century, sea level rise in the area from Mong Cai to Hon Dau is in the range of 66 to 85cm. Average sea level rise in entire Vietnamese territory is in the range of 78 to 95cm.

2.2.2. The Risk of Flooding under the Sea Level Rise

The results identify areas at risk of flooding under the sea level rises show that if the sea level rises 1 meter, about 39% of MRD, over 10% of RRD, over 2.5% of the areas of the central coastal provinces are at risk of flooding.

Results calculated on the basis of data on transportation of the Mapping Publisher in 2005 shows that, if sea level rises 1 meter, the country has about 4% on the rail system, over 9% of national highway system and about 12% of the provincial road system will be affected. Particular, RRD has about 5% of highway, 6% of provincial road system and nearly 4% of railways will be affected.

According to population data of GSO in 2010, if the sea level rises 1m, over 9% population of RRD will be directly affected. Overall, according to medium scenario, RRD should concern to threes issues including the increase in average temperature, increase in average rainfall and the risk of flooding and inundation due to sea level rise. Currently, droughts and floods have increased sharply in recent years in RRD, in addition, the salinization process is increasing in the region which significantly reduces the cultivated area, and therefore with such scenarios the situation will probably get worse in the coming years. RRD will definitely need to have the appropriate measures and drastic response to the new context.

Table 2-6. The risk of flooding (%) under the sea level rise in RRD

No	Risk	Sea level rise (m)								
		0.50	0.60	0.70	0.80	0.90	1.00	1.20	1.50	2.00
1	Flooding area	4.1	5.3	6.3	8.0	9.2	10.5	13.9	19.7	29.8
2	National highway system	1.9	2.2	2.8	3.4	4.1	5.1	7.4	11.6	19.9
3	Province road system	2.2	2.6	3.5	4.0	5.1	6.3	9.2	16.0	29.5
4	Rail way system	1.3	1.6	1.9	2.3	2.9	3.7	5.6	8.8	16.2
5	Population	3.4	4.1	5.2	6.5	7.9	9.4	12.9	19.6	31.5

Source: CC, sea level rise scenario of Vietnam, MONRE, 2012

Currently there is no calculation in term of economic damages for rising sea levels in the Red River Delta.

2.2.3. Impact of Sea Level Rise for Rice Cultivation in 2030

According to the selected scenario, in 2020 sea level rise 12 cm, accordingly the nationwide flooded area is 32,497 ha, of which flooded rice land area is 5,714 ha, mainly in the Mekong Delta of 3,900 ha, North Central coast 838 ha, the remaining areas have negligible flooded rice land.

In 2030 sea level rise 17cm, the nationwide flooded area is 42,420 ha, including affected and flooded rice land of 19,873 hectares, most flooded area is in Mekong Delta 15,152 hectares (76.2% of flooded rice land nationwide), North Central Coast: 2,184 ha (11% of the nationwide flooded rice land area), Southeast 1.565 ha (7.9%), the Red River Delta and South Central Coast have negligible flooded rice area.

Table 2-7. Flooded rice area due to sea level rise by 2030

Region	2020 (12cm)		2030 (17cm)	
	Flooded area	Flooded rice area	Flooded area	Flooded rice area
Whole country	32,497	5,714	42,420	19,873
Northern Midland and mountainous area	98	20	124	56
Red Rive Delta	1,042	288	1,506	622
Northern Central Coast	3,757	838	5,429	2,184
Southern Central Coast	490	89	709	293
South-east	2,520	579	3,642	1,565
Mekong River Delta	24,590	3,900	31,010	15,152

Unit: ha

Source: MONRE

2.2.4. Impact of sea level rise to the RRD

The RRD has 5 coastal provinces namely Quang Ninh, Hai Phong, Thai Binh, Nam Dinh and Ninh Binh. According to 2 sea level rise scenarios in 2020 and 2030, the Red River Delta has negligible flooded rice area. Under scenario 12 cm sea level rise by 2020, the flooded area of entire region is 1,042 hectares, flooded rice land of the region in 2020 by rising sea level is 288 ha, of which Hai Phong province: 124 ha.

Forecasts to 2030, sea level rise 17 cm, in RRD 1,506 ha will be flooded, of which flooded paddy land is estimated at 622 ha, including 239 ha of Hai Phong, Nam Dinh 210 ha, Thai Binh: 85 ha and Ninh

Binh: 88 ha. Since the majority of the land area for rice cultivation placed deeplly inland, therefore in 2030, when the sea level rises by 17 cm, the area of rice cultivation distributed in the inland is less affected.

The extent of salinity intrusion into inland is expressed through the following tables:

Table: Length of average salinity intrusion into the river systems in cases of different sea-level rise

SourceMONRE, 2012.

Impacts of sea level rise and salt water intrusion are accompanied by a lot of other impacts to residents as additional investment costs

2.2.5. Impact of extreme weather events to agriculture, forestry and fisheries

a. Potential impact and damage on agriculture

Agriculture sector is directly and most affected by climate change in general, and of climatic change and extreme climatic phenomena in particular.

As global average temperature increase can cause a fundamental change in farming system of an area due to shifting vegetation and plant boundaries, ie change in regime and environmental conditions (climate) of agricultural production in the region, the climatic changes and extreme climatic events may cause potential impacts of climate disasters often overwhelm response capability leading to crop failure, reduced productivity, agricultural output, even making the land incapable for cultivation (eg severe drought, lasted many years due to lack of rain)

The extreme climate phenomena can occur with single factors such as temperature (maximum, minimum), rainfall (maximum daily rainfall, rainfall intensity, heavy rains), and there may be a combination of many factors such as storms (heavy rain, strong winds, surges), drought (low rainfall, high temperature), the ENSO etc. The main effects and possible damage on agriculture are:

1) Due to the rising temperature trend, adaptation scope and timing of tropical crops expanded, while for sub-tropical crops are shrinking. That means some sub-tropical species are at risk of decline or disappear in some areas. Projected to 2070, the sub-tropical species will only survive in the mountains with elevations above 100 - 500 m in the north and 500 - 1000m in the south. Meanwhile, the tropical plants will be expanded to higher elevations towards the northern part (average, when the temperature increase of 1°C, the plant boundary will shift toward higher latitudes 100 - 200 km). From this effect, the structure and patterns of production in some regions will be changed.

2) Productivity and agricultural outpts reduced in dry areas, even when the temperature does not increase much (1-3 ° C). In particular, the maximum temperatures tend to increase, along with increased heat spells and hot days increases the thermal pressure on many agricultural crops, especially in the central region, as yield loss, even with no harvest.

3) The amplitude of the minimum oscillation can occur outside the interval [-5, 5] to the extreme low record may occur in the northern climates, especially in mountainous areas (though with low frequency) due to fluctuations of temperature increase may lead to prolonged very cold weather spells caused serious damage to crops and livestock.

4) Maximum daily rainfall and number of days of heavy rain tends to increase caused flooding increased leading to reduction of crop yields, even dead lost, even if occurring at a time close to maturity.

5) Drought tends to increase, but at different level in each climate zone. Drought increases while the volatility of rainfall increases caused shortages of rainfall in long period, combined with hot weather result in evaporation increased. Effects of drought on agriculture (both crops and livestock) is very serious and cause the most risk, crop failure, even loss of capability to cultivate on degraded land due to frequent and prolonged droughts.

6) Pests, diseases have more opportunities to develop in conditions of rising temperatures combined with high humidity in many areas.

b. Potential impact and damage on forestry

1) The rising trend of temperature maiking the boundaries of premitive forests and secondary forest to be moved. The dipterocarp forests will expand northward and to higher elevations. In areas where soil moisture deficits due to reduced rainfall and increased evaporation, the deciduous forests and high drought tolerance will grow stronger.

2) Some plants are unable to adapt with the volatile climate extremes in temperature, moisture may decline or extinction. Remarkably, in important species such as Aquilaria crassna, Fokienia, Cupressus torulosa, Chukrasia velutina, etc. ..

3) The rise in temperature, especially at maximum high temperatures with heat spells occur more resulting high risk of forest fires, especially in the dry season.

4) The conditions of climate change are in worsening trend in many areas are an opportunity to pests, disease development.

c. Potential impact and damage in fishery

1) Rising temperatures alter the distribution and reproduction of fish species, affecting fishery sector.

2) The decline of mangrove forest due to the maximum water level (including sea level rise, waves, tides) encroaching inland making change in the living conditions of many wild aquatic species.

3) Saline intrusion into deep inland local result in loss of habitat for some freshwater aquatic species, some species have to migrate if possible or loss because of natural or artificial barriers.

4) High rainfall intensity with increasing flow cause reduce the salt in a certain time affecting the lives of brackish water species, particularly bivalve molluscs (oysters, clams, oysters), some species die due to unable adapt promptly. Heavy rains and flooding could overflow lake or broken aquaculture embankments.

5) The short-lived species, the first link of the food chain to zooplankton species decline due to climate change, reduce zooplankton species, main nutrients for the middle and upper tier species.

2.3. Climate Change Impacts and its Stakeholders for Response

Viet Nam known as one of the poor country, would be the most seriously affected by CC, especially by sea level rise. CC could increase

Viet Nam's esposure to extreme weather and could cause a yearly capital loss in Viet Nam of up to 17 billion USD (World Bank, 2008).

Being aware of this danger, the GoV signed the United Nations Framework Convention on Climate Change (UNFCC) in June 1992 and ratified Kyoto Protocol on 25 September 2002. On 17 October 2005, the Viet Nam's Prime Minister (PM) has issued a Directive on the implementation of Kyoto Protocol to UNFCC, which instructs various ministries and government agencies, as well as provincial/municipal People's Committee, to effectively implement the Clean Development Mechanism (CDM) of the Kyoto Protocol.

Viet Nam has formulated and issued a number of legal documents with the target of attaining the UNFCC's objective which are summarized as below:

2.3.1. National Climate Change Strategy

The Strategy has been approved by the PM on 5 December 2011, through the Decision N2139/2011/QD-TTg. Main objectives are:

1) Ensure food, energy and water security, and so on in the context of CC.

2) Consider low carbon economy and green growth as principles in achieving sustainable development; GHG emission reduction and removal to become a mandatory index in social and economic development.

3) Take advantage of CC opportunities for social and economic development; promote climate-friendly behaviors.

4) Join forces with international communities in addressing CC; increase international cooperation to address CC effectively.

2.3.2. National Target Program to Respond to Climate Change (NTP-RCC)

The program has been approved by the PM on December 2008, through the Decision N 158/2008/QD-TTg. This program comprehensively addresses CC effects, impacts and adaptation responding to sea level rise and GHG emission mitigation. Its general objectives are: (1) To assess CC impacts on sectors and regions in specific periods; (2) To develop feasible actions plans to effectively respond to CC in the short-term and long-term to ensure sustainable development of Viet Nam; (3) To take opportunities to develop towards a low-carbon economy; and (4) To join the international community's effort in mitigating CC and protecting the climatic system.

In this Strategy, the Ministry of Natural Resources and Environment (MONRE) plays key responsibilities in cooperation and collaboration with other related governmental bodies, including the Ministry of Agriculture and Rural Development (MARD), etc.

MARD itself has issued its action plan in respond to CC in the agriculture sector (N66/QD/BNN-KHCN, 11 January 2013) for the period 2012 – 2020.

At the provincial lelvel, provincial Department of Natural Resources and Environment (DONRE) is mainly responsible to implement CC impact responding efforts in cooperation and collaboration with other local related agencies, including provincial Department of Agriculture and Rural Development (DARD). For instance, Quang Ninh Province People's Committee has issued its decision N 6285/KH-UBND, 19

November 2013, on CC response in connection to natural resources management and environmental protection.

Notably, mass-organizations such as the Farmers Union, Women Union, Fatherland Front, etc. are also involved with this Strategy in mobilizing people to participate in as well as taking part into general dissemination and propagation of CC impact mitigation activities thanks for these organizations can be found in almost all rural communes in Viet Nam, have similar four layers organizational structures from central to rural levels and are committed to implementing national target operations (rural development, poverty reduction, CC response, etc.) at local level. Their main activity is organized, aiming to nurture people's "spirit" to support specific programs or issues, including awareness building campaigns, by hanging posters or banners in public spaces, or even broadcasting TV programs. Training programs for the cadres and members on specific topics are also held as a part of such activity.

In local area, people are being involved with CC mitigation through various manners for instance via a specific project (either international or domestic sources), related operations under DONRE, DARD, etc. For instance, NIAPP has been working with 2 provinces, Quang Ninh and Thai Nguyen in the implementation of the Spain-funded project (SE2435/10 Project) for improving livelihood patterns in the context of CC in 4 districts, Dong Hy and Pho Yen of Thai Nguyen and Dong Trieu ad Hai Ha of Quang Ninh.

2.3.3. Environmental Policies

Viet Nam Agenda 21 policies were approved by the PM and issued through the Decision N 153/2004/QD-TTg, regarding to strengthening the legal basis for environmental protection, supporting research and

development into, and transfer of, environmentally friendly technologies, and stipulating Viet Nam's active participation in international activities related to the 1992 UNFCC.

The Law on Environmental Protection Number 52/2005/QH11 dated 29 November 2005 (replaces the 1993 Law on Environmental Protection) (National Assembly, 2005).

2.3.4. Agriculture, Forestry and Land-use Policy

The most important policies were the Land Law (1993) and its revised versions (1998, 2001), the new Land Law (2003) and Ordinances 64/CP (1993) and 02/CP (1994) of the government dealing with the regulation of agricultural and forestry land allocation.

Forestry policy was set at priority consideration of country's policies. In 1998 the government's main policy for forestry investment has been made the five Million Hectare Reforestration Programme, in which three million ha for protection forest and two million for production forest. In the strategy of forestry development of Viet Nam (VFDS), there are the Programme on Sustainable Forest Management and Development; Programme on Forest Protection; Biodiversity Conservation, and Environmental Services Development; Programme on Forest Products Processing and Trade.

2.4. Climate Change Response of the Agriculture Sector

The PM and MARD have issued a number of legal documents relate to CC response, GHG emission reduction and Green Growth which are summarized as below:

○ PM Decision on Approval of Master Plan on restructuring national economy in linking growth model change towards quality, effective and competitiveness improvement for the period 2013 – 2020. Decision No 339/QD-TTg, 19th February 2013. One of solutions (on agriculture) is to sustain 3.8million ha of rice plantation area for immediate and long-term national food security, effective implement Green Growth Strategy and Climate Change response.

○ MARD Master Plan on Restructuring Agriculture Towards Value Added Improvement and Sustainable Development, June 2013. Sustainable development consists of three (03) pillars, including economic development, social development and environmental protection. In order to realize this goal, the Green Growth Strategy plays a focus on sustainable natural resources utilization, waste minimization and social non-equality reduction. To ensure national food security the area of 3.8 million ha under rice plantation will be sustained and flexibly used. And new cultivation methods (such as "3 reduce, 3 increase" "1 must, 5 reduce"), scientific application and large-scale field construction will also be applied for reducing production costs, water source pollution and GHG, etc.

○ MARD' Action Plan on the Implementation of National Action Plan on CC period 2012 – 2020, No 66/QD-BNN-KHCN, 11thJanuary2013. Main tasks: (1) Deploy to carry out plans, programs and projects which assigned by the Government during 2012-2015; (2) Review and deploy activities which belong to the MARD's Plan on CC Response during 2011-2015 and vision to 2020 (as approved by MARD's Decision No 543/QĐ-BNN-KHCN, 21st March 2011); and (3) Strongly push up the implementation of GHG emission mitigation in agriculture and rural by 2020 (as approved by the MARD's Decision No 3119/QĐ-BNN-KHCN, 16th December 2011).

To deal with CC issue in the agriculture sector, the MARD has conducted various research activities on rice cultivation through related institutes such as Institute of Agricultural Environment (IAE), Center for Agrarian System of Research and Development (CASRAD), etc. in focusing on rice cultivation including short duration, Sulphate Ammonia (SA) application, compost, 3 reductions 3 Gains (3R3G), biochar for rice, Alternative Dry and Wet irrigation (ADW)/ System of Rice Intensification (SRI), biogas from livestock. Implementation of these mitigation measures will bring benefit (win-win) to all stakeholders and do not interfere existing agricultural production. Farmer will gain benefit from mitigation measure application; government also gain benefits to reduce investment for implementing mitigation options. The research results conducted by IAE (Mai Van Trinh) bring about initial conclusions as follow:

- Emissions are the highest from paddy rice production, followed by aquaculture, livestock and tea production the current policy emphasis on paddy rice is warranted but the more options should be added, which are as much as possible suited for localized needs.

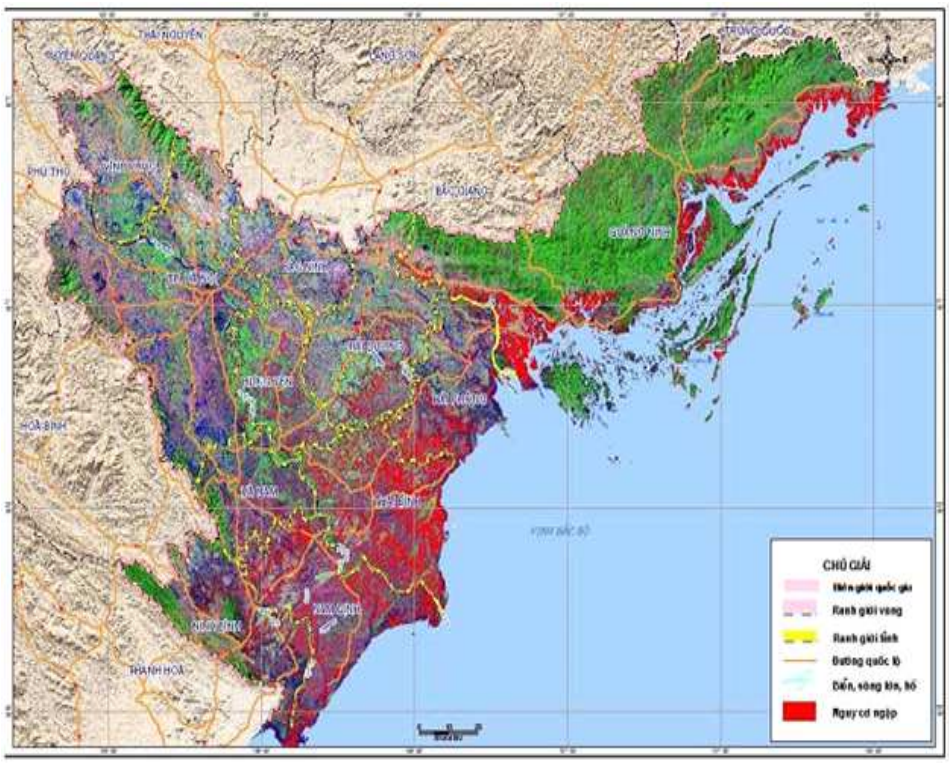
- Rice production also has the largest potential for mitigation of GHG emissions, in which better management and composting of crop residues will lead to GHG emission reductions emission. These options have significant positive environmental and health impacts. Applying biochar is also a good measure to reduce emission and to fix more carbon in the soil so increase drought resilience;

- Shifting from rice cultivation to other non-rice crop is a good option to reduce emission, as shifting from triple rice to double rice and aquaculture, rice-soybean-maize and maize-rice-maize have high GHG

mitigation potential and increases labor and land productivity (in monetary terms);

○ Composting, using ammonium sulphate fertilizer in-stead of urea, short duration varieties and 3R3G are the most economic effective for mitigation implementation while SRI is relatively expensive because of high associated investments in adjusting irrigation infrastructure.

Figure 2-7. The Risk Flooding Map with 1m Sea Level Rise in Red River Delta



Chapter 3

Discussion and Recommendations

1. Socio-economic Development in the Red River Delta

1.1. Strong domestic market in Viet Nam

Table below clearly show that food consumption and expenditure per capita in both urban and rural areas are increasing. This shows that the lives of the people in Viet Nam have improved. The high demand is also one of the main reasons impacting on the prices of food. Until 2002 to now, food price is continously increasing, especially during 2007 and 2008 (price of many food prices increased from 25 30%, MARD). The labor structure change can explain as number of laborers have left agriculture sector to persue jobs in industrial and service sectors, resulting high rate of food purchases. This still orientation of food consumption in the coming years. The value of self-supply will be

reduced, while there is increase of food purchase. In Viet Nam, consumption of rice dominates the food industry, higher than that of meat such as pork, poultry and beef.

Table 3-1. Consumption and Expenditure for Food in Viet Nam

Type of indicators	1993	1998	2002	2004	2006
Consumption in urban areas (1000 VND/capital)	1455	1830	2302	3050	3779
Consumption in rural areas (1000 VND/capital)	1006	1236	1519	1793	2235
Population in urban areas (1000 people)	13,961.2	17,464.6	19,873.3	21,601.4	23,046.1
Population in rural areas (1000 people)	55,683.3	57,991.7	59665.4	59,836.3	60,266.9
Consumption in urban areas (million VND)	20,313,546	31,960,218	45,748,337	65,884,270	87,091,212
Consumption in rural areas (million VND)	56,017,400	71,677,741	90,631,743	107,286,486	134,696,522
Total consumption (million VND)	76,330,946	103,637,959	136,380,079	173,170,756	221,787,733
Exchange rate (VND/USD)	11,100	13,500	15,100	15,700	16,100
Total consumption (billion VND)	6.9	7.7	9.0	11.0	13.7
Average consumption/capita (USD)	98.7	101.7	113.5	135.4	165.3
Total food purchases (USD) *	3.5	3.7	6.7	8.6	11.0

Type of indicators	1993	1998	2002	2004	2006
Value of agricultural exports (billion USD) **	1.3	3.1	4.4	5.8	9.6
Rate of purchase in urban areas (%)	95.2	95.3	95.4	95.29	95.78
Rate of purchase in rural areas (%)	56.8	63.8	71.75	70.02	72.26
Expenditure in urban areas (1000 VND/capita)	1384	1743	2198	2907	3620
Expenditure in rural areas (1000 VND/capita)	571	786	1086	1255	1615
Expenditure in urban areas (million VND)	19,322,301	30,440,798	43,681,513	62,795,270	83,426,882
Expenditure in rural areas (million VND)	31,795,164	45,581,476	64,796,624	75,094,557	97,331,044

Source: GSO, VLSS 1993, 1998, 2002, 2004, and 2006 (and FaoStat for **)

* All data are in current prices; food purchases include cigarettes and drinks.

The value of food consumption, as well as the value of exports, ha s increased in the period 1993–2006. During this period, the value of domestic consumption has always been higher than the value of exports. The data shows that the domestic agricultural market still plays a more important economic role than the export market, as shown by (Moustier et al., 2003), although the difference between the two is decreasing. Moreover, some domestic agricultural products will face difficulties in exportation if they cannot meet international standards or rules of WTO on SPS and others. Selling in the domestic market, which has less demanding standards for quality, will be necessary for the inclusion of

small farmers. And the increasing standards of quality in the domestic market (in particular in supermarkets) can serve as a first step before entering the international market.

The economy in the area has been developed in the structure of industry - construction, tourism - services, agriculture, forestry and fisheries. Geographical location of the project area is favorable as it situates near to large consumer markets, abundant labor resources, culture, science and technology, infrastructure facilities of several sectors are being focused in investment and development. Good land favorable for diversified products, many products are popular in and outside the region as well as internationally.

Agriculture in the RRD contributes to sustainable development, however, acreage, yield and production are varying as the plant structure is unstable, arable land is being reduced due to urban development, population increase, industry, tourism and services. Enhancement of intensive specialization, diversification, increasing the efficiency is underlying trend in agriculture. Aquaculture is the strength of a number of provinces in the region.

The development of domestic market leads to agricultural diversification. The agricultural development process at the sub-region in RRD in recent period shows that some of the sub-regions can strong diversify, in contrast to others which are less diversified (*Dao The Tuan, Dao The Anh, 1997*). Diversification is required in two directions: i) To produce products in big quantity, average quality and ii) To push up export products of high quality and high added value based on Vietnamese products‘ specification. The production diversification at the household level is now popular in the RRD (above 70%) and is considered as temporary transformation stage in the specialization process (*Dao The*

Anh, 2003). The production diversification at the household level will help the poor households to have stable income.

Industry, construction, tourism - service have become the largest contribution to the total income of the provinces, cities as well as the project area. Urban and industries arerapidly expanded and developed. Populations are increasingly migrating to urbans, urban areas are also invested in building and expanding. Tourist sites and services such as Suoi Hai, Dong Mo - Ngai Son, Huong Pagoda, Cuc Phuong, Hoa Lu, Xuan Thuy, etc. in the future will appropriate high proportion of income in the economy of the region. The network of roads, waterways, railways and rural roads are also broadly built.

1.2. Opportunities and Constraints of Vegetable Production in the Red River Delta of Vietnam

1.2.1. Opportunities

Vegetable production in the RRD plays an important role in providing vegetables to the urban areas of the region. Among conventional vegetables traded in Hanoi, the leafy vegetables, such as kangkong, green choy sum, Indian mustard and lettuce, and summer fruit vegetables, such as wax gourd and yard long bean (*Vigna unguiculata* ssp. s*esquipedalis*), are all produced in the RRD. Given the increasing urbanization in the RRD, the demand for vegetables is likely to grow. Vegetable production in the RRD has advantages. Farmers can earn a higher income with vegetable production than with rice and corn production (Thuy *et al*., 2002). As continuous vegetable production

brings in greater profits than the vegetable–rice–rice rotation (Anh *et al*., 2006), farmers may be stimulated to grow vegetables year-round.

Taking into account the agro-ecological conditions of the area and the potential of crop rotations in terms of product marketability, profitability and plant-health aspects, vegetable production systems could be designed to achieve the following objectives: (1) to facilitate year-round vegetable supply for the RRD's increasing population, (2) to increase the income of small farmers by growing potentially profitable crops, and (3) to improve soil conditions for better growth and yield stability of vegetables.

Presently, mulching of crops is not common practice. Mulching, e.g., with rice straw or rice husks, material that is abundantly available, could help to reduce (1) leaching of nutrients, (2) soil surface erosion, and (3) labour demand for weed control, while at the same time preventing soil surface compaction and adding organic matter to the soil.

Permanent vegetable production systems indeed may be an option to improve vegetable production systems in the RRD. By taking out flooded rice, permanent vegetable production systems may improve soil physical properties by eliminating the repeated wetting, puddling and drying of the soil, possibly resulting in greater yield stability and higher crop yields. In addition, it would reduce labour costs because of eliminating the need for raised bed construction and subsequent flattening after vegetable production. Permanent raised beds would be fixed in place, offering opportunities for long-term soil improvements.

By designing and implementing systems that couple greater yield stability with better timed marketing and higher profits, farmers could gradually improve their position. With an improved financial situation and greater professional confidence, farmers would have the opportunity

to get better organized, enlarge their operations in terms of hiring additional land and labour, and explore opportunities to improve their marketing.

Product prices influence the profitability of vegetable production in the RRD more than intensification of production would do (Yanagisawa *et al*., 2001). In order to improve their bargaining position with collectors, wholesalers or retailers, growers would need to be able to offer their product in larger quantities and on a regular, planned basis. Farmers' participation in commercial co-operatives or producer organizations would be an option to achieve this goal. Further co-operative integration, involving exchange of land to obtain larger or neighbouring plots would open opportunities to work on a larger scale in order to reduce costs of operation. Furthermore, it may offer opportunities to collectively implement harvest date planning and product quality control and aim for integration of production and marketing in a value chain. The introduction of cool storage and transport would widen the choice of crops to grow and would reduce post-harvest losses. For 'safe vegetables', although on a modest scale, there already are co-operatives that organize their own harvest planning, quality control, integrated pest management training and retailing, with farmers sharing the profits of joint activities (Moustier *et al.*, 2006).

1.2.2. Constraints

The seasonal variation in temperature in the RRD poses limits on the year-round production of vegetables of tropical or temperate origin. Presently, most of the vegetable crops are produced in the period with low temperatures. Heavy rainfall in the hot and wet period from May to September may cause low vegetable productivity because of mechanical damage and may result in loss of nutrients by leaching or

surface erosion. Yield losses due to pests and diseases are higher in the wet season than in the dry season.

Flooded rice is the dominant crop in the period with high temperatures. This dominance exists because (1) national food security in rice was promoted by the government (Linh, 2001; Nguyen and Grote, 2004), and (2) farmers grow rice in the hot season to ensure that at least they will have enough food when other crops fail or when they lose other sources of income. This is especially true in the RRD, where the average area of agricultural land per capita is comparatively low. So rice contributes to the seasonality of supply and prices of vegetables because in the hot season most of the land is used for rice production.

Growing flooded rice has a negative effect on soil structure because of the repeated wetting, puddling and drying of the soil. In addition, the yearly build-up and break-down of raised beds requires high labour inputs.

High labour requirements and high costs of production may limit vegetable production. Production costs of vegetables are often twice as high as those of cereals (Thuy *et al*., 2002). Without some form of secure marketing, for most farmers vegetable cultivation is substantially more risky than rice, maize (*Zea mays* ssp. *mays*) and corn (*Zea mays* var. *rugosa*) production.

Urbanization and industrialization may negatively influence vegetable production in the RRD. Whereas peri-urban vegetable growers may have better connections to markets, consumers and knowledge (Ali, 2007) than their rural colleagues, they face higher risks in terms of pollution and the possibility of losing their land to urban and industrial development (van den Berg *et al*., 2003).

Product safety is becoming a major concern in society. Official protocols to produce vegetables and to control their quality are lacking, except for the comparatively small quantities of 'safe vegetables' produced by 'safe vegetable' co-operatives. Presently most of the vegetables produced in the RRD are produced conventionally with high inputs of pesticides (Hoi *et al.*, 2009). Excessive use of organic and inorganic fertilizers may result in soil and water pollution (Khai *et al.*, 2007) and high nitrate contents in vegetables. Samples of conventionally produced Indian mustard and green choy sum all had nitrate contents above the threshold level (Ha, 2008). Consumers are concerned about pesticide residues, over-application of fertilizers and the use of growth regulators in vegetable production in the RRD (Ali, 2007; Figuié, 2003).

The insecure marketing conditions have been considered the most important constraint on vegetable production in the RRD (Anh *et al.*, 2004). Because there are no contracts between producers and traders, except for the small amount of safe vegetables traded through co-operatives and distribution companies, producers depend on fluctuating free market prices. In general, the small vegetable producers are planning their operations without market information or product price agreements. Producers try to grow temperate vegetables as early as possible to benefit from the generally high prices in the period September–November. As a consequence, vegetables are sold at high prices when demand still exceeds supply, but they are sold at low prices, or may not be sold at all, when supply starts to exceed demand.

The small scale farming operations and the comparatively high costs of the marketing of only small amounts of product, limit the farmer in organizing his own supply directly to a retailer. The small amounts of product offered, and the perishable nature of the product, reduce his bargaining power with collectors, who try to maximize their own profit.

1.2.3. Challenging

Government is concerned that pressure from urbanization, commercialization, industrialization, and infrastructure might reduce rice land to unacceptably low levels and compromise food security of the nation. In response to this concern it is proposed to set aside a certain amount of rice land (4.1 million ha to be reduced to 3.6 million ha by 2030). The trade-offs between food security concerns and growth make this issue relevant to the issue of economic transformation – a set aside of rice land might in fact retard the process of economic transformation without necessarily contributing to the stated objective of food security.

The current land policy designating rice areas has costs for farmers and costs for Viet Nam. The costs for farmers are mainly linked to lost opportunities to plant and sell higher value crops such as horticulture crops where this is possible. The costs to Viet Nam are lost opportunities to export a greater volume of higher value commodities than rice.

In spite of remarkable progress on farm productivity growth, considerable inefficiencies remain in the rice value chain in terms of postharvest losses, processing, and marketing. Postharvest losses for rice around 12-13%. Marketing system with too many intermediaries. Dominance of rice exports by SOE. And impact of investment, organization of value chain, and general efficiency outcome have not been assessed.

RRD is a region with fast economic development speed, but if compared with the South East region, the Red River Delta provinces have lower contribution to national GDP and export, infrastructure is poorer and attracted less capital investment. The main cause of this situation is due to the lack of synchronous policy mechanism, not

formed real estate markets, capital markets, as well as not having a master plan to promote the advantages of the region.

Many irrigation schemes are severely degraded, induce much difficult for drainage, irrigation as well as obstructing waterways especially in rural areas. Increasing water supply for new urbans, rural water supply, industrial zones, water environmental improvement cause water shortages. Land use coefficience is increased (2 to 3 crops), nowadays not only development of irrigation for rice but also for industrial crops, fruit trees, especially inmountainous areas causing serious water shortage.

Environmental sanitation quality of the entire region in general and urban areas in particularare the main issues that the RRD is facing, especially in the big cities, the situation is becoming more and more serious. The speed of RRD's urbanization happens quickly while the technical andsocial infrastructuresare unable to accommodate in time is the main cause of environmental problems. Besides, dense population, narrow area and the rapid development of the industries also contribute to make more serious environmental problems.

1.2.4. Challenges for Agricultural Land Use Planning

- Uneven awareness, low consensus, poor coordination between levels, departments and units etc., mainly run under the administrative procedures.
- Land use planning is not really considered as an important legal basis for land allocation, land lease, land acquisition, land use purpose changes
- The conversion of large quantities of paddy land to non-agricultural purposes without consideration of the overall development effectiveness have adversely impacted on production and life of a part of farmers and threat target of national food security.

- Although the "land consolidation" has been successfully implemented in many localities, but not yet incorporated the ỉsuccessfu of field planning, production land remains fragmented, hindering the industrialization and industrialization process
- Poor management of plans after approval, observance of the law provisions on adjusting or canceling plans have not been respected and obeyed.

a. Reasons

- Low quality of the planning projects, unreasonable planning, planning fraught with subjectivity, imposed by key local leaders.
- Poor scientific-based planning, economic, social and environmental effects are not being verified by qualitative and quantitative analysis, environmental factors in planning have no common standards, they are being used depending entirely on the circumstances and local conditions.
- The estimation of needs of land use in planning is superficial, affecting the quality and content of the land use planning as soon as at the time of planning formulation as well as put into practical implementation.
- The planning management, performance monitoring and the observance of land legislation is insufficient; access and participation of people from the planning stages to implementation of planning and monitoring of planning performance is faint; planning management level is limited; planning imposed by the leader's subjective is persisting.

b. Suitabilities for Crop Convertion on Rice Land

- In the RRD there are many valuable economic crops which can suitably be planted on the rice land such as vegetables, potato, chili,

carrot, etc. Such products are consumable for local daily demand (resident, urban and industrial centers, etc.) as well as surrounding areas.

- Rice areas which designated for conversion are concentrated, thus it would be easily to develop large-scale and high quality rice plantation fields serving for commercial development.
- The RRD exposes potential of human resources and scientific and technology development with many training centers, research institutions and farmers having high cultivation skills. These conditions are suitable for the advanced technology applications and new models on new varieties, crop rotation, mixed cropping as well.

c. Disadvantages for the Crop Conversion on the Rice Land

- Crop conversion is still lacking concrete connection to consuming markets and without large-scale production planning.
- Local authorities are hesitant in conducting conversion options since (i) no available specific instructions from central bodies and (ii) difficulties in complying with the Government Decree 42/2012/NĐ-CP dated 11 May 2012 on rice land use and management.
- Farmer's knowledge on commercial production is limited. Land accommodation process is slow plus scattered production in many areas. Weak connection in production, especially between production and consumption. Uneven product circulation and co-ordination among many areas, poor appropriate distribution channels of vital products.
- Poor and weak implementation of local line agencies in the conversion process, resulting in farmers are spontaneous with their own operation in accessing market.

2. Land Use in the Red River Delta

Rice planting subsequently declined as some lands – especially in the RRD – were converted from agricultural to industrial and urban use, and as some other rice land were converted for use in aquaculture, fruit tree production, or, less commonly, other annual cash crops, for domestic market. Due to the loss of agricultural land (mainly rice cultivation) for urban construction, physical construction, etc. Therefore it is essential to increase soil improvement to compensate for lost paddy land through the solutions: (I) Partial conversion of specialized rice seeding land into paddy cultivated land; (ii) Partial conversion of subsidiary crops land to grow rice; (iii) Conversion of unused land to the rice land; (iv) Intensive farming on the subsidiary crops, short term industrial crops land, specialized vegetables land and other annual crops land.

2.1. Key Land Use Stakeholders in RRD: Agriculture; Transport; Airport

2.1.1. Agriculture

Rice production area by 2015 will be 1032.5 thousand ha, by 2020 1005.5 thousand ha, i.e. down 90.0 thousand compared with 2012. Total annual corn area, by 2015 will be 115.0 thousand ha, by 2020 138.5 thousand ha, an increase of 57.9 thousand compared to 2012. The aquacultural surface is expected to be 113.583 ha; 116.474ha, and 124.229 ha, by 2020, 2030 and 2050, respectively. The area of forest

land area by 2020 is expected 494.580ha, in 2030: 509.460 ha, in 2050: 526.780 ha.

2.1.2. Transport Development

Seven (07) highways will be estabilished in the RRD for connecting to Ha Noi capital with a total length of 1,099 km, including: Lang Son - Bac Giang - Bac Ninh (130 km); Ha Noi - Hai Phong (105 km); Ha Noi - Viet Tri - Lao Cai (264 km); Noi Bai - Ha Long - Mong Cai (294 km); Ha Noi - Thai Nguyen – Cho Moi (90 km); Lang - Hoa Lac - Hoa Binh (56 km); and Ninh Binh - Hai Phong - Quang Ninh (160 km).

2.1.3. Airport development

Construction of Noi Bai International Airport (T2 terminal at international standards with the most modern design within ASEAN region, which can accommodate from 8 to 10 million passengers/year). Construction of Van Don airport, expansion of Cat Bi airport and formation of Taxi airports serving tourists in groups (Hoa Lac, Ha Long, etc.). It is expected to form the 2nd airport for the Hanoi capital since the Noi Bai aiport would likely be excess capacity.

The limited amount of land suitable for agriculture is a major resource constraint for Vietnamese agriculture, so that productivity per ha is a key consideration for the growth of the sector. The current situation of agriculture in Viet Nam is still strongly influenced by the small size of the landholdings and equity in landholding led to creation of a large number of small farms on which, given a weakness of rural markets at the time, impressive increases in rice production achieved in MRD and

RRD, the country's two rice bowls, have not, however, resolved the problems associated with large number of small holdings with limited earning potential. An important finding is that the process of structural change and urbanization that has been evident in Viet Nam since 1990s will have major implications for the Vietnamese landscape in the future.

Today, markets are developed, and, except for land designated by the government as rice, farmers are free to select the crops they wish to growth. But the legacy of the past remains, with the government still prescribing rice national self-sufficiency approach as the best way forward and prescribing lands that are only allowed to produce rice. One consequence of this approach is that income from specialized rice farming on very small farms (less than 0.3 ha in RRD) is particularly low and continues to fall further behind that of other segments of the population as the economy grows. Already for many of these farmers rice is a part time occupation and unless the restrictions on diversifying out rice are eased, the country faces the risk of only the old continuing with rice cultivation. Increasing rice productivity, cropping intensity and farm mechanization could somewhat ameliorate this situation but with yields already at a fairly high levels the scope is limited.

Box 3-1. Land Conversion Process in Hung Yen Province

Industrialization causes the decline of household food production in various aspects. Firstly industrialization has the direct impact on the decline of household agricultural land holding. Similar to other provinces in the RRD, Hung Yen province concentrates its development strategy on promoting industrialization with the formation of industrial zones and clusters. Therefore, the agriculture land has been decreasing at high speed. From 2000 to 2005, on average, each year the agricultural land in Hung Yen decreases by 870 ha. In fact, the approved plan by the central government is always lower than the plan of the province and is out of date in comparison to the practical development of industrialization in Hung

Yen. In 2005, total land of industrial zones and clusters in Hung Yen was 2128 ha while the approved plan of government was only 1894 ha (Hung Yen PPCs and Hung Yen DIP 2006). The land use plan of a province accelerates the area of industrial zones in the year of 2015 with the land use is 6155 ha and 9305 ha in 2020 (Mai Xuân Nghiên 2008). As the province in the central of delta, agricultural land conversed to industrial 7 zones and clusters in Hung Yen mostly used to produce rice and other food crops that sustain livelihood of peasant households.

(Source: Land conversion to industrialization and its impacts on household food security in Red River Delta, Viet Nam - Nguyen Thi Dien, Phillipe Lebailly and Vu Dinh Ton)

3. Climate Change in the Red River Delta

In Viet Nam, RRD is severely affected by the sea level rise in the mid-21st century due to its low elevation. There have been several studies on the effects of CC on RRD. However, there has been no attempt to quantify such effects in details for a particular region of RRD.

Five provinces in the RRD with the coastal lines include Quang Ninh, Hai Phong, Thai Binh, Nam Dinh and Ninh Binh. In general, according to the two sea level rise scenarios in 2020 and 2030, the rice cultivated area in Red River Delta to be flooded is low, not significant. According

to 12cm sea level rise scenarios to 2020, the flooded area in entire region will be 1,042 hectares, rice land area of the region flooded by rising sea levels by 2020 will be 288ha, of which 124 ha in Hai Phong province. It is expected by 2030, sea level rise 17cm, RRD will be flooded 1,506 ha, of which 622 ha of rice land will be flooded, including Hai Phong 239 ha, Nam Dinh 210 ha, Thai Binh 85 ha and Ninh Binh 88 ha. (NIAPP, Hoang Xuan Phuong).

It is important, however, to note that the assessment of CC impacts (social/economic conditions, health, environment, industry, agriculture and ecosystems) for RRD is critical for the river basin planning and development in near future. . The assessment procedure will potentially serve as a scientific guidance for policy making process in the RRD in a sound and wise manner.

The potential risks in the RRD, such as water level rising, difficult flood regulation; rapid urbanization and high population growth shall create more pressure for dyke management; rain, storm and flood forecast. Increased extent and duration of flooding, changes in wet season and dry season precipitation, inundation from sea level rise and possible changes in salinity intrusion patterns have all been identified as significant threats to the region's agricultural productivity and the livelihoods of the population of the RRD.

4. Food Security

This study adopts FAO's widely accepted formulation of food security as a "condition that exists when all people, at all time, have physical, social, and economic access to sufficient, safe, and nutritious food that

meet their dietary needs and food preferences for an active and healthy life". In most ASEAN countries – including Viet Nam – food security is an important plank of national agricultural policy and is often equated with self-sufficiency. ASEAN countries have experimented with several regional food security frameworks that correctly focus on emergency relief, sustainable and conducive food trade, and early warning and information, as focal elements in maintaining the smooth and stable functioning of the food production and distribution system. Many studies have found, however, that governance problems afflict the operation of the different systems. These problems arise from fundamental tensions between unilateral versus cooperative approaches, as well as tensions due to competing domestic interests.

As in many other countries, Viet Nam faces a serious problem of consumer' distrust in the quality of national food products, particularly products of animal origin. Food safety is also affected by the pollution of air, water and land sources as for the industrial development strategy so - called "*growth first and clean later*". Consumers are expressing a growing concern for the quality – and more importantly safety – of food products. This demand has encouraged the development of supermarkets as the point of sale for food products and is also promoting new retailing enterprises operating at markets stalls or shops, for which efforts towards visual quality (attractive presentation or packaging) and communication about product safety are major promotional tools.

The RRD is probably one of the most intensively cultivated agricultural areas in the world, in terms of both cropping intensity and the cumulative amount of grain produced per year. Wet cultivation of transplanted rice started about 4,000 years ago and has intensified since then because of the dramatic increases in population density in the fertile Delta, which now exceeds 2,000 people km^2 in several provinces. In case of RRD, the following issues should be taken into consideration

of policy inputs which relate to food security, namely land use, climate change, productivity, prices, stocks, trade, supply chains, consumption, institutional structure, etc. For purpose of national food security, as calculated and analyzed in many international and local studies that a reduction of 3.8 million ha of rice land would be acceptable during 20 years ahead in the context of climate change and trade-off between the target of 4 miilion ton rice for export and other options (other high value crop production). “More” is not always “better”. Under many scenarios, producing and exporting less rice could prove to be much better – from a welfare and economic growth perspective – for Viet Nam (*Dao The Anh, Denis Sautier, Local Food Systems in Viet Nam – Strengths and Opportunities*).

Table 3-2. The State of Food Security in Viet Nam - At a Glance

Food security and nutrition status core indicators		
Food consumption	**Health status**	**Nutritional status**
Calorine supply per capita (2003-2005), 2650* kcal/person/day	Life expectancy at birth (2007), 74	Proportion of children under 5 underweighted (2006), 20%
Cereals, roots, tubers as % of DES ** (2003-2005), 68%	Under 5 morality rate (2000), 30/1000	Percentage of adult with body mass index BMI***<18.5 (2000), 26.5%
Percentage of population undernourished (2004-2006), 13%		

Note: Minimum dietary energy requirement (2004-2006): 1800 kcal/person/day

** Dietary Energy Supply

*** Body Mass Index

Source: WB, UNICEF, WHO, FAO

Box 3-2. Food development plan for the Red River Delta (NIAPP, Hoang Xuan Phuong)

1. Rice production

Rice production is arranged on a land resource balance, determine the total annual cultivated area, in 2015 willbe 1032.5 thousand ha, in 2020: 1005.5 thousand ha, down 90.0 thousand compared with 2012.

Spring crop: in 2015: 500.8 thousand hectares, in 2020: 487.0 thousand ha, down 61.0 thousand compared to 2012.

Moonsoon crop: in 2015: 531.7 thousand hectares, and in 2020: 518.5 thousand hectares, down 29.0 thousand compared to 2012.

Main solutions: (1) Planning intensive rice cultivation areas with high quality in the provinces, with a size of about 220-250 thousand ha, concurrently with the implementation of the policy of building large fields in 63 districts; (2) Planning the conversion of rice production areas to other more efficient production purposes (converting rice production in lowland to produce rice + aquaculture or specialized aquaculture in some low-lying districts of Ha Noi, Ha Nam, Bac Ninh and Ninh Binh. Conversion of upland rice area (in arid highland) to subsdiary crops, short-term industrial crops and fruit trees); and (3) Land consolidation to address land fragmentation;

2. Corn production

Determination of total annual corn acreage, in 2015 will be 115.0 thousand hectares, in 2020 will be 138.5 thousand ha, increase 57, 9 thousand compared with 2012. Size of corn acreage will be increased at the cost of other crops land and expansion of winter corn crop.

Main solutions: Planning concentrated corn production areas in provinces, with a size of about 80-90 thousand hectares in 39 districts.

Aquaculture development: water surface area for aquaculture is expected 113.583 ha in 2020; 116.474 ha in 2030, and 124.229 ha in 2050.

Forestry Development: The forest land area in entire region is expected 494.580 ha in 2020, in 2030: 509.460 ha, in 2050: 526.780 ha.

5. Recommendations

Rural Development

Growth in the rural economy and of agricultural in particular will increasingly involve choices driven by market signals and competitive pressure from opening markets. Successful response to these markets opportunities and challenges will benefit from attention to four (04) aspects: (i) diversification of agricultural activities; (ii) deepening of market systems; (iii) management of trade integration and (iv) pursuit of SOE reform (*Accelerating Viet Nam's Rural Development – Growth, Equity and Diversification, Three Pillars of Rural Development, The World Bank in Viet Nam)*

Agricultural diversification: Accelerating agricultural diversification will require a package of efforts tailored to the different production systems. Strengthening agricultural support service is critical across these systems, encompassing research and extension, agricultural technology, food safety, vocational training and information dissemination. Expanded access to financial services will be important, as will further improvements of the quality of trade infrastructure related to supply chains for new inputs and non-traditional product lines.

Market development: Deepening of market structures remains an important agenda to achieve better transmission of market information to participants in product value chains, heightening competitiveness through efficiencies gains in product market functions, and improve small holder integration into evolving market structures. Longer-term market development will proceed more quickly with an opening of the legal scope for different types, and stronger, autonomous farmer organizations which are capable of representing their own interests.

Trade integration: In promoting trade, care will be needed that new regulations to enable tariff rate quotas not be deployed so as to raise protection excessively for crops in which Viet Nam has little comparative advantage or that risks penalizing high potential sub-sectors in favor of others. More use could be made of trade promotion (but not through export subsidies, currently low), particularly through public support in collaboration with product associations, a direction that Viet Nam is already heading in. Within the agricultural sector, short-term responses can assist poor households with emergency provision of critical production inputs and rescheduling of official credits, but the longer term effort, through research and extension, should focus on expanding options for agricultural activity to shift away from crops with unfavorable markets.

SOE reform: Continued progress on reforming SOEs in the agricultural sector is an important component of accelerating market orientation. State Forest Enterprises (SFFs) are an additional category of SOEs with a reform agenda of particular importance to rural households in poorer highland areas. Irrigation Management Companies (IMCs) play an important role in provision of irrigation services and in management of investment decisions. Both are integral to broader agendas of market-orientation, agricultural diversification, and public expenditure efficiency.

Food Consumption

As in many other countries, Viet Nam faces a serious problem of consumer' distrust in the quality of national food products, particularly products of animal origin. Responsibility for food safety needs to be better coordinated and led by a high level in government. Inadequate action is this domain will severely set back the development and growth

of the sector. The development and encouragement of supermarkets would be a way of remedy for this. Supermarkets do potentially offer income-generating opportunities for small-scale farmers who can form associations and guarantee product quality.

The Government will also have to take account of a change in the Vietnamese diet. Rice remains of extreme importance for the poor, but urban dwellers, with higher incomes, are already moving to other food sources including wheat based products and higher protein products, particularly meat and fish. Rice consumption can be expected to decline in importance in the coming years from the current dominant level will enable more balanced national agricultural policies to be developed in the future.

Linkages between Climate Change and Land Use Changes

Land delivery, resettlement planning, good use of public lands, are here all related to land use. Good land use planning creates cities that are more compact, which less transportation and less need for heating and cooling, to name few measures. Good land use planning also creates a rural area that enriches soil carbon, produces perennial instead of annual tilled crops, reduces livestock production, protects natural habitats such as forests and restores degraded watersheds and rageland, again to name a few. (Paul van der Molen, University School for Land Administration Studies, AE Enschede, the Netherlands; David Mitchell, RMIT University, Melbourne, Australia)

The surveyor can play a significant role, establishing, quantifying, and managing CC. He can substantially contribute to helping mitigate and adapt CC to reduce climate-related risk. Requirements are not only engineering know-how but also the surveyors' variety of skills and knowledge in geoinformatics, land management and development,

building and land law, real estate and business administration as well as social competence. Furthermore, surveyors work with the land, people, political and social institutions to bring about sustainable socio-economic development. Data gathered by field surveyors or collected from existing spatial databases such as land registers and cadastres can be an efficient starting point for the assessment and evaluation of the impacts of CC as well as developing policy indicators. (Frank Frieseeke, STEG Academy, Germany)

Land Policy

The Government should make every effort to ensure that prices available to farmers are not unduly distorted by Government administrative actions. Meanwhile, trade-offs betwwen Rice Land Policy and Economic Transfromation should be taken into consideration. Rice is a relative low value (and low value added) commodity. At a policy level, the "value" of rice exports also needs to take into account: (i) unmeasured costs, including the depreciated value on dedicated water resources infrastructure and the system for irrigation management, (ii) broader social costs, especially adverse environmental impacts associated with high levels of agro-chemical and fertilizer use (and run-off), and (iii) the opportunity costs of the land, labor, water and other resources devoted to producing surplus rice – as opposed to producing other exportable or import – commodities which can be substituted.

Over time a broad land consolidation program should be implemented to facilitate expanding farm areas taking advantage of continuing departures from the rural areas. The full and timely implementation of the Government's ongoing Land Administration and Management program to upgrade the administration of land management can greatly facilitate this process.

Over time, the Government should give farmers more freedom to choose their own cropping patterns particularly in those rice designated areas which are amendable to flexible cropping rotations. The Government should start moving away from a centrally planned directed approach to cropping towards a more market based approach. Below table suggests a way of changing approach towards more sustainable agriculture development.

Advanced technologies such as Remote Sensing and Geographical Information System (RS and GIS) should be more applied in detecting changes of areas in terms of agricultural production and other land uses in order serving better for effective management and sustainable development.

Table 3-3. Changing Approach

Current approach	New approach
Protect paddy land	Protect agricultural land
Rice self-sufficiency	Increase farmer income and improve nutrition
Resource intensive	Technology intensive and environmental friendly practices
Production focus	Post-harvest and trade focus
Small farm and middleman domination	Large scale and value chain linkage
Administrative control	Market-based intervention
Food export	Utilize the benefit of international integration
Inflation control	Target to poor and vulnerable groups of consumers

Source: Agrcultural Plausible Future: Policy Approaches for Viet Nam Food Security, IPSARD, Dr. Nguyen Do Anh Tuan

Water Utilization and Control

Government need to rethink the investment policy in the rural areas particularly regarding support for irrigation schemes to be determined on the basis of economic priority. This should lead to more support for rehabilitating and upgrading existing schemes by incorporating a better flexibility and water control so that farmers can a choice in cropping patterns based on market demand. The country must remain vigilant in this respect and continue negotiations with neighboring states, particularly China in terms of water utilization and control. Thus, the integrated water management in the Red River basin has to be considered as a trans-boundary issue, requiring the joint efforts of the three countries. Unfortunately, this topic up to now is not yet appropriately addressed. At the same time, the Government needs to work to help upgrade water use efficiency so that Viet Nam is best prepared for possible future limitations in water availability from CC and other reasons.

Private Involvement

Support for the development of the post-harvest value chain by private sector investors and managers by ensuring that the investment climate is geared better to encourage investment by the private sector, in a level playing field with State Enterprises particularly regarding access to land, access to production for processing, access to credit and marketing channels. Viet Nam is currently backward in this areaa.

On Scientific Application

The Government can play an important role in bringing about an

upgrading research in Viet Nam and encouraging the private sector to participate in this effort, enabling Viet Nam maintain its cutting edge in growth and development of the rural areas in the coming years as the country is faced with multiple challenges from technology and CC. The aging of the population, the continuous flight of younger people from the rural areas, and the development of bigger farm sizes should lead to increased mechanization of farming activities to increase labor productivity. The Government research system should work with the private sector to test and demonstrate opportunities to make farming more profitable through increased mechanization.

On fishery

The Government needs to continue to play a supporting role in the areas of (1) assistance with fishing boat, design and safety; (2) improving and in some instances consolidating value chains, supply channels, disease controls and environmental management within the full range of aquaculture options; (3) increase training of workers, restructuring and in some instances relocating fishing villages, strengthening fisheries inspection capacity; and (4) improving management through co-management options partnering fisheries and local communities.

On Climate Change response

While the country study has assessed that not too much negative impact on food supplies is expected on Viet Nam up to 2040 due to CC, current models predict that serious impacts could start around 2050. In preparation for future effects it would be advisable for the Government to monitor carefully evolving changes being caused by CC to best

determine the timing and type of mitigation measures that should be introduced. It will be important to exercise caution and careful phasing when considering high cost public expenditures to build dykes and embankments to deal with slow, long term and uncertain threats of sea level rise otherwise scare resources can easily be wasted on measures taken too early in the expected CC cycle. The Government should also further strengthen institutional capacity to manage CC through continue improvement in its unique resource allocation framework for climate expenditures and through integrated management of its coastal zones.

The emergence of the concept of Green Growth (GG) marks a shift in the paradigm for economic progress to an approach which emphasizes environmentally sustainable development. In agriculture and other sectors, progress on GG is measured by the ability to contribute to social well-being by providing sufficient goods and services in ways that are economically efficient and environmentally beneficial. The GG paradigm in agriculture offers a menu of approaches for maintaining the sustainability of diverse farming systems from the economic and environmental perspective (Candice Stevens, Former OECD Sustainable Development Advisor).

Climate Smart Agriculture (CSA) addresses the challenges of building synergies among climate change mitigation, adaptation and food security that are closely related within agriculture and minimizing their potential negative trade-offs. It seeks to enhance the capacity of the agricultural sector to sustainably support food security, incorporating the need for adaptation and the potential for mitigation into development strategies. CSA practices – which include agroforestry, improved fallows, conservation agriculture, improved seed varieties that increase biomass, soil and water conservation structures and improved grazing land management – often generate both adaptation and mitigation benefits.

As RRD is one of national rice producing areas, it is necessary to set up action plans that address the CC impact on ecosystem functions and services important for rice production to feed into adaptation, natural resources management and food-security making.