VIETNAM'S NATIONAL DATABASE ON THE STATE OF MARINE ENVIRONMENT

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1. Introduction

Vietnam's marine territory covers an area of approximately 1 million square kilometers, which is triple to the 330,000 square kilometers of its terresterial area, and the coastline of Vietnam is 3,260 kilometers long. In average, Vietnam has100 square kilometer of terrestrial land per kilometer coast line, compared to the global average that is 600 terrestrial square kilometer per kilometer coast line.

The total area of Vietnam's coastal region includes up to 41% of the total country area. The approximately 41.2 million people living in this area make up half of the country's total population. Annually, the coastal provinces contribute to approximately 30% of Vietnam's total GDP and about 50% of the Vietnam's total income from export.

Vietnam is located in a connecting point between the Pacific and Indian Oceans and the Asian, European, Middle East and Oceania regions. This strategic location presents many advantages in terms of international connections and enhances the potential for development of marine works for the country.

Vietnam's marine area includes diverse natural resources and coastal and marine habitats. There are approximately 2,000 fish species living in the coastal and offshore regions. Among them, there are approximately 130 fish species that have high economic value. Coastal fishery constitutes a significant contribution to the local and national economic incomes. There is approximately 40,000 hectare of coral reef spreading along the coastal area such as in Ha Long Bay, Cat Ba Island, Son Tra – Hai Van, etc. The coastal area also includes various types of mangrove forests.

Natural resources in Vietnam's East Sea also include precious minerals such as titanium, iron, oil, gas and glass sand. Oil is an especially economically important resource and oil export has provided substantial financial resources for the socio-economic development of the country.

Vietnam's sea is also important for the tourism industry. Beaches such as Tra Co, Ha Long, Lang Co, Non Nuoc, Hoi An, Nha Trang, Vung Tau and Mui Ne are popular tourism sites for both national and international tourists. Furthermore, there are approximately 950 historical and cultural heritages situated along the coast.

Despite the economic importance of coastal and marine natural resources, economic developments in Vietnam's coastal areas are often environmentally unsustainable because of inappropriate planning. Fishery is primarily small-scale and takes place primarily in inshore areas, often through destructive methods. This is leading to negative impacts on fish resources in the area.

While the trend of increasing urbanisation and tourism development in the coastal areas has promoted resettlement and reallocation of labor between rural and urban areas, it has also raised difficult problems and issues related to the supply of drinking water, environmental degradation, inappropriate land use planning etc.

In parallel with economic development, in general, and marine economic development in particular, environmental protection has become a critical issue in the sustainable development and management of coastal and marine resources in Vietnam. In order to create a sound scientific foundation for marine resources management planning, policy making and institutional arrangements, the collection of information and the development of a database on marine resources and environment has been recognized as one of the priorities under the "Master Plan on Basic Survey and Management of Marine Resources and Environment until 2010 and Vision until 2020".

Up until now, Vietnam has not had a comprehensive information system including information from central to local levels, on marine resources, in general, and the status of marine environment in particular. Such an information system could provide information from national and local sources to assist the management of the marine environment, and to forecast potential disasters and pollution risks in the coastal and marine areas. Since environment is a cross-cutting and inter-disciplinary field, significant amounts of information targeting a large number of audiences is required for scientifically appropriate management. It is imperative that sufficient and frequent collection and management of data and information is supported at national level. Therefore, it is the hope that the development of the database on the state of marine environment, as a part of the development of a national database on marine resources and environment, would strengthen the effectiveness of the marine resources management at national and regional levels.

2. About Vietnam's pilot national database development on state of marine environment

The Coordinating Body on the Seas of East Asia (COBSEA) consists of ten member countries (Australia, Cambodia, People's Republic of China, Indonesia, Republic of Korea, Malaysia, Philippines, Singapore, Thailand and Vietnam) and was formed in 1981 to oversee the implementation of the 'Action Plan for the Protection and Sustainable Development of the Marine and Coastal Areas of the East Asian Seas region'. East Asian Seas Regional Coordinating Unit (EAS/RCU) acts as the secretariat of COBSEA. Information management and state of marine environment reporting are some of the main components of the Action Plan.

Recently, the need for improved information management on coastal and marine data and activities has been re-emphasized by the COBSEA member countries and it has been suggested that COBSEA should give this area a higher priority. Subsequently, information management and capacity building were identified as the two immediate priority areas for COBSEA at its 18th Meeting, held in Sanya, China, 24-25 January 2006.

Vietnam's development of a national database on the state of marine environment has been supported by both UNEP EAS/RCU and the Vietnamese government. The database will provide marine environment status data as part of the larger national database on marine resources and environment that is being developed under the "Master Plan on Basic Survey and Management of Marine Resources and Environment until 2010 and Vision until 2020". The support from UNEP EAS/RCU for the development of the national database on the state of marine environment is part of its regional information management programme and this database will constitute a national node in COBSEA's regional database system: the East Asian Seas Knowledgebase.

National Objectives:

- Building up a national database for strengthened state of marine environment reporting;
- Supporting marine resources management and environmental protection at national level.

International Objectives:

- Providing one point of contact for all relevant information and data of the coastal and marine environment, organizations, project activities and experts;
- Demonstrating an example of a Coordination Center or a One-Stop-Shop to COBSEA member countries for continued database development throughout the region.

3. Activities undertaken during database development

- Determination of required marine environment information/data types
- Data/information investigation
- Data collection
- System analysis and design
- Database design and development
- Interactive application development
- Data processing; Incorporate data/information into the database
- Testing and setup of system at implementing institution

The project comprised 2 components i.e (1) information/data investigation, collection and processing; and (2) application design and development.

3.1. Information/data investigation, collection and processing

Marine environment information covers a large and diverse range of aspects including quantitative and qualitative natural and social-economic parameters and factors. In terms of format, the database not only holds data, documents, tables, pictures etc. but they need to link to spatial and temporal factors. Given the fact that the marine environment information and data are scattered in various agencies, efforts have been made to create collaborations with a number of partners including:

- Departments under the Ministry of Natural Resources and Environment including the National Centre for Hydrometeorology, the Department of Water Resources Management;
- Ministry of Agriculture and Rural Development;
- Ministry of Aquaculture;
- General Department of Statistics;
- Research institutions such as the Institute of Oceanography, Institute of Marine Resources and Environment, Institute of Ecology and Biological Resources; and
- A number of universities.

For more information on the main indicators, formats and scopes of the database, see Annex 1.

3.2. Application design and development

The system was designed in to meet the following requirements:

- Easy-to-update information system;
- Easy-to-access needed information;
- Easy-to-exchange information;
- Creating an enabling environment to link geographical data with attribute ones on order to provide an overall picture of the state of marine environment;
- Supporting data analyses and cross-checking;
- Facilitating the data systemation; and
- Creating an enabling enviroment to disseminate marine environment information.

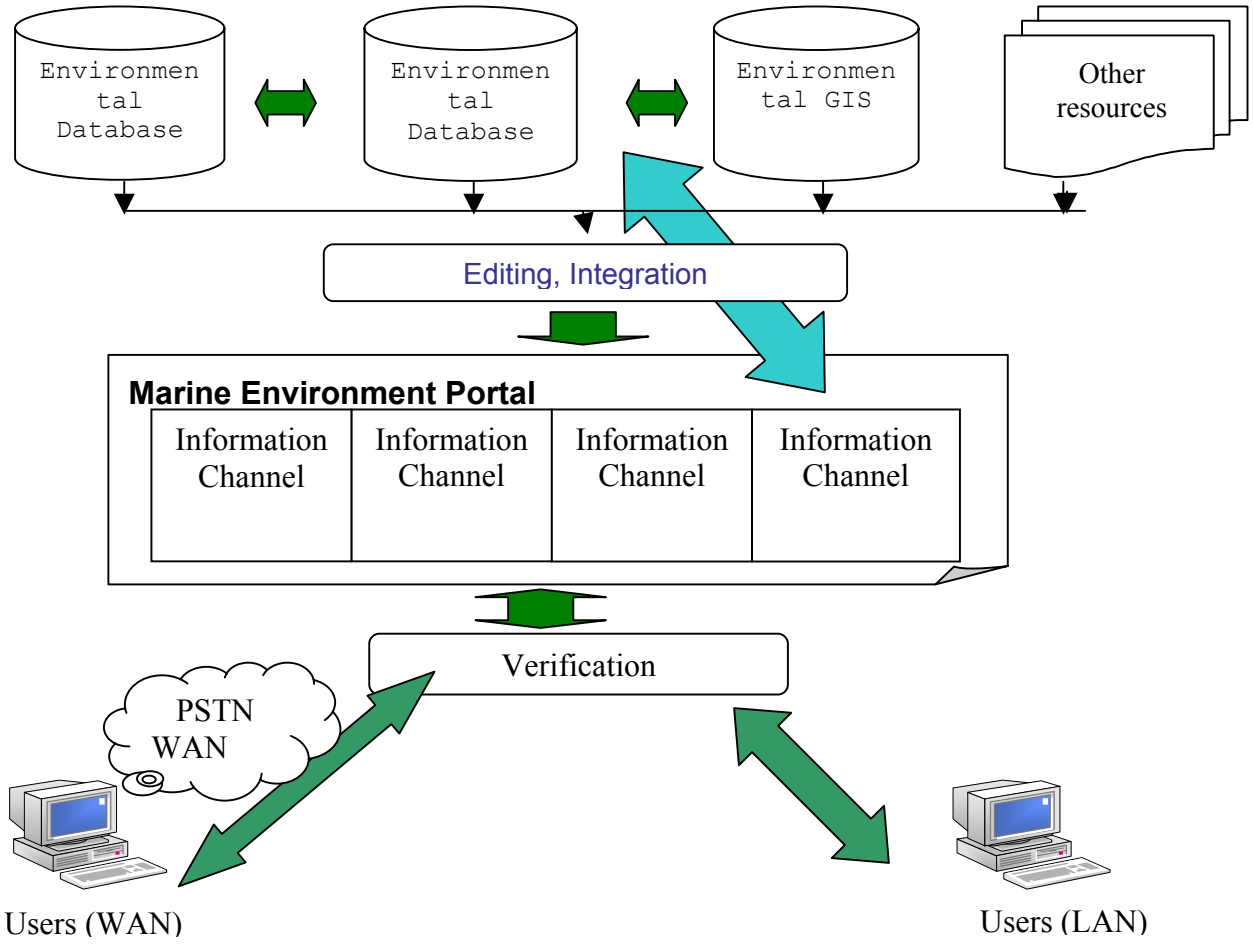
Also, the system was developed to ensure:

- The compatibility with national and international technological status and trends; and
- The integration capacity with the national existing systems as well as the futures.

Therefore, the selection was to combine the licensed and open-sourced solutions, as the followings:

- Database – SQL Server, Oracle
- Web Server – IIS
- Web mapping server – ArcIMS
- Application development
    - .NET Portal – Dot.NETNuke (Open Source)
    - ASP, ASP.NET

Marine Environment Portal Model



4. Challenges encountered during the development of the Vietnam National Database on State of Marine Environment

4.1. Status of marine environment data/information in Vietnam

At the present time, environmental information and data attract special attention from the Government, line Ministries and other relevant institutions in Vietnam. *Even so, the data that is being collected is not yet comprehensive*. *Several important environmental information and data is either lacking or collected infrequently while some information and data that are collected, are not shared among different stakeholders.* In addition, while various ministries and government agencies are in possession of large amounts of environmental data, this existing information/data are often insufficient or irrelevant. There is still a lack of a united system with good co-ordination among different sectors to share environmental information/data and this hinders the information flow from sources to users.

Because of the inter-disciplinary natures of the marine environment, data generally need to be *collected in a large scale and should cover various sectors* of the entire country. Most of the time, government agencies and institutions collect data based on their own requirements and demands with little consultation with other agencies or institutions. This leads to overlaps and incomparability of data. Besides, some necessary indicators have been neglected and therefore neither collected nor analysed. Obviously, there is not yet sufficient co-ordination among agencies in collecting, interpreting and integrating data for a united environment data sharing at national level.

Despite of the rich information on marine environment, the data has not been organised in a standardised formats. The data collectors have either not paid appropriate attention to existing information and guidelines on standardisation or they have developed new ones without appropriate consultation and

consensus with other agencies. For this reason, it is very difficult to integrate the information from different sources.

Information and data on the status of the marine environment is often either insufficient or infrequently updated. Apart from the frequent collections of hydrometeorology data and some other environment monitoring parameters in a limited number of monitoring stations, most of the marine environment data have only been obtained from separate surveys and researches. In addition, most of the data that have been archived originate from state agencies rather than from the private sectors, leading to difficulties in analysing and benchmarking.

Marine environment information and data is only collected in small scales. There has been *insufficient attention* from ministries, institutions and local authorities *to identify suitable data management measures and utilization of data*. This has led to many difficulties in creating a holistic overview on the marine environment data status both at provincial and national levels.

4.2. Mechanism for marine environment information/data sharing

As mentioned above, marine environment information/data is available in various organizations and institutions. However, the mechanisms for sharing this data differ in form and range from free publishing and trading, to selling or providing on contract basisor when a request letter is presented There is also some information/data that is still not widely disseminated.

Characteristics of the mechanism for information sharing are listed below:

- Marine environment information/data is often not available for users. Only annual statistic books provide available annual information and can be bought at any time. However, these contain very limited information on environmental indicators.
- Information on data and data sources are rarely widely publicized.
- Accessing data and their sources complicated and time-consuming.

There is still a lack of an appropriate mechanism for marine environment information sharing among the different agencies in Vietnam.

4.3. Status of open-source software development in Vietnam

In recent years, IT development has been strong in all sectors in Vietnam and the use of IT is increasing with 25% per year. For this reason, Vietnam has been seen as a country with high potential for IT development. Almost agencies have applied IT in management and invested strong IT infrastructure i.e. hardware, software and LAN and WAN connections.

However, similar to other developing countries, Vietnam has faced difficulties in protecting property rights. While the increasing demands of IT access among government agencies, enterprises and the general public, the cost of software, especially foreign ones, is often too high.

Open-source software offers low costs and is increasingly used in Vietnam. Going along with the global trend, Vietnam has invested great efforts in studying, applying, developing, building capacity and raising awareness on open-source software in all sectors. The 2nd of March 2004, the Prime Minister adopted the decision 235/QD-TTg approving the master plan “Application and Development of Open-source Software in Vietnam, 2004 – 2008”. The major purpose of this decision is to promote the application and development of open-source software in Vietnam to contribute to the protection of property rights, the reduction of software procurement cost and to strengthen the IT industry in general and the software development industry, in particular.

However, the process of developing and applying open-source software has faced a number of difficulties. Using open-source software is more difficult than working with established software, which makes it less attractive on the market, often because of the lack of habit among users and the lack of human resources to develop open-source software. Other constraints include the small numbers of available open-source software applications and the fact that different open-source softwares are often incompatible with each-other. The lack of guidelines and technical support for the use of open-source software has been another constraint.

In Vietnam, most available imported and domestic software is commercially licensed. Most of enterprises and their programmers have developed commercial licensed software. There are currently only a limited number of about 30 companies that develop open-source software. The licensed software has been predominant on IT market. In order to ensure the smooth changes from the trend of developing licensed

softwares to the open-source ones, it has been the priority of the country to encourage the two technologies at the present time.

4.4. Main constraints

The development of the database on the state of marine environment has experienced a number of constraints including:

- Overlap and inconsistency of available marine environment data, since many different institutions collect information. On the other hand, there are some relevant data, which have not yet been collected by any institution.
- The mechanism for information/data gathering differs from institution to institution, and is not agreed among Ministries, often not even within the same ministry.
- Marine environmental data collection and management is often only meeting immediate demands, but often lack long-term perspective in order to be able to provide analysis and support to the decision making process.
- There is a lack of compatible standards for and formats of information and data collection.
- Electronic data is rarely legally accepted.
- Insufficient reporting and monitoring schemes (in terms of frequencies and sites).
- Although the use of information technology is developing rapidly in Vietnam, most of the available software has been licensed software which is often too expensive for the user. The use of open source software is in the beginning of its development and still experience many difficulties.

5. Achievements

The Vietnam National Database on the State of Marine Environment was completed and posted on the internet. This has been highly appreciated by a large number of the users.

However, as this is still in the beginning of the database development, there are still a number of technical issues and limitations in terms of uploading information to the portal.

The portal of the Vietnam Marine Environment (VME_Portal) can be accessed at:http://www.nea.gov.vn/VMEportal/.

For more information on the portal, see Annex 2.

6. Lessons learnt

There is a need to:

- Investigate carefully the available information/data on marine environment status in order to create an appropriate information collection strategy;
- Develop a transparent mechanism for information sharing to ensure the smooth flow of information/data while assessing what types of information can either be shared freely and determine responsibilities of the in order to respect intellectual property rights etc.;
- Determine the needs of the users to develop appropriate outputs;
- Assess the status and trends of national and international information technologies in order to be able to apply suitable solutions;
- Develop appropriate data formats to ensure integration with existing and future systems; and
- Maintain frequent and close interactions with the users in order to develop applications in a way to make it as user-friendly as possible.

7. Recommendations for marine environmental data management in Vietnam

- Co-ordination in the task of marine environment data collection has not yet been achieved, data is still scattered and lacks consistency. Standards and guidelines need to be formulated for consistency.

- A strategy for the collection and management of marine environment data is required (e.g. identification of required environmental information to be collected for Vietnam and international exchange, assign and authorize institutions to collect, process and provide environmental data and information, assign and authorize institutions who manage environmental information etc.).
- The establishment of a mechanism for reporting, exchanging and sharing data and information among management and research organizations in the marine environment sector is required to assist the decision making process.
- It is necessary to define a model for information collection and sharing, to make sure that the collection of marine environment data is sufficient and adequate:
    - Ministries/departments closely relating to marine environmental issues need to have regularly updated information system and responsibility to control the information flow among Ministerial/department level and other stakeholders;
    - For other ministries/departments, marine environment data should be integrated into statistic reports or specialized research and surveys. The data collection forms for those should be simple but also meets their management requirements and external demands; and
    - There's a need for a unit that systematically manages, updates, synthesizes and analyses the marine environment data to meet management needs and undertake coordination with other relevant bodies.
- Standards for marine environment data need to be developed and promulgated in order to have comprehensive data sets for this sector.
- The applications on VME_Portal need to be upgraded and completed.
- VME_Portal needs to be integrated with regional Portal.
- The data/information collection from diverse souces to VME_Portal needs to be strengthened.

References

1. Ministry of Post and Telematics, Assessment and Plan for Vietnam Information Technology – Communication Development, The Second National Workshop on Development Research and Application on Information Technology – Communication, 2004.
2. Vietnam Environment Protection Agency, Current status of environmental information/data and its sharing mechanism in Vietnam, 2003.

ANNEX 1

Main indicators, formats and scopes of the Vietnam's National Database on State of Marine Environment

Theme 1. General information

	Indicators	Description of data	Data format	Area coverage of data	Period of data coverage
1.1	**Total country**				
1.1.1	Total country area	Extent of land areas in km2	Number	National	Present
1.1.2	Total marine area	Extent of marine areas in km2	Number	National	Present
1.1.3	Total length of coastline	Length of coastline in km	Number	National	Present
1.1.4	Total population	Number and density of total population	Database/ table	National and provincial	5-10 years
1.1.5	GDP per capita	Gross Domestic Product in USD/capita	Database/ table	National and provincial	5-10 years
1.2	**Coastal zone**				
1.2.1	Total coastal area	Extent of coastal areas in km2	Number	National	Present
1.2.2	Coastal provinces	List of coastal provinces (name, area, population, coastal area of province)	Database/ table	National	Present
1.2.3	Coastal cities	List of coastal cities (name, area, population)	Database/ table	National	Present
1.2.4	Total coastal population	Number and density of total coastal population (50 km from coastline)	Database/ table	National and provincial	5-10 years
1.2.5	GDP per capita coastal population	Gross Domestic Product in USD/capita among coastal population	Database/ table	National and provincial	5-10 years

Theme 2. Physical characteristics of coastal areas

	Indicators	Description of data	Data format	Area coverage of data	Period of data coverage
2.1	Morphology	Map describing shoreline features + Relevant reports	GIS + Text	National and provincial	Present
2.2	Tides and currents	Map describing high/low tide and currents + Relevant reports	GIS + Text	National and provincial	Present
2.3	Environmental impact on physical characteristic of the coastline	Map showing erosion and sedimentation areas + Relevant reports on causes and impacts	GIS + Text	National and provincial	5-10 years

Theme 3. Coastal development trends and pollution loading

	Indicators	Description of data	Data format	Area coverage of data	Period of data coverage
3.1	**Population pressure**				
3.1.1	Growth rate of total coastal population	Average annual change in population in numbers	Database/ table	National and provincial	5-10 years
3.1.2	Growth rate of coastal urban population	Average annual change in population in numbers	Database/ table	National and provincial	5-10 years
3.1.3	Growth rate of coastal rural population	Average annual change in population in numbers	Database/ table	National and provincial	5-10 years
3.1.4	Coastal population below poverty line	Nr and percentage of total coastal population + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.1.5	Main sources of income among coastal populations	Statistics + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.1.6	Urban sprawl	Map showing extent of urban areas + Relevant reports	GIS, Database/ table + Text	National and provincial	5-10 years
3.1.7	Urbanization	Average rate of urbanization annually (nr of people/year) + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.1.8	Domestic waste discharge	Type and amount (m3/year) of domestic waste water and domestic solid waste discharge (ton/year) in coastal areas + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.1.9	Beach/marine litter from domestic sources	Amount (ton/year) and type of generated beach/marine litter + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.2	**Coastal agricultural development**				
3.2.1	Coastal agricultural areas	Type, location and coverage (km2) of coastal agricultural areas	GIS + Database/ table + Text	National and/or provincial	5-10 years
3.2.2	Coastal agricultural production	Total production (ton/year) and value (USD/year) of coastal agriculture + Relevant reports	Database/ table + Text	National and/or provincial	5-10 years
3.2.3	Employment in coastal agriculture	Total number of people employed by agricultural sector	Database/ table	National and/or provincial	5-10 years
3.2.4	Pollution from agricultural activities	Type and amount (ton/year) use of fertilizers and pesticides and percentage discharged into the sea + Relevant reports	Database/ table + Text	National and/or provincial	5-10 years
3.2.5	Loss of coastal habitats due to agricultural development	Maps of mangrove and wetland areas converted for agricultural use + Relevant reports	GIS + Database/ table + Text	National and/or provincial	5-10 years

3.3	**Coastal aquaculture development**				
3.3.1	Coastal aquaculture installations	Total number + Map showing locations of shrimp farming, shellfish farming on land and fish cages in the coastal waters	Number, GIS + Database/ table + Text	National and provincial	5-10 years
3.3.2	Coastal aquaculture production	Total production (ton/year) and value (USD/year) of coastal aquaculture + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.3.3	Employment in aquaculture sector	Total number of fishermen, sea skippers and those employed in the seafood industry	Database/ table	National and provincial	5-10 years
3.3.4	Pollution from aquaculture activities	Type and amount (ton/year) of chemicals used in aquaculture + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.3.5	Loss of coastal habitats due to aquaculture development	Maps of mangrove and wetland areas converted for aquaculture use + Relevant reports	GIS + Database/ table + Text	National and/or provincial	5-10 years
3.4	**Fishery development**				
3.4.1	Fishing grounds	Map showing total area of fishing grounds + Relevant reports	GIS + Text	National and provincial	5-10 years
3.4.2	Fishing fleet	Number and tonnage of fishing vessels	Database/ table	National	5-10 years
3.4.3	Maximum sustainable yield (MSY)	The largest long-term average catch or yield (ton/year) that can be taken from a stock or stock complex under prevailing ecological and environmental conditions (if established)	Database/ table	National and provincial	5-10 years
3.4.4	Fish catch	Total amount (ton/year) and value (USD/year) of fish catch	Database/ table	National and provincial	5-10 years
3.4.5	Employment in fishery sector	Total number of people employed by fishing sector (number)	Database/ table	National and provincial	5-10 years
3.4.6	Unsustainable fishing	Relevant reports and data on the extent of destructive fishing methods (overfishing, dynamite, poison etc)	Text + Database/ table	National and provincial	5-10 years
3.4.7	Marine litter from fishery sources (ex. discarded fishing gear)	Number and type of discarded fishing gear + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.5	**Industrial development**				
3.5.1	Industrial facilities	Data and maps on number, type and location of industrial facilities + Relevant reports	GIS + Database/ table + Text	National and provincial	5-10 years
3.5.2	Industrial production	Total value of industrial production (USD/year) + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.5.3	Employment by industrial sector	Total nr of people employed by industry sector + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.5.4	Environmental impact of industrial activities	Type and amount (ton/year) of industrial waste discharge + Relevant reports	Database/ table + Text	National and provincial	5-10 years

3.6	**Marine transport development**				
3.6.1	Ports and habours	Maps and data showing total number, location, total capacity and existing environmental facilities of ports	GIS + Database/ table	National and provincial	Present
3.6.2	Shipping	Number and tonnage of ships registered nationally	Database/ table	National	5-10 years
3.6.3	Number, location and total capacity of ship yards	Maps showing number, location and total capacity of ship yards	GIS	National and provincial	Present
3.6.4	Channel dredging	Number and location of dredging works and dumping of dredging materials + Relevant reports	GIS+ Database/ table + Text	National and provincial	5-10 years
3.6.5	Cargo tonnage	Cargo tonnage of inward and outward ship calls	Database/ table	National and provincial	5-10 years
3.6.6	Employment by marine transport industry	Total number of people employed by marine transport industry	Database/ table	National and provincial	5-10 years
3.6.7	Waste discharge from ports	Type and amount (ton or m3/year) waste discharge from ports	Database/ table	National and provincial	5-10 years
3.6.8	Waste discharge from shipping operation	Type and amount (ton or m3/year) of waste discharge (including ballast water and marine litter) from shipping operation	Database/ table	National and provincial	5-10 years
3.6.9	Accidental spills	Number and extent (tons) of oil and chemical spill incidents + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.7	**Coastal tourism development**				
3.7.1	Coastal tourism areas	Map describing main coastal recreation areas (name, location)	GIS	National and provincial	Present
3.7.2	Coastal tourism facilities	Number, type and location of tourism facilities (resorts, hotels, restaurants etc.)	GIS + Database/ table	National and provincial	5-10 years
3.7.3	Coastal tourists	Number of coastal tourists annually + total value of coastal tourism (USD/year)	Database/ table	National and provincial	5-10 years
3.7.4	Employment by tourism sector	Total nr of people employed by tourism sector	Database/ table	National and provincial	5-10 years
3.7.5	Waste discharge from tourism facilities	Type and amount (ton or m3/year) of waste discharge (solid and liquid) from tourism facilities	Database/ table	National and provincial	5-10 years
3.7.6	Beach/marine litter in tourism areas	Type and amount (ton/year) of beach/marine litter in tourism areas + Relevant reports	Database/ table + Text	National and provincial	5-10 years
3.8	**River input**				
3.8.1	Main sources of upstream pollution	Maps showing major sources of pollution and data on pollution loading + Relevant reports	GIS+ Database/ table + Text	National and provincial	5-10 years

3.8.2	Pollution load from river input (SS, BOD, nutrients, heavy metals)	Data and reports on amount (ppm) and type (SS, nutrients, heavy metals) of pollution from river input	Database/ table + Text	National and provincial	5-10 years

Theme 4. Quality of marine water, sediments, fauna and flora

	Indicators	**Description of data**	**Data format**	**Area coverage of data**	**Period of data coverage**
4.1	**Existing water quality standards**				
4.1.1	Existing water quality standards	Information on parameters and concentration levels	Database/ table + text	National	Present
4.2	**Monitoring programme**				
4.2.1	Monitoring programme	Number, location, measured parameters and frequency of data collection (periodic/sporadic) at water quality monitoring stations	GIS + Database/ table	National and provincial	Present
4.3	**Water quality**				
4.3.1	Eutrophication				
	Dissolved Oxygen	DO concentration at monitoring stations	Database	National and provincial	5-10 years
	Biological Oxygen Demand (BOD)	BOD at monitoring stations	Database	National and provincial	5-10 years
	N-NH4+	N-NH4+ at monitoring stations	Database	National and provincial	5-10 years
	N-NO3-	N-NO3- at monitoring stations	Database	National and provincial	5-10 years
	N-NO2-	N-NO2- at monitoring stations	Database	National and provincial	5-10 years
	P-PO4---	P-PO4--- at monitoring stations	Database	National and provincial	5-10 years
	Nutrient concentration	Tot-N and Tot-P concentration at monitoring stations	Database	National and provincial	5-10 years
	Chlorophyll-a	Chlorophyll-a concentration at monitoring stations	Database	National and provincial	5-10 years
	Chlorophyll-b	Chlorophyll-b concentration at monitoring stations	Database	National and provincial	5-10 years
	Red tide	Data and relevant reports on red tide occurrences, period and extent	GIS+ Database/ table + Text	National and provincial	5-10 years
	Harmful algae blooms	Data and relevant reports on harmful algae bloom occurrences, period and extent	GIS+ Database/ table + Text	National and provincial	5-10 years
4.3.2	Micro-organisms				
	Total Coliform concentration	Total Coliform concentration at monitoring stations	Database	National and provincial	5-10 years

4.3.3	Oil prevalence				5-10 years
	Oil slick	Area and volume of oil slick	GIS + text	National and provincial	5-10 years
	Oil concentration in water	Oil concentration at monitoring stations	Database	National and provincial	5-10 years
4.4	**Sedimentation**				
4.4.1	Heavy metals	Heavy metals (Cu, Pb, Zn, Hg, Cd, As) concentration at monitoring stations	Database	National and provincial	5-10 years
4.4.2	Persistent Organic Substances concentration	POP concentrations at monitoring stations	Database	National and provincial	5-10 years
4.5	**Biota**				
4.5.1	Biodiversity Index	Biodiversity Index of phytoplankton, zooplankton, zoobenthos at monitoring stations	Database	National and provincial	5-10 years
4.5.2	Pollutants in biota (fish, shellfish, algae)				
	Heavy metals	Data on heavy metal concentration on biota	Database	National and provincial	5-10 years
	Persistent Organic Substances	Data on POP concentration in biota	Database	National and provincial	5-10 years

Theme 5. Impact on ecosystems and natural resources

	Indicators	**Description of data**	**Data format**	**Area coverage of data**	**Period of data coverage**
5.1	**Coral Reefs**				
5.1.1	Coral reef area	Map showing extent and location of coral reef areas + total area in km2	GIS + Database/ table	National and provincial	5-10 years
5.1.2	Rate of destruction (km2 annually)	Based on 5.1.1	5.1.1	National and provincial	5-10 years
5.1.3	Causes of coral reef destruction	Relevant reports on activities such as fishing, coral mining, sedimentation, pollution etc. which have impact on coral reefs	Text	National and provincial	5-10 years
5.1.4	Species composition	Relevant reports and data on number of species and their population of each site	Text + Database/ table	National and provincial	5-10 years
5.2	**Mangroves**				
5.2.1	Mangrove area (km2)	Map showing extent and location of mangrove areas + total area in km2	GIS + Database/ table	National and provincial	5-10 years
5.2.2	Rate of area loss (km2 annually)	Based on 5.2.1	5.2.1	National and provincial	5-10 years

5.2.3	Causes of mangrove destruction	Relevant reports on activities such as shrimp farming, reclamation, pollution etc which have impact on mangrove areas	Text	National and provincial	5-10 years
5.2.4	Species composition	Relevant reports and data on number of species and their population of each site	Text + Database/ table	National and provincial	5-10 years
5.3	**Seagrasses**				
5.3.1	Seagrass area (km2)	Map showing extent and location of seagrass areas + total area in km2	GIS + Database/ table	National and provincial	5-10 years
5.3.2	Rate of area loss (km2 annually)	Based on 5.3.1	5.3.1	National and provincial	5-10 years
5.3.3	Causes of area loss	Relevant reports on activities such as fishing, pollution etc which have impact on seagrasses	Text	National and provincial	5-10 years
5.3.4	Species composition	Relevant reports and data on number of species and their population of each site	Text + Database/ table	National and provincial	5-10 years
5.4	**Coastal wetlands**				
5.4.1	Coastal wetland area (km2)	Map showing extent and location of coastal wetlands areas + total area in km2	GIS + table	National and provincial	5-10 years
5.4.2	Rate of area loss (km2 annually)	Based on 5.4.1	5.4.1	National and provincial	5-10 years
5.4.3	Causes for area loss	Relevant reports on activities such as reclamation, pollution etc which have impact coastal wetlands	Text	National and provincial	5-10 years
5.4.3	Species composition	Relevant reports and data on number of species and their population of each site	Text + Database/ table	National and provincial	5-10 years
5.5	**Biodiversity**				
5.5.1	Threatened and endangered species	Relevant reports and data on species composition, number and type of threatened and endangered species, reasons for biodiversity loss etc.	Text + Database/ table	National and provincial	Present
5.5.2	Invasive species	Relevant reports and data on invasive species, reasons and impact.	Text + table	National and provincial	Present

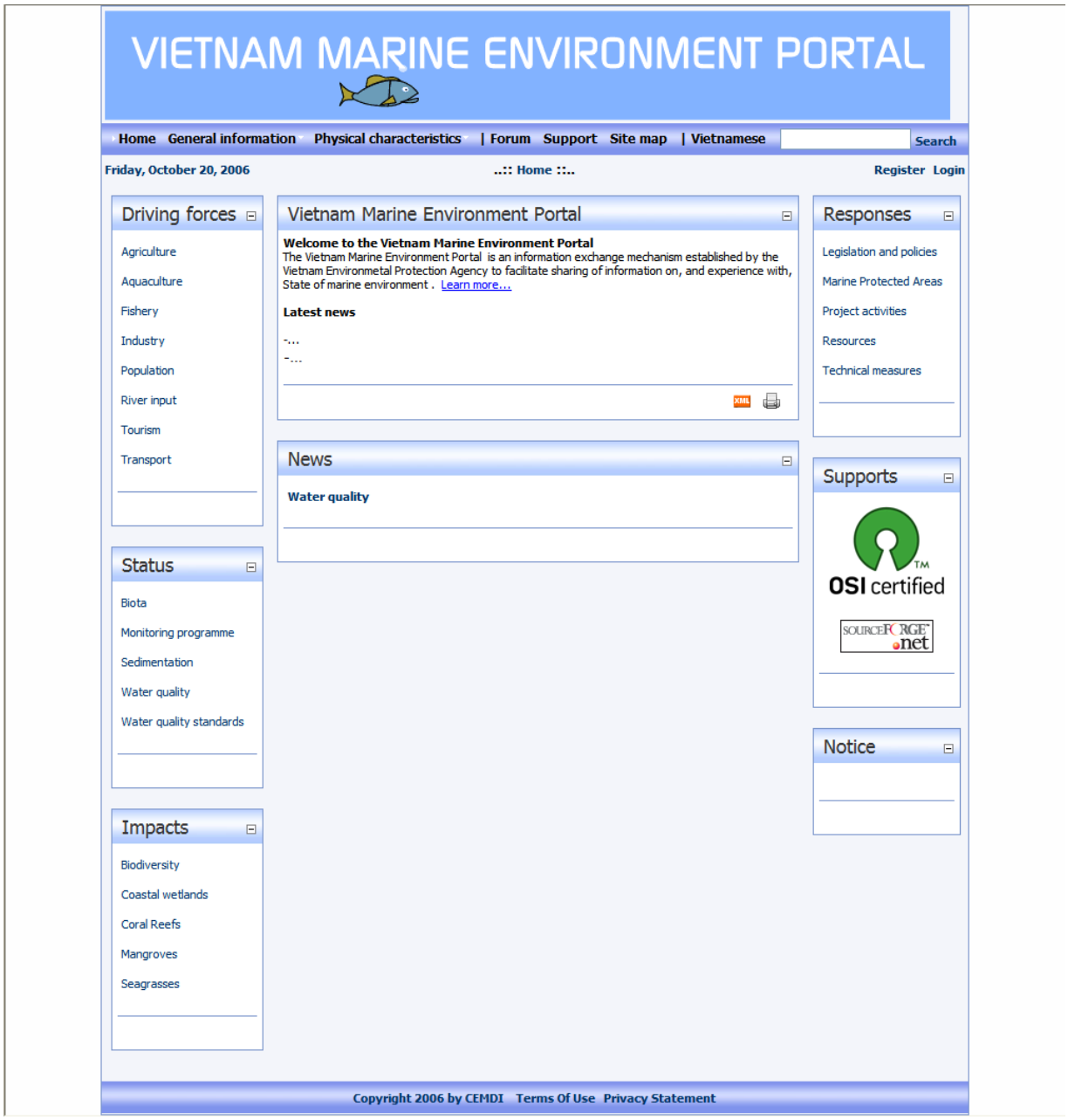
Theme 6. Response measures

	Indicators	**Description of data**	**Data format**	**Area coverage of data**	**Period of data coverage**
6.1	**Marine Protected Areas (MPAs)**				
6.1.1	General information MPAs	Map of MPAs, Table of name, type (national, regional global), IUCN category (park, reserve etc.) date of establishment etc.	GIS and Database/ table	National and provincial	Present
6.1.2	Area coverage of MPAs	Total area (km2) of MPAs	Database/ table	National and provincial	Present

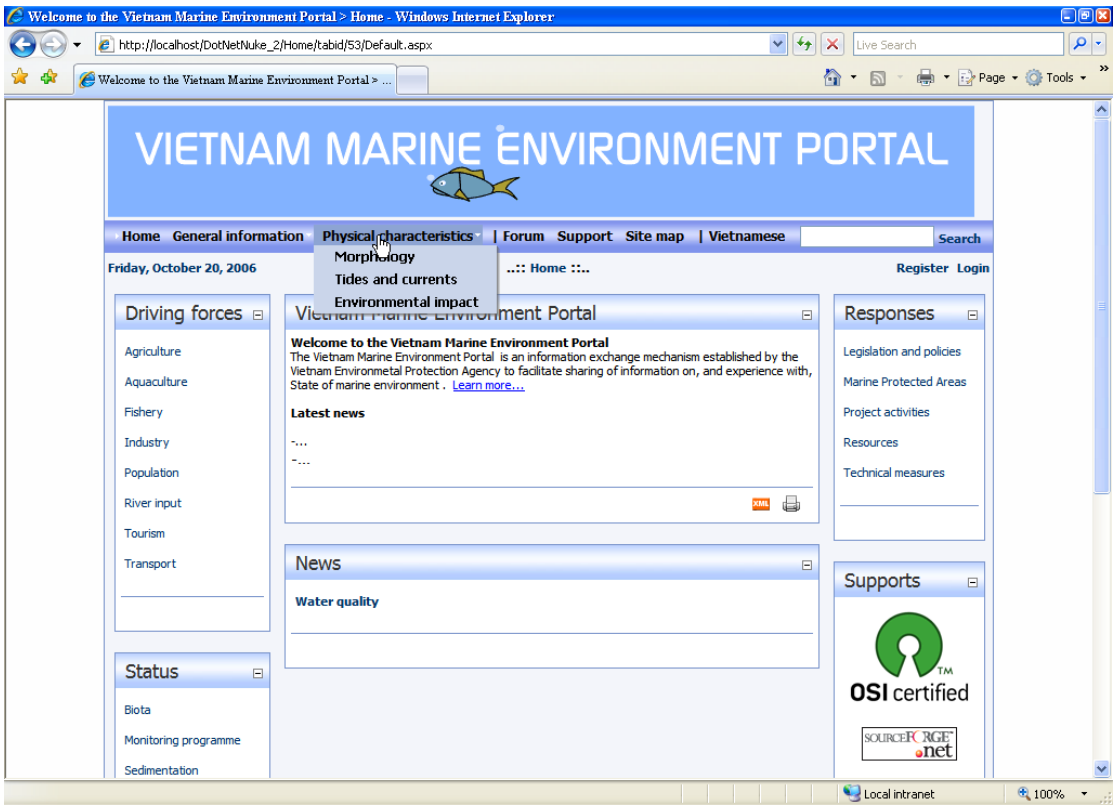
6.1.3	Details of existing management plans	Policies, strategies and plans for managing the MPAs	Text	National and provincial	Present
6.2	**Legislation and policies**				
6.2.1	Relevant national legislation and policies	Policy documents and references to legislation	Text	National	Present
6.2.2	Relevant local legislation and policies	Policy documents and references to legislation	Text	Provincial	Present
6.3	**Technical measures**				
6.3.1	Waste water treatment systems	Number, location, type and capacity of waste water treatment systems + Relevant annual reports of government department	GIS + Database/ table + Text	National and provincial	Present
6.3.2	Environmental Impact Assessments (EIAs)	Relevant reports on the application of EIAs	Text	National	Present
6.3.3	Oil spill preparedness plans	Relevant reports and documentation on oil spill preparedness plans and their implementation	Text	National	Present
6.3.4	Integrated coastal zone management	Relevant reports on the state of integrated coastal zone management	Text	National and provincial	Present
6.3.5	Ecotourism development	Relevant reports on the state of ecotourism development	Text	National	Present
6.3.6	Community awareness initiatives	Relevant reports on community awareness intiatives + Outreach materials	Text + Outreach Materials	National and provincial	Present
6.4	**Project activities**				
6.4.1	Major ongoing programmes/project activities for coastal marine environment protection	Name of project, main objectives/activities and time frame for project activities + Published project reports	Database/ table + Text	National and Provincial	Present
6.4.2	Major completed project activities for coastal marine environment protection	Name of project, main objectives/activities, major outcomes and time frame for project activities + Published project reports	Database/ table + Text	National and Provincial	0-5 years
6.5	**Resources**				
6.5.1	National experts	Title, name, date of birth, organization, fields of expertise, experience and publications	Database/table + Text	National	Present

ANNEX 2

Vietnam Marine Environment Portal



Picture 1. Homepage: http://www.nea.gov.vn/VMEportal/



Picture 2. Function Menus

Picture 3. Information page level 1

Picture 4. Information page level 2