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Scientific bases for defining the coastal zone of Quang Binh, Quang Tri, Thua Thien Hue provinces

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Abstract. Vietnam has more 3000km of coastline and the features of the coastal zone in various areas (Northeast area, Red River Delta, Central Region and Mekong River Delta) are also different. Therefore, it is necessary to study specific characteristics of each area and find out the suitable boundaries for the coastal zone.

The legal basis related to Vietnam's territorial sovereignty on the sea, the typical natural resources of the Quang Binh - Quang Tri - Thua Thien Hue coastal zone (Quaternary sand terraces, sand dunes, lagoons, sea grass, coral reef…), administrative organization, project ability, the capacity of data inheritance, and the experiences of successful ICZM projects in Vietnam and in the world, all are scientific bases for defining the coastal zone of Quang Binh, Quang Tri, Thua Thien Hue provinces in general and the study area of project KC 09.08/06-10 in particular. The landward portion of the study area includes 206 communes of Quang Binh, Quang Tri, Thua Thien Hue provinces that have their entire or most area located east of the 25m contour line. The seaward boundary of the project study area is found mainly along the 30m isobath. The boundary is extended to the 50m isobath (the limit of coral ecosystem distribution) around Con Co Island. The total study area of the project KC 09.08/06-10 is 9,837 km sq.

Keywords: Coastal zone, Integrated Coastal Zone Management, Quang Binh, Quang Tri, Thua Thien Hue.

1. Introduction

The coastal zone is a special and important part of the Earth's surface, the contact place between the spheres: lithosphere, biosphere, hydrosphere, and atmosphere of the Earth but also the place that contains ecosystems with the highest productivity, richness and biodiversity. Since a long time ago, the coastal zone, especially the estuarine region, has become places for crowded human exploitation and residence. The trend of seaward migration from land areas is ever increasing and occurs globally. According to the Green Cross Australia's latest statistics, in 1999, when the world population reached 6 billion, about 240 million people lived in cities located in the coastal zone. To date, as the world population is estimated at approx. 6.7 billion, up to 634 million people live and about two thirds of cities with more than 5 million population are built in the coastal zone, within 10m elevations above sea level. In Vietnam, by 2005 about 41.4 million people lived in the land strip with

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the elevation of 10m or less (ranked 5th place in the world's 10 countries) accounting for approx. 53% of the country's total population (ranked 8th in the 10 countries with the highest proportion)...

Also due to such importance, rich coastal natural resources have become priceless asset, object of special interest for studies, exploitation and use, and management in marine states. However, due to complexity of natural, social processes in the coastal zone, legal constraints as well as difficulties, limitations in the study process, determining the coastal zone boundaries for management is also very diverse. Depending on research objectives of programs or projects, management strategies, the extent of the coastal zone is also determined in different ways or scales.

One of the important research contents of the State Project under Marine Science and Technology Program coded KC09.08/06-10 "*Scientific arguments on the coastal zone management and sustainable development model of Quang Binh, Quang Tri, Thua Thien Hue provinces*" is to define the extent of the coastal zone within three provinces in general and depending on the specific conditions to determine the study space of the project. Following are some results of this research content.

2. The concept of coastal zone: conception and limits

The boundary between the sea and land does not appear as a clearly defined map line, it is a gradual transition strip of land and water. This strip of land and water is named coastal zone or coastal area [1]. This is a special and important part of the Earth's surface, where there is a gradual transition between the sea and land, the Earth's spheres meet: lithosphere, biosphere, hydrosphere, and atmosphere, and contains ecosystems with the highest productivity, richness and biodiversity.

Natural definition of the coastal zone

Generalized and widely used is the definition of the coastal zone in interaction between sea and land environments: "A coastal zone is a transition region where sea and land interact and shape an unified environment" (Barbara E. Brown, 1997) [2]. In theory, the definition shows a complete nature of the coastal zone, as a specific space where the natural environment bears specific characteristics of the combination between marine and terrestrial environments, simultaneously highly generalized. This is also a definition used by many books on the natuarl environment of coastal zones.

Based on the integrated and system view,, Lymarev V.I. defined "a coastal zone (or also called interaction zone between sea and land) is an adjacient land-sea band not very large with a particular nature making up a component of the Earth's landscape and a place where there is a complex and contrary interaction between lithosphere, atmosphere, hydrosphere and biosphere".

For geomorphological science, a coastal zone is regarded as an interaction place between land and sea to form its paticular landforms. Here, sea waves and all kinds of currents generated by them are dynamic elements very important to landform formation and modification as well as sedimentation. In addition, elements such as tide, river, current, wind, organism...also play an important role. The lower limit of the coastal zone is the depth at which waves start to be deformed, as well as topography and bottom sediments start to be altered. That depth is determined to be half the

wave length. And the landward limit of the coastal zone is determined to be the line of peak climbing wave. This applies to open sea areas, also the coastal zone has a land strip frequently impacted by other marine factors such as tide, salinity, current...These are semi-closed or closed waters but connected with bays, lagoons and estuaries [3]. These formations are considered the components of a complete coastal zone.

Definitions in the study of coastal zone natural resource exploitation, use and management policy making

Coastal zone management involves continuosly managing coastal zone resource use, hence the boundary of the coastal zone is usually defined with caution for management and executive activity (Jones và Westmacott, 1993). As far as management policy making is concerned, the coastal zone space is usually defined in 4 ways as follows: *1) fixed distance definitions, 2) variable distance definitions; 3) definitions according to use; or 4) hybrid definitions* (Kay R. and Alder J., 2005) [1].

Following fixed distance definitions along the coastline, a zone in which natural elements of the coastal zone are concerned, is calculated from some boundary between sea and land – usually by the mean tidal level. The seaward limit is usually taken as the limit of the national sovereignty extent.

As for fixed distance definitions, the coastal zone space defined by variable distance is also defined by some boundary between sea and land. The only difference is that the boundary distance is not fixed along the coast, but varies according to variables: physical features (e.g. the landward limit of Holocene sand dunes, or the seaward limit of submarine platforms); biological features (e.g. the landward limit of a coastal vegetation complex, or the seaward limit of a fringing reef); constructed landmarks (e.g. roads, canals, or well known buildings); or administrative boudaries (e.g. the landward limit of marine localities) [1].

International organizations and large coastal nations often define the limits of the coastal zone according to specific management issues, for example for marine pollution management purposes, defining the limits of the coastal zone must take into account the whole catchment and its associated groundwater.

In summary, there is no exact definition of the coastal zone and its extent. All definitions try to take into account both coastal, estuarine areas and the entire land portion extended along the coast on which natural and human processes act and are affected. The limits of a coastal zone can be very large, defined not only by ecological features, but also depend on policy terms and authority management ability. The extent of the coastal zone can be only a narrow border band between land and sea that is from some meters to some kilometers large, but sometimes the boundaries are widened landward to the divide of river basins flowing into the sea and seaward to the whole national special economic zone.

Natural products of the coastal zone become real resources with human actions. These actions have direct impact on coastal zones through the relationship between the coastal zone system and its surrounding systems. Coastal zone management arises from human impacts on coastal zone systems with the purpose of protecting and developing coastal zone resource systems *(Figure 1)*.

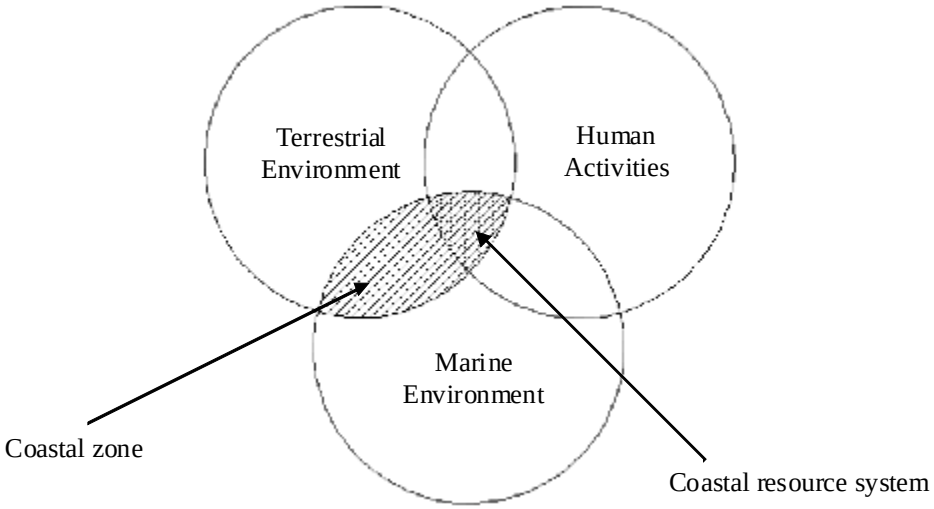

Figure 1. Relationship between coastal zone and coastal zone resource system (Chua, 2001) [4].

This was the Declaration on May 12, 1977 of the SRV's Goverment on the territorial seas, adjacient areas, special economic zone, continental shelf and islands located within these sea areas. According to this declaration, Vietnam's marine territory has a width of 12 miles calculated from the baseline; adjacent areas are also 12 miles wide from the territorial sea; the territorial sea and adjacent areas have a width of 24 miles calculated from the baseline; the special economic zone is 200 miles wide calculated from the baseline; the continental shelf is the sea bed portion and the ground under seabed extended to the outer margin of the continental shelf, where the continental shelf margin is nearer, the continental shelf is widened to 200 miles calculated from the baseline. At present, Vietnam is using this scheme to orient all activities of scientific research, socio-economic development and maintaining sovereign security on its sea and island areas.

Next, there was the declaration dated Nov. 12, 1982 on the baseline used to calculate the width of Vietnam's territorial sea and other sea areas. According to this declaration, the baseline of Vietnam is a straight baseline consisting of 11 điểm points and 10 segments starting from Tho Chu Island to the last point of Con Co Island. Next, the Law of the National Border was passed by the National Assembly on June 17, 2003.

And Vietnam'coastal zone in the Gulf of Tonkin was defined in the *Vietnam-China Agreement on the territorial sea, special economic zone and continental shelf delimitation in the Gulf of Tonkin* signed on 25/12/2000 and ratified by the 11th Session National Assembly of the Socialist Republic of Vietnam on 15/6/2004. According to this Treaty, the delimiting line consists of 21 points with defined geographic coordinates sequentially connected in segments with different lengths (Table 1, Figure 2). The delimiting line goes 15 miles east of Bach Long Vi Island calculated from the most protruding point of the island and Point 21 located in the middle of the segment connecting from Oanh Ca cape of Hainan Island to Con Co Island *(Figure 2)*. In accordance with this delimitation line, Vietnam manages 53.23% and China 46.77% of the Gulf area.

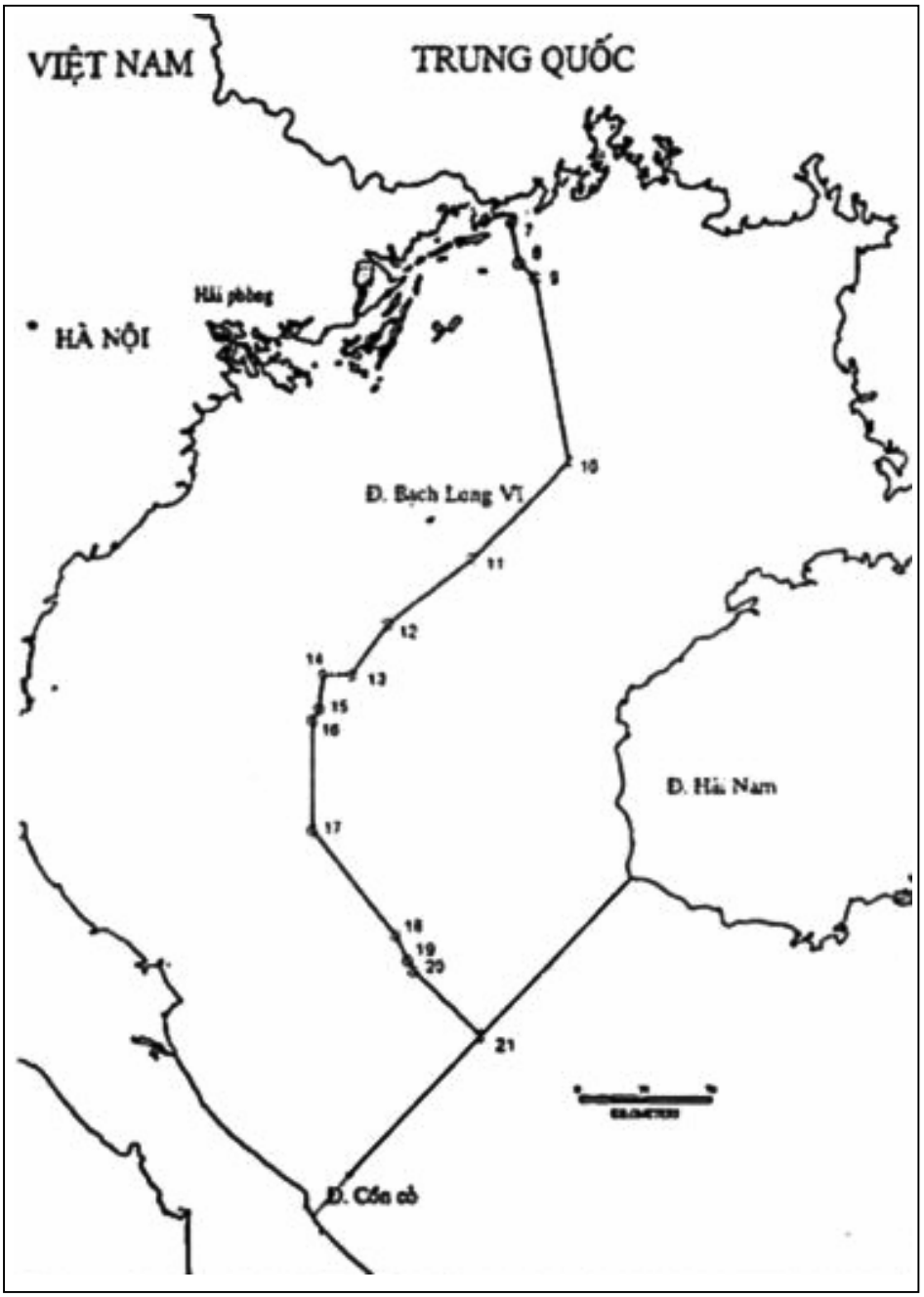

Figure 2. Line delimiting the Gulf of Tonkin between Vietnam and China.

The limits of the coastal zone proposed by sectors, programs of management, use and exploitation research

The definition of Vietnam's coastal zone seaward boundary according to the 1982 UN Convention on the Law of the Sea and international rules by the Government aims to affirm sovereignty and formulate national strategies, policies for management, exploitation and use of natural resources. In this case, the coastal zone is understood as part of the national territory spatially planned for implementing management policies. During the deployment of national, ministerial and sectorial programs and projects, the the coastal zone space is defined again specifically to comply with research objectives and contents as well as financial and technological capacities.

The criteria for defining the coastal zone in our country include natural resources, social management and legal administration. However, so far there has been no agreement between ministries, sectors on the boundaries of Vietnam's coastal zone. Practically, this agreement is very difficult to reach, since as mentioned in heading 2, the definition of the coastal zone limits is very flexible and there are many different ways to do it.

Vietnam has a territory stretching latitudinally with more than 3000km of coastline. There are two large deltas formed by the Red and Mekong rivers in the north and the south together with the continental shelf extending seaward. In central Vietnam, mountainous and hilly landforms are found close to the sea with narrow plain strips and the continental shelf right near the coast. With such features, the definition of a common boundary for the national coastal zone requires a combination of many different criteria. Proposals relating to the coastal zone boundary have already been made by some ministries, sectors, for example the landward boundary, according to the National Environmental Protection Agency, is taken as the boundary of district with marine features, and seaward, according to the Ministry of Fisheries, in northeast, south Vietnam and the Gulf of Thailand as the 30m isobath, in central Vietnam as the 50m isobath [5]. Recently, in accordance with Decision No. 158/2007/QĐ-TTg dated October 9, 2007 by Prime Minister approving "*Program on integrated management of north central coastal zone and central coast until 2010 and orientations until 2020*" (including 14 coastal provinces from Thanh Hoa to Binh Thuan), the seaward boundary is calculated 6 miles of the coast, and landward the boundary of all coastal districts of the provinces in the region.

Taking the landward boundary based on marine districts is logical, since they are independent administrative units, easy to implement institutions, management policies. However, during the process of boundary definition, besides management elements physical features of the coastal zone, specifically coastal zone natural resources should be considered. In the north and the south, if the boundary is taken as the natural one, for example, the boundary of Quaternary landforms of marine and fluvio-marine origin, the coastal zone boundary will be very deep landward, thus, taking the boundary by marine districts is reasonable since it harmonizes both criteria of management and coastal zone typical natural resources. But this way applied to Central Region or northeast region (in Quang Ninh province) will face difficulties in the assessment of coastal zone resources. The boundary of some districts such as Hai Ninh, Quang Ha, Tien Yen (Quang Ninh) or Bo Trach, Quang Ninh, Le Thuy (Quang Binh), Vinh Linh, Gio Linh (Quang Tri) also covers a large area of hills and mountains.

Table 1. Geographic coordinates of delimitation points in the Gulf of Tonkin

1	Point No. 1: 21°28'12".5 N, 108°06'04",03 E	12	Point No. 12: 19°39'33" N, 107°31'40",00 E
2	Point No. 2: 21°28'01".7 N, 108°06'01",06 E	13	Point No. 13: 19°25'26" N, 107°21'00" E
3	Point No. 3: 21°27'50".1 N, 108°05'57",07 E	14	Point No. 14: 19°25'26" N, 107°12'43",00 E
4	Point No. 4: 21°27'39".5 N, 108°05'51",05 E	15	Point No. 15: 19°16'04" N, 107°11'23",00 E
5	Point No. 5: 21°21'28".2 N, 108°05'39",09 E	16	Point No. 16: 19°12'55" N, 107°09'34",00 E
6	Point No. 6: 21°27'23".1 N, 108°05'38",08 E	17	Point No. 17: 18°42'52" N, 107°09'34",00 E
7	Point No. 7: 21°27'08".2 N, 108°05'43",07 E	18	Point No. 18: 18°13'49",00 N, 107°34'00" E
8	Point No. 8: 21°16'32",00 N, 108°08'05",00 E	19	Point No. 19: 18°07'08",00 N, 107°37'34",00 E
9	Point No. 9: 21°12'35",00 N, 108°12'31",00 E	20	Point No. 20: 18°04'13",00 N, 107°39'09",00 E
10	Point No. 10: 20°24'05",00 N, 108°22'45",00 E	21	Point No. 21: 17°47'00" N, 107°58'00" E
11	Point No. 11: 19°57'33",00 N, 107°55'47",00 E		

The definition of seaward boundaries is also very cautious, taking into account sovereignty, legality, physical features, natural resources and ability to deploy management programs, projects. First of all one must affirm that for sovereignty and long term management strategies, Vietnam's coastal zone boundaries are taken seaward to cover the entire special economic zone. And step by step in management strategies or depending on programs, research projects deployed one can adjust the boundary to comply with the objectives and technological capacity of marine research. The seaward boundary proposed by the Ministry of Fisheries basically lies in inner waters, covering the coastal island system, not too large area, suitable for current scientific and technological capacity and initial stage in deploying coastal zone research and management programs in Vietnam.

In comparison to many other marine countries in the world, in Vietnam, marine science in general and marine geographic research in particular is developed much later. To date, coastal zone management in Vietnam essentially involves only the protection of sovereignty and territorial integrity on both land and sea areas. And coastal zone management in its strict sense has not yet been so much implemented, it has just started since the end of the 20th century [6]. There have been some projects carried out in Vietnam, and depending on each project or program of coastal zone management, the study area boundary is again selected flexibly to suit the research objectives, tasks and contents. For example, in the National Case Study Project on Integrated Management of Da Nang City's Coastal Zone, the study area boundary was defined based on three main elements: administrative boundary for easy deployment; importance and level of impact of economic activities and livelihood of the people in land-sea interaction; and management capacity during the project deployment. Therefore, the landward boundary is taken following the administrative boundaries of urban and rural districts, consisting of 5 urban districts: Hai Chau, Thanh Khe, Lien Chieu, Son Tra, Ngu Hanh Son and Hoa Vang district. Although not adjacent to the sea, Hoa Vang is still counted since it belongs to the catchments of rivers flowing into Da Nang bay [7]; In

Vietnam-Netherlands project on integrated coastal zone management deployed as a case study in Nam Dinh, the extent of project implementation is again limited within a marine commune of Loc An (Long Dat district). Also in this project deployed in Nam Dinh, the study extent is defined by the coastal area with 17 communes and townlets of three districts of Giao Thuy, Hai Hau and Nghia Hung [7].

4. Bases for defining the coastal zone space of Quang Binh, Quang Tri, Thua Thien Hue

Criteria for defining the study space

The extent of the coastal zone can be very large theoretically. However, in Vietnam as well as in many other marine states in the world, the definition of the coastal zone space also depends on management capacity of authorities and ability to deploy programs, projects or coastal zone management actions *(Table 2)*.

In the framework of the project coded KC 09.08/06-10, the coastal zone space is also defined to suit specific natural conditions and natural resources of the coastal zone, as well as project feasibility. On this basis, the project set forth some criteria for defining the study space as follows:

- to inherit the experience of coastal zone management projects succesfully completed in the world and in Vietnam;

- to meet the objective of fitting administrative boundaries and authority to impose sanctions, local policies and encompassing main natural resources of the coastal zone of Quang Binh – Quang Tri – Thua Thien Hue: beaches, tidal flats, estuaries, lagoons, sandy terraces, marine sand dunes, mangroves, sea and coastal islands and coral reefs,...;

- to suit the project capacity relating to statistics, assessment of resources and ability to inherit already available research, survey documents;

- to concern about the importance and impact level of economic activities and people livelihood in land-sea interaction (concerned about the districts that are not adjacent to the sea , but have clear influences on bordering /lower river area), e.g. districts related to East-West Economic Development Axis along National Road No.9.

Definition of the study area boudaries of project KC 09.08/06.10

- *Landward boundary*

Unlike in the Red and Mekong River Deltas with the plain relief extending landward, in the Central Region, mountainous and hilly landforms are distributed close to the sea and make rapid transition down to a narrow strip of coastal plain. Thus, if the landward boundary for programs, projects of coastal zone management in the Red and Mekong River Deltas is rather easily agreed as administative boundaries of coastal districts, provinces, the definition for the Central Region requires a careful between selection of administrative boundary and relief and distribution of coastal zone resources.

Table 2. Coastal zone boundary of some states and management programs

State	Landward boundary	Seaward boundary	Remark
New Jersey USA	30 m - 30 km depending on boundaries of urban areas	National tidal area, bay and sea	National coastal program
Malaysia	District boundaries	20km from the coast	ASEAN/US CRMP
Philippines	Inner waters or 1km calculated from the coast	Beyond fishing grounds, where there is interaction or impact of coastal zone	ADB (Asian Development Bank)
Singapore	All islands	Territorial sea and coastal islands	ASEAN/US CRMP
Sri Lanka	300 m from mean tidal level	2 km from lowest tidal level to the sea	URI CRMP. Coastal conservation 1981
Australia (New South Wales)	1km calculated from mean low water level	3 miles calculated from baseline	-
China	10km calculated from mean tidal level	15m isobath	-
Spain	500m calculated from the deepest impact of storms or from highest tidal level	12 miles	-
Vietnam	District administrative boundaries	50m isobath	National case study project on integrated management of Da Nang city's coastal zone

In regard to coastal zone natural resources of the study area, the project considers them types of natural resources closely related to landforms generated by land-sea interaction throughout Quaternary to present, existing and having direct impact on current socio-economic development activities. With such criteria of coastal zone resources, the landward natural boundary of Binh Tri Thien's coastal zone is defined by the project following the contour line of 25m, inner limit of Pleistocene fluvio-marine and marine terraces, in other words, to the limit of the farthest marine action on the coast during the Quaternary (not taking into account the impact along rivers).

However, the definition of the coastal zone natural boundary usually satisfies only scientific reasoning, but faces difficulties in project deployment at management levels. This is extremely important, critical to success, failure of coastal zone management programs/actions.

Taking the landward boundary following coastal districts proposed by the National Environmental Agency, or according to Decision 158/2007/QĐ-TTg of Prime Minister signed for the Program on Integrated Management of North Central Coastal Zone and Coastal Central Region is not suitable for the project study area, since there are many districts extending close to the western border (i.e. it will cover a large area of mountains, hills), such as districts of Bo Trach, Quang Ninh, Le Thuy (Quang Binh). To overcome this problem, the project has adopted the option of integrating the natural boundary (following 25m contour line) with the administrative boundary of communes. Those communes that lie completely east of the natural boudary, evidently belong to the study extent. For communes crossed by the natural boundary, those communes that have most area lying east of 25m contour line, the western boundary of those communes will be the landward boundary of the study area.

- *Seaward study boundary*

As established criteria, the seaward coastal zone within the study extent of Project *KC.09.08/06-10* is defined to ensure integrity of sovereign security, facilitate localities to perfectly deploy management activities and impose sanction, policies as on land. The coastal zone extent also has to encompass some important marine ecosystems of the study area, especially coral ecosystem. Besides this, the activity of marine survey, research is very difficult, requiring lots of expenses, time and manpower, hence the definition of seaward boundary should be done in such a way as to best inherit already available documents.

The project established the seaward boundary of the coastal zone based on: legally, the straight baseline published by the Government in 1982 calculated from south Con Co Island and as proposed by Project KHCN 06-05,1999 approved by the State Scientific Council in north Con Co Island; in regard to resource distribution and ability to inherit published documents of projects, programs and materials of supplementary survey and investigation by the project.

In this way, the boundary is defined basically following the 30m isobath (lies completely in inner waters). For the Con Co island area alone, the boundary is extended to the 50m isobath (depth limit of coral ecosystem distribution) encompassing the whole island (*Figure 3)*.

Thus, the project study area shown in *Figure 3*, and calculated from land to sea consists of the following natural landscape zones: *1)* coastal mound, hill and low mountain; *2)* central low plain; *3)* sand dunes and beaches; *4)* lagoon and estuaries; *5)* coastal sea; and *6)* coastal island (Con Co).

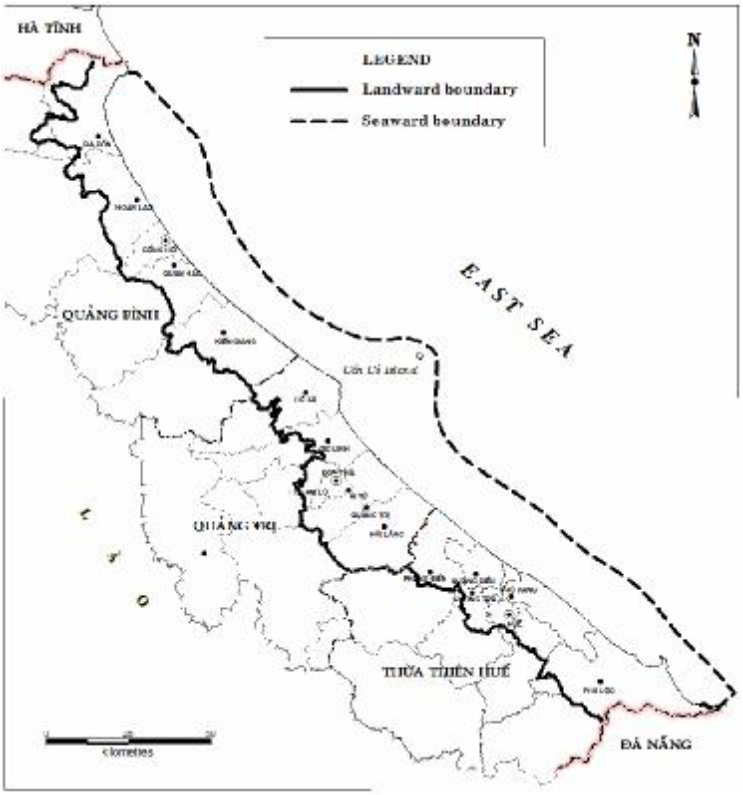

Figure 3. Scheme showing the study space of project KC.09.08/06.10.

5. Conclusion

Due to territorial physical features, the criteria selected for defining the coastal zone boundary are different among the Red River delta, Mekong river delta and central region of Vietnam.

Legal basis, territorial integrity, coastal zone natural resources, favorable conditions in administrative management, ability to inherit materials and experiences from sucessfully completed projects on coastal zone management in the world and in Vietnam are scientific bases for defining the coastal zone extent of Quang Binh, Quang Tri, Thua Thien Hue in general and the study area boundary of project KC.09.08/06-10 in particular.

The landward study extent of project KC.09.08/06-10 includes communes of 3 provinces of *Quang Binh, Quang Tri, Thua Thien Hue that have entire or most area located east of the 25m contour line*, comprissing 206 plain communes with a total area of 5,106km^2. The study area seaward boundary is defined: in north Con Co island basically following the *30m isobath, in south Con Co island following the national straight baseline published in 1982*, with an area of 4.731km^2 including Con Co island district. Thus, the total area of the study area is *9.891km^2*.

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