International Biodiversity Day, Vietnam 2007

– Papers –

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Opening Speech - Mr. Pham Khoi Nguyen

Vice Minister of Ministry of Natural Resources and Environment on the Occasion of International Biodiversity Day 2007 Biodiversity and Climate Change

Dear Ladies and Gentlemen!

I am very honored, on behalf of Ministry of Natural Resources and Environment, to participate in the meeting to celebrate International Biodiversity Day and deliver an opening speech for the Symposium on Biodiversity and Climate change: Links with Poverty and Sustainable development. As you may know, biodiversity is essential to life on the Earth, and it is a crucial element for prosperity and sustainable development of human society. Biodiversity conservation is a crosscutting principle for conservation and utilization of our invaluable natural resources. Therefore, the United Nations and member nations of the Convention on Biodiversity agreed to choose the 22nd May as an International Biodiversity Day and organize series of activities for celebration of this Day every year in order to enhance awareness of people and alert about problems with this regard. This is an opportunity for us to view biodiversity in a fairer and more comprehensive manner.

Dear distinguished guests and participants!

The year of 2007, with an official theme of "Biodiversity and Climate change", affirms the importance of biodiversity and impacts of biodiversity loss and climate change on the life on our Planet.

This theme is also related to a decision of the United Nations to select the year of 2007 as a Year of Polar and the International Environmental Day of this year, which is highlighted with a theme of "Melting ice – a hot issue".

We have clearly known that since the 19th century, the Earth's temperature has been increasing about 0.6°C, affecting the whole world and it is forecasted that by 2100 the Earth's temperature will continue to increase approximately 1.4°C – 5.8°C. If the temperature of the Earth increased 2.5°C, very severe consequences would happen and that means approximately 3 billions of people would suffer from lack of water; 50 millions of people would suffer from hunger and about one millions of wildlife would not be able to adapt to climate change and might go to extinct.

Dear distinguished guests and participants!

Vietnam is a member country of the Convention on Biodiversity and also a member country of the Framework Convention on Climate Change. Therefore, organization of activities for celebration of the International Biodiversity Day has become an annual task of many in-line Ministries, agencies, localities, socio-political organizations, and communities.

This year with a message of "Biodiversity and Climate change", activities for celebration of this event in Vietnam will focus on encouraging local communities to get involved in learning and dialoguing the importance of biodiversity and interrelationship between biodiversity and climate change. The Ministry of Natural Resources and Environment has issued a guideline to give in-line Ministries, agencies, mass organizations, and local people some suggestions on how to celebrate the International Biodiversity Day, particularly paying attention to propaganda and dissemination of information and knowledge on the subject of biodiversity and climate change to local communities. Activities to celebrate the International Biodiversity Day will be happening in various forms such as meetings, workshops, dialogues, exhibitions, competitions of drawing pictures, writing articles, or photographing related to the subject of biodiversity. These activities will be followed by a series of activities to celebrate the International Environmental Day on the 5th June.

Dear distinguished guests and participants!

On the occasion of the International Biodiversity Day in this year, the Ministry of Natural Resources and Environment of Vietnam, in collaboration with Ministry of Economic Cooperation and Development of Germany and other international donors, organizes a Symposium on "Biodiversity and Climate change: Links with Poverty and Sustainable development" in order to

share experience and research results on climate change and interrelationship between climate change and biodiversity; introduce national and regional adaptation measures and strategies; as well as discuss priority actions and make recommendations related to biodiversity, climate change, poverty reduction and sustainable development available for policy makers.

On behalf of Ministry of Natural Resources and Environment, I would like to urge in-line Ministries, mass organizations, people, national and international NGOs to take necessary, concrete actions, contributing to conservation and sustainable use of biodiversity as well as sustaining adaptation of biodiversity to climate change at national, regional, and global levels. At the same time, I would like to announce opening of the Symposium on “Biodiversity and Climate change: Links with Poverty and Sustainable development”.

Wish you good health and our successful Symposium.

Opening Remarks – Ms. Heidemarie Wieczorek-Zeul

The German Minister for Economic Cooperation and Development, on the Occasion of International Biodiversity Day 2007 Biodiversity and Climate Change
(Hanoi and Tam Dao National Park, Vietnam)

(presented and spoken by Dr. Guenter Riethmacher, GTZ Country Director)

Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung

ONE WORLD Deutsche Entwicklungspolitik

This year, the celebration of International Biodiversity Day takes place for the seventh time as a joint action of the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH and GEO Magazine. For the first time, the Secretariat of the Convention on Biological Diversity (CBD) also participates as a partner.
This year, in addition to biodiversity, the Biodiversity Day takes up another important topic: climate change and its consequences. Although climate change is mainly caused by people in the industrialized countries, it most affects those who are least responsible for it, i.e. people in the developing countries whose life depends to a large extent on the utilization of natural resources. Millions of people are concerned, including those in the densely populated river plains and coastal regions of Asia, but also in other areas where the change in climatic conditions is resulting in extreme weather conditions.
The United Nations has chosen Vietnam to be one of ten countries where adaptation to global warming is to be piloted. Vietnam has more than 3,000 km of coastline, as well as the estuaries of the Red River in the North and the Mekong River in the South, and so is particularly affected. Rising temperatures, salt intrusion into inland rivers and the rising sea level cause water shortages on the one hand and floods and storms on the other hand, affecting half the country's population as well as resulting in the loss of biodiversity. Animals and plants form the basis of many poor people's livelihoods, as they generate their income from the use of forests, from fisheries or from tourism. As in many other parts of the world, biodiversity is the life insurance for many Vietnamese people.

Recently, the German Ministry for Economic Cooperation and Development (BMZ) has initiated the action programme "Climate and Development". One element of the action programme concerns measures for the adaptation to climate change. However, for the BMZ and its partner organizations the conservation of biodiversity has been a key to the development of sustainable livelihoods for poor people for a long time: biodiversity helps to reduce poverty and therefore contributes to achievement of the millennium development goals (MDGs). Since 1985, over 450 biodiversity conservation projects have been supported by the BMZ. Currently, the BMZ supports about 150 projects and programmes on this theme. From 2000 to 2005 an average of about Euro 40 million were invested annually for this purpose within the framework of bilateral cooperation. The occasion of the Biodiversity Day on May 22nd represents an investment of only one day in the organization of events, but its effect can be significant. Today, politicians, donor organisations and simple farmers can all have their say. All of them will experience, feel, discuss, and get to grips – in the very sense of the word – with the extraordinary variety of biodiversity.

Decision-makers from the political, economic, and scientific arena and the major donor organizations will sit around a table in Hanoi to consider global climate change and its impact on biodiversity from the local perspective. However, in Tam Dao National Park, not far from the capital, we are forewarned of the significance of the apparently abstract warming of the earth for the fauna and flora right on our doorstep. In the National Park, the experience of the senses combines with the cultural appreciation of historical sites. Similarly to how Vietnamese Buddhism has spread outwards from here, where the Tay Thien pagoda still attracts thousands of pilgrims, over the whole country, so the knowledge of the relationships between biodiversity, climate change and sustainable development could spread. As the message spreads, people will be made more aware of precious resources now under a worldwide threat, regardless of geographical,

political, economic or cultural borders: the world as we know it, and its future, are at risk if we are not able to stop the worst consequences of climate change and the loss of biodiversity.

I think that Biodiversity Day is a great initiative to make the idea of biodiversity more tangible, to stir our curiosity and to encourage us to act! We should become actively involved together with the GEO magazine, the CBD, and the BMZ. Children and adults, colleagues from all sectors are involved in Biodiversity Day. Together, let's discover the diversity surrounding us, admire and protect it, and carry this message from the Tam Dao National Park and Hanoi into the world.

I would like to wish success to all the events conducted during Biodiversity Day and I would like to invite you all to get involved in fruitful discussions and to marvel at the diversity of nature – both in Vietnam and in Germany. Help to shape the future: starting today, but continuing beyond today. Let's not compromise our limited natural resources because of a lack of financial resources now! Time, money and dedication invested today are an investment for our lives tomorrow.

Yours faithfully,

Opening Message - Mr. Ahmed Djoghlaf

Secretariat of the Convention on Biological Diversity, Executive Secretary, on the occasion of the International Day for biological diversity

CBD

Climate change is real. The United Nations lead scientific authority on climate change, the Intergovernmental Panel on Climate Change, in its most recent report, prepared by 2,500 experts from 130 countries, has indicated that the concentration of carbon dioxide (CO_2) in the Earth's atmosphere is at a level not seen for some 650,000 years. The cause: human activities. Biodiversity loss is real. The Millennium Ecosystem Assessment, the most authoritative statement on the health of the Earth's ecosystems, prepared by 1,395 scientists from 95 countries, has demonstrated the negative impact of human activities on the natural functioning of the planet. As a result, the ability of the planet to provide the goods and services that we, and future generations, need for our well-being is seriously and perhaps irreversibly jeopardized. We are indeed experiencing the greatest wave of extinctions since the disappearance of the dinosaurs. Extinction rates are rising by a factor of 1,000 above background rates. Every hour, three species disappear. Every day, up to 150 species are lost. Every year, between 18,000 and 55,000 species become extinct. The cause: human activities.

Climate change is one of the major driving forces behind the unprecedented loss of biodiversity. The second edition of the Global Biodiversity Outlook, recently issued by the Secretariat of the Convention on Biological Diversity, demonstrates that before the end of the century, species and ecosystems will struggle to keep pace with changes in temperature and rainfall and extinction rates will increase. This is already evident in the Arctic, the environmental "barometer" of our planet, where reduced sea-ice threatens to lead to the disappearance of the iconic polar bear and other unique species. The consequences of climate change will be distributed unequally around the globe, but will affect the most vulnerable countries. Africa, which contributes the least to climate change, will be the first to suffer. Climate change has already caused the level of Lake Victoria to drop by about 30%, Between 25 and 40 per cent of unique Africa' s species could be lost by 2085.

The relationship between biodiversity and climate change runs both ways. Climate change is an important driver of the loss of biodiversity. At the same time, the loss of biodiversity and the deterioration of natural habitats also contribute to climate change. It is said that every human being on Earth owes one breath to forests and a second to the oceans. The loss of coral reefs and the destruction of intact forests and mangroves will exacerbate climate change, biodiversity loss and their impacts.

Maintaining biodiversity will make ecosystems resilient in the face of a changing climate. Forests and peatlands represent an important storage place for carbon dioxide. Intact mangroves are an important protection against sea-level rise. A variety of crops and livestock are important resources against changes to the rhythm of the seasons.

Climate change is indeed an energy and a security issue but is also an environmental issue. Biodiversity loss is an environmental issue but it is also an economic, financial, cultural, ethical as well as a security issue. Coinciding with the Polar Year, this year's celebration by the international community of the International Day for Biological Diversity, on 22 May, offers a unique opportunity to acknowledge that climate change and biodiversity are two faces of the same coin of life. Addressing both requires the mutually supportive implementation of the Rio conventions for the benefit of life on Earth. We in the Secretariat of the Convention on life on Earth shall spare no effort to achieve such a strategic objective.

We wish all the countries of the world and their people a successful and memorable celebration.

Opening remarks - Dr. Vu Van Trieu

Country Representative of IUCN Vietnam at the Symposium on Biological Diversity and Climate Change

Excellencies Prof. Manfred Niekisch,
Distinguished Guests,
Ladies and Gentlemen,

On behalf of the IUCN- The World Conservation Union, Vietnam Country Office, I warmly welcome all the distinguished delegates and guests to Hanoi to attend this important event that IUCN had the pleasure to co-organize with MONRE and GTZ.

Also, I warmly welcome Prof. Manfred Niekisch who has accepted to be the Ambassador for the Countdown 2010 Initiative in Viet Nam.

Ladies and Gentlemen,

Countdown 2010 is a network of active partners working together towards the 2010 biodiversity target. Nearly all countries of the world came together for the World Summit on Sustainable Development in 2002 and promised to 'achieve by 2010 a significant reduction in the current rate of loss of biological diversity'. Since 2002, Countdown 2010 has become a global initiative and each partner all over the world commits additional efforts to tackle the causes of biodiversity loss.

IUCN VN is creating a Countdown 2010 Hub in Viet Nam, Laos and Cambodia; this afternoon, after Prof. Niekisch's presentation, we will have a ceremony for the signing of the Countdown 2010 declaration. Such declaration is an important step to show our effort to halt the loss of biodiversity by 2010. We strongly invite you all to sign it and become partner to the Countdown 2010 network."

I hope that the participants to the Meeting will find that it is really necessary and useful for biodiversity conservation in Vietnam and I wish the Meeting success.

I wish you, Prof. Niekisch, distinguished delegates and representatives good health, happiness and an enjoyable time in Vietnam.

Thank you for your attention.

Session 1 – Overview

Challenges of Climate Change and Biodiversity Loss for South East Asian Countries – Links to Poverty and Sustainable Development

Linkages between Biodiversity Conservation, Climate Change and Poverty Alleviation
Prof. Dr. Manfred Niekisch, IUCN

Climate Change and Adaptation – Overview on scientific status and international initiatives
Dr. Bernd-Markus Liss, GTZ Climate Protection Programme, AGEG Consultant

Stern Review – The Economics of Climate Change, Summary of Conclusions
Mr. Donal Brown, DFID, Head of Office

Effects of Sea Level Rise on Critical Natural Habitats in Vietnam
John Pilgrim, BirdLife International, Conservative Advisor

The impact of ENSO on the weather, climate, environment and Viet Nam's socio-economic status
Prof. Dr. Nguyen Duc Ngu, Center for Hydro – Meteorological and Environment Science and Technology (CHMEST), Viet Nam Union of Science and Technology Associations (VUSTA)

Linkages between Biodiversity Conservation, Climate Change and Poverty Alleviation

Prof. Dr. Manfred Niekisch, IUCN

No paper available, please view appropriate presentation in the attached CD.

Climate Change and Adaptation – Overview on scientific status and international initiatives

Dr. Bernd-Markus Liss, GTZ Climate Protection Programme, AGEG Consultant

Climate change caused by human activities is a fact. Since 1780 the concentration of CO_2 in the global atmosphere has increased by one third. Since the beginning of systematic weather statistics in 1850 the average temperature world-wide has increased by 0.74 ºC, whereby temperature in the arctic has increased twice as much compared to global temperature rise. Eleven out of the twelve past years are among the twelve warmest since 1850. In the 20th century the sea level has risen by 17 cm, snow covered areas have decreased by about 5% since 1980. The number and intensity of extreme weather events have increased, tropical storms have become stronger. Depending on the scenario, the average temperature for the period 2090 – 2099 will be 1.1 – 6.4 ºC higher than the average in 1980 – 1990. 20 – 30% of all animal and plant species will be extinct with an average temperature rise of 1.5 – 2.5%. Increased floods in conjunction with sea level rise will threaten large areas of low lands causing sever damage to economy and ecology. Extreme weather events will result in mounting social and ecological cost, while affecting the health of many million people. Storms, heat waves, flooding and fire will result in increased incidence of death, sickness and injuries, malnutrition and follow-up diseases.

In order to prevent catastrophic impacts of climate change, the average temperature rise needs to be limited to + 2 ºC during the next 50 years. This requires a reduction of CO_2 and other greenhouse gas emissions globally by 85% during this period. Urgent action is necessary, since reduction needs to start already by 2015 to be effective to this end. But even with such a reduction many impacts of climate change will happen. Therefore major efforts need to be taken for adaptation to climate change. This requires mainstreaming of climate change in all sectors and at all levels. At the micro- and meso level this includes, inter alia, protection and maintenance of gene pools (agro-/forest biodiversity), watershed management, introduction of drought resistant seeds, adaptation of infrastructure to climate change, adjustment of settlement and construction planning, and disaster preparedness. Macro level adaptation measures refer i.a. to adjusted approaches in protected area management, management of resettlement and migration processes, integration of adaptation into planning processes of relevant line ministries, introduction of special insurance products. Emphasis should be on integrated approaches to reduce vulnerability. GTZ is spearheading these efforts in mainstreaming climate protection in technical assistance projects and supporting pilot adaptation processes.

STERN REVIEW –
The Economics of Climate Change, Summary of Conclusions

Mr. Donal Brown, DFID, Head of Office

There is still time to avoid the worst impacts of climate change, if we take strong action now. The scientific evidence is now overwhelming: climate change is a serious global threat, and it demands an urgent global response. This Review has assessed a wide range of evidence on the impacts of climate change and on the economic costs, and has used a number of different techniques to assess costs and risks. From all of these perspectives, the evidence gathered by the Review leads to a simple conclusion: the benefits of strong and early action far outweigh the economic costs of not acting. Climate change will affect the basic elements of life for people around the world –access to water, food production, health, and the environment. Hundreds of millions of people could suffer hunger, water shortages and coastal flooding as the world warms. Using the results from formal economic models, the Review estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more. In contrast, the costs of action – reducing greenhouse gas emissions to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year. The investment that takes place in the next 10-20 years will have a profound effect on the climate in the second half of this century and in the next. Our actions now and over the coming decades could create risks of major disruption to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes. So prompt and strong action is clearly warranted. Because climate change is a global problem, the response to it must be international. It must be based on a shared vision of long-term goals and agreement on frameworks that will accelerate action over the next decade, and it must build on mutually reinforcing approaches at national, regional and international level.

Climate change could have very serious impacts on growth and development.

If no action is taken to reduce emissions, the concentration of greenhouse gases in the atmosphere could reach double its pre-industrial level as early as 2035, virtually committing us to a global average temperature rise of over 2°C. In the longer term, there would be more than a 50% chance that the temperature rise would exceed 5°C. This rise would be very dangerous indeed; it is equivalent to the change in average temperatures from the last ice age to today. Such a radical change in the – where people live and how they live their lives. Even at more moderate levels of warming, all the evidence – from detailed studies of regional and sectoral impacts of changing weather patterns through to economic models of the global effects – shows that climate change will have serious impacts on world output, on human life and on the environment. All countries will be affected. The most vulnerable – the poorest countries and populations – will suffer earliest and most, even though they have contributed least to the causes of climate change. The costs of extreme weather, including floods, droughts and storms, are already rising, including for rich countries. Adaptation to climate change – that is, taking steps to build resilience and minimize costs – is essential. It is no longer possible to prevent the climate change that will take place over the next two to three decades, but it is still possible to protect our societies and economies from its impacts to some extent – for example, by providing better information, improved planning and more climate-resilient crops and infrastructure. Adaptation will cost tens of billions of dollars a year in developing countries alone, and will put still further pressure on already scarce resources. Adaptation efforts, particularly in developing countries, should be accelerated.

The costs of stabilising the climate are significant but manageable; delay would be dangerous and much more costly.

The risks of the worst impacts of climate change can be substantially reduced if greenhouse gas levels in the atmosphere can be stabilised between 450 and 550ppm CO2 equivalent (CO2e). The current level is 430ppm CO2e today, and it is rising at more than 2ppm each year. Stabilisation in this range would require emissions to be at least 25% below current levels by 2050, and perhaps much more. Ultimately, stabilisation – at whatever level – requires that annual emissions be brought down to more than 80% below current levels. This is a major challenge, but sustained long-term action can achieve it at costs that are low in comparison to the risks of inaction. Central estimates of the annual costs of achieving stabilisation between 500 and 550ppm CO2e are around

1% of global GDP, if we start to take strong action now. Costs could be even lower than that if there are major gains in efficiency, or if the strong co-benefits, for example from reduced air pollution, are measured. Costs willbe higher if innovation in low-carbon technologies is slower than expected, or if policy-makers fail to make the most of economic instruments that allow emissions to be reduced whenever, wherever and however it is cheapest to do so. It would already be very difficult and costly to aim to stabilise at 450ppm CO2e. If we delay, the opportunity to stabilise at 500-550ppm CO2e may slip away.

Action on climate change is required across all countries, and it need not cap the aspirations for growth of rich or poor countries.

The costs of taking action are not evenly distributed across sectors or around the world. Even if the rich world takes on responsibility for absolute cuts in emissions of 60-80% by 2050, developing countries must take significant action too. But developing countries should not be required to bear the full costs of this action alone, and they will not have to. Carbon markets in rich countries are already beginning to deliver flows of finance to support low-carbon development, including through the Clean Development Mechanism. A transformation of these flows is now required to support action on the scale required.

STERN REVIEW: The Economics of Climate Change

Action on climate change will also create significant business opportunities, as new markets are created in low-carbon energy technologies and other low-carbon goods and services. These markets could grow to be worth hundreds of billions of dollars each year, and employment in these sectors will expand accordingly. The world does not need to choose between averting climate change and promoting growth and development. Changes in energy technologies and in the structure of economies have created opportunities to decouple growth from greenhouse gas emissions. Indeed, ignoring climate change will eventually damage economic growth. Tackling climate change is the pro-growth strategy for the longer term, and it can be done in a way that does not cap the aspirations for growth of rich or poor countries.

A range of options exists to cut emissions; strong, deliberate policy action is required to motivate their take-up.

Emissions can be cut through increased energy efficiency, changes in demand, and through adoption of clean power, heat and transport technologies. The power sector around the world would need to be at least 60% decarbonised by 2050 for atmospheric concentrations to stabilise at or below 550ppm CO2e, and deep emissions cuts will also be required in the transport sector. Even with very strong expansion of the use of renewable energy and other lowcarbon energy sources, fossil fuels could still make up over half of global energy supply in 2050. Coal will continue to be important in the energy mix around the world, including in fast-growing economies. Extensive carbon capture and storage will be necessary to allow the continued use of fossil fuels without damage to the atmosphere. Cuts in non-energy emissions, such as those resulting from deforestation and from agricultural and industrial processes, are also essential. With strong, deliberate policy choices, it is possible to reduce emissions in both developed and developing economies on the scale necessary for stabilisation in the required range while continuing to grow. Climate change is the greatest market failure the world has ever seen, and it interacts with other market imperfections. Three elements of policy are required for an effective global response. The first is the pricing of carbon, implemented through tax, trading or regulation. The second is policy to support innovation and the deployment of low-carbon technologies. And the third is action to remove barriers to energy efficiency, and to inform, educate and persuade individuals about what they can do to respond to climate change.

Climate change demands an international response, based on a shared understanding of long-term goals and agreement on frameworks for action.

Many countries and regions are taking action already: the EU, California and China are among those with the most ambitious policies that will reduce greenhouse gas emissions. The UN Framework Convention on Climate Change and the Kyoto Protocol provide a basis for international co-operation, along with a range of partnerships and other approaches. But more ambitious action is now required around the world.

STERN REVIEW: The Economics of Climate Change

Countries facing diverse circumstances will use different approaches to make their contribution to tackling climate change. But action by individual countries is not enough. Each country, however large, is just a part of the problem. It is essential to create a shared international vision of long-term goals, and to build the international frameworks that will help each country to play its part in meeting these common goals.

Key elements of future international frameworks should include:

- **Emissions trading:** Expanding and linking the growing number of emissions trading schemes around the world is a powerful way to promote cost-effective reductions in emissions and to bring forward action in developing countries: strong targets in rich countries could drive flows amounting to tens of billions of dollars each year to support the transition to low-carbon development paths.
- **Technology cooperation**: Informal co-ordination as well as formal agreements can boost the effectiveness of investments in innovation around the world. Globally, support for energy R&D should at least double, and support for the deployment of new low-carbon technologies should increase up to five-fold. International cooperation on product standards is a powerful way to boost energy efficiency.
- **Action to reduce deforestation:** The loss of natural forests around the world contributes more to global emissions each year than the transport sector. Curbing deforestation is a highly cost-effective way to reduce emissions; largescale international pilot programmes to explore the best ways to do this could get underway very quickly.
- **Adaptation:** The poorest countries are most vulnerable to climate change. It is essential that climate change be fully integrated into development policy, and that rich countries honour their pledges to increase support through overseas development assistance. International funding should also support improved regional information on climate change impacts, and research into new crop varieties that will be more resilient to drought and flood.

Effects of Sea Level Rise on Critical Natural Habitats in Vietnam

John Pilgrim, BirdLife International, Conservative Advisor

In a recent World Bank study modelling negative impacts of climate change-induced sea level rise[1], Vietnam was predicted to be one of the two worst-affected developing countries worldwide. Severe impacts were predicted on human population, agricultural land, and GDP, with a large proportion of Vietnam's most productive land predicted to be inundated. However, the study provided little insight into initial impacts of sea level rise on biodiversity, let alone knock-on effects from increased pressure for agricultural land or living space. Assessing impacts of sea level rise on Vietnam's remaining natural habitats is critically important, not just to guide biodiversity conservation, but also because poor people are disproportionately dependent on these natural resources.

The scenarios presented in the World Bank study are cited as one of the key reasons that a conference to address climate change adaptation and biodiversity conservation issues in Vietnam was jointly organised by German Technical Cooperation, GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit), and the German Development Service, DED (Deutscher Entwicklungsdienst), on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), in cooperation with the Vietnamese Ministry for Natural Resources and Environment (MoNRE) and the Secretariat of the Convention on Biological Diversity (CBD) as well as other national and international partners. Like the World Bank analysis, this study does not address impacts on biodiversity from climate change effects other than sea level rise, and does not assess knock-on effects of sea level rise. However, this study does provide an initial analysis of impacts on biodiversity of sea level rise, by modelling the same scenarios and using official World Bank definitions of biodiversity.

The World Bank defines 'natural habitats' as "land and water areas where the ecosystems' biological communities are formed largely by native plant and animal species, and human activity has not essentially modified the area's primary ecological functions"[2]. Further, 'Critical Natural Habitats' are defined as "(i) existing protected areas and areas officially proposed by governments as protected areas... and sites that maintain conditions vital for the viability of these protected areas... or (ii) sites identified on supplementary lists... Such sites may include... sites that are critical for rare, vulnerable, migratory, or endangered species."[3]
For the purposes of this study, Critical Natural Habitats thus comprise existing and proposed protected areas and areas supporting important populations of threatened ('endangered'), restricted-range, or congregatory species. Although knowledge of freshwater biodiversity in Vietnam is fragmentary, enough data exist to identify and map existing and proposed terrestrial protected areas[4], and terrestrial areas supporting important populations of threatened, restricted-range, or congregatory species, whether as Key Biodiversity Areas (KBAs)[5] or Important Bird Areas (IBAs; a subset of KBAs)[6]. Overall, in these terms, Vietnam has Critical Natural Habitats at 286 sites, comprising 139 proposed or existing protected areas, 40 KBAs that are unprotected, and 107 areas that are both KBAs and protected areas.

By modelling the same range of sea level rise scenarios as in the World Bank study against maps of these Critical Natural Habitats, and identifying sites at which there may be a more or less

[1] Dasgupta, S., Laplante, B., Meisner, C., Wheeler, D. and Yan, J. (2007) *The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis.* World Bank Policy Research Working Paper 4136, February 2007. World Bank, Washington, DC.
[2] World Bank Operational Policy 4.04
[3] World Bank Operational Policy 4.04
[4] Tordoff, A. W., Tran Quoc Bao, Nguyen Duc Tu and Le Manh Hung (Eds.) (2004) *Sourcebook of existing and proposed protected areas in Vietnam. Second edition.* BirdLife International *in Indochina* and the Forest Protection Department of the Ministry of Agriculture and Rural Development, Hanoi.
[5] Critical Ecosystem Partnership Fund (in prep.) Ecosystem Profile: Indochina Region of the Indo-Burma biodiversity hotspot.
[6] Tordoff, A. W. (Ed.) (2002) *Directory of Important Bird Areas in Vietnam.* BirdLife International *in Indochina* and the Institute of Ecology and Biological Resources, Hanoi.

continuous inundation of salt water from the sea, it is predicted that a 1m sea level rise may impact 78 (27% of) Critical Natural Habitats to some degree, comprising 46 (33% of) Protected Areas, 9 (23% of) KBAs, and 23 (21% of) areas that are both protected areas and KBAs (Table 1). Likewise, a 5m sea level rise may impact 87 (30% of) Critical Natural Habitats to some degree, comprising 52 (37% of) Protected Areas, 10 (25% of) KBAs, and 25 (23% of) areas that are both protected areas and KBAs (Table 1).

The magnitude of these potential impacts is striking – a quarter to a third of all Critical Natural Habitats in Vietnam may be impacted by sea level rise alone under climate change scenarios that are widely accepted as realistic. These areas include a large proportion of Vietnam's existing and proposed protected areas, since they are concentrated on islands and coastal areas. It is even more remarkable that a relatively small (1m) rise in sea level will impact almost as many Critical Natural Habitats – and almost as much area within sites – as a large rise in sea level (5m). Clearly Vietnam's biodiversity is facing a crisis from sea level rise, even under the most conservative climate change scenarios. It is not only coastal provinces and land managers that should be concerned – in the south, the effects of just a 1m sea level rise stretch into areas of the Mekong Delta right through Vietnam and into Cambodia, over 180km inland, and in the north, extensive limestone aquifers will ensure that effects of salination spread widely, even to areas far inland such as Van Long Nature Reserve in Ninh Binh Province.

There are no easy solutions to climate change or sea level rise. However, many countries have already recognised the problems and are starting to not only prevent the situation getting any worse, through ambitious targets to reduce greenhouse gas emissions, but also mitigate impacts. Vietnam has huge potential to reduce its own national greenhouse gas emissions through conservation of its remaining forest (tropical deforestation globally accounts for around 20% of all greenhouse gas emissions), embracing renewable power (particularly wind, solar, and tidal technologies that do not have the same detrimental environmental effects as hydropower dams), and forming a rational policy on transport that emphasises – contra current plans – a shift towards the use of more sustainable transport (particularly buses and rail) and away from large single-passenger vehicles. Such efforts may seem trivial, but it is worth noting that the transport sector often accounts for more than a quarter of, and remains the fastest growing source of, greenhouse gas emissions in industrialised countries.

For Critical Natural Habitats that are already facing impacts from sea level rise, Vietnam faces very difficult choices. Firstly, these sites could be ignored, or 'given up', and their biodiversity and ecosystem servies abandoned. Given the scale of pending problems, this may – sadly – be the most efficient solution for sites that are not irreplaceable, i.e. the species and ecosystems that they contain are found in other places that can be conserved. Secondly, the government could put its faith in a sea defence strategy and simply build up sea walls to protect sea level rise. Unfortunately, such solutions have been proven unrealistically expensive in many countries. Finally, there is perhaps the most pragmatic option of continuing to conserve irreplaceable Critical Natural Habitats in the short-term, while trying to find long-term solutions. For example, while sea defence was the prevailing policy in the United Kingdom for many years, official government policy now includes 'managed retreat' or 'coastal realignment', whereby coastal land under threat is now slowly released to the sea and natural saltmarshes – rather than sea walls – actively regenerated in order to create new habitats and to buffer farmland from the sea. Habitat recreation is difficult and expensive, but few choices may remain in the long-term unless Vietnam is willing to watch its natural resources and heritage be washed away.

Given the concentration of sea level rise impacts in the low-lying Mekong and Red River Deltas, many of the Critical Natural Habitats that are predicted to be impacted are understandably wetlands. Freshwater areas in particular (as they will be most affected by salination from sea level rise) and wetlands in general, are a scarce but essential resource for not only biodiversity, but also for the ecosystem services they provide to humans, such as drinking water, sanitation, fish for food, and irrigation for ricefields. As always, poor people are most reliant on the natural environment and these basic ecosystem services for their livelihoods. Impacts on biodiversity, and the ecosystem services it provides, thus urgently need to be considered in plans to mitigate climate change, not only by the government and environmental organisations, but also by development organisations.

Table 1: Critical Natural Habitats potentially impacted by sea level rise

Name	KBA	PA	1m	5m
Bac Lieu	*	*	*	*
Cat Ba	*	*	*	*
Can Gio	*	*	*	*
Hai Van-Hon Son Tra	*	*	*	*
Hoa Lu	*	*	*	*
Huong Son	*	*		*
Kien Luong (Ha Tien)	*	*	*	*
Kien Luong	*	*	*	*
Lac Thuy-Kim Bang	*	*		*
Lang Sen	*	*	*	*
Mui Ca Mau i	*	*	*	*
Mui Ca Mau ii	*	*	*	*
Nam Hai Van	*	*	*	*
Nghia Hung	*	*	*	*
Nui Chua	*	*	*	*
Phu Quoc	*	*	*	*
Phu Quoc	*	*	*	*
Thai Thuy	*	*	*	*
Tien Hai	*	*	*	*
Tien Lang	*	*	*	*
Tram Chim	*	*	*	*
U Minh Thuong	*	*	*	*
Van Long	*	*	*	*
Xuan Thuy	*	*	*	*
An Hai	*		*	*
Ba Tri	*		*	*
Bim Son	*		*	*
Binh Dai	*		*	*
Ca Mau	*		*	*
Chu Hang	*		*	*
Ha Nam	*		*	*
Tra Co	*		*	*
Tra Cu	*		*	*
Trung Son	*			*
Bai Chay		*	*	*
Bai Tu Long		*	*	*
Ban Dao Son Tra		*	*	*
Binh Chanh		*	*	*
Binh Chau-Phuoc Buu		*	*	*
Cac Dao Vinh Ha Long		*	*	*
Cha La		*	*	*
Con Dao i		*	*	*
Con Dao ii		*	*	*
Con Son		*		*
Cu Lao Cham i		*	*	*
Cu Lao Cham ii		*	*	*
Cu Mong		*	*	*
Dam Doi		*	*	*
Dao Bach Long Vi		*	*	*
Dao Cat Ba		*	*	*
Dao Co To		*	*	*
Dao Con Co		*	*	*
Dao Ly Son		*	*	*

Dao Phu Quy		*	*	*
Dao Tran		*	*	*
Den Ba Trieu		*		*
Deo Ca-Hon Nua		*	*	*
Do Son		*	*	*
Dong Thap Muoi		*	*	*
Ghenh Rang		*	*	*
Hai Van-Hon Son Tra		*	*	*
Ham Rong		*	*	*
Hon Cau-Vinh Hao		*	*	*
Hon Chong		*	*	*
Hon Khoai		*	*	*
Hon Me		*	*	*
Hon Mun		*	*	*
Lung Ngoc Hoang		*	*	*
Nai		*	*	*
Ngoc Trao		*		*
Nam Du		*	*	*
Nha Phu-Hon Heo		*	*	*
Nui Ba		*	*	*
Nui Cam		*	*	*
Nui Chung		*		*
Nui Sam		*	*	*
O Loan		*	*	*
Quy Nhon		*	*	*
Rung Thong Dong Son		*		*
Sam Son		*		*
Ta Kou		*	*	*
Tam Giang-Cau Hai		*	*	*
Thanh Phu		*	*	*
Thuy Trieu		*	*	*
Tra Su		*	*	*
Vo Doi		*	*	*

The impact of ENSO on the weather, climate, environment and Viet Nam's socio-economic status

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Introduction

"El Nino" is understood as the abnormal warming of surface ocean waters in the eastern equatorial Pacific, it lasts from 8 – 12 months or even longer. EL Nino occurs once in 3 – 4 years; however, the frequency may be more or less than usual. "La Nina" is characterized as the unusual cold ocean temperatures in the eastern equatorial Pacific, La Nina has the same frequency or lesser than El Nino.

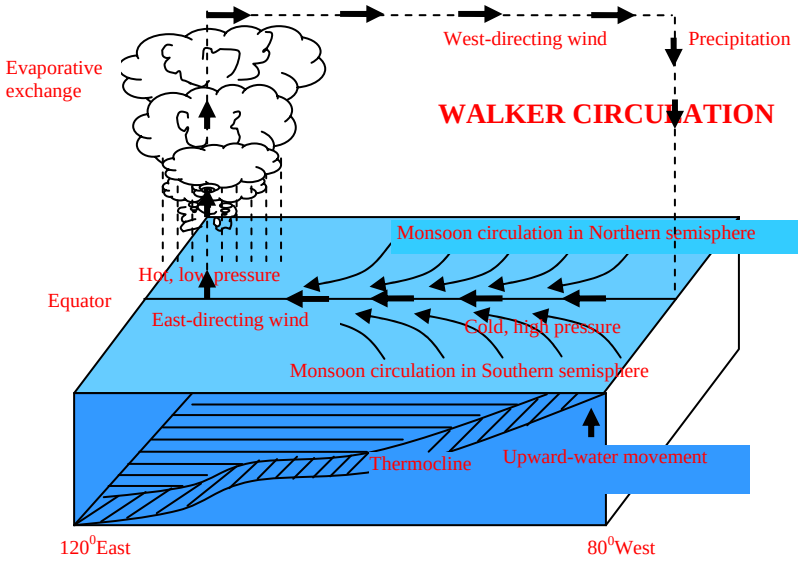
ENSO is the abbreviation for El Nino Southern Oscillation, which is used to mention both El Nino and La Nina and related to the atmospheric oscillation between the Eastern Pacific and Western Pacific – Eastern Indian Ocean (referred as the Southern Oscillation) in order to distinguish from the atmospheric oscillation in Northern Atlantic Ocean. El Nino and La Nina phenomenon have impacts on the global weather and climate in the different and various levels. However; the main impacts, which represent the distinctive characteristics of each phenomenon, could be indentified for the specific regions.El Nino and La Nina phenomenon represents the anomalies in the ocean – atmosphere system with the frequent or periodical interval between years. In the context of Climate change, ENSO phenomenon also has the anomalies in the intensity. The researches of ENSO phenomenon aim in understanding the physical mechanism, characteristics, rules of the process and the consequences caused by its impacts; therefore, we can give the early warning for the occurrence of ENSO, the possible impacts on the weather, climate and socio-economic status so as to recommend the effective measures to prevent, reduce and mitigate the damage caused by ENSO.

I. General overview of the physical mechanism of ENSO

Southern Oscillation and Walker Circulation

Southern Oscillation is the large-scale and interannual fluctuation of atmospheric pressure in Eastern and Western of the equatorial tropical pacific. Gilbert I. Walker found this phenomenon in the end of 1920s; 40 years after, Jacob Bjerknes (1966) confirmed the large-scale oscillation of the monsoon circulation in the North and South hemisphere of Pacific Ocean, which was related to the Southern Oscillation. When the monsoon circulation was strong, the relatively-cold water from the equatorial upwelling in the Southern America coast was formed by the pressure of the East-directing wind on the ocean surface and expanded westwards to the central of the Pacific Ocean. The difference of atmospheric pressure between the East (High) and West (Low) and the temperature between the East (Low) and West (High) leaded to the reverse movement in the low air layer (East-directing wind) and the high air layer (West-directing wind); the sinking air movement appeared in the East, the rising air movement appeared in the West; the circulation was created. Bjerknes called the circulation "Walker Circulation". The stronger difference in temperature and atmospheric pressure between the East and West of Pacific Ocean, The more powerful the Walker Circulation was and vice versa, the lower difference in temperature and atmospheric pressure, the weaker the Walker Circulation was.

Figure 1.1: Walker Circulation in the normal condition



Normally, the ocean temperature decreases gradually in accordance with the depth. Therefore; from the ocean surface to the depth of hundreds of meter, the ocean temperature in Western Pacific is higher than the Eastern Pacific. Then a transitory layer of water (Usually called as "Thermocline") between the hotter layer of upper water and the colder layer of below water with the declination from Eastern to Western Pacific. The depth of Thermocline in the West coast is around 200 meter and decreased gradually to the East coast to only tens of meter. When the Walker Circulation becomes stronger, the activity of upwelling intensifies and the declination of Thermocline becomes steeper; in contrast, when the Walker Circulation gets weaker, the activity of upwelling is restrained and the declination of Thermocline is decreased.

The ocean – atmosphere interaction

The ocean – atmosphere interaction is the exchange process of heat, moisture, motive power and energy between the ocean surface water and the upper air layer, which occurs mainly through the circulation and the atmospheric whirls. Above the Eastern equatorial Pacific (The warm pool), where the East-directing wind and the West-directing wind in the lower layer converses, the deep circulation in the West branch of Walker Circulation occurs frequently. Cloudy, High amount of rainfall and the Outgoing Long wave Radiation (OLR) from the ocean surface usually do not exceed 240w/m^2. Therefore, the Quantity of Shortwave Radiation (Qsw) is usually smaller than the Quantity of Evaporation (Qe).

In contrast, in the Eastern Equatorial Pacific, Walker Circulation usually has the sinking air in the Eastern branch; the activity of circulation is restrained, the amount of cloud and rainfall is little. The OLR from the ocean surface regularly reaches the maximal values (>280w/m2). The Shortwave Solar Radiation achieves the maximal values and bigger value than the Qe.

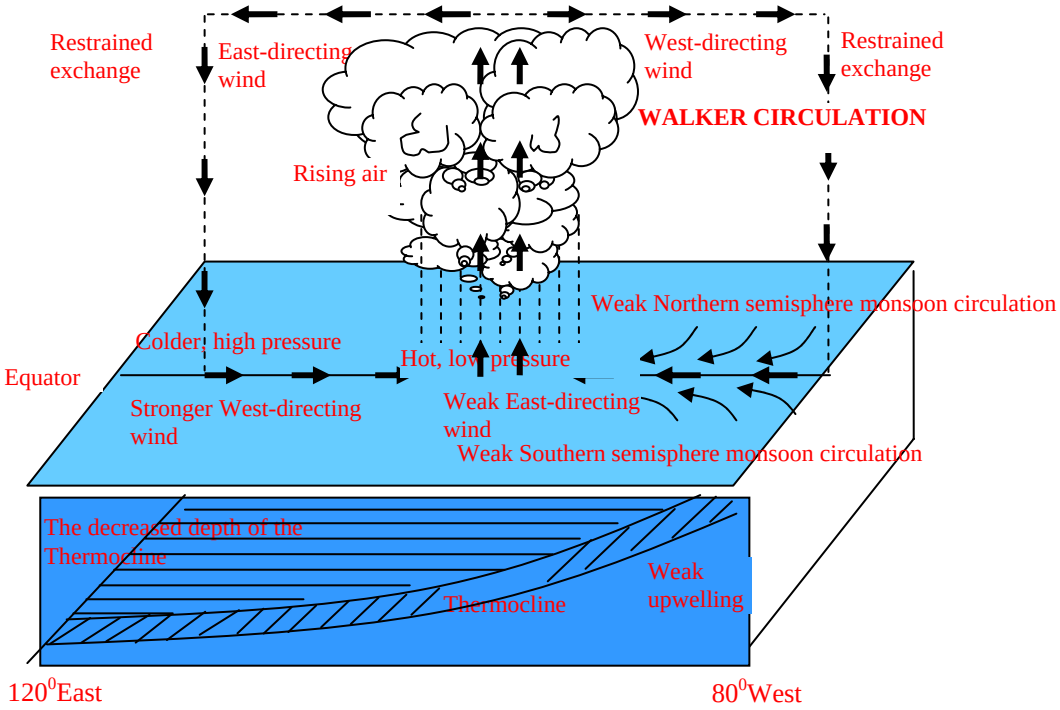
When Walker Circulation operates lower than usual (The weak East-directing wind in the lower layer; meanwhile, the West-directing wind in the Eastern Equatorial Pacific becomes stronger), the deep convection in Western Pacific is moved easterly to the central Pacific. Which intensify the whirls in the atmosphere of this region, the amount of cloud and rainfall increase; the OLR reduces the transmission of heat and moisture from the ocean into the atmosphere reduces; the OLR increases, the transmission of heat and moisture from the ocean into the atmosphere increases.

The operational mechanism of ENSO

Under the pressure of East-directing wind in the lower layer, the ocean surface in the Equatorial Pacific declines eastwards (The Sea level in Western Pacific coast is around 30 – 70 cm higher than the Eastern coast). When Walker Circulation declines or divides into 2 parts, the pressure of East-directing wind on the ocean surface reduces. This results in the declination of the upwelling

and the Easterly flow and creates an oceanic equatorial flow (Kelvin wave) transmitting eastwards. The heat from the warm pool is transferred to the central and eastern Pacific leading to the abnormal warming of the ocean surface. As a result, the difference in temperature of the ocean water between the Eastern and Western area reduces; meanwhile, the temperature of the ocean in the East increases, the vertical air circulation in the water increases remarkably the disturbance of the ocean water.

Figure 1.2: Walker Circulation in the condition of El Nino



It takes 50 days on average to disperse the Kelvin wave to Eastern Pacific and reflects. This reflection causes an oceanic wave (Rossby wave) which moves westwards with the average period of 6 months. Therefore, the warm surface water is moved westwards. The mutual reflection between Kelvin wave and Rossby wave in two banks of Pacific Ocean determines the duration and the instability of the phases in one process of El Nino. Therefore, it is noticeable that Kelvin wave reduces the difference in the temperature between Eastern and Western Pacific (The negative effect); in contrast, Rossby produces the positive effect. In fact, the long-term sustainability for the abnormal warming of the ocean surface water in the central and Eastern equatorial Pacific (One process of El Nino) proved the thermal effect of the stratosphere caused by Kelvin wave is greater than the effect of upwelling caused by Rossby in this ocean area. In the Eastern Equatorial Pacific, the change (Reduction) in the temperature of the ocean surface water during the process of El Nino is not greater than in the central and Eastern Equatorial Pacific, which proved that the thermal effects caused by Kelvin wave and Rossby wave are remarkably eliminated.

When the Walker Circulation is stronger than usual, the pressure of East-directing wind on the ocean surface increases resulting in the reverse process with El Nino process (La Nina process) due to the stronger activity of upwelling and the increase of the Easterly cold current which caused the cold anomalies in the Central and Eastern Pacific.

The main unstable factors have impacts on the Walker Circulation in the Pacific Ocean resulting in the commencement of one ENSO process

1/ The fluctuation of the high pressure of the subtropical Pacific in terms of intensity, scope and center of the high pressure, which have the direct effect on the monsoon circulation of two hemispheres.

2/ The rapid increase of West-directing wind in Eastern equatorial Pacific is related to the operation of the high pressure in Southern Indian Ocean and in the Oceania.

3/ The Madden – Julian Oscillation (MJO) has the circulation of 30 – 60 days in Eastern Indian Ocean and Western Equatorial Pacific.

4/ The abnormal activity of the tropical cyclones in the ocean area which is far away from the equator and the central Pacific Ocean, is related to the operation of the West-directing wind in the average latitude.

II. The process of ENSO during the period of 1951 – 2005

2.1 The indicators of identification for the processes of ENSO

In this research, it is understood that:

One process of El Nino is the continuous period which lasts over 6 months and has the 5-month running mean sea surface temperature deviation (SSTA) in the NINO.3 index (5^0N – 5^0S, 15^0W – 90^0W) larger or equal to $0,5^0$C.

One process of La Nina is the continuous period which lasts over 6 months and has the 5-month running mean sea surface temperature deviation (SSTA) in the NINO.3 index smaller or equal to $0,5^0$C.

1.2The processes of El Nino and La Nina in the period of 1951 - 2005

Table 1: The periods of hot ENSO (El Nino)

Order	Period of El Nino	The starting month	The closing month	Duration	Maximal SSTA (^{0}C) and the occurring month	
1	1951/1952	6/1951	1/1952	8		10/1951
2	1953	3/1953	11/1953	9	1.1	9/1953
3	1957/1958	4/1957	5/1958	14	1.8	12/1957
4	1963/1964	6/1963	2/1964	9	1.2	12/0963
5	1965/1966	5/1965	2/1966	10	1.8	12/1965
6	1968/69/70	9/1968	2/1970	18	1.4	12/1969
7	1972/1973	4/1972	3/1973	12	2.6	12/1972
8	1976/1977	6/1976	2/1977	9	1.2	9,10/1976
9	1979	7/1979	12/1979	6	1.2	9/1979
10	1982/1983	4/1982	9/1983	18	3.6	1/1983
11	1986/87/88	9/1986	1/1988	17	2.0	9/1987
12	1991/1992	4/1991	6/1992	15	1.7	1/1992
13	1993	2/1993	8/1993	7	1.5	5/1993
14	1997/1998	4/1997	6/1998	15	3.9	12/1997
15	2002/2003	7/2002	1/2003	7	1.4	11,12/2002

Note: The underlined periods are the strong El Nino

Table 2: The periods of cold ENSO (La Nina)

Order	Period of La Nina	The starting month	The closing month	Duration	Maximal SSTA (^{0}C) and the occurring month	
1	1949/1950	End of 1949	4/1950	-	-1.7	2/1950
2	1954/55/56	5/1954	2/1956	22	-2.0	11/1955
3	1964/1965	4/1964	1/1965	10	-1.2	12/1964
4	1967/1968	9/1967	4/1968	8	-1.3	2/1968
5	1970/1971	6/1970	12/1971	19	-1.5	12/1970
6	1973/1974	6/1973	3/1974	10	-1.4	1/1974
7	1975/1976	4/1975	3/1976	12	-1.5	12/1975, 1/1976
8	1984/1985	10/1984	12/1985	15	-1.2	12/1984
9	1988/1989	4/1988	3/1989	12	-1.7	11, 12/1988
10	1998/99/00	10/1998	3/2000	18	-1.6	1/2000

Note: The underlined periods are the strong La Nina

1.3 The comments on the characteristic of distribution and operation of the ENSO process

1/ In 55 years (1951 – 2005), there were:

- 15 periods of El Nino; of which:
- The longest period (1968 – 1970 and 1982 – 1983): 18 months.
- The shortest period (1979): 6 months.
- The average time per period: 12 months.
- 10 periods of La Nina; of which:
- The longest period (1954 – 1956): 22 months.
- The shortest period (1967 – 1968): 8 months.
- The average time per period: 13 months.
- 6 times of 2 consecutive El Nino, but only one time of 2 consecutive La Nina.

2/ There were 8 strong El Nino (Average SSTA per month ≥ $1,5^0$C)

There were 6 strong La Nina (Maximal SSTA in a month ≥ $1,5^0$C)

3/ Most periods of ENSO started in the spring season (March – May), especially for April, and ended in the winter season or spring season (December – April).

- There was no strong El Nino starting from middle of winter season or summer season.
- There was no strong La Nina starting from the middle of winter season.

4/ The strongest stage (Maximum) of each period of ENSO was in the middle of winter season (December – January).

5/ Each period of ENSO represents clearly 7 stages, each stage lasts 2 – 3 months.

1. The stage before commencement.
2. The stage of commencement.
3. The stage of development.
4. The stage of Transition.
5. The stage of maximum.
6. The stage of decrease.
7. The stage of disintegration.

II. The impact of ENSO on some factors and phenomena of Hydrometeorology.

3.1 The impact of ENSO on the activity of cyclones and tropical depressions

In 45 years (1956 – 2000), 311 cyclones and tropical depressions (Hereinafter called as the tropical cyclones) have direct impacts on Viet Nam; there have been 6.9 cyclones per year and 0.58 cyclones per month.

Table 3: The monthly and yearly average frequency of the tropical cyclones which have direct impact on Viet Nam (1956 – 2000)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Year
Frequency	**0**	**0**	**0,1**	**0,1**	**0,1**	**0,7**	**0,7**	**1,2**	**1,4**	**1,3**	**1,0**	**0,3**	**6,9**

Within the same period, there was the total of 150 months of El Nino with 63 tropical cyclones; each month had 0.42 cyclones on average, which was lower around 28% than the average of many years. Meanwhile, each month within the period of La Nina had 0.80 cyclones on average (86 cyclones/107 months), which was higher around 38% than the average of many years.

In the season of cyclones (From June to December), the average numbers of many years were 6.64 cyclones, each month in the season of cyclones had 0.95 cyclones. In the condition of El Nino, the whole season of cyclones had 4.83 cyclones on average; each month had 0.69 cyclones, which is lower around 27% than the average of many years. In contrast; in the condition of La Nina, the whole season of cyclones had 9.17 cyclones on average; each month had 1.31 cyclones, which was higher around 38% than the average of many years. Besides; in the condition of El Nino, the tropical cyclones usually concentrated on the middle of the season of cyclones (July, August and September). In the condition of La Nina, the tropical cyclones usually focused on the second half of the season of cyclones (September, October and November).

2.2 The impact of ENSO on the frequency of the front cold

In the years of El Nino and La Nina, the number of the front cold had impact on Viet Nam was lower than usual. The ratio between the total positive and negative standard deviation for the frequency of the cold front, which had impact on Viet Nam, only accounting for 70%. The activity of the cold front in Viet Nam ended earlier than usual.

Table 4: The standard deviation for the frequency of the cold front which had impact on Ha Noi within the months of El Nino and La Nina

Sign of Standard Deviation		1	2	3	4	5	6	7	8	9	10	11	12	Total
El Nino	Positive	7	4	1	2	5	7	2	1	7	9	9	6	60
	Negative	4	7	7	10	8	6	11	12	7	4	4	7	87
La Nina	Positive	0	2	2	3	5	3	0	4	4	7	4	8	42
	Negative	4	6	6	5	2	6	8	4	5	4	7	3	60

2.2The impact of ENSO on the temperature

Most of the regions in Viet Nam, the average temperature in the condition of El Nino is higher than usual the winter season has the noticeable difference than the summer season; the southern areas are under remarkable impact than the northern areas. In contrast; in the condition of La Nina, the average temperature of each month is lower than usual, the northern areas are under remarkable impact than the southern areas.

Table 5: The ratio between the positive and negative standard deviation of the average temperature between the months in the conditions of El Nino and La Nina

Station	Lang Son	Son La	Ha Noi	Vinh	Da Nang	Pleiku	Can Tho	Tan Son Nhat	Average
El Nino	1.4	1.5	1.2	1.2	1.8	1.3	1.6	2.0	1.5
La Nina	0.7	0.5	0.7	0.7	0.6	0.6	0.6	0.7	0.6

Besides; El Nino phenomenon, especially for the strong periods of El Nino (1982 – 1983, 1997 – 1998), created many records of the absolute highest temperature in many areas. In contrast, La Nina made the records of the absolute lowest temperature.

Table 6: Some records of the absolute highest temperature (Tx) and the absolute lowest temperature (Tm) in the periods of El Nino and La Nina

Station		Lang Son	Son La	Ha Noi	Vinh	Da Nang	Pleiku	Can Tho	Tan Son Nhat
El Nino	T_X (month/ year)	37.6 (7/83)	36.3 (3/98)	39.4 (6/83) 39.6 (6/98)	40.0 (5/98)	40.1 (6/98)	38.9 (5/98)	36.0 (4/98)	39.3 (5/98)
	Tm (month/ year)			5.4 (1/77) 10.6 (11/79)		13.1 (2/77)	8.6 (2/77)	16.5 (12/63)	
La Nina	T_X (month/ year)		39.5 (6/99)		40.0 (5/88)		37.3 (3/99)		39.7 (1/99)
	Tm (month/ year)	-1.7 (2/68) -1.5 (12/75)	-0.2 (12/75)	5.0 (2/68)	5.9 (1/74) 5.1 (12/99)	9.4 (12/99) 10.2 (1/74)	6.1 (12/75)	14.8 (1/63)	

2.3 The impact of ENSO on the rainfall

The reduction of rainfall in each period of ENSO is defined as the subtraction between the actual rainfall in each period of ENSO and the total of average rainfall of many years within the same period, same point of time. The reduction is represented by % (DR). The research results showed that most periods of El Nino caused reduction of rainfall in most of areas, DR was usually from 25

to 50%; most periods of La Nina cause the rainfall higher than the average of many years in the provinces of the Middle's coastal areas and the West of Southern Viet Nam, but they caused the reduction of rainfall in Northern Viet Nam, the Central Highland and the East of Southern Viet Nam (Table 6: The reduction of rainfall in the periods of ENSO in some areas).
It is noteworthy that most periods of ENSO caused the reduction of rain; however, some periods of El Nino and La Nina showed the records of the highest rainfall within 24 hours and the consecutive months of rain in some areas. This showed that ENSO increased the fluctuation of rain in Viet Nam.

2.4The impact of ENSO on the Sea level in the coastal areas and the islands of Viet Nam.

For the Sea level in the coastal areas and islands of Viet Nam, El Nino caused the negative effect ($\Delta h < 0$); in contrast, La Nina caused the positive effect ($\Delta h > 0$).

Table 7: The reduction of rain in the condition of ENSO in some areas

Characteristics	Vinh	Da Nang	Nha Trang	Phan Thiet	Plei Ku	Buon Ma Thuot	Da Lat	Note
The number of El Nino caused the reduction of rain in the whole period over the total 11 surveyed periods	6/11	8/11	9/11	10/11	7/11	10/11	8/11	
The reduction level of rain on average per one period of El Nino (%)	22,6 (12,4)	17,6 (12,8)	24,1 (19,7)	13,4 (12,2)	17,4 (11,1)	21,7 (19,7)	19,0 (13,8)	Number in ( ) is the average of the total 11 surveyed periods of El Nino
The number of La Nina caused the reduction in rain in the whole period over the total 8 surveyed periods	3/8	3/8	1/7	5/8	5/8	3/7	3/7	
The reduction level of rain on average over one period of La Nina (%)	15,0 (5,6)	19,2 (7,2)	47,2 (5,9)	17,0 (10,6)	18,0 (11,3)	20,9 (8,9)	9,7 (5,5)	Number in ( ) is the average of the total 8 surveyed periods of La Nina

2.5 The impact of ENSO on the salinity of Sea water in the coastal areas and islands of Viet Nam.

In general, El Nino increased the salinity; in contrast, La Nina reduced the salinity of Sea water in the coastal areas and islands of Viet Nam.

2.6 The impact of ENSO on the flow of rivers in Viet Nam

- In the years under the impact of El Nino, the annual flow of rivers was lower by over 10% than the average of many years.
- In the years under the impact of La Nina, the annual flow of rivers was usually higher by 80 – 100% than the average of many years; some rivers were reduced by 50 – 60% in several years.
- The flow in the flood season also had the similar characteristic: in the years under the impact of El Nino, the flow was lower than the average flow of many years, the ratio (%) between the flow of flood season and the average flow of many years reached by 65 – 95 %; in contrast, in the years under the impact of La Nina, this ratio reached by 101 – 110% and even by 130 – 140%

in some regions (The mountainous areas of Northern Viet Nam, the Middle and the Central Highland). However, the fluctuation of this characteristic under the condition of ENSO was very high, even in the years under the impact of El Nino, the flow of the flood season was higher than the average flow of many years; in contrast, in the years under the impact of La Nina, the flow was higher by 101 – 140 % than the average value of many years. The smallest flow of a month also had the similar characteristic.

2.7 The impact of ENSO on the output of the hydroelectricity

The relationship between the average water volume per year with the annual output of four hydroelectric plants including Hoa Binh, Thac Ba, Tri An, Da Nhim was in the direct proposition with the correlation rate of 0.5 – 0.8. Therefore, it is notable that ENSO had the impact on the reduction of the output for the hydroelectricity. Meanwhile, the impact of La Nina facilitated the increase in output of the above-mentioned hydroelectric plants.

2.8 The impact of ENSO on the agriculture

- In the condition of El Nino, the average turnover of the spring harvest reduced comparing with the previous harvest, especially for the Midland in Southern Viet Nam; in contrast, the turnover of the autumn harvest increased, especially for the Mekong River delta.
- In the condition of La Nina, the average turnover of the spring and the autumn harvest also increased than the previous harvests; of which, the spring harvest had the remarkable increase in the Red River delta, the autumn harvest had the remarkable increase in the Mekong river delta.
- In the condition of ENSO, the coverage of coffee plant that could be harvested and the turnover of coffee bean also increased comparing with the previous harvest; in the years under the impact of La Nina, the coverage of coffee plant was higher than in the years under the impact of El Nino, but the turnover of coffee bean in the years under the impact of El Nino was higher in the years under the impact of La Nina.

2.9 The impact of ENSO on people's lives and health

- In accordance with the statistics from 1977 to 2000, the total number of dead and missing people caused by the natural disaster was 14,962 people; of which 64 % of cases occurred in the years under the impact of ENSO (43% in the years under the impact of El Nino and 21% in the years under the impact of La Nina).
- The prevalence of petechial fever reached 100,000 cases in the period of 1976 – 1998 in relation to El Nino phenomenon with the correlation rate from 0.4 – 0.6. Only within a period of El Nino from 1997 – 1998, the petechial fever occurred in 51 provinces and cities of Viet Nam with the average rate of 306 cases/100,000 people.

III. The capability of forecasting the impact of ENSO on the factors and phenomena of the hydrometeorology.

Based on the analysis of the relationship between the distinctive characteristics of ENSO (The South Oscillation Index), the standard deviation for the temperature of the ocean surface water and the climatic factors as well as the hydrometeorological phenomena, some models of seasonal statistics and forecasts (3 months) were built based on the information of ENSO on the following factors and phenomena of the hydrometeorology:

1. The frequency of the tropical cyclones in the South China Sea and Viet Nam.
2. The average and maximal temperature of the air.
3. The rainfall (The total and the maximal amount).
4. The flow volumes in some locations of Red River catchment area.
5. The drought.

The forecasted results are assessed by the evaluative criteria of forecast such as: the Forecasting index (FI), the Root mean squared error (RMSE), the RV and the Heidke score. The results of the assessment are good.

IV. Some measures to mitigate the harmful impacts and the damage caused by ENSO.

In addition to the measures for construction works in relation with the fields of water resources, the protective forest and the protection of the coastal areas…the other main measures are:

1. To plan and manage comprehensively the watershed areas, the system of reservoirs.
2. To adjust the mechanism of production and crops in some areas to adapt to the impacts of ENSO.
3. To build and complete the procedures of surveillance, warning and forecast for the impact of ENSO.
4. To strengthen the national and sectoral activities of organization and management of natural disasters for the impact of ENSO as an element of the National Strategy on the Sustainable Development.

5. To continue to disseminate information and improve people's awareness on ENSO and the preventive measures.

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Climate change, biodiversity modelling and linkages with Poverty alleviation
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The Impact of Climate Change on Infrastructure
Prof. Dr. Tran Viet Lien, Viet Nam Construction Environment Association

The Impact of Vietnam Industrial Production on Climate Change
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Current status of biodiversity conservation in Vietnam – Links with Sustainable development and climate change

Mr. Nguyen Huy Dung, Mr. Vu Van Dung, Forest Inventory and Planning Institute (FIPI)

Foreword

Located in the South East Asia in the area of about 330,541 km^2, Vietnam is one of 16 countries that have rich biodiversity in the world (Ministry of Agriculture and Rural Development, 2002 – Vietnam's national projected area management strategy in the period 2002-2010). The country's geographical and climate features and so on have contributed to its abundance and diversity of ecosystems and species. In terms of geo-biology, Vietnam is an intersection point of fauna and flora in India - Myanmar, South of China and Indo-Malaysia region. These features endow the country with one of regions with rich biodiversity in the world. The country is home of 10% of total species while its area accounts for only 1% mainland area of the world (Ministry of Agriculture and Rural Development, 2002 – National report on conservation and economic development areas).

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Biodiversity plays a very important role in maintaining natural cycle and ecological balance. These are the basis of existence and wealth of human and sustainment of nature in the earth. It is estimated that every year biodiversity resources provide USD33,000 billion to human in the global (Constan Za et al-1997). As for Vietnam, biodiversity resources in Agriculture, Forestry and Fishery Industries supply about USD 2 billion in a year to the country (Vietnam's Biodiversity Action Plan – 1995).

At the moment, due to many different reasons, biodiversity resources in Vietnam have been decreased. Many ecosystems and living environment have been narrowed down and many Taxons of species and sub-species are in danger of extinction in the near future.

To overcome the above issues, Vietnamese Government has set up many measures in accompanied with many policies in order to better protect the country's biodiversity. However, it is the fact that there are many issues related to biodiversity conservation that need to be settled such as the link between conservation and sustainable development or effects of climate change on biodiversity conservation, etc…

1. Biodiversity in Vietnam

1.1. Diversity of ecosystems

The natural biodiversity resources in Vietnam concentrate in 03 ecosystems: on-land ecosystem (forest ecosystem), wetland ecosystem and marine ecosystem.

i) Wetland ecosystems

Wetland ecosystems are much diversified. According to assessment of the Forest Inventory and Planning Institute (1999), there are 39 types of wetland including:

- Natural wetland: 30 types
- Coastal wetland: 11 types
- Inland wetland: 19 types
- Man made wetland: 9 types

There are many biodiversity resources in some wetland types such as peat marsh, mangrove forest, coral reefs, lagoon, sea swamp and wetland sites in the mouth of Red River and Mekong River, etc…

ii) Marine ecosystems

Terrorial waters of Vietnam spread over the coast in the area of about 226,000 km^2. As a result, marine ecosystems are much diversified too. There are 20 typical ecosystems with rich biodiversity and high biological productivity. In our marine territory, there have been 11,000 species found living in different marine biodiversity. Components in ecosystems are very rich, complex in structure and abundant in species. These are convenient and wide environments that link closely with life of millions of people living along coast in Vietnam.

iii) Forest ecosystems

Vietnam's forest ecosystems are much diversified. Each forest ecosystem is truly a very complicated one that is operated and controlled by in-sity and ex-situ rules. Some typical forest ecosystems are: forests in Limestone Mountains, defoliating forests and semi-defoliating forests, ever green forests in low, medium and high mountains, etc… with rich biodiversity that play important roles in biodiversity conservation in Vietnam.

Vietnam's forest area has experienced many changes. According to statistic of Paul Maurand (1943), in 1943, forest area in Vietnam was 14.3 million ha that contribute to coverage rate in the whole country at 43%. From 1943-1975, forest area narrowed down to 11.2 million ha with the coverage rate at 34% (Forest Inventory and Planning Institute, 1976).

In the period 1976 – 1990, forest resources were exploited in a large scale in order to serve socio-economic development of the country after the war. Forest area in this period increasingly decreased to less than 9.2 million ha in 1990 with coverage rate at just 27.8%.

In the period from 1990 up to date, the Government has delivered many measures in the form of policies and investment. As a result, forests, both natural forests and man made forests, have been recovered gradually. In 2005, forests area was 12.6 million ha with coverage rate at 37%.

Table 1: Forest areas and coverage rates by periods

Year	Forest area (1000 ha)			Coverage rate (%)	Ha/capita
	Total	Natural forest	Plantation forest		
1943	14.300,0	14.300,0	0	43,2	0,57
1976	11.169,3	11.169,7	92,6	33,7	0,31
1980	10.683,0	10.180,0	422,3	32,1	0,19
1985	9.891,9	9.308,3	583,6	30,0	0,14
1990	9.175,6	8.430,7	744,9	27,8	0,12
1995	9.302,2	8.252,5	1.049,7	28,2	0,12
2000	10.915,6	9.444,2	1.491,4	33,2	0,14
2002	11.784,6	9.865,0	1.919,6	35,8	0,14
2003	12.095,0	10.005,0	2.090,0	36,1	0,14
2004	12.306,9	10.088,3	2.218,6	36,7	0,15
2005	12.616,7	10.283,2	2.333,5	37,0	0,15

Source: Forest Inventory and Planning Institute and Forest Management Department

There are many reasons that led to the decrease in natural forest area in the previous period that in turn resulted in the decline in biodiversity in forest ecosystems in general.

Ecosystems in Vietnam are very abundant and diversified. However, these ecosystems are facing many challenges that mainly derive from people's socio-economic activities and climate change in the world. Natural forest area is likely to be decreased in term of quality and quantity. Marine environment has been impacted by resource exploitation activities such as exploitation of oil and sea products and pollution, etc….

1.2. Diversity of species

In recent years, along with biodiversity conservation efforts, may biodiversity inventories and researches have been carried out by domestic and international organizations? Studies mainly focus on components of animal and plant species and typical ecosystems. Research results consolidated from scientists and research agencies show that:

Table 2- Components of species that have been recognized so far

Order	Species group	Number of species recognized
1	Floating plants	1.939
	- Fresh water	1.402
	- Sea water	537
2	Marine algae	697
	Fresh water	About 20
	Sea water	682
	Seaweed	15
3	On land plant	13.766
	Low class plant	2.393
	High class plant	11.373

4	Aquatic invertebrate animals	8.203
	Fresh water	782
	Sea water	7.421
5	On land invertebrate animals	About 1.000
6	Insects	7.750
7	Fish	2.738
	Fresh water	700
	Sea water	2.038
8	Reptile	296
	Sea snake	50
	Sea tortoise	4
9	Amphibian	162
10	Bird	840
11	Mammal	310
	Sea mammal	16

Source: Institute of Ecology and Bio-resources, 2005

In a short time from 1992-2004, Vietnamese scientists and some international organizations recognized 7 additional mammal species and 2 new bird species to contribute to science.

- Pseudoryx nghetinhensis
- Megamuntiacus vuquangensis
- Pseudonovibos spiralis
- Canimuntiacus truongsonensis
- Muntiacus puhoatensis
- Viverra taynguyenensis
- Pygathrix cinereus
- Isolagus timminsis
- Garrulax ngoclinhensis
- Actinodora sodangonum

In terms of vegetation, in the period 1993 – 2003, there were 13 branches, 222 species and 30 taxons under species recognized and newly described for science, etc….

1.3. Diversity of genetic resources

According to Jucovski (1970), Vietnam is one of 12 centers of seed sources and a center of taming famous animals in the world.

Table 3- Main domestic animal species

Order	**Specoes**			
	Species	**Total**	**Domestic species**	**Imported species**
1	Pigs	20	14	6
2	Cows/Oxes	21	5	16
3	Goats	5	2	3
4	Buffalos	3	2	1
5	Sheep	1		1
6	Rabbits	4	2	2
7	Horses	3	2	1
8	Chicken	27	16	11
9	Ducks	10	5	5
10	Wild gooses	7	3	4
11	Gooses	5	2	3

Source: Agriculture and Rural development Science and Technology in 20 renovation years – Ministry of Agriculture and Rural development, 2005.

There are about 50 bred fish species imported from foreign countries and domesticated in Vietnam, in which 35 species are ornamental fish and the remaining are bred fish for food.

Crop plant species in Vietnam are very diversified and abundant. According to statistics, there have been 802 popular crop plant species belonged to 79 branches so far. Human is consuming 40% primary capacity of the earth (sun energy transferred through photosynthesis process). Many economic industries such as agriculture, husbandry, aquaculture, wood processing industry, wild animal trading, power production, fresh water uses, etc… have effected directly on reserves.

Species by using purposes are as follows:

Table 4- Number of popular crop plant species in Vietnam

Order	Plant group	Number of species
1	Essential plants for food	41
2	Additional plants for food	95
3	Fruits	105
4	Vegetables	55
5	Spice	46
6	Plants for drinking water	14
7	Plants for fibre	16
8	Plants for foodstuff	14
9	Plants for fat oil	45
10	Plants for attar	20
11	Plants for improving soil	28
12	Plants for medicine	181
13	Ornament plants	62
14	Plants for shade	7
15	Industrial plants	24
16	Timbers	49
	Total	**802**

Source: Agriculture and Rural development Science and Technology in 20 renovation years – Ministry of Agriculture and Rural development, 2005.

2. Current status of biodiversity in Vietnam

In order to prevent biodiversity degradation, Vietnam has implemented biodiversity conservation activities rather soon. There are two popular biodiversity conservation methods that are applied in Vietnam: In-situ conservation and Ex-situ conservation.

2.1. In- situ conservation

In-situ conservation includes measures and tools with the purposes of protection species, races, habitats and ecosystems in natural conditions. Depends on conserved subjective, appropriate managing methods shall be applied accordingly. In general, status quo conservation is carried out by establishment of reserves and proposals of appropriate managing methods.

In-situ conservation has been the main conservation method in Vietnam in recent years. Outcomes of this conservation method are most clearly seen in the establishment and operation of special forest systems.

Ě **Systems of nature reserves in Vietnam**

Vietnam is one of countries that pay early attention to biodiversity conservation.

On 07 July, 1962, Cuc Phuong National Park was the first conservation area in the South of Vietnam. In its early presence, it was called as Cuc Phuong “forbidden forest”. This is a conservation area with flora and fauna in Limestone Mountains contiguous to ecosystems in the North delta and the North West area.

In the South, in 1965, Pham Hoang Ho and Phung Trung Ngan suggested to establish 10 protected areas in lowland region: Con Dao, Chau Doc, Bao Loc, Duc Xuyen hunting forbidden forest (Buon Ma Thuot), Hoang Loan island and Mui Dinh and they were accepted by Sai Gon authority. There are 3 protected areas in high mountainous region: Chu Yang Sin (2405m), Lang Bian Peak (2183m) and Bach Ma - Hai Van (1450m). According to IUCN (1974), there are 07

reserves in the South of Vietnam spreading in the area of 753,050 ha (Cao Van Sung- Systems of Natural Protected areas in Vietnam-1994).

After the national unity day, systems of reserves have been increasingly widen, added and improved in terms of scope and protecting and managing systems. There are 211 reserves in Vietnam including:

- Forest reserves (special forests) under management of Ministry of Agriculture and Rural Development: 128 reserves (recognized by the Government)

- Nature reserves proposed by Ministry of Fishery: 15 reserves

- Wetland reserves proposed by Ministry of Resources and Environment: 68 reserves

- Wetland reserves and sea reserves have just been on proposals but not get approval officially.

Table 5. Classification of special forest systems in Vietnam

Order	Type	Number	Area (ha)
I	**National parks**	**30**	**1.041.956**
II	**Nature reserves**	**60**	**1.184.372**
IIa	Nature reserves	48	1.100.892
IIb	Species/habitat reserves	12	83.480
III	**Landscape protection areas**	**38**	**173.764**
	Total (Reserves)	**128**	**2.400.092**

Source: Statistics up to October, 2006 – Forest Management Department and Forest Inventory and Planning Institute

In 12 current reserves, there are 30 national parks, 48 nature reserves, 12 species and habitat reserves and 38 landscape reserves in the area of 2,400,092 ha that contribute to nearly 7.24% on land natural area of the whole country. Some research forests in Institutes, Centers and Schools are included in the special forest systems, according to Law on Forest Protection and Development (revised version) in 2004.

Present special forest systems are located widely in all ecosystems in the whole country. However, the current special forest systems are mainly in small size and disperse. In 128 reserves, there are 14 areas smaller than 1000 ha that account for 10.9%. There are 52 area smaller than 10.000 ha that make up 40.6% of reserves, including 04 national parks, 9 nature reserves and 30 landscape protection areas. Many reserves cover agricultural land and tenure land. Boundaries of some reserves are not clear or under conflicts. Linkages between reserves are poor. Corridors linking small reserves that have similar features have not been established, etc...

In agriculture and forest industry, status quo conservation is understood as conservation of agricultural species and forest species in cultivated fields and plantation forests. In addition to reserves, the following conservation forms are recognized in Vietnam.

- 5 national biosphere reserves recognized by UNESCO: Can Gio area (Hochiminh city), Cat Tien area (Dong Nai, Lam Dong and Binh Phuoc), Cat Ba area (Hai Phong city), Red River Delta coast (Nam Dinh and Thai Binh) and Kien Giang biosphere reservation area.
- 2 natural heritage areas of the world: Ha Long Bay (Quang Ninh) and Phong Nha - Ke Bang (Quang Bình);
- 4 natural heritage areas of Asean: 4 national parks: Ba Be (Bac Can), Hoang Lien (Lao Cai), Chu Mom Ray (Kon Tum) and Kon Ka Kinh (Gia Lai)
- 2 Ramsar areas: Xuan Thuy National Park (Nam Dinh province) and Cat Tien National Park.

Some remaining issues in in-situ reserves

- In the systems of reserves, there are many reserves small in size and poor in linkage with one another so that conservation activities in wider areas are limited.
- Boundaries between reserves are not clearly determined in the sites so that there still are invasion and violation activites in those areas.
- Budgets for conservation are limited and mainly depend on the State budget so that reserves under local management receive very limited budgets for conservation. There are no specific policies on socializing conservation activities.
- Some policies on conservation are insufficient, such as investment policy, policy on managing buffer zone, etc...
- Vietnam's category classification system is defined in the Law on Forest Protection and Development in 2004 and has been applied in reality. However, there are some shortcomings in Vietnam's special forest category classification in compared with IUCN category classification system: in Vietnames category classification system, we are still confused between category and sub-category: species conservation is a category in 6 category classification systems of IUCN serving different management purposes that cannot be classified as a sub- category of natural conservation area.

- We are still confused in classificating national parks and nature reserves that we consider national parks are of more conservation importance than nature reserves. As a consequence, in a long time, since we found that national parks withdrew more attention and investment so that provinces and cities wanted to convert their reserves into national parks. As it is, many natural parks have not met their conservation objectives, etc.

- Classification systems and perceptions are different so that management policies at the moment mainly focus on restricted protection and do not linked with advanced conservation perception as conservation going along with development.

2.2. Ex- situ conservation in Vietnam

Ex-situ conservation includes botanical garden, zoological gardens, pools for aquatic products, collections of microorganism, museums, seed bank, collections of sprout and tissue… Measures are moving plant species, seedlings and microorganism out of their natural living environment. Purposes of the movement are to multiplicate, maintain and replicate cloning or rescue in the following circumstances: i) their living areas are degraded or damaged that no longer can sustain, ii) in order to be inputs for researches, experiments and development of new products, to improve knowledge for the communities. Even though ex-sity conservation is considerably new in Vietnam, in recent years, it has gained some significant achievements.

- Initially establish botanic garden network, collection gardens and forest components for forest genetic conservation and zoological gardens nationwide and they have been gradually operated stably. In fact, ex-situ conservation systems have supported studies and researches on biodiversity conservation effectively. Many studying topics have been successful in many aspects of ex-situ conservations in botanic and zoological gardens.

- Botanic gardens, forest components for forest genetic conservation, herbal remedy gardens and zoological gardens have collected a significant great amount of species and individuals. Of which many native species have been studied and replicated successfully. Many wild animals have been fed and multiplicated in man made conditions. Especially, many special herbal remedy gardens or herbal remedy gardens in botanic gardens have contributed substantially for medicine researches and replication of Vietnamese traditional medicines based on herbs to provide inputs for pharmaceuticals.

- Ex-situ conservation has contributed significantly to in-situ conservation with respect to wild animals that are facing danger of extinction in the nature. Some wild animals such as spotted deer, musc deer, lilac crocodile (animals), and plants such as Sua, erythrophloeum fordid, etc…

- Initially set up genetic bank for conservation genes of plant and animal species, long time reservation, support for bio-technology and agro-forest development, etc… The current main ex-situ conservation forms are as follows:

i) Experimental forests

In the new catagory classification system of experimental forests, scientific research is classified as a category under management of reserves. Results from planning reviews of 03 forest types in 2006 determined 17 experimental forests in the area of 8,516 ha. Experimental forests include timber gardens, botanic gardens, forest tree collection gardens and forest components for forest genetic conservation. Some typical experimental forests are: Trang Bom timber forest (Thong Nhat District, Dong Nai Province) which contain 155 species of 55 families and 17 bamboo species. Sai Gon zoological and botanic garden with more than 100 plant species, timber garden of Lang Hanh forest experimental station (Duc Trong district, Lam Dong province), Mang Linh tinber garden (Da Lat city), Ha Noi Botanic garden, etc...

ii) Medicinal plant gardens

According to survey of Medicine Institute in 2000, there are 3.800 medicinal plants belonged to 270 plant families in Vietnam (La Dinh Moi, 2001). Medicinal plant species are located across various ecosystems in Vietnam. In which, most of medicinal plants grow naturally and about 20% of them are planted. Since 1988, medicinal plant genetic conservation has been implemented. However, in 848 medicinal plants that are decided to be conserved, there are only 120 species and sub-species conserved in research areas and bases. At the moment, there are many medicinal plant gardens that have been established. In addition, there are systems of medicinal plant gardens belong to households specializing in trading Vietnamese or Chinese traditional herbal medicines. The following are some existing medicinal plant gardens:

- In Medicine Institute, there is SaPa medicinal plant station with 63 medicinal species that are preserved at altitude of 1,500 m.
- Tam Dao medicinal plant station preserving 175 species at altitude of 900m.
- Van Dien medicinal plant station (Hanoi) - 294 species
- Garden in Hanoi Medicine University - 134 species
- Garden in Army Medical Institute - 95 species
- Seedling Center in Da Lat that collectss 88 species and preserve at altitude of 1500 m.
- Vietnam's ginseng Center preserves 6 species. In addition, the Center collects seeds of some medical plants for short and medium term preservation in cool conditions.

iii) Seed bank

Reservation of seeds and breeding animals has newly implemented in some research bases. At the moment, there are 04 agencies in Vietnamese agriculture that have cool preservation storehouses: Vietnam Agricultural Science and Technology Institute, the Southern Agricultural Science and Technology Institute, Can Tho University and Crop and Food Institute. All the cool storehouses are small in size with backward technologies so that they have just satisfied preservation requirements in the short and medium term. There is no storehouse for long time preservation.

According to statistics of : Vietnam Agricultural Science and Technology Institute (2005), the national plant genetic bank has preserved more than 14,300 seeds of 115 species in storehouses so far. There are 03 genetic banks:

- Seed genetic bank: 12,500 seeds of 83 species.
- Field genetic bank: 1,720 seeds of 32 asexual reproduction species.
- In vitro genetic bank: preserves 102 species of taro and Indian taro.

In 19 agencies and networks of the seed genetic preservation system, there are 5000 seeds of 50 species, 3,340 genotypes kiểu gen and 200 specimen of rubber trees. 300 genotype groups have been established. 2,000 genotypes of rubber trees have been materialized.

- Remaining issues of ex-situ conservation in Vietnam

The implementation of ex-situ conservation in Vietnam has exposed some remaining issues and simultaneously challenges. They can be grouped as follows:

- There is lack of overall and detailed planning. The existing systems of botanic gardens, timber gardens and forest components of forest genetic conservation are planned and designed unsystematically, not specialized and not represented for each eco-region and for the whole country. Zoological gardens are mainly for visiting but do not pay much attention to conservation.

- Collection has not focused on endangered and valuable species and forest non-timber products. Number of species in the collection is small. There is no botanic garden that contains

more than 500 species (excluding natural plant species that have been available in the planning process).

- Training for ex-situ conservation staff, especially staff specializing in ex-situ conservation working in botanic gardens, zoological gardens and rescue stations, is limited.

- Ex-situ conservation has not withdrawn enough attention from policies and guidelines on nature conservation. There have been some documents so far: Decision No. 225/1999/QD-TTg of the Prime Minister on seeds and breeding animals and forest seeds that includes botanic gardens; Decision No. 86/2006/QD-TTg of the Prime Minister on overall planning of Vietnam Nature Museum to 2020. There is no document providing detailed guidelines for ex-situ conservation activities.

- To date, investment in developing botanic gardens, timber gardens, forest components of forest genetic conservation, zoological gardens and rescue stations has not been truly focused. There is no policy to attract investment from other funding sources such as socio-economic organizations, individuals, communities, etc.

3. Conservation and sustainable development

3.1. Sustainable development

Sustainable development is the development that meet current requirements but not obstruct the satisfaction of next generations' requirements (Report on our common future, United Nation, -1987).

Sustainable development is a process combining 03 aspects of the development in a close, appropriate and harmonious manner. 03 aspects are:

- Economic development: focusing on economic growth and stability in economic growth…
- Social development: to make social progress, social equality, hunger elimination and povery reduction, job generation…
- Environment protection: treating and overcoming poluttion, recovering and improving environment quality; controlling and fighting against fire and deforestation, appropriate exploitation, economical use of natural resources …

In order to ensure sustainable development, it is necessary to conserve biodiversity and use it sustainably. As for bio-resources that are able for re-creation, the important thing is to reach maximun and stable output but not make basic resources exhausted. This output is limited and cannot be overexploited if future outputs will not be effected.

Objectives of natural conservation, biodiversity management and sustainable use of bio-resources is 'to maintain the optimal balance betwwen natural diversity conservation and improvement of human living quality'

3.2. Impacts of reserves on sustainable development

As mentioned above, stable economic growth, hunger elimination and povery reduction, and ecological environment protection are objectives of development and conservation processes and they support one another in their development. The total reserves of more than 2 million ha of forests is a great biodiversity resources. They are not only places for maintaining and supplying natural resources but also supportive sites and fields for economic development, hunger elimination and povery reduction and natural disaster restriction, etc...

▪ Conservation support the development of the communities and hunger elimination and povery reduction. Many reserves in Vietnam are habitats of minority ethnics where hunger and poverty rate are high. As for remote areas, reserves are places to provide medicinal plants, secondary forest products and fresth water and minimize illegal migration, etc...

▪ Provision and adjustment of water resources: reserves are places with high forest coverage levels that play good protection functions, constrain flood and provide water resources for lowland areas, etc.

▪ Contribution for agricultural development: Reserves are places to reserve and supply genetic sources that are transformed to plant and animal species, at the same time they are places to adjust water resources and to make climate equable for production and life of local people living surrounding conservation and lowland areas, etc.

▪ Aquacultural development: systems of wetland reserves and coastal mangrove forests are convenient environment for aquatic species to develop and for developing and exploiting this type of resources such as Xuan Thuy national park, Thai Thuy reserves, etc.

▪ Tourism development: reserves, especially national parks, are convenient for access. They are attracting destinations of domestic and foreign tourists, e.g. Phong Nha national park – Ke Bang earns 5 billion dong per year from tourism activity.

▪ Enviroment protection: reserves are pools to absorb CO_2 effectively to contribute to reduction of greenhouse effects, prevention of global climate change that attract attention of all countries in the world, etc.

Conservation and sustainable development herein are related to activities that maintain biodiversity in the following aspects: provision of essential inputs, social and cultural values, and ecological services that are exploited and used in a sustainable and effective manner, etc... Biodiversity conservation include all activites related to conservation of species, genetic sources of each species, specimen, habitat and landscape through conservation of ecosystems and appropriate exploitation of plants, animals and microorganism resourves to serve people's life, prodiction and sharing benefits from organism resources. As a result, to get stable economic development, it is necessary to pay attention to protection of the existing reserves in all relevant aspects.

4. Conservation and climate change

4.1. Climate change

Climate change is the change that are resulted directly or indirectly from human activites that change greenhouse emission concentration in the air, increase greenhouse effects and make climate change in the global scale.

Climate change due to greenhouse emissions resulted fron human activites has increasingly gone up. The current CO_2 concentration is 30-35% higher than its natural concentration 10,000 years ago. Temperature of the Earth surface increases $0,6^0C$ on average in compared with the 20th century and it is estimated to increase $1,4 – 5,8^0C$ in 2100, the biggest change in the last 10,000 years. The consequence is that ice will melt, sea water level has increased and climate regime has changed too. Level of climate change depends on each region. However, all regions in the world are impacted more or less. Number of species will change. Temperature of the earth surface will increase. Sea level will rise higher. Primary production systesm such as agriculture and forestry will be effected significantly. However, nature and allocation of those impacts in the future have not been determined. In short, climate change will change some factors as follows:

- Increase in the earth temperature
- Rise in sea level
- Partial desertization or desertization in a wide scale
- Change in hydrographic cycle
- Change in climate rules, e.g. rain, sun, flood, wind, storm, etc.

At the moment, we are living in a world that climate is changing, sea level is rising up, population is increasing rapidly, occupation of exotic species is accelerating, habitat is narrowed down and separated, pressure of industrialization and global trade is more severe, etc… All these changes have impacted the management of reserves as well as the common life of human being.

4.2. Impacts of climate change to biodiversity conservation

Climate change has created great impacts on nature and society and directly effected people's life. Climate change will affect biodiversity conservation too. Details are as follows:

- Some species those are recorded in IUCN Red Book, especially species in most danger or in danger that survive in a specific location will disappear.
- In ecosystems and habitats that are essential for migration species, species in danger with narrow living areas and endemic species will disappear or be reduced in number.
- Ecosystems are changed and divided into pieces: since sea level increases, some locations where important races and flora and fauna at international level concentrate or those of species that have narrow habitats can disappear, be partitioned or divided into pieces such as island and coastal region, etc.…
- Some landscape reserves is of socio-economic, cultural and scientific importance or representative, unique or important in making progress or biological processes in island, coastal or river mouth regions will disappear or be narrowed down.
- Occupation of exotic species: the change in living environment creates sufficient conditions for exotic plant and animal species to occupy and develop. Along with trading activities, occupation of

exotic species is a big threat to the stability and diversity of ecosystems, right after threat of losing habitat. Small islands and fresh water and coastal ecosystems are affected the most seriously.

4.3. Impacts of systems of reserves on climate change

Current systems of reserves are not only places to conserve biodiversity the most efficiently but also contribute significantly to limit climate change as well as its impacts:

- Reserves are pools to absorb huge amount of CO_2 effectively to contribute to reduction of greenhouse effects, one thing that results in climate change.
- Reduce consequences of flood, prevent erosion and soil drifting, protect production and basic infrastructure.
- Limit partial desertization or desertization on a large scale, one effect that becomes considerably popular in our country.
- Contribute to make climate equable in the region as well as in the larger scale, etc...

As a result, systems of reserves not only play important roles in terms of conservation but also satisfy many objectives of socio-economic development and limit consequences of climate change, etc... that contribute to meet people's requirements more effectively, one objective that we try to achieve.

4.4. Solutions for biodiversity conservation in the context of climate change

In order to minimize impacts of climate change on biodiversity resources, the following measures need to be applied::

- To improve and concretize policies on biodiversity to be executed
- To set up detailed policies to attract social components to participate in biodiversity conservation.
- To establish rescued areas to protect species that are in danger of extinction due to climate change.
- To have detailed programs to improve knowledge on biodiversity conservation for communities and different industries and levels.
- To strengthen international co-operation on biodiversity conservation and climate change in the globe.

Conclusion

Biodiversity conservation is of interest of not only each country individually but also of human kind in general, since it links closely with socio-economic development of each country and limits impacts of climate change.

The current systems of reserves have brought into play their impacts on protecting biodiversity resources. However, in order to get better conservation, it requires not only each country and each locality to make proposals on appropriate management plans, but also requires managers and policies to have throughout understand on biodiversity in socio-economic and cultural conditions of specific regions… to make precise decisions and policies that are appropriate for conservation.

Objectives of nature conservation and sustainable development are to satisfy requirements of people's life on all aspects more effectively. In order to achieve these objectives, it requires involvement, support and assistance of governments, international organizations, scientists, enterprises, communities….to make the development process not affect conservation activities and the make conservation activities better support development process.

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Climate change, biodiversity modelling and linkages with Poverty alleviation

Mr. Tonnie Tekelenburg, Netherlands Environmental Assessment Agency (MNP)

Biodiversity is essential for the sustainable delivery of ecosystem goods and services, which contributes to human wellbeing (Millennium Ecosystem Assessment 2005). This presentation follows a pathway from the impact of climate change at the global scale via biodiversity impact assessment at the national scale towards the poverty impact at the local scale.

The Global Biodiversity Outlook 2 for the CBD shows that it will be unlikely that the 2010 CBD target will be met for terrestrial biomes at the global and regional levels. The loss of biodiversity is expected to continue at an unchanged pace in the coming decades as a consequence of human population increase and economic development. The biodiversity loss in the South and East Asia region is higher than the global average, expecting a decrease from the current (2005) 55% remaining biodiversity to 46% in 2050. Biodiversity is expressed as MSA: Mean Species Abundance of original species relative to the abundances in undisturbed situations and is calculated by the GLOBIO 3 biodiversity model at MNP in cooperation with WCMC and UNEP Grid Arendal. Direct effects from climate change (as an effect of increasing average temperature of the environment) is expected to contribute less than 5% of the loss until 2050. Agriculture and especially infrastructure and settlements contribute most to the loss of biodiversity, caused by high economic growth. Asia has the highest demand for wood in the world and a situation of overexploitation is expected before 2050. Abandoned land will develop into secondary natural ecosystems or will be used for forest plantation which contributes to a higher biodiversity value in that areas. Biodiversity impacts of 5 policy options were assessed. The climate mitigation option includes bio-energy production taking advantage of available agricultural land and by increasing intensity of land use. This counteracts the biodiversity gain from climate change mitigation, but the net total effect is positive in comparison with the OECD baseline scenario.

The state of biodiversity in Vietnam was assessed with the recently developed national biodiversity model at the Agenda 21 office of the ministry of planning and Investment (MPI) in cooperation with national partners. The assessment made use of the of GLOBIO 3 methodology and geo-referenced information on pressure factors at the national scale: land use (intensity), road infrastructure, fragmentation, nitrogen deposition and climate change. The resulting map of the year 2000 shows that the remaining biodiversity can be found in remote areas along the border with Laos. Biodiversity in protected areas is worse than expected.

Studies on the linkages between biodiversity and poverty (CRES 2006; Pham Manh Cuong 2005) use a driver – pressure- state – response framework of analysis. Although it might be expected that human wellbeing increases if biodiversity is exploited for wood, food and conversion into agricultural-livestock production, there are also typical “losers” in the battle of access to biodiversity. Further biodiversity loss may affect livelihoods in the future. The case studies revealed that tree cover is increasing in Vietnam, but the extend of primary forest with high biodiversity values is still decreasing.

Examples of people that suffer from biodiversity loss are the ethnic minorities in the forest area along the Laos border as well as traditional fishing and gathering people in the costal area. In mangrove areas CRES found evidence that the original open access (tragedy of the commons) to biodiversity has been restricted by at least three historical processes: privatization of land for shrimp ponds and clam production; biodiversity conservation in protected areas, (both in terms of reducing quantity of the area) and the open access policy by which people from outside fish and gather as well (overexploitation and reducing quality of the remaining natural resources). Protected areas and mangrove plantation result in improved biodiversity levels and storm protection, but intensity of the exploitation outside these areas may increase. A sustainable development pathway for the poor in coastal areas could be community based natural resource management for the commons with restricted access.

The rural communities that live in mountain areas from shifting cultivation in combination with small fields of paddy rice and exploitation of natural forests, demand the exploitation of the buffer zones

of protected areas (with strong regulations) and hardly accept governmental support in forest plantation on degraded land. The access to land of good quality for production is limited by soil degradation processes and erosion. Additional poverty reduction strategies such as intensification of agricultural production (increase of irrigation systems for rice production) as well as exit from agriculture may support sustainable development in the area.

Studies on the relationship between biodiversity and poverty shows that impact on both are caused by the production systems of types of resource users. Poor people suffer limitations on their access to natural capital and or human capital, which are heavily influenced by policy regulations, market integration and demographic trends. War and conflict as well as environment – climate shocks and stresses may produce also specific biodiversity loss-gain situations and poverty. Finally, we discuss possible changes on forest ecosystem in the above mentioned mountain and coastal areas caused by climate change.

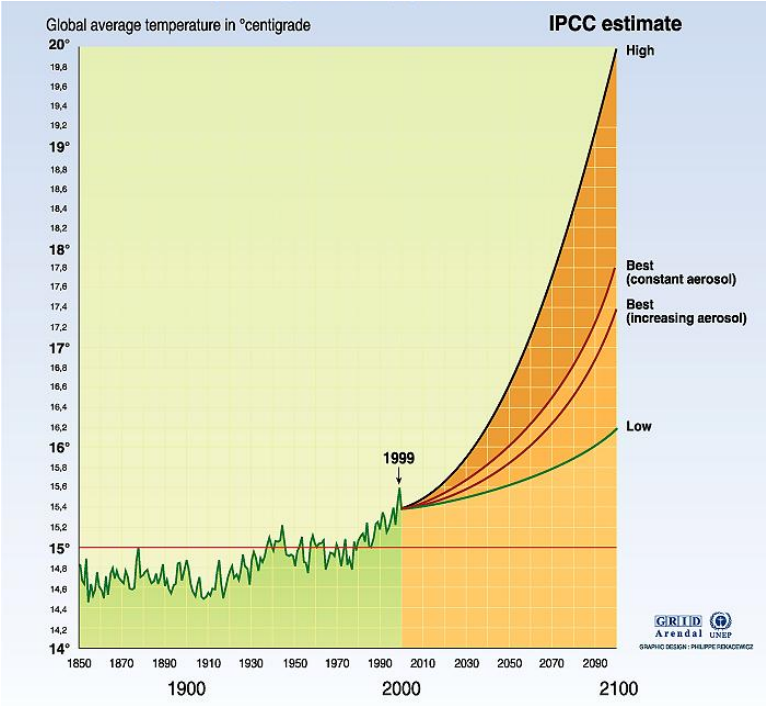
Climate Change Impacts on Fishery and Aquaculture

Representative of MoFi

1. Impacts of climate change:

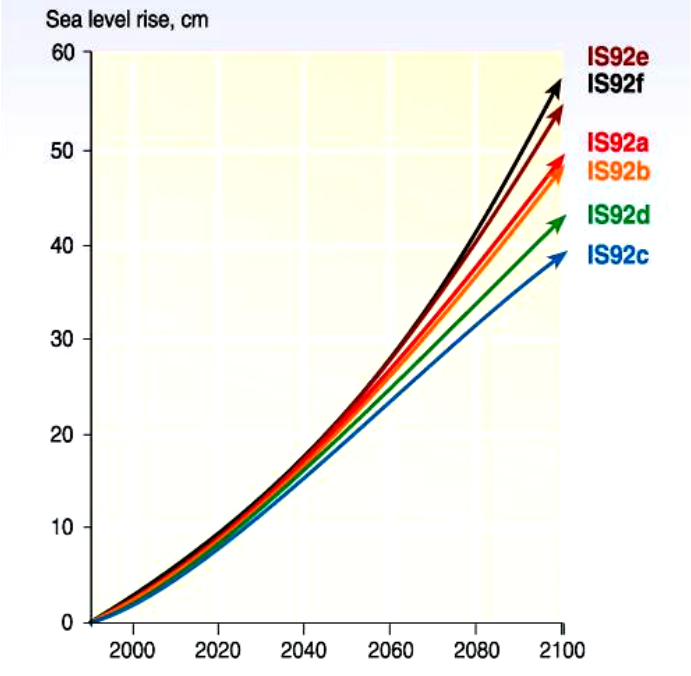
Global climate change is observed through some important phenomenon as follows:

- Global warning of the Earth: in the 20th century, average temperature of the Earth's surface increased 0.60 C



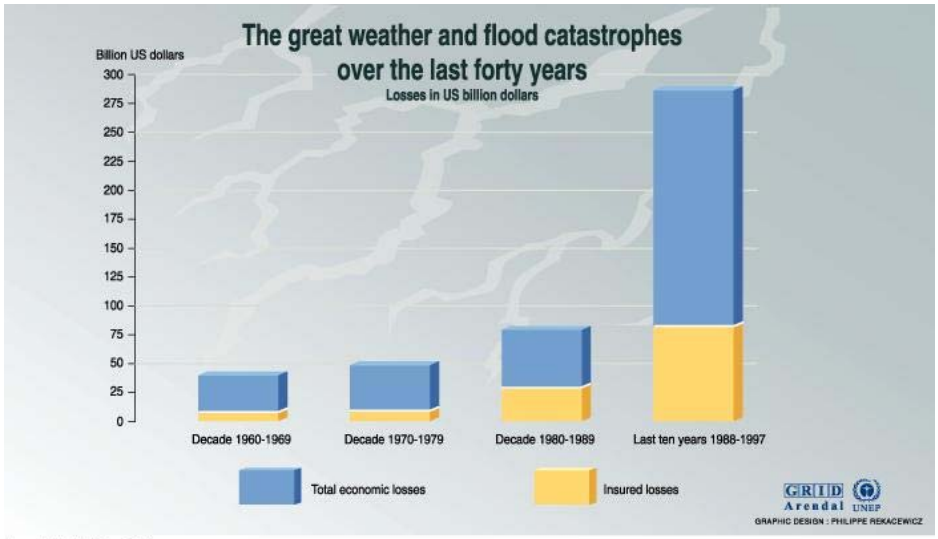
Source [1]

- Sea level rise: in the 20th century, sea level rose about 10-20cm



Source [1]

- There are also some other important changes like too much rain, cloudy, extreme temperature, etc.



Source [1]

Economic losses caused by floods and other weather changes

2. Impacts of climate change on capture of marine products:

2.1. Overview on capture of marine products in Vietnam

2.1.1. Yield:

In the last decade, yield and export value of aquatic products have been increasing continuously, making Vietnam become one of the leading export countries of aquatic products. In 1990, total yield of aquatic products was about 1 million tones, and total export value was 200 million USD. In 2003, total yield of aquatic products was 2.5 times higher and total export value was 10 times higher than in 1990 (Figure 4).

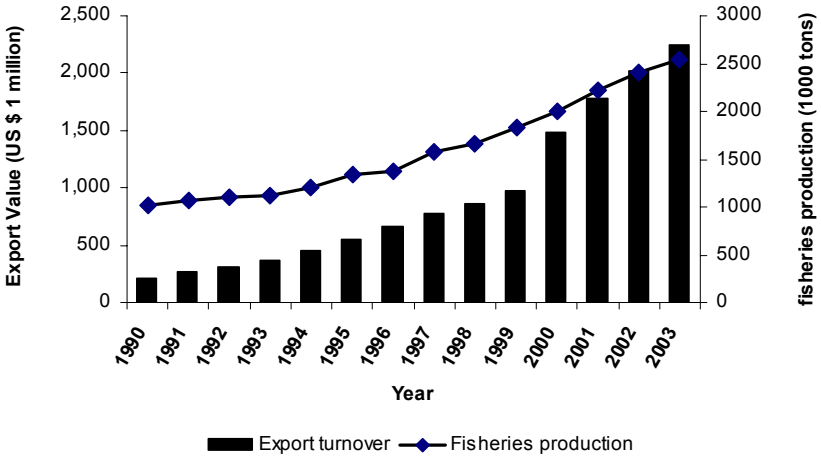


Figure 4.

Source: *Data provided by Ministry of Fisheries [2]*

2.1.1.1 .Fishing tool or gears:

Fishing tools or gears for capture of marine products in Vietnam are various and many both in terms of names as well as scales. According to an incomplete statistics, there are about 20 different types of gears classified into 6 groups, which are being used in Vietnam. By the end of 1997, statistic figures collected from 19 provinces shows that structure of gears, which are being used for off-shore fishing boats, are as follows:

- Dredging net, accounting to 34%
- Purse seine, accounting to 21%
- Drift net, accounting to 20%
- Tune long line, accounting to 17%
- Lift net, accounting to 5%
- Others, accounting to 3 %

Additionally, about 10,000 fishing boats with engine power of about 33-45 CV can operate in off-shore areas in good weather conditions. However, capture capacity is somewhat limited.

2.1.1.2. Composition of fishing boats/ships:

According to statistics of Ministry of Fisheries (MOFI, 2001), total off-shore fishing boats with engine power from 90 HP or above is about 6,000 boats. Total number of fishing boats with engine power of less than 45 HP accounts up to 85% of total fishing boats with engine power of less than 45 HP. Out of fishing boats with engine power of more than 45 HP, 33% are equipped with GPS facilities, 21% are equipped with fish detecting facilities, 63% are equipped with short-wave generating and receiving facilities, and 12.5 % are equipped with long-range wave generating and receiving facilities.

2.12. Some threats and challenges of exploitation of marine products in Vietnam

Vietnam has a long coastal line of about 3,260 km, and total exclusive economic zone is more than 1 million km^2, these are potential conditions for development of exploitation of marine products. However, exploitation of marine products in Vietnam has been encountering some threats and challenges as follows:

The first challenge is a too fast growing and uncontrolled exploitation of marine products in recent years. Until 1990, exploitation of marine products played a modest role with about 260,000 fish folks, who did fishing for their livelihoods and for domestic markets but until now exploitation of marine products has become one of prominent economic sectors of the economy [3]. There are about 560,000 fish folks out of 3.4 million workers working in the fishery sector (accounting to about 10% of total labor force of the whole country). Total export value of aquatic products in 2004 was 2.35 billion USD, accounting to about one tenth of total export value of the whole economy [3, 4].

Secondly, fisheries in Vietnam is characterized by small scales, multi fishing modes and using traditional gears therefore it is difficult to control capture intensity in fishing grounds [5]. According to statistics, there are about 2000 recorded fish species, including 130 economically-value fish species [4]. Fishing boats with engine power of less than 84 HP make up to more than 90% of total fishing boats of the whole country [5].

Thirdly, most of capture activities take place in on-shore areas and capture intensity (including the number of fishing boats and the aggregated engine power) has been continuously increasing [5]. Figure 5 shows that the number of mechanized fishing boats had increased two folds and total engine power had increased 3 folds while non-mechanized fishing boats had decreased a half during the period of 1990 - 2002.

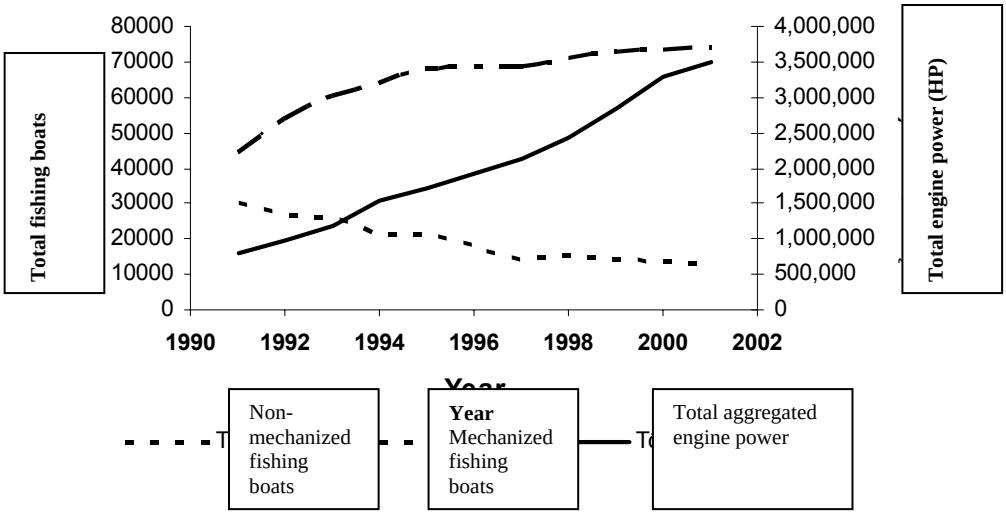


Figure 5.

Source: *Data provided by Ministry of Fisheries [2]*

Fourthly, due to low incomes generated from agriculture, many farmers are driven to get involved in capture of marine products and they consider capture of marine products as the last livelihood means and eventually the number of people involved in on-shore capture activities increased, resulting in a decrease in yield per area and increasingly-degraded marine sources [3].

Finally, over-exploitation in coastal areas has become increasingly obvious, for example, in the Tonkin Gulf, the actual yield had exceeded the maximum sustainable yield (MSY) since 1994 [6]. On-shore fisheries are considered by fish folks and the Government as over-exploitation, and the Government has been trying to reduce capture intensity in on-shore areas. However, results of such efforts are still far below expectations because there have been no clear coordination and responsibility arrangement among authorities at all levels, and lack of basic necessary scientific inputs and of investments [4, 5].

2.2. Impacts of climate change on exploitation of marine products in Vietnam

Climate Change has influenced marine ecosystems, and disturbed marine habitats and fish sources, therefore it has affected livelihoods of fishermen communities in coastal areas directly [1]. Massive coral bleaching in the last 20 years was caused by several causes, including increased temperature in sea [1].

Potential impacts of climate change on environment and socio-economic structures can be assessed based on sensitivity, adaptability and vulnerability of these structures [7]. In Vietnam, no comprehensive study on impacts of climate change on exploitation of marine products has been available. However, with given potential threats and challenges on capture fisheries, potential impacts of climate change can be huge. These impacts had been partially demonstrated through statistics of losses caused by storms and typhoons on fishermen communities in coastal areas in recent years.

According to statistics of Ministry of Fisheries since 2001-2006 [8]: *"natural disasters tend to be more unpredictable with increased frequency and intensity in all types. Storms and typhoons, sea level rise, intensified sea waves, floods, flash floods, etc. have been continuously occurring in an unpredictable manner".*

Year	Storms and typhoons evolved in the South China Sea	Storms and typhoons affecting Vietnam directly	Tropical depressions in the South China Sea	Tropical depressions affecting Vietnam directly	Losses associated with fishermen communities in coastal areas	Estimated losses
2001	9	1	11	0	- 261 fishing boats sunk, 135 fishing boats damaged - 4 fish folks died	97 billion VND
2002	5	1	11	3	-	-
2003	7	2	10	1	-	-
2004	5	2	4	0	- 11 fishing boats sunk - 14 fish folks died, 7 people wounded	
2005	9	6	5	2	-	-
2006	10	3	4		1457 fishing boats sunk, damaged 40 people died	-

Statistic data of impacts of storms and typhoons on aquaculture [8]

Storms and typhoons affecting Vietnam do not only tend to increase in terms of frequency but also intensity. In 2006, 10 strong storms and typhoons, prolonged North Eastern seasonal cold winds, and other extreme weather events had significantly influenced on aquaculture, and resulted in losses of human life and fishing boats operating in sea, especially the 1st (Chanchu) storm had resulted in a huge loss of fish folks operating in off-shore areas. Additionally, losses of human life and materials of fishermen communities in coastal areas are significant after the attack of the 9th (Durian) storm.

3. Impacts of climate change on aquaculture in Vietnam

3.1. Status of development of aquaculture in Vietnam

Aquaculture is a potential economic sector in Vietnam. In recent years, aquaculture of our country has experienced strong development and obtained great achievements, contributing to promotion of socio-economic development of the country. The sector plays an important role in contributing to poverty reduction, provision of nutrition and income generation for people, and gradually increasing export values of the country. Until 2003, laborers working in aquaculture and fisheries account to 5.1% of total labor force of the country; until the end of 2006, total aquaculture yield reached at 1,526,000 tones, an increase of about 14% compared with 2005 (Chart 1 and Chart 2). Aquaculture is mainly concentrated on the Mekong River delta, and followed by the Red River Delta (Chart 3)

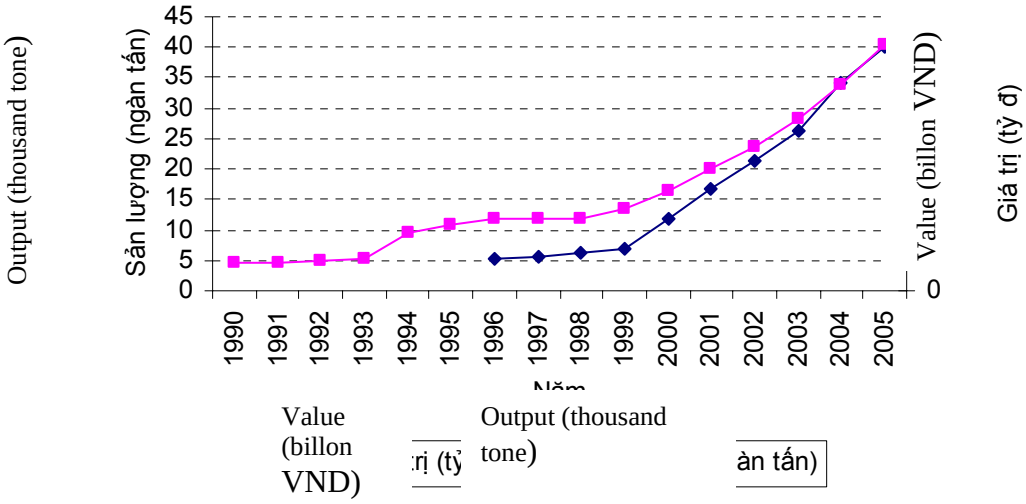


Chart 1: Total aquaculture yield and export values of Vietnam 1990 - 2005

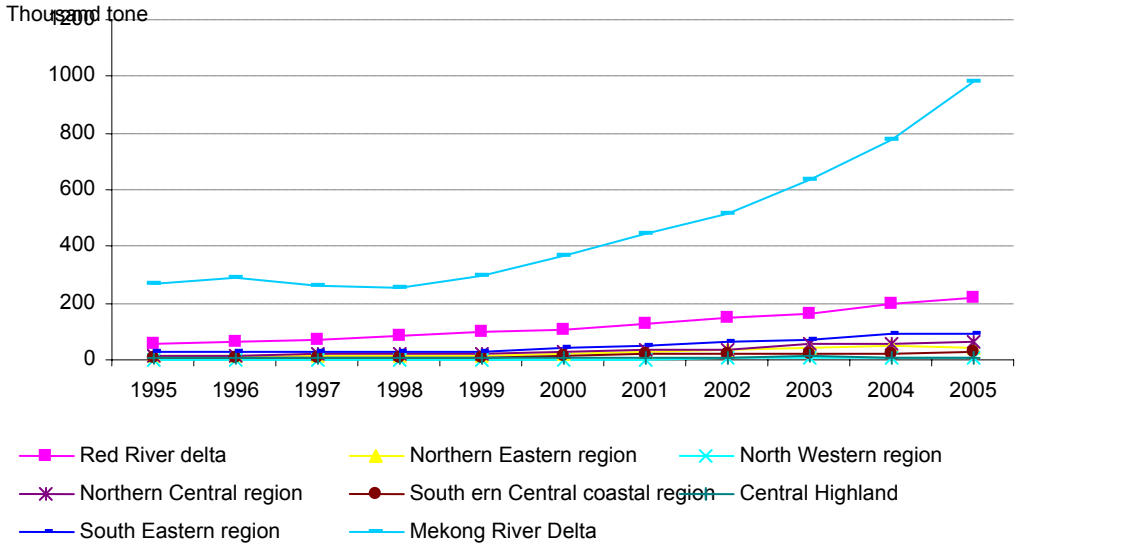


Chart 2: Aquaculture yield distributed per region from 1995 – 2005

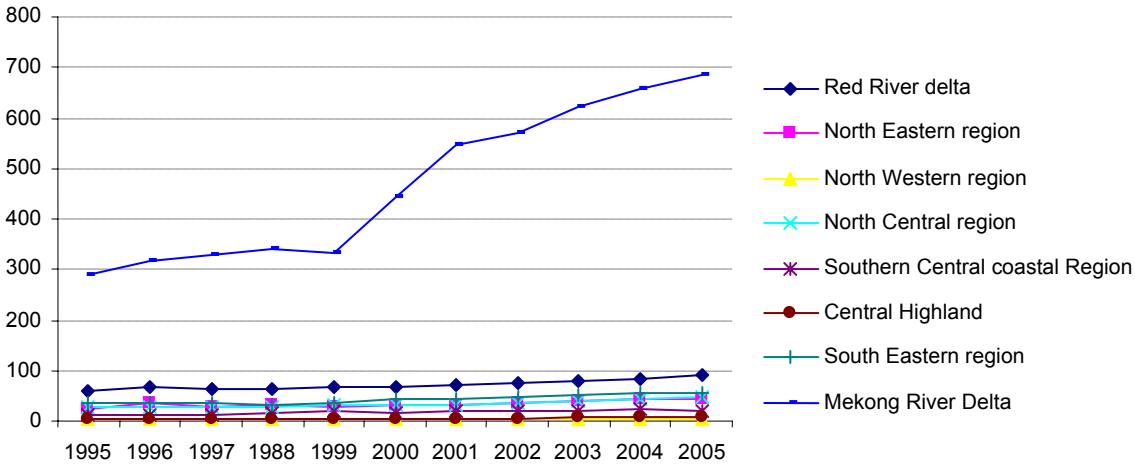


Chart 3: Water surface area for aquaculture distributed per region from 1995 – 2005

3.2. Impacts of climate change on aquaculture of Vietnam

3.2.1. Impacts of temperature

Temperature plays an important role in growth and development of creatures in general and aquatic species for aquaculture in particular. Each species lives in a certain temperature range. Their resilience falls within a certain range or limitations. For example: suitable temperature range for growth and development of shrimps fall within about 25 – 32 ^{o}C, if temperature is higher than 32 ^{o}C or lower than 25 ^{o}C, development of shrimps will be affected such as shrimps will grow slowly.

Water temperature in ponds and lakes depends entirely on weather and locations (Chart 4). Increase in temperature of atmosphere makes water hotter; however, changes in water temperature in ponds and lakes will happen slower than changes in atmosphere. In Vietnam, especially in central provinces, hot weather makes water temperature extremely hot that goes beyond temperature range of creatures, including aquatic species. Hot water causes massive death of shrimp and fishes, especially in shallow ponds and lakes. As for deep, large water basins, or running water, changes in temperature take place more slowly and water is cooler. Therefore cage-based aquaculture in large water basins like rivers, streams, or sea is less influenced by prolonged, extremely increased temperature, while aquaculture in idle, small water basins are is more easily and seriously influenced.

Increased temperature can decrease yield of aquatic products in ponds and lakes. Many studies show that increased temperature reduces oxygen content in water sharply at night due to over consumption of aquatic plant species, or decomposition of organic matters. Decrease in oxygen contents affects growth and development of aquatic species, for example, shrimp can die or grow slowly. This can be observed through over-nutriment phenomenon in shrimp or fish ponds; fishes emerge their heads in shrimp or fish ponds in the morning; red waves and massive death of seaweed in coastal areas.

Changes in temperature are also a condition for developing and spreading many diseases for aquaculture species. High temperature weakens health of aquaculture species, and pollutes water environment, which is a good condition for development of harmful microorganisms. In recent years, degradation of environment for aquaculture and extreme weather changes have caused a massive death of shrimp in most of provinces such as diseases caused by Vibrio bacterium, or by virus (e.g. MBV, HPV and BP). These diseases commonly happen in a large scale with a very fast transmission rate, and are difficult to cure. As a result, risks are too high.

In addition to negative impacts, increased temperature is also a favorable condition for aquaculture. Increased temperature allows to increase preliminary yield of shrimp or fish ponds, and to create favorable conditions for development of aquatic species, which are important feed source of aquaculture species. In Northern provinces, aquaculture is subject to temperature in spring and decreased salinity of water in summer. Increased water temperature in spring nurtures development of water catchments biomass, and people can release breeds earlier and thus avoid risks of died shrimp and fishes due to a sudden decrease in salinity of water.

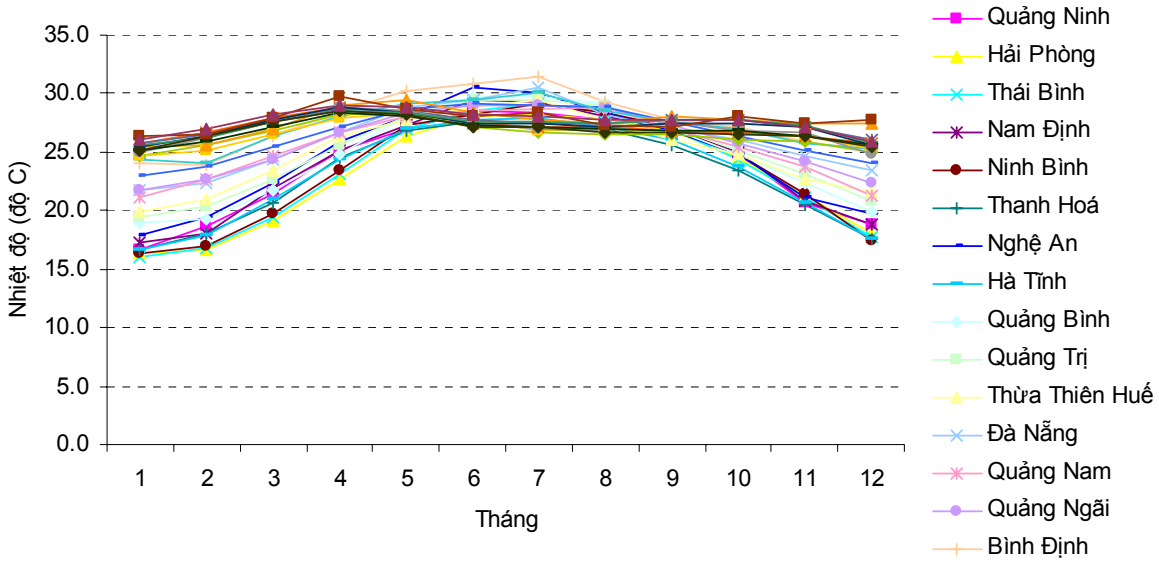


Chart 4: Monthly average temperature of some provinces of the country

3.2.2. Impacts of droughts and floods

Water basin is one of decisive factors that influence the success of development of aquaculture. Prolonged hot sunshine dries up fresh water basins and increases water evaporation rate in shrimp or fish ponds, however, as for shrimp or fish ponds, which are near by water basins or cage-based aquaculture in big water basins (e.g. rivers, streams, and sea), such impacts are not significant but as for shrimp or fish ponds, which are far away from water basins, such impacts on aquaculture are very severe. The Central region is a place, where total sunshine hours are highest and evaporation rate is highest too. As a result droughts in this region are most serious. Many shrimp and fish ponds are left abandonee since no water is available for raising. Some shrimp or fish ponds run out of water before the harvesting time comes hence farmers have to do early harvesting or give up their business. Early-harvested shrimps and fishes are sold at very cheap price or used as feed for cattle and poultry because they are too small for sales.

Too much sunshine must be followed by too much rain that causes floods in many locations. Average rainfall varies among regions (Chart 5). Floods had caused very severe impacts on many localities in the country. Many areas are considered as potential areas for development even if droughts occur but these very areas are considered as vulnerable areas for development of aquaculture if floods occur. If drought occurs, water can be provided to drought-affected areas but it will be much more difficult to handle with flood-affected areas, if flood occurs. Many strong, high dykes have been built to protect shrimp and fish ponds from high water level rise during rainy season but such dykes can not stand against floods. As for brackish aquaculture, salinity is the most influencing factor of growth and development of aquatic species. When heavy rain occurs, salinity in shrimp or fish ponds suddenly falls below a range that shrimps and fishes can stand or slows down growth of fishes and shrimps. Floods also reduce salinity of catchments areas like river mouths, aquaculture of molluse, shrimp, fishes, and seaweed will be seriously affected.

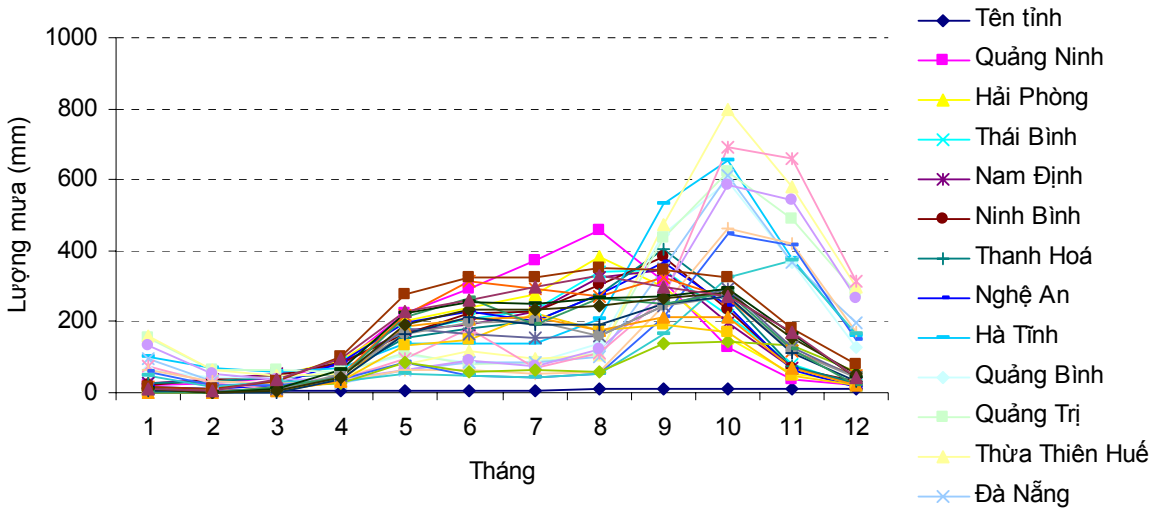


Chart 5: Average monthly rainfall of some provinces of the country

3.2.3. Storms and typhoons and typhoons

Because of being located in the tropical region, Vietnam has been suffering from impacts of storms, typhoons and tropical depressions. Storms, typhoons and tropical depressions often cause heavy rains and strong winds. Storms and typhoons had caused formidable waves that might destroy protection dykes for ponds and cages for aquaculture in the sea completely, therefore losses are unavoidable. Storms and typhoons and tropical depressions caused a lot of damages to ecosystems of aquaculture areas – that takes a long time to recover. Compared with temperature changes, it is more difficult to forecast or predict storms, typhoons and tropical depressions. In contrast, impacts of storms and typhoons and tropical depressions are much more severe. It can be said that extreme climate changes have had very huge impacts on not only aquaculture but also every aspects. In coastal areas, where local communities depends their livelihoods on aquaculture, if storms and typhoons happen, economic losses will not be avoidable and consequently their livelihoods will be lost too.

3.2.4. Solutions

As mentioned above, phenomenon of storms, typhoons and tropical depressions with floods have had great impacts not only on aquaculture but also on other sectors and activities. Therefore early forecast or prediction of evolution of abnormal climate changes is a decisive factor for prevention and mitigation of storms and typhoons and floods. When a timely forecast or prediction is provided, concerned agencies in localities, where storms and typhoons may invade, should collaborate closely with each others to mitigate and minimize losses of human lives and assets.

As for aquaculture, specific solutions for aquaculture models should be found out in order to avoid and mitigate severe changes of climate. Identification of proper locations for aquaculture may contribute to avoiding prolonged droughts, floods, and extremely high or low salinity in shrimp ponds. It is recommended to develop bio-technology to breed aquatic species, which are able to adapt well to changes in environmental factors (e.g. temperature, or salinity); improve technologies for cage-based aquaculture such as designing cages that are resistant to strong waves; and identify suitable time range for aquaculture of each aquatic species in each specific regions in order to avoid changes of weather.

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The Suitable Utilization and Development of Water Resources

Prof. Dr. Ngo Dinh Tuan, Water Resource University

I. Viet Nam has the water resources at the average level in the world and consists of many unsustainable factors.

1. Viet Nam has around 830 billion m^3 of the surface water; of which, just 310 billion m^3 are from the rainfall within the territory, and the remaining of 63% is from the rainfall in different countries. The total potential reserve of underground water resources, which is except for water resources in the islands, is estimated at 60 billion m^3 per year. The water reserve at the initial stage of exploration only reaches 8 billion m^3 per year (Accounting for around 13% of the total reserve).

Taking account of both the surface and underground water resources within the territory, Viet Nam has the average amount of 4400 m^3 per capita/year (The worldwide average amount is 7400 m^3 per capita/year). In accordance with evaluative criteria of the International Water Resources Association, The countries, those have the amount of water below 4000 m^3 per capita/year, are categorized as the countries suffering from the water shortage. Therefore, Viet Nam is one of the countries which have been suffered from the water shortage in the present as well as in the near future (Actually; if the amount of water resources flowing to the territory is added, Viet Nam has the average of around 10,600 m^3 per capital/year).

2. The unsustainable factors in Viet Nam's water resources

1) The amount of water resources flowing to the territory accounts for around two third of the total water reserve. Those water sources are very difficult to control and even unusable.

2) The surface and underground water are distributed unevenly. In terms of the geographical distribution, Bach Ma area has the highest amount of rainfall with 8000 mm per year, the rainfall in Bac Giang and Ba Na is recorded by 5000 mm per year. Meanwhile, the rainfall in Phan Ri river mouth is measured approximately at 400 mm per year. In terms of time distribution, the flood season only lasts from 3 – 5 months, but the water reserve in this season accounts for 70 – 80% of the annual water reserve. In the flood season, the highest amount of rainfall in one day could be higher than 1500 mm, but in the dry season there has been no rain for several months. The coastal areas in the Middle region of Viet Nam hold the record for the occurrence of floods and rains in the whole Southeast Asian region. Droughts posed severe impacts. Therefore, it is necessary to reserve water sources in the flood season to adjust and supplement the water sources in the dry season, this is the most important and positive measure.

3) The disadvantages of the utilization and management of water resources

- Viet Nam has around 2360 rivers with the length over 10 km. 13 catchment areas of the main rivers and tributaries cover the areas of over 10.000 km^2; of which, 10 out of 13 rivers are shared with the neighboring countries: 3 out of 12 rivers have the upstream areas in Viet Nam's territory and the downstream areas are in the neighboring countries, the remaining 7 rivers have the upstream areas in the neighboring countries and the downstream areas are in Viet Nam. This shows that Viet Nam has the obligations for the benefits of the water resources with other countries base on the sharing and unanimous principles.
- The total reserve of water resources with p = 75% reaches 720 billion m^3 per year. The water reserve of the dry season are estimated at 170 billion m^3 (Including 30 billion m^3 which are supplemented from the reservoirs till 2010). The total demand for water will be 110 billion m^3 in 2010, the demand in the dry season will be 85 billion m^3 (Excluding the water reserve used to ensure the biological environment in the downstream areas). The ineffective management could result in the possibility of the water shortage till 2010, the water shortage is obvious in some areas and some periods, especially for the regions of Ninh Thuan, Binh Thuan, Daklak, Daknong, Mekong river delta, the Midlands along Thai Binh river and Red river, and the coastal areas.

4) The exhaustion of water resources is increased.

- The population increases, but the amount of water per capita is decreased. This amount was at 16,641 m^3 per capita in 1943. If Viet Nam's population reaches 150 million people, the amount of water per capita is just 2467 m^3 per year. The amount is approximate to the countries which are suffered from the water shortage.
- Because the countries in the upstream areas increase the water utilization in the negative direction. For example: China has been built more than 10 large reservoirs along Mekong river and Nguyen river; Laos has been built 35 irrigational – hydroelectric works including 27 reservoirs in the tributaries and 8 spillways in the main stream of the river. Thailand already has 10 reservoirs and

plans to build more. Cambodia also has the plan to keep the water in the Tonle Sap Lake at a certain level to develop the irrigation…

- The deforestation is increasingly expanded with the purposes of planting coffee plants (when the coffee bean are at a high price), making woods, timbers, and the cultivated areas…The deforestation is very difficult to control; as a result, many rivers and streams are dried up in the dry season, but the erosion and the severity are intensified in the flood season…Additionally, the biodiversity is also damaged seriously.
- The water pollution is on the rise due to the rapid urbanization, industrialization and modernization. Meanwhile, the sewage and waste treatment are not under the close supervision. Besides, water pollution is also caused by the increasing and uncontrollable utilization of the chemical pesticides and fertilizers, the direct flows of the untreated sewage and waste from the aquacultural ponds to water sources.

II. Viet Nam's water resources tend to be degraded due to the impacts of the global climate change.

1. It is confirmed that the atmospheric temperature is on the increase. In 2070, the acceptable scenario may be the possibility of increasing by + 1.5^{o}C in the coastal areas, + 2.5^{o}C in the hinterland. Consequently, the water evaporation will be raised by around 7.7 ~ 8.4%, the irrigation demand also increases, the surface water streams will be decreased if the rainfall patterns remain unchanged.
2. Storms, El Nino and La Nina phenomenon will intensify the climatic extremes. As a result, the streams during the year within the rivers also intensify the extreme characteristics.

1) In the years under the occurrence of La Nina phenomenon, the number of storms and tropical depressions, which affected Viet Nam's weather, is bigger than in the years under the influence of El Nino phenomenon. In these years, if the cold fronts occur, there will be the big floods, which have both long-term and widespread impacts.
2) In the years under the occurrence of El Nino phenomenon, just a small number of storms and tropical depressions have impacts on Viet Nam's weather, but there are also the storms and tropical depressions with high level of intensity causing very serious damage.
3) In general, the storms, which have impacts on Viet Nam, tend to increase both the intensity and the frequency. The occurrences of storms those hit the coastal areas in the North and the Middle of Viet Nam tend to follow the sequential direction in each period. In recent years, it has been a tendency that many storms affect the coastal areas of Viet Nam's Middle region, especially for the coastal area in the Southernmost of the Middle region.

3. *Droughts*. El Nino phenomenon has the close relationship with the severe droughts in Viet Nam. In the years under the occurrence of El Nino phenomenon, the rainfall and the amount of stream flows are remarkably decreased, particularly in the dry season. Even though, there is not any stream flow such as Long Song River, Luy River… (Binh Thuan), LrongBuk river (Daklak), Ha Thanh river (Binh Dinh)…droughts are too severe that the animals could not survive, so that people have to move the animals to the other regions. Thousands hectare of plants died because of the water shortage.

III. Viet Nam's water resources tend to be degraded due to the unsuitable, incomprehensive development and utilization.

1. The socio-economic developments are related to the increase of the green house effect.

a. The population increase leaded to the development of the rice plantation areas and the rice output.

Comparing the year 2000 with the year 1900: Viet Nam' population rose by 1.6 times, F_{rice} increased by 2.56 times and the total rice production volume increases by 8.2 times.

b. The deforestation and reforestation. In 1943, forests covered 43% of the territory; the current coverage of the forests is just estimated at 35% of the territory. However, the quality of forests is degraded seriously; most of them are the secondary forests, the degraded forests and the artificial forests.

c. Before 1994, the total reserve of the irrigational – hydroelectric reservoirs reached 20 billion m^3 and the total effective reserve was 16 million m^3.

d. Due to the utilization from the energy sources such as coal, gas, the industrial processes and the waste; the great amount of greenhouse gases were released.

2. The unsuitable, incomprehensive development and utilization of water resources.

a. To block the distributaries to utilize the alluvial grounds behind the dykes for the agricultural production. For example:

1) In 1990, Ca Lo river mouth, the natural distributary of Red River, was blocked. Ca Lo River became a tributary of Cau River to reserve the rain water and the sewage which were polluted by the organic substances, oil and grease.
2) In 1937, Day River was blocked by the Day dam; Day River became the dead-end river (From the Day dam to Ba Tha). In 1976, Day river mouth was covered by the Van Coc culvert and Cua Hat dam in order to utilize the reservoir form Van Coc to Day dam. At present, Nhue River has been turned into the reserve of the sewage, the polluted water from the large urban areas such as Ha Noi and Ha Tay. Nhue River is under very alarming condition.

b. The small rivers flowing through the cities are severely polluted by the sewage from the civil and industrial processes.
1) Phuong Hoang stream flowing through Thai Nguyen city is seriously polluted by the untreated sewage of the De paper production factory.
2) To Lich, Set, Kim Nguu River…those flow through Ha Noi capital are severely polluted, but these rivers also flow directly to Nhue River.
3) Nhieu Loc – Thi Nghe canal, Tau Hu canal, Tan Hoa – Lo Gom canal, Tham luong canal, Doi – Te canal and other canals run through the urban areas of Ho Chi Minh City then flow directly to Sai Gon River and cause the severe pollution.

c. In general, the rivers could divide the polluted areas where the rivers flow through the urban areas, industrial zones, handicraft villages or the agricultural activities…

d. Construction of the spillways to use up the basic amount of water and create the “dry area” of the river below the spillways.
1) In the dry season, the spillways used for irrigation had the spillovers in 30 years ago such as Thach Nham dam in Tra Khuc River, Lai Giang dam in Dai Giang River, Dong Cam dam in Da Rang River, Nha Trinh – Lam Cam in Cai River of Nha Trang…But in several recent decades, the increase of irrigated areas, water demands for civil and industrial utilization combining with the serious deforestation of the watershed forests, the catchment areas of those dams have run out of water in the dry season, this situation could lasted several months in case of without the occurrences of rain. In these catchment areas, many people live along the river banks and on the river, so that people have been influenced noticeably by the above phenomenon.
2) The spillways used for the hydroelectric generation:
- Creating the “dead” sections of rivers between the catchment areas of the dams and the hydroelectric plants. Although, just a small number of people live in these areas; the damage to the biodiversity and the aquatic ecosystem should be noticed.
- Because the adjustment of the water resources is carried out in the day and evening, there is no water in half of the day in the catchment areas. Therefore, this phenomenon has remarkable impacts on both the socio-economic activities related to the waterway transportation and the aquatic habitats of animals and plants.

e. In accordance with the master plan; for a long time, the designs of the reservoirs have not taken the adequate consideration for the environmental flow in the catchment area of the dam. Therefore, this caused the complaints by many local people and areas.

f. The overexploitation and the lack of planning and unanimity in the utilization of water resources.
1) The overexploitation of the underground water caused the severe pollution in Daklak, Ninh Thuan and Binh Thuan. It required the measures to supplement the water resources.
2) In accordance with the master plan for water resources, the demand for irrigated areas in 5 provinces in the Central Highland would be 80,000 hectare of coffee plants. However, Daklak province (the former name of the province) planted 260,000 hectare of coffee plants; as a result, thousands hectare of coffee plants died due to the water shortage.

g. The management of water resources lacks the concentration, the mutual connection and the unanimity. Which resulted in:
- The “artificial” shortage of water occurred because this was no operational process for management of water resources for the lakes in the dry season (Annually, the water reserve of Red River could not meet the requirement of the necessary water level in February and March).
- There is the lack of the concentration and the strict regulation. Many relevant agencies and sectors issued the regulations but none of them can make the decision. For example: Giang Son gauging station has three regulations for a section of Giang Son bridge in Krong Ana River. Three regulations were issued by three ministries: Ministry of Transportation, Ministry of Natural Resources and Environment, Ministry of Agriculture and Rural Development. Three prohibited signs have the same content: No exploitation of sand. In fact, the regulations are not obeyed: The

pivots of the bridge are still eroded; many boats exploit the sand that caused the erosion of the riverbanks and distorted the data of hydrographic measurements.

IV. The measures for the suitable development and utilization of the water resources in Viet Nam or the measures for the sustainable development of the water resources in Viet Nam

1. To limit and mitigate the degradation of the water resources due to the global climate change.

a. Reduction of the greenhouse gases in accordance with the National Action plan.

b. From 1994 – 2020, the additional number of around 70 reservoirs used for irrigation and hydroelectricity has been build, these reservoirs have the following indicators: $V_{hi} \geq 10$ million m3 with $\sum V_{tb_3} > 50$ billion m^3 and $\sum V_{hi} > 33$ billion m^3; of which, there are 46 reservoirs with $V_{hi} \geq 400$ million m^3.

c. To upgrade, improve and expand the system used for dealing with floods and inundation.

1) To upgrade the old systems

2) To plan the supplementary construction of the new system that is independent from the system of irrigation and water supply.

3) To implement completely the Law on Water Resources, Law on Environment Protection, Law on the Protection of Dykes…in order to ensure the measures for floods, protect the riverbanks, to adjust and harness the riverbed and the river mouth with the purpose of mitigating the floods.

d. Improving the sea dykes and the dykes at the location of the estuaries

e. Strengthening the structural improvements for the river dykes to ensure the safety of the dykes in accordance with the regulations for the designed level of water.

f. Utilizing suitably the wastelands

g. Implementing the clean production mechanism

2. To limit and mitigate the degradation of the water resources due to the unsuitable development and utilization of water resources

a. Reduce the demand for water

1) To save water resources used for the irrigation.

2) To reduce the loss of water resources:

- To build the canals and ditches
- To upgrade the key components of the irrigation system
- To improve the effectiveness of the management

❖ The management is in accordance with the demand for water utilization and does not based on the capacity of the system.

❖ Creating favorable conditions for the participation of the society, the citizen and community in the management

3) To change to the structure of plants and animal breeds which have low demand for water

4) To prevent the water pollution

b. The industry

1) To improve the effectiveness of the water recycling

2) To build the sewage treatment system

3) To prevent the pollution of the water resources

c. Tourism – Service – Domestic utilization

1) To use the water efficiently and prevent the waste of water sources

2) To reduce suitably the demand for water, improve the appliances those process the water.

3) To prevent the pollution of the water resources

d. The water exploitation and utilization have to be in parallel with the protection of the water resources, guarantee of the environmental flows in order to keep the river clean, to protect and develop the aquatic ecosystem. To legitimize the content of ensuring the environmental flow in the planning, design and operation of the spillways and reservoirs those used for irrigation and hydroelectricity. To have the plan of improving the underground water for the areas where were under the overexploitation of water sources in order to prevent the desertization process.

e. To invest in the researches of the assessment and the planning for the long-term forecast of water resources. In order to have the suitable and safe plans for water utilization, it is necessary to prepare the seasonal, yearly and long-term forecasts on the water resources, natural disasters in parallel with La Nina and El Nino phenomenon…

f. To manage comprehensively the water resources. The watershed management organization should have the suitable and efficient structure of management.

g. To protect the aquatic environment, to prevent and mitigate the water pollution, to implement strictly the new laws and the relevant documents.

1) Understand and implement completely the Law on Environmental Protection, Law on Water Resources, Law on the protection of Dykes, the National Strategy on Water Resources to 2020 and other relevant decrees, regulations issued by the Government.
2) Impose the fee on the polluters.
3) Create favorable conditions for the society, the community to participate in the management and protection of the aquatic environment.
4) To reform, improve and restore the polluted rivers, the dead-end rivers such as Nhue River, Day River, Cau River, Sai Gon River and the rivers as well as the canals flowing through the urban areas.

3. To limit and mitigate the degradation of the water resources due to the shortcomings of the management, the organization and the law.

1) The Government should issue the complete and comprehensive sublaw documents in order to guide the implementation of the Law on Environmental Protection and the other Laws related to the water resources.
2) The Government should amend the Law on Water Resources in compliance with the current condition of the socio-economic development (That already showed some shortcomings) and the sublaw documents.
3) The Government should focus and unify the agencies for management of the water resources from the central to the grass root level and to form the suitable organizations of watershed management which have the specific tasks and functions. These organizations are operated and managed efficiently by the "people in the watershed areas" with the assistance from the central level (The organizations should not just focus on managing the master plans; in fact, the master plans have not been formed yet. The managers and directors are mainly "People of the central level" so that the operations are ineffective and felt into the formalism).
4) The Government should implement the mechanism and policies to encourage people, the community organizations to participate really in the protection of water resources, the aquatic environment. Additionally, to create favorable conditions for people to participate from the stage of planning the construction to the stage of exploitation, utilization and protection.
5) The Government should promulgate the documents regulating gradually the adequate environmental flow for the rivers to ensure that the rivers are alive, healthy and clean. This lays the foundation for the sustainable development of water resources.

V. Conclusion.

1. The degradation of water resources due to the Climate change and the socio-economic development is obvious and remarkable.
2. The most obvious impact of Climate change is the increase of atmospheric temperature which resulted in raising the water evaporation and the demand for water utilization. The Climate change also increases the water level as well as the frequency and intensity of the storms that influenced Viet Nam. In combination with El Nino – La Nina phenomenon, Climate change caused the natural disasters such as storms, floods, droughts, flash floods and the invasion of the sea water.
3. The socio-economic development resulted in the pollution for the river sections, the whole river (In the urban areas) or created the dead-end rivers and river sections.
4. The measures for improvement and mitigation are only effective when they are collectively and unanimously implemented from the central level to the grass root level and vice versa including the improvement of awareness, understanding to the specific activities and actions.

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Summary

Viet Nam has the water resources at the average level in the world and consists of many unsustainable factors. These factors are on the rise due to the impacts of the Climate change, the suitable development, utilization and management. Consequently, Viet Nam's water resources tend to be more and more degraded, exhausted and poor. To prevent and restore effectively the water resources, the Report recommends the measures for suitable development and utilization (Or sustainable development) which are in need of the enthusiastic, unanimous and timely implementation.

The Impact of Climate Change on Infrastructure

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The Climate change - the typical phenomenon is the global warming - was discovered in the second part of 20th century and was confirmed gradually in the researches of the United Nations' Intergovernmental Panel on Climate Change (IPCC) in the beginning of 1990s to the current time (IPCC – 2006). The international conventions stated the significance and the urgency of the Climate change include: The Framework Convention on Climate change in Rio de Janeiro Earth Summit (1992), the Kyoto Protocol in Kyoto Earth Summit (1997)…which required that all nations coordinate their actions to reduce the threats to human being in the near future. In the United Nations' Sustainable Development Agenda 21 and the Johannesburg Earth Summit (2002), Climate change was continued to be regarded as the major threat to the Sustainable Development Goal and it required the Human beings' coordinated efforts to address.

Based on the IPCC's research result; since the commencement of the Industrial era (In the middle of 18th Century), the greenhouse gases emissions from the industrial process and deforestation attributed to the continuous increase of the Earth's surface temperature. As a result, the Sea level rose, activities of the atmospheric circulations increased and strengthened; then the activities of natural disasters became stronger.

During the past century, only with an increase of 0.74°C in the global average temperature (IPCC, 2007) caused the Sea level to rise from 15 – 20 cm, the activities of natural disasters were intensified in many areas…the casualty and the material damage were increased rapidly. The annual damage caused by the natural disasters increased from below 10 billion USD (In 1950s) to 50 – 60 billion USD (In 1990s of 20th Century) (IPCC, 2001). In accordance with IPCC's latest forecast (2007), the content of greenhouse gases will doubles at the end of this century (In 1970s – 1980s) in comparison with the pre-industrial era, the global average temperature increases from 2°C to 4.5°C, which means that it is 3 to 6 times increase than the previous century. At this time, the Sea level could rise to 28 – 58 cm (In comparison with the period of 1989 – 1999) and to 1m with the current rate of meltdown in the 2 polar ice caps. In this context, natural disasters are to increase with the forecasted variations such as: storm, blizzard, whirlwind, torrential rain, drought, prolonged periods of high temperature, even the prolonged frosty periods …, big floods in the rivers, flash floods and the landslides in the mountainous areas; huge waves, flood tides during storms…The status of Climate and Hydrology in many regions would experience the remarkable changes, especially for the regions with cold climate, the dry areas, the coastal areas…

In accordance with IPCC (1996, 2001), Climate change would continue to impact on every aspect of the society and nature; of which, the infrastructure is an important factor. Within this report, the infrastructure is understood as all the civil and industrial construction works in these sectors: Construction, Energy, Transportation, Industry, Agriculture, and Tourism – Service…There sectors have been established recently but they will last in many following decades, even several following centuries. Therefore; during the existing period, these sectors will be influenced directly and continually by the Climate change with more and more influential tendency. To date, the research results of the observations from the past to the present (Mostly in the 20th Century) still provide the foundation for the planning and design of construction works. They are presented in the national or sectoral standards of the environment and the climate which are applicable to the construction and other objects. Therefore, the planning would be reasonable; the construction work would be safe if we assume that the climatic and environmental process were "motionless". In other words, these processes were random and had no obvious tendency; it also meant that the past processes would repeat themselves in the future.

The Climate change under the artificial influences caused many climatic characteristics to become stronger and incompletely natural; particularly, the extreme climatic conditions remarkably increased. Within this context, the construction work would not be safe and the conditions, which provided the foundation for the planning and designing, are not the same convenience as in the past. Whether the currently – reasonable master plans and the construction designs could be adaptable to the climate and the environment in the second part of the century?...Presently, these problems can not be ignored in the planning and design process. In the IPCC's researches, from the first evaluation (1998 – 1990), the second evaluation (1993 – 1995), the third evaluation (1998 – 2000) and to the current fourth evaluation (2004 – 2006); the issues in the planning and the construction were also mentioned in many researches of the Sub workgroups under IPCC's

Workgroup II such as the Sub workgroups on the residential quarter, the coastal area, the Agriculture, the Transportation – Industry – Energy…These research papers are very diversified; Nevertheless, they are not specific for each country due to the fact that the climate and the Climate change vary in the Earth's surface in terms of the influential degree; some places experience the strong effects, while the others experience the weak effects, some locations are under the strong influence of certain effects but under weak influence of other effects…Therefore, based on the common foundation of the Climate change and the global strategy of mitigating the Climate change, all nations should have their own researches; particularly, the impact assessment of Climate change on the specific socio-economic objects in order to issue the suitable and effective strategies and measures.

In recent years, Viet Nam has also conducted many research papers and research projects on the Climate change and its impacts on the country. However, most of the research approaches are general and qualitative, the quantitative approaches are limited. Therefore, it is necessary to continue the researches on many issues such as the specific scenarios of Climate change in each region, the extreme climatic phenomena… the impact assessment of Climate change on some socio-economic objects was also conducted; however, the impact assessment just focused on the general level and mostly on the agricultural sector, the forestry sector, the energy sector and the healthcare sector. IPCC's global researches also mentioned the infrastructure, but Viet Nam does not have enough capacity to conduct the in-depth researches to assess quantitatively and specifically in order to provide the foundation for the planning, design and the monitoring of the current climate standards on the construction issued by the sector and by the State.

The recent article in Nhan Dan newspaper (No. 18839 dated March 14th 2007) written by Mr. Tran Duc Luong – Viet Nam's former President – showed a policy maker's relatively-comprehensive viewpoint on the Climate change. In his article, He recommended that it is time to conduct a national research program on the Climate change. The program should include the policy makers and experts in the field of planning to revise, re-examine the available research results and to approach the latest research results in the world in order to provide the reliable scientific foundations for the strategic planning and long-term master plan to ensure Viet Nam's sustainable development. In this article, Mr. Luong also highlighted the significance of issuing the forecast of Climate change scenarios for the next decades and centuries. In the above-mentioned research program, He stressed the planning objects in the construction plans of the infrastructure system, the construction of urban areas, the residential quarter, the industrial zone…In my opinion, these ideas are reasonable.

In accordance with the available researches of Viet Nam and other countries in the world, it is obvious that the impacts of Climate change could present in the following main objects:

1. The construction planning. The construction planning of the infrastructure includes not only the urban and rural planning, planning of the residential quarters, the industrial clusters; but also the construction planning in the Transportation sector, Water resources management, Healthcare, Education, Tourism – Service…Climate, Hydrology and Ocean are the important natural factors for the construction planning. Different architectural patterns are adaptable to the different climatic zones from tropical, temperate, frigid, desert and monsoon climate…these different architectural patterns were formed in a long period, selected intentionally by many generations, expressed typically by the traditional architecture of each nation and incorporated in many textbooks of the tertiary education. The map of climatic zones, which was produced by each nation, provides an important foundation for the construction planning. In Viet Nam, the monsoon mechanism remarkably classifies the country's climate and produces the distinctive features in the construction planning of different regions. In Northern Viet Nam, the construction planning should combine the requirements of keeping cool in the summer season and keeping warm in the winter season. Meanwhile; in Southern Viet Nam, the only requirement is just to keep cool. The annual variation level and the seasonal structure of many climatic elements in Northern Viet Nam are profoundly different from the Middle and also different from Southern Viet Nam, which require the different levels of adaptability among each region's infrastructure. Particularly; in the coastal areas, the construction planning has to take account of the distinctive features of the oceanic climate (Which are completely different from the mountainous areas) for example: the Sea level, tides, waves, the water rise…In Viet Nam, most of the coastal areas is directly suffered from the windstorm; this is a special meteorological loading capacity that should be taken into account for the planning of urban areas, residential quarters and industrial clusters.

Climate change leads to the change in the space distribution of many climatic features and even the partial change in the structures of these features. Some types of natural disasters will become stronger; however, some other types become weaker. These changes could result in the alteration

in the distribution of space – time of some features and some climatic indicators. Therefore, the available map of climatic zones could be changed. In Viet Nam, coastal areas account for over half of the national border and take an important part in the economic development and in the construction of the infrastructure such as the urban areas, the industrial zones and the residential quarters. Viet Nam's two key deltas also attach to the coastal areas. The Climate change will have remarkable impacts on these regions due to the important consequences for instance: the Sea level rise in combination with the intensified activities of different natural disasters such as wind and rainstorm, water rise during the storm, huge wave…IPCC proposed 3 adaptive strategies for the Climate change and Sea level rise in the coastal areas, it is necessary to study and apply these strategies to the master planning in general and the construction planning of the infrastructure for the coastal areas in particular.

In many mountainous areas, Climate change leads to the increase of rainfall with the stronger intensity in combination with the deteriorated forest; as a result, the flash floods and the landslides are on the rise. Therefore, it is necessary to re-plan the urban areas and the residential quarters to avoid the previously-occurred disasters. In parallel to the increase of floods, the drought also occurs more frequently, some areas appear the desertization process and this phenomenon would be surely intensified in the following decades. The problems of water supply and irrigation will become more sophisticated and urgent in many regions. These characteristics should be taken into account for the construction planning of the infrastructure in the regions and the urban areas.

Currently, Energy is the big issue for the world and for each nation. It requires that each nation has to plan the energy development in general and the construction of the energy infrastructure in particular including the production, transmission and consumption system of energy in conformity with the Climate change. The energy sectors of each nation try to achieve the target of a clean energy production system and production of the energy with a low level of greenhouse gases emissions. The renewable energy sources such as the solar power, the wind power, the tidal power, the thermal power; hydroelectric power and nuclear power…are put in the strategy of energy development as well as in the planning of the infrastructure construction for the energy sector.

In line with the requirements to adapt to new situations which are caused by the Climate change including the positive and negative impacts, the requirements in mitigation of the Climate change with the focus on the decrease in the greenhouse gases emissions by all nations. This is also each nation's urgent problem to formulate the development plan in general and the plan of infrastructure construction in particular of all relevant sectors.

2. The Construction design. The construction design and the construction planning are under the great influence of the Climate change. At first, the construction design is under the general control and the management of the construction planning in terms of the measures to adapt to the environmental changes of the region caused by the Climate change. In addition, the construction design has to pay more attention to the locally-specific impacts and the microclimate conditions. If the construction planning could delay and use the qualitative evaluations of the environmental changes caused by the Climate change, the construction design requires the quantitative evaluations in order to incorporate in the calculating models, to release the specific data of the changes in the construction materials and the expenditures of the construction work.

In the construction design, the climatic loading capacity takes a very important role. Viet Nam has no frost loading capacity, so there are two major climatic loading capacities are the wind the thermal loading capacity. Both two loading capacities also include the changes caused by the Climate change; of which, the changes in the wind loading capacity are mostly noticeable. The wind loading capacity, which put over the construction work, consists of two major factors: storm and whirlwind. Obviously, each factor has the different characteristics and contributions. In the ocean and the coastal areas, storms take the important role. Meanwhile, in the mainland, particularly in the far-flung mountainous areas, the whirlwinds take the pivotal role. The Climate change leads to the increase in the frequency and the intensity of these factors, which results in the increase of wind pressure on the construction works in many regions.

Rain has the direct relationship with the design of the water supply and the sewage system, especially for the urban areas, the residential quarters and the industrial clusters in the low-lying areas, the deltas and the coastal areas. The Climate change would continue to increase the rainfall and the frequency of the heavy rains… As a result, the urban sewage system will have a lot of difficulties. Presently, the inundation phenomena become an urgent problem in the large urban areas. If the impacts of Climate change could not be taken into account from the stage of the new design and the improvement of the sewage system, the inundation phenomena after each heavy

rain will be a long-time problem without the effective measures to address. Climate change has the characteristic of increasing the variation of climatic factors; therefore, Climate change could increase the intensity of rain and the frequency of heavy rains, in other hand, Climate change also prolongs the rainless periods and reduces the rainfall in the dry season. Then this situation has a great impact on the water supply for the production and the household's consumption. Obviously, at the stage of design for the water supply system in the regions, it is necessary to conduct the comprehensive survey of this phenomenon, especially for the regions where may be prone to the possibility of drought and have the signs of the desertization phenomenon. The energy resources use for the water supply and the irrigation system will be surely increased; as a result, the expenditures of the water supply and the sewage system also increase.

In the energy sector, the design of the energy production plants aims at the low emissions of greenhouse gases such as the thermal power plant using the liquefied gas turbine and the nuclear power; the constructions of clean power production plants such as the hydroelectric plants, the wind power plants, solar panels for the power generation, boiling water and drying purposes…the tidal power plants, the geothermal power plants…the buildings, which include residential apartments and public buildings, are designed with the optimal conditions in energy consumption in terms of the lighting, heating and cooling purposes; the buildings which are installed with the solar panels…This is the preferential development direction. This tendency will become the construction standard in many countries and this standard will also applied in Viet Nam.

3. Revision and issuance of new climatic and environmental standards for construction sector. The standards include: sectoral standards, national standards and regulations on climate and environment which are applicable to the construction sector. These standards are also the important and legitimate tools to encourage and force the planners and designers to comply in order to ensure the safety, convenience and cost effectiveness of the construction. The Climate change leads to the changes in the climatic criteria and the changes in the inputs of the design models and planning models. In this context, it is necessary to have the researches and the scientifically-based evaluations on the impacts of the Climate change on different objects of the construction work and the calculation models in order to adjust the climatic parameters used in the construction standards. To revise the climatic maps and to establish the forecast maps for the different periods of 21st Century. On this basis, the recommended adjustments and amendments are incorporated in the relevant standards or new standards and regulations are proposed to help the designers and planners to have the necessary documents for the application to the construction planning and design from the next years.

In the same situation with the other natural and social objects, the impacts of Climate change on the different objects are not completely similar; In addition, these impacts are not identical between the regions. The above parts mention some of the most typical and general objects in the infrastructure construction and the impacts of Climate change on these objects in Viet Nam. In order to achieve the scientific valuations on the possible impacts of Climate change on the infrastructure in general and the different objects of the construction in Viet Nam's regions; I recommend that some measures should be implemented:

- At first, to approach and update the latest research results of the global climate change which have been announced worldwide. To focus on the IPCC's research results which are released in 2001 and 2007. In line with the general evaluations, there are also the specific and comprehensive evaluations on the impacts of Climate change on the infrastructure. It is necessary to update and analyze these evaluations to apply to the reality. It is very essential to build the forecast scenarios of Climate change for 21st Century; more importantly, to study the measures, the models to transfer these scenarios of global climate change to the nations and small regions. Based on this foundation, to research the suitable applications to Viet Nam's conditions; afterwards, to apply the scientific methods and the most modern tools to build the scenarios of Climate change for each region, each area which are in focus. At present, many arithmetic models could help us to quantify the impacts of Climate change to the objects, regions and periods that we need to concentrate.
- To assess the impacts of Climate change on the planning of the infrastructure. To pay great attention to the environmentally-sensitive areas and the key development areas at present such as the coastal areas, Mekong delta, Red River delta, mountainous areas prone to flash floods and dry areas with the desertization phenomenon…On that foundation, to propose the suitable measures in the planning of the infrastructure to the end of 21st Century. To recommend the adjustments in the construction strategy and the current master plan considering the impacts of Climate change through the different stages to the end of 21st Century.

- To assess the impacts of Climate change on the different objects in the construction design. To find the different objects, parameters and stages of the construction design which are under the influence of Climate change. These factors should be paid more attention by the designers. In terms of the completed construction works, it is necessary to study the objects and the work items of the construction that could be under the impacts of Climate change during the existing period of the construction works. Then to map out the necessary processes and measures to guarantee the usage period and functional requirements of the construction works in accordance with the previously-designed purposes.
- To revise the climatic regulations and standards apply for the construction. The revision of standards is the regular task of all sectors. It is necessary to prepare the foundation for the revision of the climatic regulations and standards applicable to the construction including the examination of amendment of the data sets to ensure the optimal update capacity. To recalculate the used parameters on the basis of the latest data source in comparison with the period of examination. To study the regulatory model of the climatic parameters which were used in different periods of 21st Century on the foundation of the relevant forecast models of Climate change. To revise the climatic maps which are being used in the climatic regulations and standards. To recommend the adjustments and even new maps with the consideration of Climate change for some important milestones of 21st Century, this could help the planners and designer to visualize more clearly the climatic situations in the next periods in order to issues the effective measures and adaptations.
- To further the cooperation among the meteorologists, experts, construction planners and designers; domestic and external experts with long experience of this problem. To promote the training activity on the Climate change and its impacts on the construction in the colleges and universities which are specialized in the architecture, construction and hydrometeorology…to provide students with necessary concepts and knowledge of this problem before they work in reality.

The above parts just mention the primary ideas of the discussed problem. I hope that this problem will be completed by the researches which are conducted in Viet Nam and bring back the practical outcomes to serve effectively Viet Nam's long-term development process.

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Impact of Vietnam Industrial Production on Climate Change

Dr. Ngo Duc Lam, Chairman of Chemical and Industrial Safety Technology Institute (Vietnam Chemical Association)

I. Introduction: Climate change which is typical by the warming of atmosphere globally is one of the most concerned issues of the world environment. Reason for the increase of warming is the emission of greenhouse gases – such gases are released from human socio-economic activities, in which industrial production process and energy usage play a major role.

Presently, in Vietnam, the emission of greenhouse gases remains in low level, but in the near future, energy from fossil fuels will be used much more than today so the amount of greenhouse gases will also increase significantly and it is sure that this will contribute to the change in climate. Therefore research on impact of industrial production to climate change so as to inventory the emission amount and propose technical measures and policy to reduce the growth rate of greenhouse gas emission is a necessary issue.

II. The development of greenhouse gases in industrial production presently and forecasting the emission levels of greenhouse gases in the future.

Greenhouses gases in the nature mostly are steam, CO_2, CH_4, N_2O, NO_x, and O_3. Gas is not of nature is Chlorofluorocarbons (CFC). Emission level of greenhouse gases mainly depends on economic and population growth rate in which industrial and energy activities are noteworthy.

In the industrial and energy activities, CO_2 and NO_x are released from the fossil fuel burning (coal, petrol) in the boilers of thermal power plants and in the incinerator of the cement, steel, paper, textile, and sugar and construction material plants.

In our country, it is noted that the greenhouse gases are also released from the coal, firewood, and agriculture by-products.

1. Greenhouse gas emission from the power industry

Present condition and anticipation of the energy consumption in power sector

- In 1990:
  + Commercial energy consumption (kgOE/person): 63
  + Commodity energy consumption (KWh/person): 93
  + Energy intensity (KgOE/US$100): 344
- In 2002: The data are 208; 380; 512 respectively
- In 2003: Power sector consumed more than 3,070,000 ton of coal, 375,000 ton of oil and 2,983,000,000 m3 of gas. Power output from the plants, which used fossil fuel, is 22,000,000 Kwh, accounting for 54% of total power production with the rate of coal consumption from 330-818g/Kwh, and oil consumption from 366-376g/Kwh.

It is estimated that in the period from now to 2020, there has been additional 3500MW coal-fired power and 6750 MW natural gas power. In addition, the first nuclear power plant with capacity of 600MW-1000MW in Vietnam will be constructed.

So the consumption of fossil fuel up to 2030 is estimated as follows:

Table 1:

Fuel	Year						
	2000	2002	2005	2010	2012	2020	2030
Coal (10^3 ton)	2054	2679	4428	9815	11346	17474	46684
DO oil (10^3 ton)	493	383	71	41	43	0	0
FO oil (10^3 ton)	326	285	259	33	34.3	0	0
Burning gas (10^3 ton)	1224	2550	5001	8274	10425	16162	19054
Total (KTOE)	3075	4466	7309	11017	15814	24331	43292

- The emission of greenhouse gases from power production is as follows:

Sector	Equivalent emission amount calculated by CO_2 (10^3 ton)						
	2000	2002	2005	2010	2015	2020	
Power	11238	15270	21526	39791	63107	73448	

Comments on technology in the production of coal-fired power and FO oil product

In general, productivity of our power equipment is still low. Recently, some new power plants have quite large productivity, so the average power productivity in Vietnam is about 60-70%. This figure is average productivity figure in the world – some equipment remains backward and old, the capacity of power unit is small, low parameters.

So, in order to reduce the greenhouse gas emission in the future, the policy chart for Vietnam Power development to 2020 is as follows:

- Do not develop direct FO-burning thermal power technology
- Choose burning chamber technology with have high productivity
- Have high and super-high pressure and temperature parameter
- Weed out old equipment

2. Greenhouse gas emission from the cement industry

Cement is the industrial sector, which consumes the most energy (accounting for 17% of energy used for industry).

According to the general development chart of Vietnam cement, demand and cement output are estimated as follows:

Demand and Cement output

Table 3:

Criteria	2002	2003	2005	2010	2015	2020
Much growth	20	15	13	10	5.8	2.5-3
Demand 10^6 ton	19.7	22.6	29	48.6	63-65	68-70
Output 10^6 ton	16	17.8	22	49.8	62.8	68

Forecasting the energy consumption of cement manufacturing sector

Table 4:

Criteria	2000	2010	2012	2020	2030
Coal (ton)	1,738,908	5,151,462	5,540,963	6,265,375	6,886,000
Power (MWh)	1,572,793	7,802,900	7,779,187	10,380,163	12,406,895

Greenhouse gases release from cement manufacturing process. Total greenhouse gas emission in cement manufacturing process including technology process, fuel burning, indirect from power consumption, and processing additive is presented in the following table:

Greenhouse gas emission in cement manufacture

	2002	2005	2010	2015	2020
Total waste (million ton of CO_2)	14.42	19.89	40.26	50.77	54.98

In order to reduce the emission of greenhouse gases in cement manufacture, we should focus on the measure of energy saving such as improving burning chamber, increasing the performance of making cool…, taking back the residual heat, shifting from wet process to dry process etc.

3. Greenhouse gas emission in steel manufacture industry

Steel sector consumes much energy, only after cement industry. Steel sector consumes about 7.7% of energy used for industry and it is the sector which consumes the most electricity – in present, technology for manufacturing steel in Vietnam remains backward, the rate of energy consumption is still high, productivity is only 50% of energy consumption.

Steel productivity in Vietnam in 2002

- Cast iron from iron	50,000	Ton/year	(From furnace stand)
- Steel alloy	500,000	Ton/year	(from electric furnace)
- Bridge and construction steel	1,600,000	Ton/year	(liquid roll, cold roll)
- Coated steel, pipe	100,000		(cast, roll)

And the correspondence greenhouse gas emission is 3,355,800 ton of CO_2.

4. Greenhouse gas emission in paper manufacture industry

Estimating energy consumption in paper and pulp sector

Table 6:

Criteria	2010	2012	2020	2030
Gasoline (ton)	96	108	172	308
FO (ton)	192,909	221,730	386,996	776,354
DO (ton)	20,084	23,037	39,880	79,187
Coal (ton)	594,532	684,503	1,132,126	2,290,247
Electricity (MWh)	862,378	1,009,607	1,897,557	4,171,028

Greenhouse gas emission in 2000-2002

Table 7:

Year		Gasoline (t)	FO (t)	DO (t)	Coal (t)	Electricity (t)	Total
2000	Energy consumption (t)	50	75,583	9,742	302,105	414,383	
	CO_2 emission (t)	124	244,889	30,785	647,862	254,845	1,228,150
2002	Energy consumption (t)	57	86,878	11,198	347,239	416,242	
	CO_2 emission (t)	147	218,475	35,386	802,122	256,019	1,375,149

5. Synthesizing the emission of greenhouse gases in industrial production presently and forecasting the amount of greenhouse gas emission in the future.

Economic growth rate in Vietnam is quite high with GDP from 7.5 – 8.5% / year, so Vietnam industry also has the growth rate of 14 – 16%/ year – demand of energy for industrial production is very high.

The increasing orientation of using energy from coal, oil and gas is presented in the following general energy table:

Table 8:

Fuel	Year						
	2000	2002	2005	2010	2012	2020	2030
Coal (10^3 ton)	2054	2679	4428	9815	11346	17474	46684
DO oil (10^3 ton)	493	383	71	41	43	0	0
FO oil (10^3 ton)	326	285	259	33	34.3	0	0
Burning gas (10^3 ton)	1224	2550	5001	8274	10425	16162	19054
Total (KTOE)	3075	4466	7309	11017	15814	24331	43292

Source: Energy Institute

EMISSION OF GREENHOUSE GASES IN INDUSTRIAL PRODUCTION PRESENTLY AND FORECASTING THE AMOUNT OF GREENHOUSE GAS EMISSION IN THE FUTURE

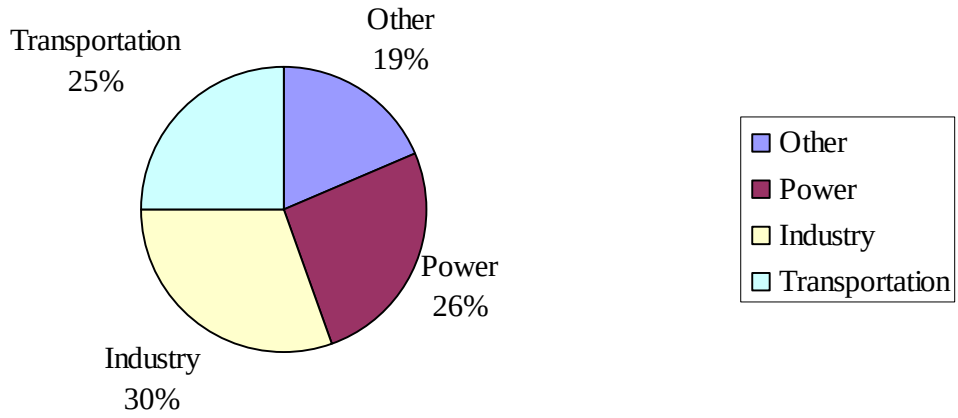
EMISSION

Table 9

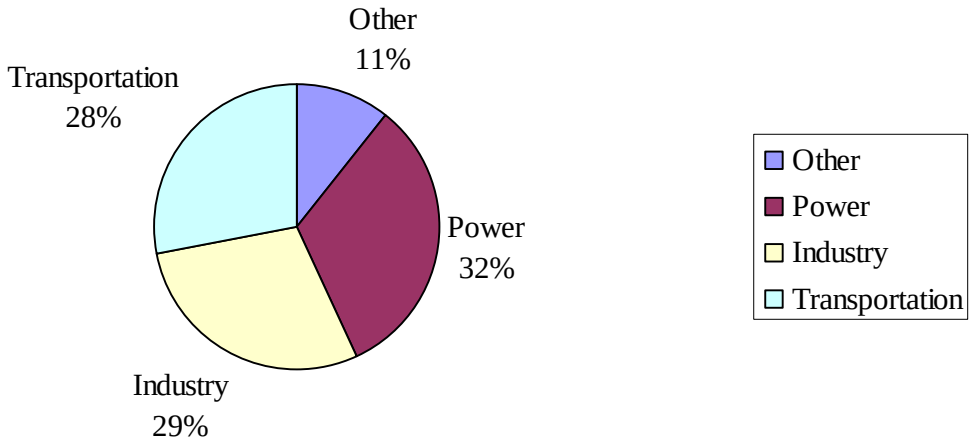
Sector	Year					
	2000	2002	2002	2010	2015	2020
Emission from coal exploitation process	1016	1391	1515	2106	2400	2696
Emission from oil exploitation and transportation	54	55	59	72	73	60
Emission from gas exploitation and transportation	238	11	974	1596	2529	2677
Power sector	11231	15270	21526	39791	63107	73448
Industry	14081	17857	24754	35597	48126	64335
Agriculture	1124	1269	1386	1479	1757	2083
Transportation	11190	14737	1896	3088	43839	62594
Trade and services	3167	3712	4354	6001	8066	9831
People's activities	3307	4286	4922	5767	6414	7823
Total	45121	58526	77426	121628	173712	222813
Industry + power sector	25312	33127	46280	75388	111233	137783

STRUCTURE AND GROWTH OF GREENHOUSE GAS EMISSION BY ECONOMIC SECTORS IN 2002-2020 PERIOD

YEAR 2002



YEAR 2020



Following comments can be made from the above tables and charts:

+ Greenhouse gas emission in our country is largest in energy, industry and transportation sectors (make up 90%) in which industry and energy sectors accounting for more than 60% and this tendency does not change up to 2020.
+ CO_2 emission rate from agricultural and industrial activities in 2002 was not as high as in 1998. However, such rate in following years has increased much: 1.35, 1.7, 2.8 and 9 times in 2002, 2005, 2010 and 2030 respectively.

III. Some measures to minimize the growth rate of greenhouse gas emission in industrial and energy sectors.

In fact, the amount of greenhouse gas emission in Vietnam is not large compare with developed countries. However, it is noteworthy that the growth rate of greenhouse gas emission in recent years and the forecasted amount of greenhouse gas emission in the future is very high together with the socio-economic development. In order to reduce such emission, we should:

1. Regarding management: Raising public awareness on climate change due to greenhouse gas emission in industrial and energy sectors. The government should have its policy so all the economic sectors shall pay attention to having effective measures to limit heavy emission.

2. Regarding technique and technology.

- Implement well the policy on energy saving.
- Use effectively the primary material source, especially coal. In order to achieve this, it is needed to innovate equipment, mainly boilers and industrial furnaces, replace backward technological equipment by advanced and energy - saving technology.
- Use and exploit rationally new energy resources, clean energy such as hydraulic power, wind power, solar power, biological gas, etc.
- Using more associated gas in order to reduce the usage of coal as a kind of fuel at present.

IUCN Countdown 2010

Prof. Dr. Manfred Niekisch, IUCN

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Session 3 – Case Studies Overview

Regional and Local Approaches on Climate Change Adaptation and Biodiversity Conservation

Working Group A – Approaches in Forestry

**"Reducing greenhouse gases through reforestation" –
Use of CDM in the forestry sector – The Vietnam experience**
Mr. Vu Tan Phuong, Research Centre for Forest Ecology and Environment (RCFEE) under Forest Science Institute of Vietnam (FSIV) , Mr. Vo Nguyen Dai, District People's Committee A Luoi – Thua Thien Hue province

Buffer Zone Management of Protected Areas in Northern Lao PDR through Payments for Avoided Deforestation and Carbon Fixation
Mr. Bernhard Mohns, Senior Advisor RDMA Bokeo

Working Group B – Approaches in Coastal and Marine Area Management

Decision Support for TT Hue
Ms. Marieke Nieuwaal, Haskoning Asia Government Sector Consultancy

Biodiversity conservation with regards to climate change and sustainable development at Coastal alluvial ground – Kim son district, Ninh Binh Province
Mr. Nguyen Ngoc Quynh, Vice Director, Ninh Binh DOST

Working Group C – Other Approaches

Improving sub-climate of coastal semi-arid land area to create a suitable living environment for crop plant diversification making contribution to eliminate hunger and reduce poverty and eradicate desertification (Desert)
Prof. Nguyen Van Truong, VKST, Chairman of Institute of Ecological Economy

Climate Change in Vietnam and the Region
Prof. Dr. Nguyen Duc Ngu. Center for Meteorogology and Hydrography and Environment, Prof. Dr. Nguyen Trong Hieu, National Steering Committee Vietnam GEF. SGP

The MRC-GTZ Watershed Management Programme – Integrated Watershed Management as a Strategy for Sustainable Use of Natural Resources and Biodiversity Preservation
Dr. Simonetta Siligato, MRC-GTZ, Cooperation Program, Laos, Advisor on Watershed Management

"Reducing greenhouse gases through reforestation" – Use of CDM in the forestry sector – The Vietnam experience

Mr. Vu Tan Phuong, Research Centre for Forest Ecology and Environment (RCFEE) under Forest Science Institute of Vietnam (FSIV),
Mr. Vo Nguyen Dai, District People's Committee A Luoi – Thua Thien Hue province
Mrs. Do Thi Ngoc Bich , Vietnam Forestry University (VFU) Xuan Mai
Mr. Akihiko Sasaki, Japanese Intern. Cooperation Agency (JICA), CDM capacity building project
Ms. Claudia Doets, SNV Netherlands Development Organisation

Introduction of CDM

The Clean Development Mechanism (CDM) is one instrument developed to take action on climate change. It is a flexible mechanism to quantify and trade GHG emission reduction between industrialized countries with a reduction target and developing countries. Reduction targets of industrialized countries and the allowed mechanisms to fulfil commitments are stated in the Kyoto Protocol (1997). The Kyoto Protocol in short is the practical implementation strategy of the UN Framework Convention on Climate Change (UNFCCC) from 1992. To qualify for CDM, projects should contribute to the sustainable development of a country and get official host country approval from their Designated National Authority (DNA)[17]. To date, most CDM projects have been large-scale and industrially-oriented; additional efforts are needed to reach the multitudes of poor small-holders.

How CDM works in the forestry sector

In this paper we will explain the use of CDM in the forestry sector and discuss the CDM components of two specific CDM projects under construction in Vietnam. In the process of photosynthesis, plants convert radiant energy from the sun into chemical energy, in the form of glucose, while emitting oxygen; carbon in glucoses is used to build cellulose of cell walls in the woody parts of the trees and stored until the tree dies and decomposes. In this way growing trees temporarily reduce the amount of greenhouse gas CO_2 in the atmosphere.

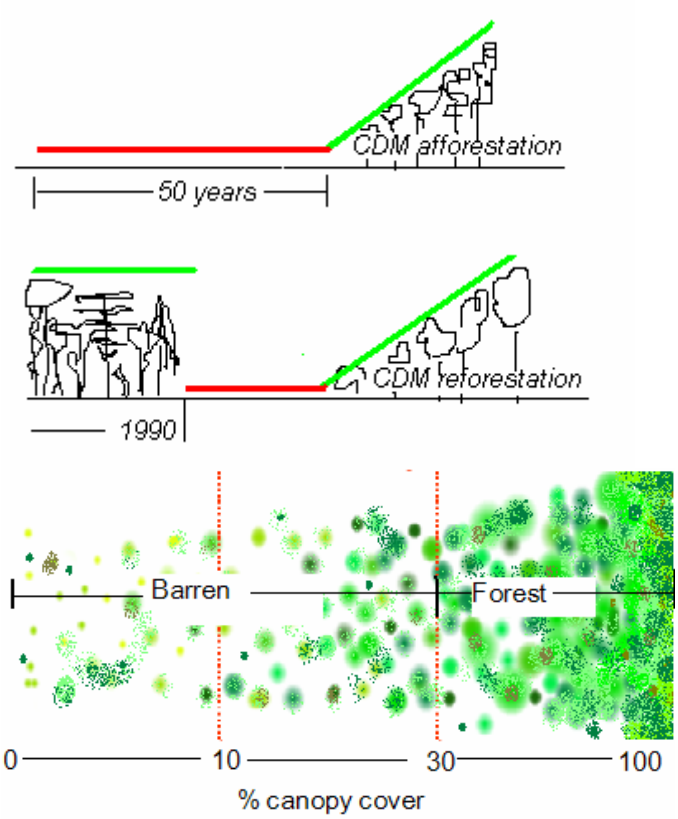
Through easy measurements on the growth of trees one can calculate carbon stored by using several conversion factors. It is this service of forests that is marketed. In principle the carbon services provided by all different forestry activities, provided the calculations are sound, can be marketed. Under the CDM however, as of yet, only two project activities are eligible: afforestation and reforestation.

Definitions for using CDM in the forestry sector
Under CDM eligible afforestation and reforestation, project activities need to result in a forest in accordance with the definition for forest set by the host-country DNA. The DNA of Vietnam has already set the Vietnamese definition[8]; a forest is:

- An area of at least 0.5 ha; with
- A minimum crown cover of 30%; and
- A minimum tree height at maturity of 3m

See pictures below to understand the definitions of afforestation and reforestation project activities and definition of "forest".

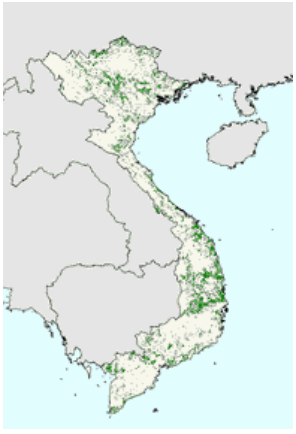
[7] See http://cdm.unfccc.int/DNA/index.html for DNA's per country
[8] See official CDM definition of VN forests at http://cdm.unfccc.int/DNA/ARDNA.html?CID=233



Left: Picture showing the difference between pre-project land requirements for afforestation (top) and reforestation (bottom); red lines depict barren land, green lines depict forest. Right: Picture showing differences of canopy cover of tree vegetation. Given trees are minimal 3m in height, after 30 percent canopy cover the vegetation is called a forest according to the Vietnamese CDM forest definition.

As only Afforestation and Reforestation are eligible activities in the forestry, the term AR-CDM is often used. AR-CDM projects are just regular reforestation projects except from the fact that they use the CDM for co-financing. This difference requires the preparation of a Project Design Document including estimation of actual net greenhouse gas removal by the project activity following methodologies approved by CDM Executive Board, validation of PDD by an accredited third party, registration of the project in CDM EB, verification of the project by third party, and issuance of so-called carbon credits by CDM EB.

Unlike energy sector CDM, development of AR-CDM has been delayed in the world due to delayed development / approval of methodologies, cumbersome procedures and economical unattractiveness comparing with energy sector CDM. Hence, there is only one AR-CDM project registered (in China) and five (5) under validation in the world.



Potential in Vietnamese forestry sector

CDM in Vietnam has most potential in the energy, agriculture and forestry sector. The potential to use AR-CDM in the forestry sector is 52 Mt CO_2 equivalent until 2010 according to the national CDM strategy. About 6.4 million hectare would be eligible to use AR-CDM according to national data from 2005. For an indication see picture (source: www.csi.gciar.org/encofor)

Readiness of the Government

Vietnamese Government has worked actively for preventing global warming by ratifying international conventions and establishing necessary institutional system: the Government ratified United Nations Framework Convention on Climate Change (UNFCCC) on 14 November 1994 and Kyoto Protocol (KP) on 25 September 2002; assigned MONRE as a national authority for implementation of UNFCCC and KP; assigned ICD

(International Cooperation Department) of MONRE as the Designated National Authority (DNA) for CDM in March 2003; established CDM National Executive & Consultative Board (CNECB) in April 2003. DNA is responsible for assessing and approving CDM projects as well as for managing and coordinating CDM activities and investment in Vietnam. Meanwhile CNECB is responsible for approval of projects that want to use the CDM.

The Prime Minister issued a Directive No.35/2005/CT-TTg (dated 17 Oct. 2005) on the implementation of KP. MONRE issued Circular No: 10/2006/TT-BTNMT (dated 12 December 2006) to guide formulation and approval of CDM projects. As of 1st April 2007, there are two (2) registered CDM projects (590 in the world) and eight (8) projects are under validation in Vietnam.

CDM projects under construction

Hoa Binh project by FSIV, VFU, MARD and JICA

A small-scale AR-CDM project will be formulated within 2007 under the on-going JICA Study on "Capacity Development for AR-CDM Promotion in Vietnam." The JICA Study aims at capacity development of Vietnamese counterpart (DOF, VFU and RCFEE) on the promotion of AR-CDM in Vietnam. Formulation of a small-scale AR-CDM project (a pilot project with about 300ha of reforestation) is an important component of the Study and will be done in Cao Phong district of Hoa Binh province by "learning by doing" approach because there are very limited examples on AR-CDM worldwide. The Study team expects that the implementation of the pilot project will stimulate the development of AR-CDM projects in Vietnam and contribute to establishment of payment mechanism to the environmental services of forests, poverty reduction in mountainous area, environmental protection, and eventually to the restoration of biodiversity.

A Luoi 5000 ha project in TTHue by DPC A Luoi and SNV

In the through the Vietnam-American War devastated areas of North Central Vietnam, the District of A Luoi tries to use the ARCDM as co-financing mechanism for reforestation. After a small pilot project of 38 hectare, currently a 5000 hectare reforestation project is under construction. It includes small-holder plantations of 3000 poor households. Through the use of ARCDM reforestation will become a financially attractive option for the households. The project plans to have the AR-CDM component registered in the beginning of 2008.

Apart from the economic gain for poor households, the use of ARCDM has several additional benefits as the mechanisms application criteria are high. Additional benefits are:

- Issuance of land-rights to small-holders
- Financial transparency throughout the project
- Pressure for mixed species plantations
- Declared positive contribution to the environment and socio-economic situation of stakeholders
- Better monitoring and mapping of plantations

For more information, download the publication: "the Golden Forest" Practical Guidelines for AR-CDM project activities in Vietnam at www.snvworld.org (Practice Areas/ Forests/ SNV publications).

Buffer Zone Management of Protected Areas in Northern Lao PDR through Payments for Avoided Deforestation and Carbon Fixation

Mr. Bernhard Mohns, Senior Advisor RDMA Bokeo

Within the target regions of the Rural Development Programme in Mountainous areas of Northern Lao PDR three conservation areas are located with a total of about 300 000 ha.

These areas are under threat from shifting cultivation in spite a government´s policy to stop this practise by the year 2010. In addition forest fires, extension of rubber cultivation and illegal logging pose further threats to the protected areas.

RDMA is presently preparing a programme component to test payments for avoided deforestation as a financing mechanism to stop further forest degradation in the buffer zones of these protected areas. The mechanism will be based on payments into village banks on the basis of actual hectarage of secondary forests protected from shifting cultivation and wild fires. These payments would be related to increments in biomass and carbon stocks. The payments in turn will be used to enhance rural livelihoods through economic activities as an alternative to shifting cultivation.
Presently first assessments are carried out to measure biomass and carbon stock increment in an age series of bamboo and tree dominated secondary forests after shifting cultivation

Main future activities of the proposed RDMA component would be

- Strengthening government policy to implement nationwide projects for carbon trading under the concept of avoided deforestation
- Testing a sustainable financing mechanism involving national, provincial and village (bank) level
- Introducing appropriate methods for forest fire control
- Strengthening measures of biodiversity protection
- Enhancing eco-tourism as a community based economic activity
- Introducing and supporting economic activities as an alternative to shifting cultivation

The presentation will focus on first experiences with the following elements of the proposed program component

- Implications of the RDMA village based land use planning for forest protection, forest management and carbon trading
- Linking the RDMA micro-finance component with payments for environmental services
- Monitoring systems for forest recovery processes and carbon accumulation

Decision Support for TT Hue

Ms. Marieke Nieuwaal, Haskoning Asia Government Sector Consultancy

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Biodiversity conservation with regards to climate change and sustainable development at Coastal alluvial ground – Kim son district, Ninh Binh Province

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Coastal alluvial ground in Kim Son district is a part of modern Red River Delta that begins at Hung Yen and stretches from Do son (Hai Phong) to Lach Truong (Thanh Hoa). This is the most deep-set place on the delta. Small waves are convenient for deposit alluvial along the riverbanks in the Northern East – Southern West direction. The Kim Son alluvial ground located between Day river mouth and Can river mouth where is the linking place of the modern delta. There are signals indicating that the sea level rises slowly at Kim son coastal area, which make favorable conditions for alluvial ground expanding to sea. Kim Son coastal alluvial ground is actually a tidal area of river mouth and sea, which play a important role in distributing and accumulating alluvial substances. Over 170 year making of Kim Son district, there were 7 times of expanding dykes to the sea that make Kim Son area 3 times larger than its original area. The man-made Dyke varied the natural bank direction, deposit alluvial direction, coastal alluvial area and alluvial growth. Since the Hong Duc dyke has been established (in 1471) until the end of 19th century, the dyke systems have been established in the Northern East – Southern West direction, in parallel with the main bank direction but the direction has been changed to Northern West – Southern direction.

The total area of alluvial ground outside Binh Minh II dyke (from dyke to water level) is 4,120 ha. The width has been varied from 150m to 250m of which the width between Bac sewer CT 1 and Dien Bien sewer is 4,700m large, near pole BM7. The highest site of Binh Minh II is 3,170m large. The height of ground is not even due to deposition processes and different bottom erosion characteristics.

I – Ecosystem of Kim son Coastal alluvial ground

According to the survey data from Center for Ecology and Biological Resources (CEBR) and Center for Sea Research Hai phong, the flora system of Kim Son alluvial ground is very rich. There are current 64 species in 28 closed seed branches, including 47 species of 24 families of 2 gamma and 15 species of 4 families of 1 gamma. There are 03 plant species covering large areas, Vet, sedge, and paddy. Besides, there are vegetables, fruit trees, shadow trees … in newly formed land but its member is still limited.

Vegetation resources in the coastal Kim Son alluvial ground are quite rich:

- Material plants for making sleeping mat and carpet: a large number of white reeds with high economic value
- Dyke protection plants: reed, bank grass
- Medicinal trees: 30 typical species
- Plants for Cattle food: 10 main species
- Flower plants for keeping bee: Vet, su
- Green manure trees: Coc, Dien Thanh
- Roof material trees: reed

As for aquatic products, different fresh water flows of Day river and Can river in the east lead to difference in composition and quality of fishes and shrimps according to sites and seasons. Fresh water shrimps live mainly at eastern side of Day river mouth while prawn seems suitable to salty water in the western side of Can River. Kim son coastal area is seriously affected by fresh water from Day River so that its typical surface animals are ones living at river mouths. Thus, the fresh water favored plants are seen at Day river and salty water favored plants are seen mainly at Can river.

The surface animals in this area include species of Copepoda, Coladocera, Ampipoda, Potatoria, flour fish and shrimp. Of two species Copepoda and Coladocera, Copepoda is the most species with large quantity and advantage in two seasons: dry season and wet season. The quantity of surface fauna and flora are dependant on salty degree and height of alluvial ground, water exchange capacity with outside ground.

In order to make planning of Kim son alluvial ground effectively and saving investment for constructing infrastructures, it is necessary to consider it a comprehensive system. This we consider it an ecosystem including sterile elements, which create alluvial ground, and living elements that maintain economic capacity. Thence the recommendations are made for sufficient use and exploitation.

This alluvial ground was made of two elements of river and sea, accumulating silts from other places. The river element is strongly active in rainy season and the sea element is mainly active in dry season. Other elements like temperature, humanity, storms, fog, mist, frog and light are consider stable ones. River and sea element annually create fresh-brackish or average brackish water flow in the rainy season and this flows turn to highly salty in the surface water in dry season. This situation varies depending on locations of the ground to Dang River, Can River and sea level. The above mention water flows absorbed by the soil creating different salty soil and different vegetations and animals are developed corresponding to their habitats. The Kim Son coastal alluvial ground s under research for such economic purposes as aquatic products raising and for planting rice, reed in fresh water areas. The objective of new sea dyke is for planting rice and reed. The coastal areas are harsh for rice and reed plantation, which cannot grow in some alum and acid or salty areas. The yield is too low to recover the investment cost. Therefore, many areas are left fallow. This contradicted with ecological protection regulations at river mouth areas where are home to birds, mammals, and sea animals. This causes loss of natural biodiversity. The scientific profiles indicated that a ha of raising shrimps consuming 4 ha mangrove or the shrimp raising area should account for only 25% of mangrove to ensure balance of ecological system. In order to have high yield for a shrimp raising dam, united protection measure is necessary. Any missing element will lead to failure or inefficiency.

Many surveys on meteorology and hydrography, temperature, tide, change in rainy and dry seasons of Day River and Can river shown that water quantity regarding to salty concentration, acidity and status of shrimps raising dams at Kim son alluvial ground are changing annually.

As for ecological indicators: Bottom floor and soil, bottom food, bottom animals, ephemeras, aquatic product resources, height of alluvial ground and mangrove vegetation indicated that Kim Son coastal alluvial ground can be used for raising aquatic products at many sites but it needs to be planned with sufficient scale. To exploit the advantage of this alluvial ground, it must have three decisive elements of irrigation, electricity and traffic roads. There is not enough capacity to implement all three elements; therefore, natural advantage should be taken for developing agriculture, forestry and pisciculture with less costly and less investments.

II- Status of management and exploitation of Kim son coastal alluvial ground

Aquatic products has high economic value under the economic market. The coastal people have transformed their high potential land into areas of Aquaculture. It is actually not the way to exploit land resources but coastal brackish areas and turn them to Aquaculture dams (since 1986). This is a spontaneous activity, which brings benefits to some households and creates a few jobs. The dam banks were constructed shortly and unsystematically that was not complied with normal Aquaculture procedures. Theses banks were not solid enough to protect it from big waves and storms.

The tidal alluvial ground is of newly formed geography layer, which is very sensitive. The unmanaged development of dams as mentioned above turned a deposit alluvia area into closed pond system. This made ecosystems in dams develop unusually: dead aegiceras, seaweeds, and dead animal bodies stagnated in the dams are polluting water. The dams are gradually degrading. Mangrove is destroying and environment is polluting severely that badly affect to coastal climate.

There are three communes just established in Kim son coastal area in sea encroachment area. Local people are poor and lives are difficult because their production and business are not stable. Thus, strengthening socio economy for these communes is important to widespread their models to the whole district. This also contributes to district objectives of developing economy and living standard as well as defense security.

Aquaculture is strength of Kim Son alluvial ground. The aquatic cultivation reached only 985 ha in the beginning years of the 1990s but it has increased to 1,520 ha in 1995 and up to 2.184 ha in 2006. Currently the Aquaculture is facing with a lot of difficulty. Firstly, the planning and projects for shrimps raising is not complete. Infrastructure, investments for Aquaculture are still limited. The on-site breeding sources can only meet a small part of production demands. The keeping techniques

of local people are poor. Raising schedule is not strictly followed and improper feeding techniques, which lead to environment protection, and diseases occurred mass killing shrimps.

According to reports from Kim son district PC in 2006, the total area of Aquaculture in the whole alluvial ground is 2,184ha, the total yield reached to 2,210 tones (equivalent to 69% of expected plan). Of which prawn is 680 tones (48.5% of plan), shrimp is 270 tones (100% of plan), and sea crab is 810 tones (73% of plan) and other aquatic products (100% of plan). The gross product value of aquatic products in alluvial ground is 145.8 billion dong (38% of plan, reduction of 50.3 billion dong comparing to that in 2005). Due to difficult production conditions, the contribution to district budget accomplished only 47.2% of expected plan in 2006.

The Kim son coastal alluvial ground is facing with difficulties such as high population growth rate (2.2%), high poverty rate, low intellectual standards, poor capacity of acquiring and applying technologies to raising aquatic products, lack of technicians, poor infrastructures for integrated exploitation of the whole alluvial ground. Agriculture is still unmanaged with small-scale production. Rice production is self-demanded and self-supplied, not for commercial purposes. The reed production is oriented for exporting but it is unstable. The raising measures are naturally extension that is not efficient and polluting environment. Aquaculture system and management procedure is inadequate. The local authority does not have a synchronous proper policy to encourage producers and investors as well as for environment protection.

The benefit conflicts occurred between different industries and proprietary modality and between different management level etc… leading to difficulties and conflicts that restrict socio economic development in general and each industry in particular.

The local authority is still limited in providing technical guidance, instructions and planning for local people. The rich and the poor are classified in society with bigger gaps in living standard.

Kim Son alluvial ground is place of big potentials and resources that are promising for effectively implementing economic strategy and sustainable environment protection. With the development of science and technology, people are exploiting and using land more effectively, especially in raising aquatic products, which make socio economic situation in alluvial ground better. The above-mentioned advantages and disadvantages indicated that authorities should manage economic activities in Kim Son alluvial ground as approved plans to get expected objectives. Local potentials and resources must be well used and exploited in parallel with efficient management of investments from province and central government.

Currently, exploitation of Kim Son coastal alluvial ground cannot be regarded as comprehensive since there are some concerns. Soil and water quality are degraded because of extensively transforming from paddy and reed planting to Aquaculture. Mangrove is destroyed that causes reduction of aquatic lives in coastal areas and river mouth. The paddy and reed yield is unstable and aquaculture is insecure.

Overall, the exploitation and use of Kim son alluvial ground is unmanaged. The efficiency of exploitation and use do not match with its available resources that cause adverse impacts to habitats and climate change.

III- Some recommendations on rational management and exploitation of Kim son coastal alluvial area concerning climate change and sustainable development

Kim son coastal alluvial ground is a place, which expands to the sea the most in Vietnam. This land has enough natural potentials for developing coastal economy in terms of aquatic products raising, agriculture and eco tourism.

The alluvial ground is rich nutrition silt that is good for developing agriculture orienting to rice extension cultivation to ensure local food security and reed extension cultivation for making goods consuming domestically and for exporting. Soil and water create conditions for environment for Aquaculture, especially salty- brackish aquatic products. Aquatic fauna and flora resources are rich creating 5 eco systems with high economic value. Aquatic creatures are living sources and play a role in providing foods for Aquaculture.

In addition to initial success, extensive Aquaculture is facing problems such as reduction of paddy fields, reed planting areas, mangrove and deterioration of aquatic environment… Aquatic product raisers are not educated with cultivation knowledge, lack of fund, poor infrastructure, degradation of aquatic environment, unstable aquatic product yield. This is a risk to arise more fallow land in the alluvial ground. On the other hand, there are many projects implemented at the same time in this area (protection forest plantation, Aquaculture and BM3 dyke) which have not had enough

interaction, that did not only limit the efficiency of each project but badly affected to environment as well.

It is a need to identify the short term and long term objectives that the alluvial ground is developed and exploited in terms of incorporating agro forestry – Aquaculture and mangrove plantation, in which Aquaculture is top priority. In the motto of developing model with high economic efficiency accompanied with environment project should be compulsory for any development orientation.

Aquaculture should be put in central position of economic development strategy for alluvial ground and every investment effort should be focused on raising economic efficiency for Aquaculture.

Strengthening the extensive and semi-extensive raising areas in zone II and zone III, in which essential elements of water environment, water resources, breeding sources, food sources and technical services should be secured. Aquaculture with proper techniques will bring huge benefit to local people and contribute to district budget by exporting its products. Developing integrated models of rice – fish, shrimps - rice and shrimps – mangrove helps ecosystem stay stable. Extensive rice and reed plants should be developed rationally on alluvial ground. The mangrove outside BM3 dyke need to be reforested, restored and tended effectively. This is an important element for sustainable development of alluvial ground as well as for environment protection.

Underground water needs to be managed and prevent exploiting and using unlimitedly in order to save it and improve the deterioration of underground water and water pollution. Water polluted with Fe and N must be treated prior to using it as drinking water.

Kim son coastal alluvial ground is promising place which is potential for exploiting. Planning of Kim Son coastal area toward 2010 with scientific bases on environmental conditions, natural resources are ground for any activities on socio economic development. With high determination of district leaders and managers and investments from provincial and central authorities plus enthusiasm and belief of local people, it is believed that Kim Son alluvial ground will be a socio-economic developed area and an attractive ecotourism place.

Improving sub-climate of coastal semi-arid land area to create a suitable living environment for crop plant diversification making contribution to eliminate hunger and reduce poverty and eradicate desertification (Desert)

Prof. Nguyen Van Truong, VKST, Chairman of Institute of Ecological Economy

- Research specific characteristic of coastal sandy region sub-climate and solutions to ensure a biodiversity development

Vietnam has about haft of million hectare of sandy soil, which has been built up by sea. The severe sub-climate makes most of such area be desert. Sandy soil reflects heat and makes surface temperature be up to 60 – 70^{o}C, no tree can exist. Sandy soil is incohesive and can not keep rain water which is an essential element for all creatures. It is very windy in coastline; wind can make double evaporation speed of soil. The severity of climate limits even destroys living conditions of plants. Many semi-arid land areas next to densely populated areas have been fallowed. Because of heat and dry condition, the incohesive sand is flown by strong wind to interior fields and builds up sandy hill somewhere threatening life and fields and gardens of adjacent population areas

- **Develop eco-villages**

From exact judgments on the severity of sub-climate in semi-arid land areas, which destroys natural and cultivated plants, it is necessary to find out effective solutions to develop eco-villages. Development of eco-villages means that the effective measures to improve severe conditions of sub-climate are found out and implemented effectively.

Firstly, the characteristics of ecological subsystems should be defined with sub-climate specific characteristics. In the short-term, Institute of Ecological Economy used research document on the strip of coastal semi-arid land and divided coastal sandy ecosystem into three subsystems. The first subsystem is sandy area, which is adjacent to interior field, and waterlogged in raining season causing root break of crop plant so that it has been fallowed. The second subsystem includes high and flat semi-arid land areas with deep underground spring water. The third one is area with many sandy hills, flying sand and stream bringing sand to interior field. At present, Institute of Ecological Economy has developed 6 eco-villages in three above-mentioned subsystems and the three specific ones are presented in this report.

As the results, farmers and fish men at the three villages all have gardens, ponds, and freshwater wells. Sub-climate of ecosystem has been improved, reaching stable condition to ensure the sustainable development. Severe sub-climate has changed to be friendly with human, crop plants and domestic animals.

- Geographical, topographic characteristics and sub-climate of the Central coastal semi-arid land region

Sea has brought sand to build up the coastline of the Central region as a wide strip of semi-arid land running from Thanh Hoa to Binh Thuan. According to research documents on semi-arid land area, the strip of semi-arid land has a total area of about 500,000 ha. As for topographic structure, the semi-arid land has three main types: sandy hill, sandy highland and flat area and sunken area like small valley.

As for climate, whole semi-arid land area is located in tropical climate zone but temperature and raining distribution are different by season. A common feature is that temperature of soil surface where tree roots take water and nutrition is very high in sunny season, up to 60 – 70^{o}C so that no crop plant can live. Strong sea wind makes evaporation speed of sandy soil double as normal soil, making sandy soil dry quickly and exhaustedly. Incohesive soil can not keep water and plants are in shortage of water and can not live. In general, sub-climate of semi-arid land area is very severe for most of food crop plants.

- Solution to improve sub-climate of semi-arid land area in order to create a suitable living environment for crop plants diversify, creating an abundant source of food, eliminate hunger and reduce poverty, strengthening health for people who are living or will live in semi-arid land area.

In some countries, resinous matter is laid to prevent incohesive sand flying to interior area and various kinds of fabric net are used to stop sands in some regions. Also, some regions cultivate anti-drought plants with thorns to improve hot and dry sub-climate protecting crop plants. In Vietnam, the measure of creating protection tree belt is used to improve sub-climate of sandy area. Tree belt helps to reduce speed of sea wind and evaporation in order to maintain the moist for soil. One kind of resulted trees is Casuarinales with small leafs, rigid and dry branches, strong developing roots.

In order to develop eco-villages in semi-arid land area, some biological measures should be applied synchronously in combination with topographic rehabilitation. Such measures should be effective for sub-climate and topographic characteristics of each ecological subsystem in semi-arid land area. The specialists in fields of climate, agriculture and forestry are needed to define climate and topographic factors in order to find out solutions with good results. The solutions should be practicable for farmers under guidance of specialist and with financial support from State or some international organizations whose targets are to improve sub-climate to raise living standard and eliminate hunger and reduce poverty, lessen area of wasteland.

All ecological subsystems require application of biological measures, planting kinds of tree, which are able to suffer hot and dry semi-arid land improved by topographic rehabilitation. Green trees have effect of sub-climate improvement. Firstly, tree creates shadow to reduce temperature of sandy soil, then the felt leafs enrich humus to dry and incohesive soil, which is a key factor to improve physical and biological characteristic for sandy soil. According to research documents, depending on number of protection tree lines and density of protection tree, the speed of wind can be minimized as requested by sub-climate improvement, creating favorable condition for good growth of food crop plants. Topographic rehabilitation aiming at utilizing moist soil thanks to capillarity of water is also a useful measure helping to save water, use underground water for tree in dry season. Coastal semi-arid land area with strong wind can use windy propellers to run small generators for usage of household that is cheap and can utilize the recycled source of energy. In the sandy hill area, rain-water run and bring fine sand to a deep level creating a layer to stop rain-water and forcing rain-water go along hillside and create sand stream. Sand stream is a disaster because the water will bring sand to interior field and villages. Banking sand stream with package of sand, making ladder of falling water to run small generator are the ways to turn natural disaster into useful energy source. In short, if we know how to improve and utilize it, the severe sub-climate of semi-arid land area is able to create ecological areas for life and production, stopping hunger and poverty in a sustainable environment.

1. Changes in living and production environment in three typical types of semi-arid land eco-subsystem in Vietnam through eco-village development

In general, eco-system of coastal semi-arid land area in Vietnam can be divided into three typical sub-systems with different topographic structures and underground freshwater systems. Due to limited resource and fund, the Institute of Ecological Economy selected to develop two villages in each sub-system. Three eco-villages were completed by the end of 2005. In sub-system of sunken area, which is waterlogged in raining season there is an eco-village of Trieu Van, belong Trieu Phong District in Quang Tri Province. In subsystem of flat and high area with deep underground water there is Canh Duong eco-village in Quang Binh. In subsystem of sandy hill with phenomenon of flying sand caused by wind and with sand stream from hills bringing sand to interior fields there is an eco-village of Hai Thuy in Le Thuy District, Quang Binh Province.

Topographical and sub-climate features of Trieu Van semi-arid land ecological sub-system: This semi-arid land area is an edged area of coastal sandy belt, which is adjacent to plain area but is still left fallow. Although the plain area has high population density, the land for living and production is in high demand but farmer can not change this land area into farming land because it is impossible to cultivate crop plants. The delegation of specialists from Institute of Ecological Economy affirmed that the green tree system must be used to improve environment and sub-climate so that cultivation of food crop plants becomes practicable. Firstly, it is necessary to dig irrigation canal and make beds for tree planting to create shadow, reduce temperature of semi-arid land surface and enrich humus in order to improve physical and chemical characteristics of sandy soil. Problem is to estimate how many irrigation canals should be dug how many tree belt should be planted and estimate between investment resources and achieved economic effects and ecological impacts to persuade farmers to accept. At beginning time, some experts also said, “It is

difficult, very difficult". Of course, how we have left fallow land for hundreds years if it is easy. But all of us know Uncle Ho's words: "Nothing is difficult; the only thing that matters is perseverance..."

Unexpectedly, trees planted to create shadow, stop wind and enrich humus for farming land in fallowed sandy beds grow more quickly and strongly than ones planted in other land area. Who can imagine this achievement when looking back on wild grass patch? Actually, it was written in some books that free-living nitrogen-fixing bacterium also enrich soil with 3 –5 kg nitrogen each year. Tree belts for protection and sub-climate improvement has been taken their use after one year. People cultivated food crop plants in strip of semi-arid land with tree shadow and humus. Two year later, gardens had various food crop plants. With the source of available underground water, people dug ponds for irrigation, fish, husbandry and vegetable cultivation. In 2002, the President and Minister of Ministry of Agriculture when visiting native land of revolution dropped in Trieu Van eco-village and praised that after 9 years of development, there were many tile-roofed houses in the village, gardens and ponds, two production models bringing high and diversified benefits were available in every households.

Village in sandy highland with more severe sub-climate: Windy, dry right after raining, freshwater is available only in depth of 6-7 meter of well. Sub-climate is so severe that people living in village located in edge of "sandy high land" have to accept to live in hustle but fail to conquer fallowed semi-arid land area" Hot and dry sandy soil is a great difficulty but another greater difficulty is that freshwater is in deep and too deep level. Question is that how protection trees can attract underground water in dry season. It is very difficult for roots of tree to reach underground water but the tree can exist over dry season if its root can go to moist soil layer thanks to capillarity attraction as a rule. Experts suggested measuring the depth of moist soil layer thanks to capillarity. This is a good idea and the survey on moist soil layer thanks to capillarity showed that this soil layer is not so deep, just 2-3 meters from ground.

So it's required to dig ditch with depth of 1 meter, plant protection tree with height of 1.5-2m. After raining season, the tree root can go deep 1 meter into entrails of earth. After one year, root of tree go deep and can attract capillarity water and grow better in the following year. Success of protection tree belt creation in sandy highland is a successful start of Canh Duong eco-village. Life will grow itself with protection tree and freshwater well. Three years after that, some households had garden, well, food crop plants, husbandry that bring a better life and scenery.

Eco-village in sandy hill in Hai Thuy District, Quang Binh province faced many challenges in development due to the severe sub-climate. Windy sandy hill flew into interior covering fields and roads. Sand stream runs from hills, bringing sand to population area. Sand invades both by air and water. The State helps people plant Casuarinales forest to stop sand. However, it is very difficult to live and produce in sandy hill area. Water is available in hills but can not be used. It is impossible to plant tree at hillside because there is no water for tree to live. It is also required to find water of capillarity by level hillside to find out moist soil area. Therefore, garden is created by leveling hillside to reach to soil layer with capillarity water. Food crop plants and fruit-trees can be cultivated in such created gardens. This is a valuable initiative because it helps to create a land area with sub-climate that is suitable with crop plants. There are two another initiatives that are banking sand stream to create motive current of water to run small generators which are available in the market with acceptable price. Luckily, there was a retired electrical worker who agreed to install propeller run by strength of sea wind. Propeller running make small generators installed at sand stream operate. The two initiatives turned negative natural power to useful power free of charge to use recycle energy. The most challenged matter was settled successfully and the model of Hai Thuy eco-village was written in book for dissemination.

Conclusion:

In order to establish life in a sensitive ecological system, it is necessary to use knowledge of every people to evaluate causes of severe climate and find out overcoming measures. The life is sustainable only when the existing or created sub-climate is friendly with creature, human, domestic animals and cultivated crop as same as conclusion of wises "Heaven Luck, Earth Luck, Human Luck" A prosperous life need a integration of three conditions that the first one is favorable climate "Heaven Luck"

Climate Change in Vietnam and the Region

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1. Vietnam climate characteristics

Vietnam has monsoon tropical climate in the Southeast Asia peninsula, stretching over latitude 15 and between the tropic of north hemisphere and it is totally affected by Pacific Ocean and East Sea.

Atmosphere flow of Vietnam is integrated monsoon flow in North East Asia and South Asia monsoon. Impacted by Asian Northern East monsoon, there are annually 26 cold fronts (PRL) landing to Northern area. In the Pacific Ocean and East Sea, there are annually 08 tropical cyclones including storms, tropical low pressure landing to coastal areas.

The annually average temperature is 8-28^{0}C in which there are many non-tropical weather areas with 800-1000 m high. The average rainfall is from 600-5000 mm, including dry Central South part with only rainfall of 1,200 mm.

Remarkably, the winter exists at latitude 16 only. In the Vietnam territory, there are two different rainy seasons: Southern West monsoon rain (rain occurred from May to October) at the Northern area, High Land, Southern area and Northern East monsoon rain (rain occurred from August to December) in the Central North area and Central South Area.

2. Climate change and the trend of climate in 100 recent years

2.1 Change of some typical climate factors

2.1.1 Change of cold front frequency in Northern Area

Standard deviation (S = $\left[\frac{1}{n}\sum_{t=1}^{n}\left(x_t - \bar{x}\right)^2\right]^{\frac{1}{2}}$, in which $\bar{x} = \frac{1}{n}\sum_{t=1}^{n} x_t$ arithmetic average) of annual frequency FRL of 2,93.

Table 2.1: Standard deviation and FRL variation

Typical	I	II	III	IV	V	VI	VII	VII	IX	X	XI	XII	Year
Standard deviation (times)	1.57	1.04	1.04	1.39	1.07	1.36	0.22	0.36	1.10	1.10	1.68	0.94	4.36
Variation (%)	39.3	30.2	30.2	53.5	41.1	97.1	220.0	180.0	91.7	45.8	46.7	27.6	16.0

With numeric value of 27.3, annual FRL variation is 16%, quite low in comparison with other factors (table 2.1)

The FRL frequency in 1994 (16) is so low that is regarded as abnormal and in 1970 (40) is regarded as extremely high.

2.1.2 Change of tropical cyclone

2.1.2.1 Change of tropical cyclone in East Sea

In 40 years (1961-2000), there have been following considerable changes of tropical cyclone:

(1). The tropical cyclone has standard deviation of 2.93 and variation of 27% (table 2.2)

Table 2.2: Standard deviation and variation of Tropical cyclone

Typical	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
Standard deviation (times)	0.26	0.22	0.33	0.33	0.77	0.75	1.08	1.09	1.03	1.42	1.24	0.60	2.93
Variation (%)	347	440	264	264	64	75	60	61	57	75	95	150	27

(2). There are 15 years (37.5%), the tropical cyclone occurred more than average and 16 years (40%), the tropical cyclone occurred less than average. Thus, the number of positive deviation years is same as the number of negative deviation years and two times more the zero deviation.

(3). The tropical cyclone occurred the most in 1981 (20) and the least in 1969 (5).

(4). The tropical cyclone is reduced from the decade of 1961 - 1970 (114) down to 1971 - 1980 (113) then to 1981 - 1990 (109) and the least in the decade of 1991 - 2000 (103).

2.1.2.2 Change of tropical cyclone affecting to Vietnam

In the period of 1961 - 2000, change of tropical cyclone frequency has following characteristics:

1) Standard deviation and variation of annual tropical cyclone frequency are 2.58 and 35% respectively, it seems to be clearer than that in East China Sea (table 2.3)

2) There were 19 years that tropical cyclone occurred more than average and 21 years which tropical cyclone occurred less than average. In principle, negative deviation standard year is equivalent to positive deviation standard year.

3) The negative deviation standard years normally interpose with positive deviation standard years.

4) Vietnam tropical cyclone had occurred the most in 1973 (12 cyclones), followed by the years of 1964, 1970, 1971, 1989, 11 cyclones and the least in 1976 (2 cyclones), followed by the year of 1969, 1977, 1987, 3 cyclones each.

Table 2.3: Standard deviation and variation of tropical cyclone affecting to Vietnam

Typical	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Standard deviation (times)	0.016	0.022	0.022	0.37	0.75	0.70	0.89	1.35	1.39	1.07	0.73	2.58
Variation (%)	63	44	44	45	107	77	99	123	87	97	243	35

2.1.3 Change in temperature

Change from year to year of average temperature has the following characteristics:

1) The change in average temperature is quite large in winter, especially in the heart of winter (December, January, and February) and quite little in summer, especially in the heart of summer (June, July, and August) (table 2.4)

2) The change in average temperature of April and October is typical for the transitional period between different seasons, it is not as much as January and not as little as July.

Table 2.4: Standard deviation of some characteristics of temperature in some typical locations (^{0}C).

Region	Typical station	Average temperature					Highest temperature of year	Lowest temperature of year
		I	**IV**	**VII**	**X**	**Year**		
North West	Lai Châu	1.0	0.9	0.5	0.8	0.3	1.33	2.45
North East	Sa Pa	1.5	1.1	0.4	0.7	0.4	0.72	1.17
Northern Delta	Hà Nội	1.4	1.2	0.5	0.9	0.5	1.07	1.46
Central North	Vinh	1.4	1.3	0.7	0.7	0.5	0.82	1.37
Central South	Đà Nẵng	1.1	0.7	0.5	0.6	0.3	0.93	1.51
Central Highland	Đà Lạt	0.7	0.6	0.3	0.4	0.3	1.29	1.72
The South	Tân Sơn Nhấ	0.9	0.6	0.5	0.5	0.4	0.69	1.38

3) The change in annual average temperature is the smallest in comparison with the change in average temperature of any month, including the mid-summer months.

4) In the same region, there is no significant different in terms of reflective characteristics of temperature change between mountainous and delta areas, high mountainous areas and low mountainous areas, island and its adjacent mainland.

The change in numeric value leads to the change of annual temperature. The major change is shown in table 2.5.

Table 2.5: Frequency of the coldest and hottest month

Characteristic	Coldest				Hottest					
Month	XI	XII	I	II	III	IV	V	VI	VII	VIII
Hà Nội		24	47	29				40	53	7
Đà Nẵng		25	68	7				49	36	15
Tân Sơn Nhất	6	45	49	0	3	77	20			

2.1.4 Change in rainfall

Change of rainfall has the following characteristics:

1) In the same location, standard deviation of annual rainfall is larger than monthly rainfall, and of high-rainfall month is larger than low-rainfall month. On the contrary, the frequency of change of annual rainfall is smaller than monthly rainfall, and of rainy months is smaller than dry months (Table 2.6).

2) Annual rainfall of the Central regions is not as stable as Northern and Southern region.

Table 2.6: Standard deviation (S; mm) and frequency of change of rainfall (Sr; %) in some typical locations

Region	Typical station	Characteristic	I	IV	VII	X	Year
North West	Lai Châu	S	29.0	55.5	129.3	61.9	286.7
		Sr	99	42	28	68	14
North East	Sa Pa	S	46.4	75.2	161.9	113.6	402.8
		Sr	69	36	36	54	14
Northern Delta	Hà Nội	S	21.6	53.4	101.8	104.8	320.0
		Sr	102	55	39	72	19
Central North	Vinh	S	29.0	37.7	119.2	353.0	514.0
		Sr	55	59	102	69	25
Central South	Đà Nẵng	S	76.6	50.7	83.1	276.6	545.4
		Sr	98	143	98	44	26
Central Highland	Đà Lạt	S	12.1	89.8	83.2	100.3	237.1
		Sr	159	55	36	41	13
The South	Tân Sơn Nhất	S	19.3	50.7	93.5	91.8	284.9
		Sr	140	101	32	34	15

Rainy season also change significantly from year to year, in terms of beginning time, high peak time, as well as finishing time. In general, rainy season can fluctuate within 3 – 4 months or more, depending on the rainfall change of the region.

2.2 Climate changing tendency in Vietnam

2.2.1 General introduction on climate changing tendency in the region.

Climate change has regional characteristics. In relation to climate change in Vietnam is some characteristics of climate change in the tropics and Asia – Pacific regions.

In general, tropical region is not a place where temperature increases the most in the global warming tendency. However, in tropical sea, rainfall and evaporation have the tendency of increasing dramatically in comparison with other regions.

In the tropical Asia - Pacific region, climate change expresses in the two following characteristics:

(1) Average temperature increases, but not as much as other regions.

(2) Rainfall increases in some places, but decreases in some other places.

However, climate change in Asia – Pacific always in connection with irregular fluctuation in monsoon mechanism, ENSO phenomenon, frequency, as well as intensity of tropical cyclone.

2.2.2 Changing tendency of some typical climate factors in Vietnam

a) Cold front frequency in Northern

Tendency equation of cold front frequency over Northern in 1961 – 2000 stage has form as Y_x = 28,3 - 0.049x

Decreasing tendency of FRL started in 1971-1980 decade in fact.

Table 2.9 Frequency of some weather type in recent decades:

Decade	Cold Front over Northern	Tropical Cyclone in South China Sea	Tropical Cyclones effecting to Viet Nam	Average number of drizzling rain days in Hà Nội per year
1961 - 1970	268	114	74	29.7
1971 - 1980	288	113	77	35.8
1981 - 1990	287	109	76	28.7
1991 - 2000	249	103	68	14.5

b) Frequency of Tropical Cyclone in South China Sea

Tendency equation of Tropical Cyclone is written as follows: Y_x = 12,1 - 0,0548x

Decreasing tendency of Tropical Cyclone is fairly consistent in all four decades 1961 – 2000, but has been shown clearly in some recent years.

c)Frequency of Tropical Cyclones effecting to Viet Nam

Tendency equation of Tropical Cyclone effecting to Vietnam is written as follows: Y_x = 8,0 - 0,0303x

In fact, decreasing tendency started from 1971 –1980 decade, and has been shown fairly clearly in recent years.

d) Number of drizzling rain days in Hanoi

Tendency equation of number of drizzling rain days in Hanoi has form as follow:

Y_x = 37,6 - 0,51x

Decreasing tendency started from 1971 –1980 decade, and has been maintained till most recent years.

e) Yearly average temperature

Tendency equation of yearly average temperature in Hanoi has formed as: Y_x = 23,4 + 0,0056x

Tendency equation of yearly average temperature in Da Nang has form as:

Y_x = 25,7 + 0,0018x

Tendency equation of yearly average temperature in Tan Son Nhat has form as Y_x = 26,8 + 0,010x
Thus, yearly average temperature in past seven decades has an increasing tendency, showing fairly clearly and consistently in Tan Son Nhat, Hanoi and less distinctly in Da Nang.

g. Average temperature in January

Tendency equation of January average temperature in Hanoi is written as:

Y_x = 16,5 + 0,0022x

Tendency equation of January average temperature in Da Nang is written as:

Y_x = 21,2 + 0,0068x

Tendency equation of January average temperature in Tan Son Nhat is written as: Y_x = 25,6 + 0,0095x

So, the tendency of January average temperature in all three places is not clear. The reason is that temperature in January has just increased in 10-20 years recently.

h. Average temperature in July

Tendency equation of average temperature in July in Hanoi has formed as: $Y_x = 28,6 + 0,0091x$

Tendency equation of average temperature in July in Da Nang has formed as: $Y_x = 28,9 + 0,0054x$.

Tendency equation of average temperature in July in Tan Son Nhat has formed as: $Y_x = 26,7 + 0,0136x$

So, increasing tendency of temperature in July is fairly clear and consistent in Hanoi and Tan Son Nhat. Meanwhile, tendency of temperature in July is not shown clearly in Da Nang due to a fairly high temperature base in two decades of 1961-1980.

i. Yearly raining volume

Tendency equation of yearly raining volume in Hanoi has form as:

$Y_x = 1644,8 + 0,3391x$

Tendency equation of yearly raining volume in Da Nang has form as:

$Y_x = 1930,7+ 1,0261x$

Tendency equation of yearly raining volume in Tan Son Nhat has form as:

$Y_x = 1831,8 + 2,1373x$

In each place, changing tendency of raining volume in nine past decades is not consitent: increase in some decades and decrease in some decades. The changing tendency of raining volume is very different among areas within Viet Nam territory.

3. SITUATION OF GREENHOUSE GAS EMISSION IN VIETNAM

3.1 Greenhouse gas emission in 1990s

3.1.1 Synthesizing the inventory result of greenhouse gas emission in 1994

With 5 sources of emission: energy, industrial process, forestry and change in land use, agriculture, waste, the amount of greenhouse gas emission by CO_2 in 1994 is 103.8393 million ton, in which energy sector accounting for the most and the least is of waste sector (table 3.1)

Table 3.1 Synthesizing the inventory of greenhouse gas emission in 1994

Emission sector	Amount of CO_2 emission (million ton)	Percentage (%)
Energy	25.63709	24.7
Industrial processes	3.80719	3.7
Forestry and the change of land use	19.38	18.7
Agriculture	52.45	50.5
Waste	2.56502	2.4
Total	103.8393	100

3.1. Inventory result of greenhouse gas emission in 1998

Regarding greenhouse gas emission, year 1998 was considered as the typical year of the half end of 1990s. According to International Convention Office of Ministry of Natural Resources and Environment, total amount of greenhouse gas emission in 1998 is 120.8 million ton of CO_2 (table 3.2).

Table 3.2 Amount of greenhouse gas emission in major sectors in 1998

Sector	Amount of CO_2 emission (million ton)	Percentage (%)
Energy	43.2	36
Industrial processes	5.6	5
Forestry and the change of land use	57.3	47
Agriculture	12.1	10
Waste	2.6	2
Total	120.8	100

The most emission sector is agriculture (47%) and the least is of waste sector (2%). In comparison with 1994, percentage of emission from agricultural sector reduces 2% and from energy sector increases more than 20%. It is noted that thanks to afforestation, the amount of greenhouse gas emission in forestry and change of land use sector reduces from 19.38 million ton in 1994 to 12.1 million ton in 1998.

3.2 Greenhouse gas emission in the coming years

According to the first declaration of Vietnam about UN Frame Convention on climate change, the amount of greenhouse gas emission in major sectors includes energy, forestry and change of land use, agriculture of Vietnam is 140.67 million ton in 2010 and 233.28 million ton in 2020 (table 3.3). Suppose that in the future, emission from industrial process and waste sector still account for 6.1% like 1994, then total amount of greenhouse gas emission in 2010 and 2020 is 149.39 and 247.74 million ton respectively.

Table 3.3: Estimating the amount of greenhouse gas emission for the year of 2010 and 2020 (million ton of CO_2)

Sector	1994	2000	2010	2020
Energy	25.64	45.92	105.17	196.98
Forestry and change of land use	19.38	4.20	21.70	28.4
Agriculture	52.45	52.50	57.20	64.70
Total	97.47	102.60	140.67	233.28

So, compare with 1994, the amount of greenhouse gas emission of 2010 and 2020 is 410% and 768% respectively in terms of energy and 109% and 123% respectively in terms of agriculture. Especially, after 2000, in forestry and change of land use sector, amount of CO_2 absorption will further exceed the amount of CO_2 emission.

4. SCENARIOS ON CLIMATE CHANGE IN VIETNAM

Like other countries in the region, scenarios on climate change in Vietnam were developed for 3 major factors: temperature, rainfall, and sea water level and for the years of 2010, 2050, and 2070. Following is the imitation of temperature, rainfall, sea wall level by regions:

Table 4.1 Imitations of climate change in Vietnam

Factor	Region	Season	2010	2050	2070
Temperature increase (^{0}C)	North West, North East	-	0.5	1.0	2.5
	Northern Delta	-	0.3	1.1	1.5
	Central North	-	0.3	1.1	1.5
	Central Region	-	0.3	1.1	1.5
	Central South	-	0.3	1.1	1.5
	Central Highland	-	0.5	1.0	2.5
	The South	-	0.3	1.1	1.5
Rainfall increase (+) or decrease (-) %	North West, North East	Rainy	0	0 - 5	0 - 5
		Dry	0	-5 - +5	-5 - +5
	Northern Delta	Rainy	0	0 - 5	0 - 5
		Dry	0	-5 - +5	-5 - +5
	Central North	Rainy	0	0 - 10	0 - 10
		Dry	0	0 - 5	0 - 5
	Central region	Rainy	0	0 - 10	0 - 10
		Dry	0	0 - 5	0 - 5
	Northern of Central South	Rainy	0	0 - 10	0 - 10
		Dry	0	0 - 5	0 - 5
	Central Highland	Rainy	0	0 - 5	0 - 5
		Dry	0	-5 - +5	-5 - +5
	The South and Central South Pole	Rainy	0	0 - 5	0 - 5
		Dry	0	-5 - +5	-5 - +5
Sea surge (cm)	Total coastal line	-	-	33	45

5. IMPACT OF CILIMATE CHANGE IN VIETNAM

Like other countries in South East Asia, climate change causes the following impacts to the important sectors of national economy.

5.1 Impact of climate change on water resources

In the two big rivers named Red River and Mekong River, negative change is much for annual flow and dry flow and positive change is much for flood flow.

In the medium and small rivers, annual flow can be decreased or increased with the same level or much more.

5.1.2 Impact of climate change on agriculture

With the warming in the whole territory, the adaptive time of tropical trees will be more and the adaptive time of sub-tropical trees will be less. According to estimation, following changes will be happened for tree distribution:

- Boundary of tropical trees will move to higher mountainous areas and Northern latitude. In the other hand, adaptive range of sub-tropical trees will be reduced. In the year of 2070, tropical trees in mountainous areas only grow in the belt range which is higher than 100 – 500m and 100 – 200 km away from the existing North.
- Flooding or draught will be occurred with higher frequency than today.
- A remarkable cultivating area of coastal plain, Red River and Mekong Delta will be saline due to sea surge.

5.1.3 Impacts of climate change on forestry

Due to climate change, forest ecological system is affected by various ways:

- Sea level rises high making mangrove forest narrowed, and in other way badly impact on indigo forest and artificial forest in alkaline land in Southern provinces
- Boundary of primeval forest and secondary forest can change. Oily tree forest will expand to the North and higher belts, deciduous forest with drought-resistant trees will develop strongly.
- Raise of temperature and drought make threats of forest fire, pestilent insect, epidemic diseases,... increase.

5.1.4 Impacts of climate change on aquaculture sector

Climate change causes following impacts on seafood source and fishery:

- Raise of sea level make physical, chemical and biological status of water environment worse. As the result, the existing biomes change on its structure and participant, the reserve decreases.
- The increase of temperature make seafood source disperses. Tropical fish kinds with low economic value increase while subtropical kinds of fish with high economic value decrease or extinct. Fishes at coral reef are killed.
- Floating plants, the first link of food chain for floating animal are exterminated, make floating animal decrease sharply, therefore, decreasing food source of middle and upper water layer animals.

5.1.5 Impacts of climate change on energy – transportation sectors

Rise of sea level impacts on operations of drill rigs installed in the sea

Maritime ports including wharf, berth, and warehouse. North-South railway route and other transportation route located close to sea.

The increase of temperature also led to a higher cost of ventilation, raise of electrical consumption for living activities and cooling cost in commercial and industrial sectors.

The raise of temperature and increase of evaporation volume together with erratic of raining regime lead to the change of water reserves and input traffic of hydroelectric lakes.

5.1.6. Impacts of climate change on people health

- The increase of temperature raises negative impacts to the health of people, leading to the increase of some threats to old people, patients with cardiovascular and neurological problems. The hotter situation makes yearly temperature and season structure. In Northern region, the winter will be hotter, causing a change of characteristic in biological rhythm.
- Climate change causes the increase of some tropical diseases such as malaria, petechial fever, increase of growth and development of various kinds of insects and bacteria, owners with disease, and raise of number of patients with spread-able bacterial contamination.

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The MRC-GTZ Watershed Management Programm – Integrated Watershed Management as a Strategy for Sustainable Use of Natural Resources and Biodiversity Preservation

Dr. Simonetta Siligato, MRC-GTZ, Cooperation Program, Laos, Advisor on Watershed Management

Introduction

The Lower Mekong drains an area of about 666,000 km^2 comprising parts of the riparian countries Cambodia, Lao PDR, Thailand and Viet Nam. In this area around 60 million people depend directly on the Mekong River itself and natural resources in its drainage area. To ensure sustainability of natural resources in the region a balanced management across national borders is required. Establishing and maintaining this balance is the mandate of the Mekong River Commission (MRC). The MRC is an international river basin organisation formed by the four riparian countries in 1995 when they agreed on "the cooperation for the sustainable development of the Mekong River Basin". The agreement stipulates that the countries will jointly manage the shared water resources and develop the economic potential of the river. By providing the institutional framework for promoting regional cooperation on sustainable development and improvement of livelihoods, the MRC's mission is to contribute to the UN Millennium Development Goals. The MRC is funded by contributions from the four member countries and from aid donors, among them the German government.

The core issue of the MRC's work is to promote the reasonable and equitable use and protection of aquatic resources of the Mekong River System. This is of crucial importance for the wellbeing of people in the region as well as for the preservation of its unique aquatic biodiversity. Maintaining adequate water quantity, quality and other natural resources in a basin requires the appropriate and sustainable management of the whole drainage area. To achieve this ambitious goal, smaller drainage units, so-called watersheds, are to be managed, often belonging to the territory of only a single country. Furthermore, it has to be taken into account that water resources conditions in downstream regions strongly depend on activities in upstream regions. Therefore, the quality and quantity of water resources in the downstream region, and thus the livelihood of many people, depend on the sustainable use and management of upstream resources.

The *Watershed Management Project*, implemented through a cooperation of MRC and the German Technical Cooperation (GTZ) is situated within the *Agriculture, Irrigation and Forestry Programme* (AIFP) of MRC. Its aim is to contribute to ensuring a politically and environmentally acceptable quantity and quality of water and related resources and their availability over time through management of land-related resources.

In Southeast Asia and the Lower Mekong Basin the climate is characterised by seasonal (monsoonal) weather patterns, and especially freshwater habitats vary substantially with the season. Climate change will add to other stresses in this region such as urbanisation and economic development contributing to unsustainable exploitation of natural resources and increased environmental problems. In this region, climate change is supposed to have most severe influence through increased temperatures. Warming will lead to more rapidly melting of the Himalayan glaciers increasing the risk of flooding in spring followed by water shortages in summer. However, also rainfall patterns and several other changes in hydrology are expected. As weather changes and their connected effects cannot be exactly predicted the whole issue poses a new threat and a new challenge: to adapt to the unknown.

Therefore, in times of changing climatic and other environmental conditions, co-operation, information exchange and exchange of experiences become even more crucial for adaptation to inevitable changes. Finding ways to adapt to a changing climate before the results of mitigation, which means lessening human impacts on the atmosphere and the climate through emission reductions, can begin to appear is the only way for humans to maintain their livelihoods. In developing countries many people live on subsistence-based farms and depend heavily on their immediate environment and its wild products not only in times of poor harvest. Therefore, these people are even more severely affected by biodiversity loss coherent with environmental change because high biodiversity is exceptionally important where genetic adaptation to changing

conditions is critical to the maintenance of local species. In this context an integrated and participatory watershed management approach conserving natural resources and biodiversity becomes more and more important for the safeguarding of basic requirements.

The regional MRC-GTZ Cooperation Programme

The *Watershed Management Project* (WSMP) presented here is a co-operation project of MRC and GTZ which started its first phase in 2002. It concentrates less on technical aspects of watershed management, but rather on its institutional requirements. The efficient cooperation of all sectors involved and the participation of all relevant stakeholders are necessary preconditions for watershed management. Therefore negotiation processes between stakeholders responsible for the regulatory framework in a country, and stakeholders living in the watershed, with responsibilities for and requirements towards the management and use of the resources are encouraged. These negotiation processes need to combine the interests of the different groups of stakeholders while considering the maintenance of watershed services and functions (Fig. 1). The programme therefore focuses on the strengthening of institutions in the riparian countries to increase co-operation, information exchange and sharing of improved approaches for sustainable natural resources management. The overall goal of the watershed management component is to ensure the maintenance of watershed functions – ecological functions of watersheds as well as economic and social functions as basis for livelihood of the population.

Most activities are set at district and partly provincial administrative levels. At the same time, national sectoral line agencies, such as the *National Mekong Committees*, ministries and their departments, are closely involved. The National Mekong Committees are of particular importance, as they coordinate MRC programmes at the national level. They provide links between the MRC Secretariat and the national ministries and line agencies which are the principal implementing agencies of the MRC programmes and projects.

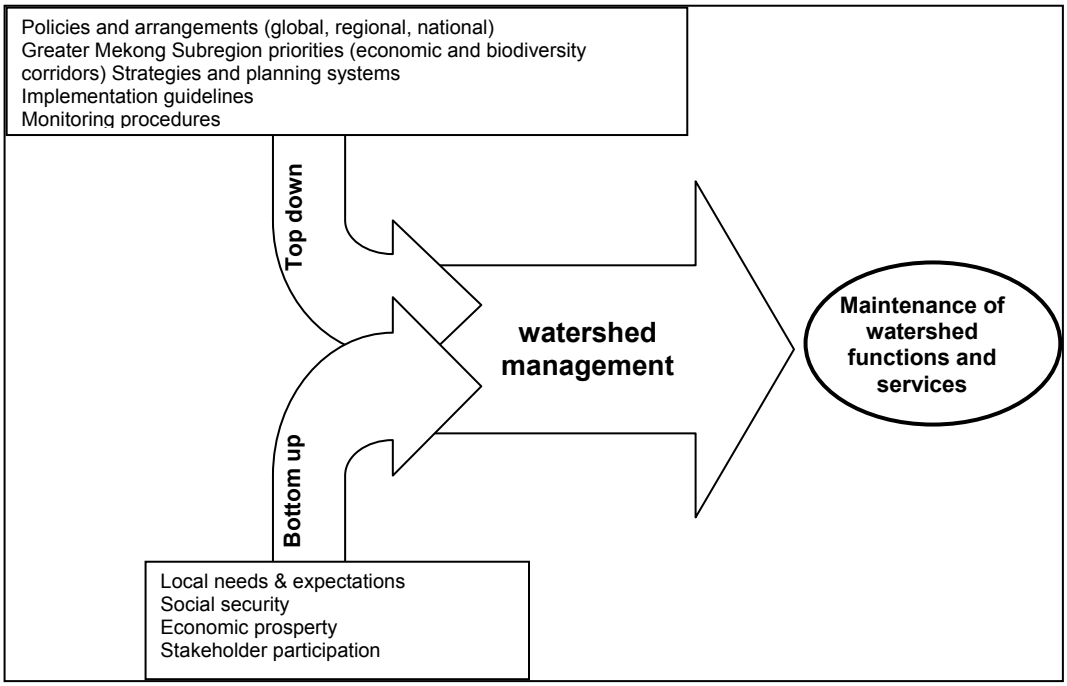

Fig. 1: The challenge of watershed management is the combination of top down and bottom up interests still considering sustainability of watershed resources.

In order to promote integrated watershed management in the Lower Mekong Basin, the WSMP is providing outputs and services in three main areas introduced below.

The policy analysis and advice component

Within this component approaches, methods and instruments for improved analysis, planning and implementation of natural resources management are to be developed together with national and local working groups. The relationship and interaction between the local population, sectoral

management and the watershed management objectives has to be analysed first, and in some cases partly adapted. All relevant land-use planning, implementation and monitoring activities should take into account the watershed management objectives. Watershed management is not a sector on its own but covers many relevant disciplines. Amongst others, agriculture, forestry, transport and energy sectors should orientate policy formulation and implementation towards a common interdisciplinary watershed management. Therefore the understanding of watershed management principles and a high consistency of sector policies are crucial.

The WSMP focuses on three institutional processes concerning policy analysis and advice. Firstly, linkages between the different levels of organisations and institutions with relevance to watersheds have to be consistent. They may either be based on geographical or on administrative borders. Furthermore, the institutions and organisations relevant to watersheds themselves and linkages between them have to be coherent. And finally also the different governance levels of the various sectors involved in watershed management or sectors relevant to watershed management issues have to align their activities towards compatible objectives.
To this end, the project currently supports a policy analysis and review process in the four countries. Legislation and policies relevant to WSM have been examined. Identified shortcomings and overlaps, but also innovative approaches and best practices will be discussed first in national consultation processes, later in a regional policy dialogue. With regard to climate change and biodiversity it has been instructive to observe a regulatory shift from a more sector-based orientation, with WSM domiciled in the Agriculture Ministries, to a more integrated perspective, with WSM now often residing in new ministries and line agencies. In line with this, for example, Vietnam has recently transferred the responsibility for River Basin Organizations to its Ministry for Natural Resources and the Environment (MoNRE). Right now, a biodiversity law is being drafted. WSMP has embarked on lobbying support for integrating a clause on WSM into the draft.
Furthermore on the institutional side WSMP has recently initiated the establishment of so called Watershed Committees in two „Pilot Watersheds“ in Lao PDR (Nam Ton) and Cambodia (Siem Reap). In this process, the whole project concept of focusing on institutional instead of technical aspects and of facilitating integration of WSM into existing structures, rather than replacing them, will be put to a substantial test. The proposal for the third phase of the project (to begin in December 2008) will contain a climate change component to deal with the expected impacts on a watershed level making use of the capacities of the newly created Watershed Committees.

Information and knowledge management component
Within the information and knowledge management component the WSMP assists MRC and the four member countries with the development of an internet based regional exchange platform on natural resources management related issues (MekongInfo), the development of local natural resources management databases and the compilation of a watershed management resource kit, which is a collection of information and knowledge relevant for watershed management from a broad range of disciplines. The information collected and analysed will be available for policy makers, institutional developers, and practitioners in the four countries. They are encouraged to use the information and knowledge on management of water related natural resources, respectively, in a watershed context.
Information and knowledge management also forms the basis for the third main component of the WSMP, the capacity building and awareness component, which will be referred to later.

The internet based regional information system is hosted by the MRC, and can be visited at www.mekonginfo.org. It is an interactive system for sharing information and experiences about natural resources management. Since its creation more than 13,000 users have registered with some 300 new users registering every month. At the moment it holds some 3,000 documents covering natural resources management issues in its online library. All documents can be accessed and downloaded by everyone. Interested persons and institutions may also use the Mekonginfo homepage as platform to share experiences and lessons learnt in posting their documents.

The watershed management resource kit focuses on six main topics relevant to watershed management:
1) Basics – This module refers to basic information on biology and ecology of waters and watersheds as well as related issues. Furthermore, information on social aspects relevant to watershed management, as for example property rights regimes and land tenure issues or gender

aspects is presented. As watershed management is a very complex field of action, the basics module may seem very broad. Nevertheless, knowledge and information on basic social, economic and ecologic issues are crucial for a successful watershed management and therefore special emphasis is given to this module.
2) Policy and legislation – International and regional policy frameworks as well as relevant country policies and legislation are presented.
3) Institutions and organisations – Information on institutions and the administrative systems, good governance principles, as well as an introduction to institutional analysis and development is provided.
4) Planning – In its planning section, the watershed management resource kit provides an introduction to integrated planning and gives information on planning systems, methods and instruments, problems, objectives, strategies and many more relevant issues connected to planning in general. The entire planning sector comprises thirteen different issues, such as land use or river basin planning, relevant for sustainable watershed management.
5) Implementation – Planning and implementation principles of watershed management as well as best implementation practices and lessons learnt are presented in this chapter. For successful implementation of watershed management involvement of locals is essential, and therefore ways of local contributions in an institutional context are being discussed besides possible financing mechanisms.
6) Monitoring and Evaluation – This chapter deals with both project and water resources monitoring and evaluation, to support the correct implementation and orientation of activities towards sustainable watershed management. Furthermore, also practical techniques and in particular community based approaches for monitoring of water resources quality are introduced.

The capacity building component
The capacity building component was developed to improve capacity of stakeholders within the pilot watershed areas as well as support decision makers on different administrative levels. The measures target improved service delivery, networking, cooperation and in particular participatory development and governance. By raising awareness about natural resources and related issues, sustainable planning and management of these will be facilitated. Project activities in this sector comprise logistics and organisational support, seminars, workshops and training courses.

Watershed management, climate change and biodiversity loss
Integrated watershed management can substantially contribute to the preservation of natural resources and biodiversity in a changing environment. The clear advantage of integrated watershed management compared to hitherto prevalent natural resources management techniques is that it considers a geographical unit, without denying the importance of administrative entities. The concept incorporates watersheds and stream catchments, respectively, as units where every single action leads to effects somewhere else in the area. Political and administrative borders and sectoral limits are to be reconciled for successful and sustainable management if they hinder to treat watersheds as units. This relatively new approach to natural resources management respects biological and ecological processes and complexity.
Within a watershed there are multiple uses of and interests in natural resources services creating multiple management challenges. Climate change is expected to add to naturally occurring fluctuations. This increases the demand for institutional arrangements that can define, and adaptively manage, the level of provision and allocation of natural resources services needed by society. Thus, intensive communication and negotiation between stakeholders to clarify needs and expectations and governance to balance competing demands for natural resources is crucial. Moreover, against the background of increasing climate fluctuations and uncertainty, adaptation, currently often understood as individual, short-term coping, will have to take place in a coordinated, long-term, i.e. institutional manner.

Whereas consensus on the global effects of climate change (rising temperature, rising sea-level, disturbed rainfall pattern,...) has significantly increased over recent years, regional and local forecasts are still lacking. It is clear that water will be the natural most severely affected. For the Mekong basin predictions vary greatly. The one thing all climate modeling activities have consistently shown is an intensification of the seasonal pulse of the Mekong, which means a longer dry and an even shorter wet season. If this is to materialize, it will intensify water problems for the poor. Reducing water availability locally and temporarily, it will disrupt food production systems

resulting in productivity losses in staple foods. To meet their basic livelihoods people will be forced to intensify the use of their wild environment for food supply stressing very much the range of biodiversity.

Climate change is also expected to directly negatively influence freshwater ecosystems and thus consequently leads to the decline or loss of aquatic species. Together with pressures from direct and indirect influences from society, freshwater ecosystems are likely to abruptly change. For example, even more changes in sediment and nutrient transport of already degraded and polluted streams will be expected due to climate change. These changes can be large in magnitude and impossible or at least difficult and expensive to reverse.

To date, most efforts of the climate change community have focused on mitigation (e. g. reduction of emissions, carbon sequestration) as means to avoid or at least minimize climate change. It has become apparent however, that even with drastic mitigation measures immediately put into action (which is not going to happen) our planet will suffer climate change effects. Therefore, adaptation – the art of dealing with climate change effects – has drawn increased attention in recent years. Concerning streams and rivers as freshwater systems, existing pressures should be removed and their resiliency improved. However, a key question is whether practical strategies for supporting and developing such resilience can be found and implemented, and which is the appropriate governance level to do so. Integrated watershed management might be a suitable and sufficiently practical strategy, as it integrates a multitude of different points of view with one common goal – the sustainable management and preservation of natural resources functions along with the preservation of biodiversity.

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Session 4 – Overview

Mainstreaming Climate Change Adaptation and Biodiversity Conservation in National, Sectoral and Donor Strategies

Mainstreaming Biodiversity and Climate Change in National Poverty Reduction and Development Strategies
Mr. John Soussan, (SEI)

Significance of Climate Change Adaptation and Biodiversity Conservation in Germany's Development Cooperation Program
Suhel al-Janabi, Consultant to GTZ, International Environmental Conventions Programmes

The Biodiversity Law in Vietnam and Core Environment Program and Biodiversity Conservation Corridors Initiative in the Greater Mekong Subregion
Ms. Huynh Thi Mai, MONRE, Environment Department

Adaptation to Climate Change – GTZ Initiatives in India
Mr. Michael Glueck, GTZ

Biodiversity Conservation and Adaptation Aspects in National Strategy on Hunger and Poverty Reduction and Social Economic Development Plan
Ms. Nguyen Thai Phuong, SD Office, MPI

Preparing for Climate Change Adaptation: The National Strategy and Action Plan for Disaster Mitigation and Management 2001-2020
Mr. Nguyen Chi Quang, MONRE

Mainstreaming Biodiversity and Climate Change in National Poverty Reduction and Development Strategies

Mr. John Soussan, (SEI)

Abstract of presentation

The evidence available shows that, despite some improvements, both biodiversity conservation and climate change are still not well represented in national development and poverty reduction strategies such as PRSPs UNDAFs. Where they are considered, the focus is on MDG 7, on environmental sustainability, rather than on the 'mainstreaming' of these issues into all of the MDGs. At the international level, biodiversity and climate change have until recently been segmented off into processes connected to the GEF and international conventions such as CBD and UNFCCC and are not incorporated into mainstream development and poverty reduction processes. There has been some change regarding climate change, but high profile international rhetoric has not yet been translated into effective national level actions.

Turning this situation around is the responsibility of the environmental community. We need to move on from detailing the problem to identifying the solutions, and doing so in positive terms. We need to show how and where achieving environmental goals contributes to, and can even be a catalyst for, reducing poverty and sustaining growth, and we need to do so in terms familiar to the development community. Some steps in the mainstreaming process are to: (i) analyse the contribution of BD conservation and CC adaptation to all of the MDGs and to different aspects of poverty reduction; (ii) provide evidence of the immediate and long-term economic values of environmental actions; (iii) link the livelihoods of poor communities to local and global environmental assets; (iv) refine the analysis to key growth and development sectors such as agriculture, industry and tourism; and (v) demonstrate how to move from "growth at any cost" to a balance between growth, sustainability and equity within a national development framework.

Significance of Climate Change Adaptation and Biodiversity Conservation in Germany's Development Cooperation Program

Suhel al-Janabi, **Consultant to GTZ, International Environmental Conventions Programmes**

Abstract of Presentation

The German Federal Government is committed to achieving the UN Millennium Development Goals (MDG) and has adopted the "Programme of Action 2015" as Germany's contribution to their implementation. These goals, agreed in 2000 by the international community of states, form together with the guiding vision of sustainable development the reference framework for development cooperation activities. The specific German contribution is set out in the Programme of Action 2015 which was adopted by German parliament in 2001. The overarching objective of the MDGs is to halve poverty worldwide by 2015. However, the attainment of many of these eight goals – such as eradicating hunger, combating diseases, securing maternal health or achieving universal primary education – is directly or indirectly jeopardized by changing environmental conditions.
The German Ministry of Economic Cooperation and Development (BMZ) considers the conventions adopted at the 1992 United Nations Conference on Environment and Development as key instruments for achieving in sustaining development. Hence BMZ supports the implementation of the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC) and also the United Nations Convention to Combat Desertification (UNCCD) – besides other efforts in broader German development co-operation – with specialized programmes executed by the German Technical Assistance (GTZ) since 1993. Especially the BIODIV and the Climate Protection Programme (CaPP) have collected considerable experiences in focal areas of implementing these international agreements trough focussed pilot measures in developing countries. Lessons learnt and best practices of various mitigation, clean development and adaptation activities (CaPP) on the one hand and of projects dealing with sustainable use of biodiversity, access and benefit sharing of genetic resources, traditional knowledge or biological safety (BIODIV) on the other hand are being processed and fed the political arena: to give guidance to German policy, to be mainstreamed into the environmental and socio-economic planning of the partner countries and to serve as tangible ground experience for negotiations at the UN – level.
In order to more effectively support the partner countries, be it at the national or the local level, project are increasingly shaped to cover aspects of more than one convention, e.g. in tropical forest conservation, costal protection or watershed management - to contribute to achieving the MDGs.

The Biodiversity Law in Vietnam and Core Environment Program and Biodiversity Conservation Corridors Initiative in the Greater Mekong Subregion

Ms. Huynh Thi Mai, MONRE

The request to develop the Biodiversity Law

Vietnam is a country with a high level of biodiversity in the world. However, this level is decreasing greatly. To preserve and develop this important natural resource in a sustainable way, Vietnam's National Assembly, 9th Legislature has decided to consider approving the Biodiversity Law. The Prime Minister has assigned the Ministry of Natural Resources and Environment (MONRE) to coordinate with other ministries and related ministerial agencies in drafting the Law to submit to the National Assembly. To draft the Law, the drafting committee consisting of ministerial leader representatives and the drafting group consisting of departmental leader representatives of ministries, ministerial agencies, related Government agencies have been established. The Department of Environment of MONRE has been assigned as a focal point in drafting the Biodiversity Law.

The Biodiversity Law will be prepared in two steps: (1) Build the background papers as the basis for the specific (identifying) name, scope of regulations, main content, chapters, articles and provisions of the draft Biodiversity Law; and (2) draft the Law, consult related parties and submit to the authorities for consideration and approval.

1.2. Objectives:

The Biodiversity Law will be developed with:

1.2.1. Long-term objectives: To solve the problem of biodiversity degradation; preserve the ecoregions with a high level of biodiversity; protect rare, valuable, endangered and wild species; ensure genetic sustainability to achieve ecological balance at a sustainable level to serve the country's sustainable development goal.

1.2.2. Short-term objectives: To build and complete the Biodiversity Law to submit to the National Assembly for approval.

1.3. The Biodiversity Law Project is built on the following viewpoints, principles and guidelines:

(1) To concretize the Constitution of the Socialist Republic of Vietnam and make into law the Party's guidelines and decisions on nature preservation and biodiversity protection which have been reflected in the Party's Congress Resolutions and Resolution No.41/NQ-TW of the Politburo on environmental protection in the country's process of promoting industrialization and modernization.

(2) To unify and harmonize with the current system of laws with consideration of reforming the laws on environment in the future.

(3) The Biodiversity Law must have a reasonable scope of regulations based on a clear border with the Law on Environmental Protection and laws on natural resources such as the Law on Forest Development and Protection, the Law on Water Resource, the Law on Fisheries, the Land Law, the Law on Minerals, the Law on Petroleum, etc.

(4) The articles and provisions of the Biodiversity Law are formed based on the current legal regulations, and on the basis of developing the reasonable ones which have been tested through practice; adjusting and amending the unreasonable ones; and supplementing the ones related to biodiversity.

(5) To unify state management on biodiversity on the basis of clear and reasonable delegation between central agencies and between central and local agencies.

(6) To pay attention to the benefits of related parties on the basis of equality and fairness in the eyes of law; protect biodiversity in the direction of supporting poverty reduction and hunger eradication.

(7) To consider and learn selectively from other countries' experience; conform to related international conventions to which Vietnam is a signatory.

(8) To conform to legislation reform requirements in a detailed, reasonable and feasible way.

1.4. The Biodiversity Law Framework

Chapter I: General provisions

Chapter II: Planning, establishment and management of protected areas

Chapter III: Conservation of endangered animals and plants

Chapter IV: Conservation of, access to and benefit sharing from genetic resources

Chapter V: Biosafety

Chapter VI: International cooperation for biodiversity conservation

Chapter VII: Mandate, responsibilities, management organization and resources for biodiversity conservation

Chapter VIII: Implementation provisions

II. CORE ENVIRONMENT PROGRAM AND BIODIVERSITY CONSERVATION CORRIDORS INITIATIVE IN THE GREATER MEKONG SUBREGION

2.1. Background

Recognizing the environmental challenges to sustainable economic growth and development in the Greater Mekong Subregion (GMS), the GMS Working Group on Environment (WGE) in September 2004 requested the Asian Development Bank (ADB) for a Core Environment Program (CEP) to address the likely stresses on the environment from economic development in the GMS, particularly in its economic corridors. The regional technical assistance (RETA) for the GMS Biodiversity Conservation Corridors Initiative, provided by ADB in December 2004 in response to that request, (i) prepared a strategic framework and action plan (2005-2014) for the GMS biodiversity conservation corridors, and (ii) facilitated the preparation of the CEP for the consideration of GMS environment ministers and summit leaders.

The GMS environment Ministers' meeting in Shanghai, People's Republic of China (PRC), in May 2005 and the second GMS summit in Kunming, PRC, in July 2005 endorsed the implementation of the CEP and its flagship component, the Biodiversity Conservation Corridors Initiative (BCI). The GMS environment ministers also endorsed the establishment of the Environment Operations Center (EOC) in Bangkok, Thailand, to provide operating capacity to the WGE and to implement the CEP and BCI.

GMS-CEP-BCI will be implemented in three phases, from 2005-2014 and was cofinanced by the Poverty Reduction Cooperation Fund and the Governments of the Netherlands and Sweden. Six GMS countries participated CEP (Cambodia, Lao PDR, Mianmar, Thailand, Yunan Province of China and Vietnam).

The key components of the GMS-CEP-BCI are:

(i) Sector strategy environmental assessments;

(ii) Biodiversity Conservation Corridors Initiative (BCI);

(iii) Environmental performance assessments (EPAs);

(iv) Capacity building for environmental management; and

(v) Sustainable financing

Component (ii) will establish sustainable development and management regimes in the GMS biodiversity conservation corridors, to prevent or reverse the fragmentation of highvalue forest

ecosystems. It will also endeavor to initiate a system whereby the hydropower and tourism sectors systematically pay to conserve non-marketed ecosystem services.

This Component (BCI) has been implemented by 5 GMS countries: Cambodia, Lao PDR, Thailand, Yunan Province of China and Vietnam (Mianmar wasn't participated in this phase) for 3 phases, phase I from 2006-2008.

2.2. Duration and pilot site in Vietnam

Pilot site in Vietnam for phase I (2006-2008) was selected in Quang Nam and Quang Tri provinces.

2.3. Activities

A. Activities at national level:

To support development of the Biodiversity Law, including activities on international experience exchange and support development of theoretical and practical basis on development of the Biodiversity Law; Overview, assessment of existing legal system related to the biodivesiry to find the gaps for the Biodiversity Law; Draft the Biodiversity Law and documents under laws and start to implement the Law; Support to carry out the environmental impact assessment/strategy environmental assessment in pilot sites; Coordinate and collaborate to develop information on biodiversity via information exchanging mechanism; Arrange meetings, national workshops and partners; Recruit national consultant; Procuce equipments for national and provincial levels.

B. Activities at provincial level:

1) Support in poverty reduction

- Economic evaluation of poverty reduction effect of comminity based environment management measures;
- Market research and analysis.

2) Harmonize land management mechanism

- Support community to plan management of natural resources;
- Support development and application of legal tools at the provincial/district levels;
- Planning of forest management in 5 districts.

3) Restore the ecosystems connection and biodiversity conservation

- Assess existing methodologies;
- Establish pilot nursery gardens in commune;
- Assess national existing policies;
- Economic and ecological assessment on forest restoration areas;
- Develop models and pilots;
- Restore and plant in selected areas by endemic species.

4) Strengthen capacity

- Assess existing strategic plans in the project participated provinces;
- Develop 5 year financial plans;
- Develop strategy for increase of supplemental resources;
- Planning and implementation of landscape M&E system;
- Support development of strategy and policy;
- Education, training on monitoring at provincial, district and commune levels;
- Enhance capacity for rangers at the district and commune levels;
- Training for community on community based environmental management and market linkage measures;
- Education and training for district leaders.

5) Disseminate program, supervise and provide sustainable finance

- Assess planning and project ideas;
- Develop evaluation plans and 6 months reports;
- Carry out researches on payment for environmental services in the selected areas in the Central Annamite;
- Develop monitoring indicators;
- Integrate monitoring system into district system;
- Analyse economic benefits of sustainable community based environmental management measures;
- Develop monitoring database.

2.4. Total capital

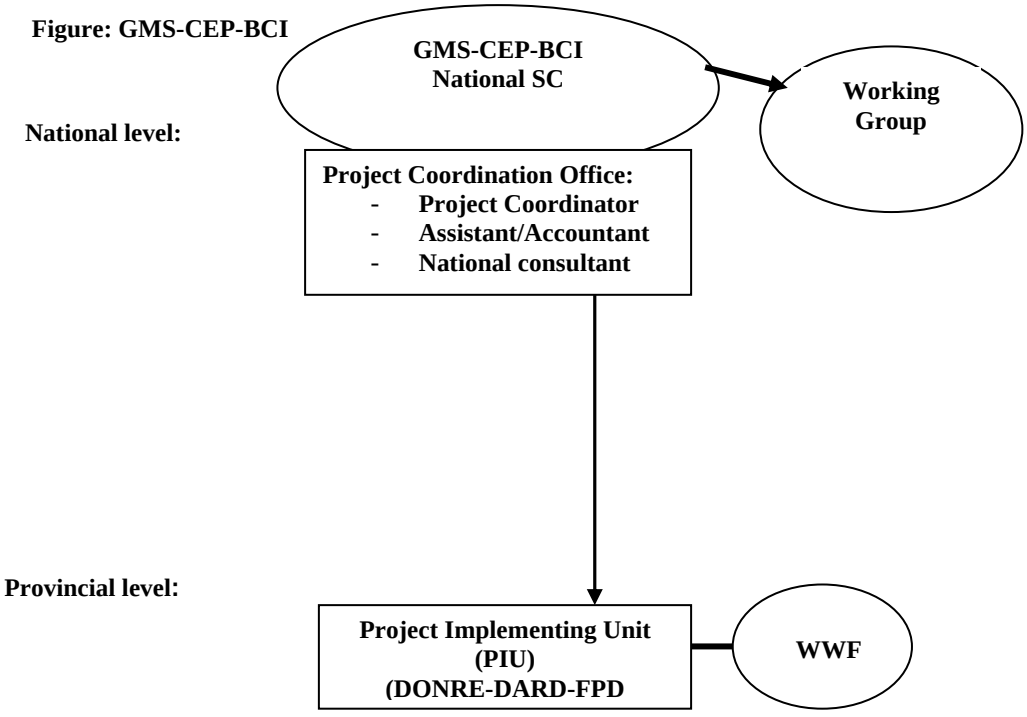
Total sponsor: 6,314 millions USD
National activities: 914, 000 USD (include about 70.000 for IUCN)
Quang Tri and Quang Nam activities : 5,400 millions USD (WWF manages)

2.5. Implementation organization

After the project was approved, MONRE has established the Project Office at DOE/MONRE, National and Provincial Steering Committees, Provincial Project Implementing Unit and also developed the Organizational and Activities Regulations and appointed a National Project Coordinator, established working group and recruited supporting staffs and consultants.

2.5. Implementation organization mechanism

Figure: GMS-CEP-BCI



Adaptation to Climate Change – GTZ Initiatives in India

Mr. Michael Glueck, GTZ

No paper available, please view presentation in the attached CD.

Biodiversity Conservation and Adaptation Aspects in National Strategy on Hunger and Poverty Reduction and Social Economic Development Plan

Ms. Nguyen Thai Phuong

I. Foreword

Vietnam is considered one of 10 centers with the highest level of biodiversity in the world. Biodiversity in Vietnam is represented by its abundance in species, genetic sources and diversity in landscape types and typical ecosystems. Biodiversity plays an important role in maintaining and developing many economic industries of the country such as forestry, aquaculture, agriculture, tourism and industry and contribute significantly on poverty reduction and improvement of people's living standards. However, biodiversity in Vietnam is threatened by pressures of rapid and robust growth of industrialization. Accompanied with insufficient knowledge, shortage of awareness and inappropriate attention to biodiversity protection and development have made biodiversity be degraded in which many biological functions are disturbed. People are shouldering serious consequences of natural disasters such as drought, whirlwind, swept flood, tube flood, erosion, pollution and so on.

II. Interactions between economic development and social issues and climate change and biodiversity in Vietnam

1. Industrial development and infrastructure building:

Vietnam's industry in the recent years has witnessed a rapid growth rate. Industrial production value has increased 16%/year on average (in the period 2000-2005). Some industries have developed quickly such as exploitation, natural gas processing, ship building, wood processing, etc... There are many industrial zones and export processing zones established across the country. This development has contributed to maintain the overall growth of the economy. However, industrial and infrastructure building activities cause pollution of species living environment. According to figures provided by scientists recently, in the Core Economic Region in the South, in order to create 1 billion VND of GDP, production and business enterprises in the region emit 3.1 tons BOD; 5.9 tons floating hard wastes, 2.9 tons CO2 and 44 tons hard wastes. Pollution types such as smoke, dust, waste water and harmful hard wastes have serious impacts on biodiversity. They effect structures of communities and force species in ecosystems change toward less sustainable trends.

Mining activities and building of big water reservoirs for hydroelectric power plants change biological scenes and effect ecosystems strongly. Many species have been destroyed because they are buried by rock and soil and sunk in deep water. Many species have lost their habitats, living environment, food sources and breeding places so that a huge amount of individuals are dead, nutrition chains are disturbed and ecological balances are damaged.

Some transport works in the building processes go across national parks, nature conservation areas and biosphere reservation areas so that species communities are partitioned or isolated.

2. Development of commerce, services and tourism:

In the recent years, commerce and services have experienced positive transformations. Annual growth rate in the period 2000-2005 is 7-8%/year. Eventful commercial and service activities accompanied with inadequate and inappropriate attitudes towards biodiversity and ineffective management on biodiversity so that they have effected biodiversity negatively.

Market needs for bio-resources (wild animals, plants, timber and non-timber products) are main factors to accelerate pressures on this type of resources. According to incomplete statistics, in 2003, there were 2000 restaurants specializing in wild animals' meat in the whole country, each restaurant consumed about 3kg of wild animals per day. As a result, in a year the country can consume more than 2000 tons of wild animals to provide food for specialty restaurants. In addition, it is estimated that about 10-20 tons of wild animals used for making medicines and 5-10 tons used

as ornament animals in a year. Going along with economic development and population increase, demands for wild animals from domestic and foreign markets have been increased either (import of exotic productions and species, etc…). This is a big challenge for biodiversity in Vietnam.

3. Agro-forestry and aquacultural development

If adequate planning and close plans that are appropriate for objective laws of the society and the nature are available, agro-forestry and aquacultural production activities will contribute to conserve and enrich resources of the country. However, to date, since people's degree of understanding is limited and organization and management are still inadequate, agro-forestry and aquacultural activities have negative impacts on biodiversity.

Issues of transforming land use objectives have completely changed components of species and relationships between species in ecosystems. Delta regions, especially natural grass plots in the Southern lowland and Mekong River Delta, suffer from strong pressures from this threat. In the Southern lowland, natural grassland almost no longer exists, while in Mekong River Delta, a large area of this type of biological scene in Plain of Reeds (Dong Thap Muoi) and Long Xuyen quadrangular have been transformed into agricultural cultivated land. As a result, many big water birds have been losing their communities, even in danger of partial extinction. Many mangrove forest areas along the coast are destroyed to widen space for shrimp culture. Many forests in Center Highland are cleared for growing rubber, coffer and tea trees.

The transformation of crop structures in agriculture has changed ecosystems' component either.

Especially, the increasing over-use of chemical medicines has polluted water sources, land and air, increased practices of absorbing medicines, increased anti-medicine capacity of pestilent insects, promoted the creation of pestilent insects, promoted the generation of anti-medicine insect communities and destroyed helpful species in agricultural ecosystems.

4. Hunger, poverty and decrease in biodiversity

In the last 10 years, Vietnam has had significant achievements in socio-economic development and hunger elimination and poverty reduction that are highly recognized in the international scope. However, Vietnam is still a poor country. Total GDP per annum of the whole country is low. Allocation of GDP among different localities are not equal. Provinces with low GDP per capital are those with high poor rate. Most of the poor mainly rely on natural resources. Their intellectual standards are normally low. They mainly live in remote and deep-lying regions where are rich of biodiversity resources. The poorer the people are, the stronger their impacts on biodiversity resources. As a consequence, they are caught in a vicious circle: poverty – exhaustion of biodiversity resources – poverty.

In addition, other social issues such as the increase in population and free migration are factors that have negative effects on ecosystems in the nature and decrease biodiversity.

III. National strategies on hunger elimination and poverty reduction and socio-economic development plans in adaptation to biodiversity conservation and climate change

The world conservation strategies were initiated by UNEP, IUCN and WWF in 1980 that have linked conservation of means of existence with sustainable development. In 1987, the World Committee on Environment and Development (WCED) concluded that policies on sustainable development require all their ecological criteria must be considered in the relation with social and economic criteria. The progress on this issue that is higher appreciated internationally was taken place in the Earth Summit Conference in Rio de Janeiro in 1992 with the approval of Agenda 21. The Agenda called upon countries to set up their national sustainable development strategies in which socio-economic development projects can be mainstreamed into environment protection. The Agenda not only drew up measures to set up consolidated mainstreaming plans but also clarified the sustainability mainstreamed in the planning processes.

At global level, efforts to mainstream socio- economic development strategies, planning and plans into environment plans have been accelerated since late 1980s.

In Vietnam, socio-economic development strategies are understood as documents presenting big and basic issues that reflect standing points and core principles of developing the countries in a certain period of time in order to successfully meet objectives set in political programs and socio – economic development policies of the Party and the State.

Before 1990, Vietnam did not set up a complete Strategy on socio – economic development. In the anti- American resistance war, the Party determined two strategic tasks as to build socialism in the North of Vietnam and to fight against enemy to unify the country. After unity date, two tasks as building socialism and protecting the nation were two main tasks. Action program of the whole socialist revolution in the transitional period was the ground based on which socio – economic development strategy and science and technological development strategy and so on were built.

Socio – economic development strategies were complied for two period 1991-2000 and 2001-2010 with main contents as the following:

- Domestic and international context
- Standing points of developing the country in strategic periods
- Overall objectives of the country development
- Detailed objectives of the country development
- Strategies of developing industries, sectors and territorial regions
- Measures to execute the strategies

Along with these strategies, socio – economic development planning and plans every 5 years or every year were set up in order to concrete the strategies.

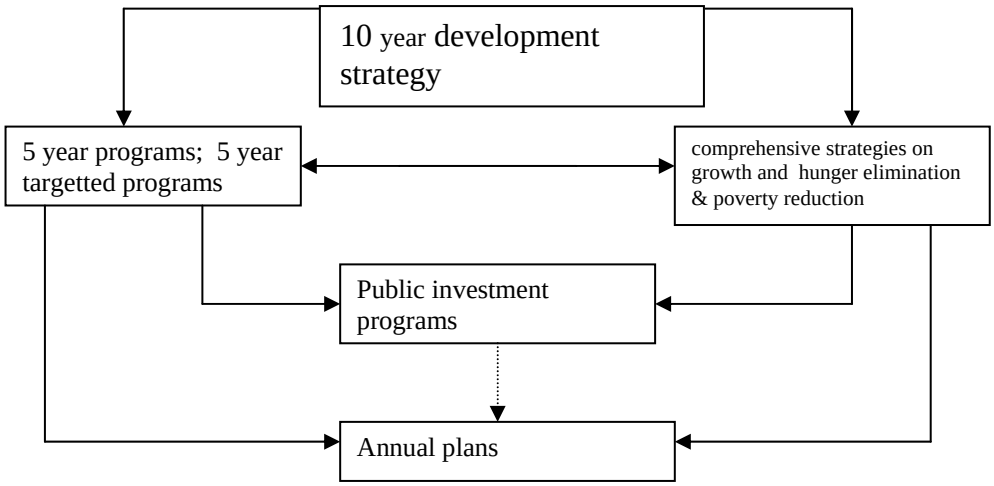
Vietnamese Government has been aware of the roles and importance of environment protection in general and of biodiversity conservation and sustainable development in particular. Degrees of awareness have increasingly been upgraded and documented in more detailed and more clearly in systems of related legal documents. Contents relevant to environment and biodiversity conservation are mainstreamed in political programs, policies and lines of the Party and the State in a certain extent.

Besides the promulgation of related legal documents, Vietnamese Government has paid many efforts to transfer the awareness into specific action through approval of some relevant strategies, plans and programs.

In these relevant strategies, plans and programs, building capacity on environment related issues in general and biodiversity conservation and sustainable development related issues for all social classes in particular are attached special importance to and are determined as one of priorities.

1. Comprehensive poverty reduction and growth strategy

Comprehensive poverty reduction and growth strategy was approved by the Prime Minister in March, 2001. This is an action program to concrete overall objectives, regimes, policies and solutions of 10 year socio – economic development strategy for the period 2001 – 2010, 5 year socio – economic development strategy for the period 2001 – 2005 of the country as well as of each industry and transfer them into detailed solutions accompanied with implementation schedules. The links between 10 year Strategy and socio –economic development programs and comprehensive strategies on growth and hunger elimination and poverty reduction are shown in the following diagram:



In this strategy, objectives on ensuring sustainable environment in general and sustainable biodiversity conservation in particular are determined with some detailed criteria besides socio – economic objectives and hunger elimination and poverty deduction ones. The details are follows:
+ By 2010, 100% of industrial zones, in urban areas and rural handicraft villages, waste water is processed, hard and hygienic waste is collected; forest coverage level was 38% in 2005 and will increase to 43% in 2010;
+ 50% deforested watershed forests will be recovered; to improve forest quality, to encourage local people to afforest.
+ Increase proportion of nature conservation areas in total natural land to 11.5%, especially sea and wetland conservation areas.
+ Improve natural forest and planted forest quality; to increase socio – economic and environment values of forest land
+Promote biodiversity in poor, sandy, desert and marsh areas; to ensure sufficient resources for production activities of local people, especially the poor.
+ Improve poor ecosystems, increase stability of ecosystems in sensitive areas such as sandy coast, tidal flat, treeless areas and ball hill, etc.
+ Carry out projects on improving and protecting environment, protecting watershed forests and building national parks, nature conservation areas and special forest areas; Develop and improve quality of botanic and zoological gardens in research centers and national parks to reserve and maintain valuable and scarce hereditary genetic sources
+ To evaluate environmental impacts on socio – economic development projects. Results of environmental impact evaluation must be considered and mainstreamed into processes from setting up to projects to implementing the projects in order to overcome and minimize negative impacts on the environment and to ensure sustainable development.

2. Orientations for sustainable development in Vietnam (Agenda 21 of Vietnam)
The Agenda was approved by the Prime Minister on 17 August 2004. This is a frame strategy including big orientations for economic and social development and environment protection. The Agenda is a basis for Ministries, industries, localities, mass organizations and people communities to implement and co-operate to ensure country's sustainable development in 21st Century. In this strategic Orientations, 9 priorities for sustainable development in resource and environment sector are committed to be carried out. 9 priorities are:
- Appropriate and sustainable use of land and prevention against land duration
- Economical, effective and sustainable use of mineral resources
- Water environment protection and sustainable use of water resources.
- Protection of environment resources and sea, coastal and island resources
- Forest protection and development
- Decrease in air pollution in urban areas and industrial zones
- Management of hard waste and harmful waste
- Biodiversity conservation

- Climate change mitigation and limitation of effects of harmful climate change; contribution to protecting and preventing natural disasters.

Even though environment related factors in general and biodiversity conservation in particular are taken into account in socio –economic development strategies, plans and programs, development planning and orientations of protecting strategic environment are not linked with one another in strategy setting up processes. As a consequence, in process of concretizing activities to carry out the strategies, resources are not located appropriately and economically according to the orientations of simultaneous settlement of development and protection objectives.

IV. International co-operation programs in order to mainstream environment in particular and biodiversity conservation in particular into socio - economic development in Vietnam.

To date, Vietnam has received many positive supports from Switzerland, Canadian, Denmark, Belgium, Japanese Governments and so on related to nature conservation. International organizations, especially UNDP, UNEP, WB, ADB, IUCN, WWWF... have very close co-operation with our country in environment protection in general and biodiversity protection in particular.

In 2001, in order to strengthen implementation and keep track on ODA funds for environment, International Support Groups on Environment (ISGE) were established. This is an initiative and effort of the Government in mobilizing aiding funds for environment protection in general and biodiversity protection in particular. Through ISGE forums, communities of donors can co-operate, share information and set up appropriate investment strategies for environment conservation activities in Vietnam.

In the context of co-operation with Holland Kingdom, co-operation relation between Ministry of Planning and Investment with Holland Environment Evaluation Office (MNP) has been initiated in order to support Conservation Development Office. Ministry of Planning and Investment has set up and carried out policies on biodiversity that are determined in Strategic Orientations of conservation development in Vietnam. Ministry of Planning and Investment will be the main partner of International project on conservation of MNP in Vietnam. Objectives of the co-operation is to support Vietnam to mainstream biodiversity criteria into monitoring and evaluation systems in order to meet objectives of convention on biodiversity that Vietnam has committed to take part in and at the same time to harmonize socio – economic development objectives to 2010. This is an opportunity to make thought that is of interests of both parties which is related to biodiversity action plans to be carried out in 2007 and a part of 2008 realistic. Hopefully, results of the co-operation, biodiversity criteria and biodiversity models at national level will be set up to mainstream into socio – economic development plans and strategies of Vietnam.

Preparing for Climate Change Adaptation: The National Strategy and Action Plan for Disaster Mitigation and Management 2001-2020

Mr. Nguyen Chi Quang, MONRE

No paper available, please view presentation in the attached CD.

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