

# METHODS TO ASSESS THE FINANCIAL VALUE OF THE SEA PARCEL AND THE ECONOMIC OF THE COASTAL AND MARINE AREA WITHIN A MARINE CADASTRE FRAMEWORK

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**Abstract.** Within a “land” cadastre, methodologies of property valuation were not new drawn back to year 2,000 B.C. when the Egyptians inhabited lands surrounds the Nile. The economic valuation of coastal and marine areas was not new since Turner et al. (1998) introduced it; nonetheless it is a newborn within a marine cadastre.

This paper elaborates a broad sense of a marine cadastre definition, coastal and marine parcels, and a method to assess the financial value of the parcels as well as the economic value of the areas and resources. In the marine environments, the value of the parcel is usually tricky, because it is not the land that could “easily” be assessed. An appropriate way is to use the **Financial Valuation Method** (FVM) to assess the projects, activities, and or resource products or uses in the sea parcel. Dixon and Hufschmidt’s formula (1986) is still widely used today to calculate NPV (Net Present Value), B/C ratio, and IRR (Internal Rate of Return). Meanwhile, the economic value of the coastal and marine area is measured by two tools, i.e. **Total Asset Value** (TAV) of the area, and **Total Economic Value** (TEV) of the zone; both consist of (DUV + IUV + OV + EV + BV) with different indicators.

For specific reference, this paper takes a case study in the coastal and sea areas of Bintan Island, Indonesia. This region has been exploited over years. The mining of sea sands and the devastation of mangroves and coral reefs have brought about vast detriments. The terrestrial and sea sands exported to Singapore islands for “filling” the sea water (some say “reclamation” as a misleading term) of its shores, so the islands become wider. The coastal and shallow sea areas have also been degraded caused by the misuses of the mangroves and coral reefs. Learning from these cases, this paper also suggests the role of a marine cadastre in the management of coastal and sea resources and areas.

**Key words:** marine cadastre, sea parcel financial valuation, coastal and marine area economics valuation, integrated coastal and ocean zone management (ICOZM), administering and planning marine spaces

## 1 INTRODUCTION

Inherent conflict of interests in the coastal and marine space use have occurred since as old as the human civilizations. According to Cicin-Sain and Knecht (1998), there are 29 activities in the coastal seas, and if each activity is put orderly into an activity matrix, then there will be 100 pairs of activities conflict each other and 60 pairs of activities endangering one to another. The fact that the administration of coastal and sea regions is a must. There have been many researches concerning the *Integrated Coastal and Ocean Zone Management* (ICOZM); however not too many researches have been conducted in the framework of a “marine cadastre” concept.

Problems occur in the coastal and marine areas could be brought about by many reasons. Nevertheless, according to the researchers (Clark, 1992; Patji and Salipi, 1995; Cicin-Sain and Knecht, 1998; Kay and Alder, 1999; Kusumastanto, 2001), the roots of the problems are generally as follows: (a) the conflict of interests caused by: high ecological potency, concentration of citizens' means of livelihood to the same resources, increasing the number of population, the quality of live, interests upon the area, changing and competition on the technology, and market distribution process; (b) the increasing of demands towards natural resources and coastal environmental services; (c) the unsustainable management practices; (d) constraints on the optimally of the execution of the coastal and marine spatial planning; (e) human behaviors: innocence, ignorance, poverty, and greedy; and (f) the three failures: market and ownership failures, policy failures, and information failures.

The extraction of all the conceptual and empirical problems on the use of coastal and space mentioned above, indicating that the conflict of interests directly associated with "**the value**" of the three main components of natural facts and phenomena, those are ABC (a-biotic, biotic, and culture). The a-biotic components are all the structural and functional of physical areas (natural resources). The biotic constituents are all biological (flora and fauna) structures and functions, whilst the culture parts are all human activities (economics, social and customs) and their outcomes (manmade resources).

## 2 VALUE AND VALUATION ON COASTAL AND MARINE ENVIRONMENTS

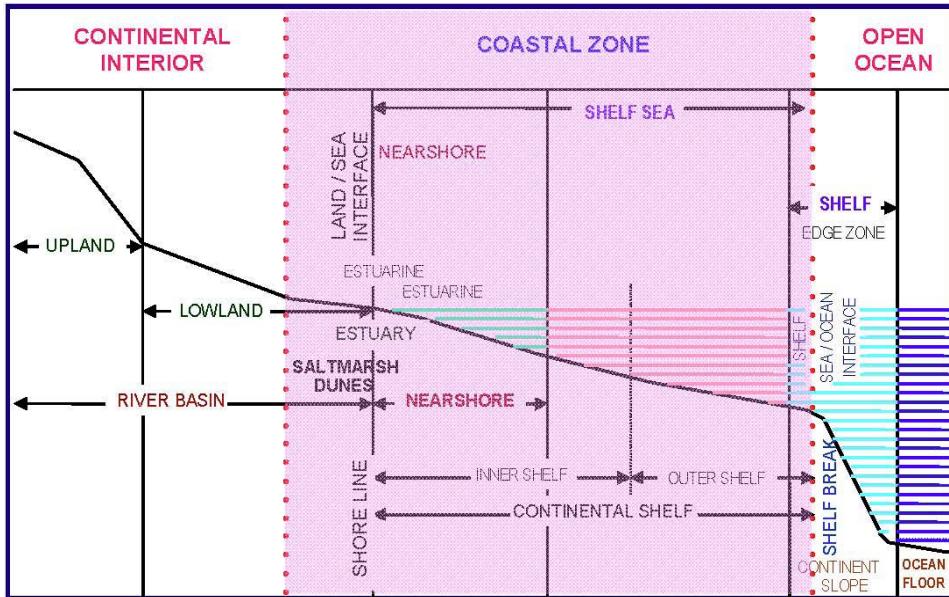
Within a "land" cadastre, methodologies of property valuation were not new drawn back to year 2,000 B.C. when the Egyptians inhabited lands surrounds the Nile. The reconstruction of property boundaries after the vast flood was immediately conducted for the reason of **the value** of the properties. From this period, historians say that the cadastre began.

Now, does "sea parcel" also have value? Obviously it does. The value of sea parcel and the value of coastal and marine areas have brought about the conflict of interests, and as it is said, it has taken place since as old as the human coastal and marine civilizations. But, how could one estimate it? It will be discussed in the next section. On the other hand, the economic valuation of coastal and marine areas was not also new since Turner *et al.* (1998) introduced it. Nonetheless, it is a newborn within a marine cadastre.

### 2.1 A Broad Sense of a Marine Cadastre (Operational) Definition

Enough, it is as much as necessary having definitions of the marine cadastre! Does it really enough? Among them not many do the definitions **share a common element** with **their land-based counterparts** and concern with **the value**, except the definition given by the U.S. DOC: United States Department of Communication–NOAA: National Oceanic and Atmospheric Administration (2002):

*"The U.S. Marine Cadastre is an information system, encompassing both nature and spatial extent of **interests in property, value and use** of marine areas. Marine or maritime boundaries **share a common element** with **their land-based counterparts** in that, in order to map a boundary, one must adequately interpret the relevant law and its spatial context. Marine boundaries are delimited, not demarcated, and generally there is no physical evidence of the boundary".*



**Figure 1:** The Coastal Areas (soft pink) according to Pernetta and Milliman, 1995.

The author agrees with this definition, simply because the marine cadastre domain shall share common elements in accordance with the notion of the "coastal area". A marine cadastre is a cadastre with the object on the territorial sea. It is not possible applying a marine cadastre in the Exclusive Economic Zone (EEZ), because there is no *tenure system* in this zone and EEZ is not the territorial sea of a state (Rais, 2002; UNCLOS, 1982).

The territorial sea means the coastal zone up to 12 nautical miles away from the shore line. Well, then what really means, that the domain of a marine cadastre shall include the two of one inseparable area, the shore (shallow) water space and the sea (deeper) water space. The classification of the two inseparable areas is needed, because it will affect the different type of tenureships system with different types of 3R (right, restriction, and responsibility):

- The "shallow" shore water space is a fragile area, firstly, it is perceived in physical and environmental aspects and secondly it is legal and socio-economical aspects as well; it is tightly connected to the shore land tenureships system; and on the other hand
- The "deeper" sea water space is the territorial water space outside the shore water space which is usually not bonded to land-based tenureships system.

Again, one more question, does it really enough? No, it does not. Among the marine cadastre definitions not many do the notions consider **the value** of marine areas, except the U.S. DOC-NOAA's. The value is one of extremely important parts of the marine cadastre:

- Today, the world's population in coastal zone is equal to the entire global population in the 1950s (Beukenkamp and Gunter *et al.* in World Coast Conference, 1993); – In 30 years more people will live in the world's coastal zones than are alive today (NASA 1994); – Up to 75% of the world population could be living

- within 60 km of shoreline by 2020 (Edgren in World Coast Conference, 1993); – Two third of the earth surface is water, and one third is land, whilst the interface between the land and the sea is a narrow path called the coastal area;
- Indeed, the coastal area is only 15% of the land surface, but 50–70% men living and working in this area; – Although the coastal area is only 8% of the total earth surface, it produces 26% global biological outcomes, especially fisheries' products (Rais, 2002).

Considering all those arguments, here it comes to the “operational” definition of a marine cadastre:

*“A marine cadastre is a public administration system arrangement, managing legal and administrative documents, encompassing both natural and spatial extent of interests in forms of rights, restrictions, and responsibilities, including the values, taxes, and the legal relationships and actions, within the shore water and the sea water space tenureships”.*

## 2.2 Sea Parcel Valuation

What is a sea parcel? A sea parcel is a (usually three dimensional) space at the sea, which is identified by: (a) delineation of its clear boundaries (coordinates); (a) explanation of its quantity (the area); (c) declaration of its right; and (d) statement of its use. A sea parcel could be an object that has a **sale value**, it could have a **service value** (public access, marine tourism, shipping lane, national park, marine protected area, conservation area); and it could also have an **economic value** (after Rais, 2002).

When it comes up to the land or property valuation, then some approaches are commonly used, those are:

- (a) Sales comparison (market) approach: the estimated amount for which an asset should exchange on the date of valuation between a willing buyer and a willing seller in an arm's length transaction after proper marketing wherein the parties had acted knowledgeably, prudently and without compulsion;
- (b) Income capitalization approach: the current value of future yearly net income remaining value at the end of the calculation period; This method uses income approach by projecting all future incomes deducted by operational costs with the return of investment calculation; This approach is especially suitable for the valuation of hotels, offices, apartments, malls or shopping centers, and entertainment sites;
- (c) Cost approach: estimation of the costs spent for procurement and development the valued property, usually for valuation of buildings;
- (d) Development technique: similar to cost approach.

But, when it comes to the valuation of a sea parcel, it is not the case that those methods could straightforwardly be applied. In the marine environments, the value of the parcel is usually tricky, because it is not the land that could “easily” be assessed. Except for the “sea parcel” located at the shore water space, when the tenure system tightly associated with land-based tenureships or ownerships, and as long as it is available the market data, then the sales comparison approach might be used.

Among other methods, the sales comparison approach are widely used for some reasons, such as: (a) most efficient for property and resource valuation; (b) acceptable for all parties; (c) used by most states in the world; (d) transparent and fair enough; (e) many actors involved in determining the market value; and (f) simple, easily understood, and not too expensive.

Unfortunately, it is not the case that the market data are available, especially for the sea parcel that has no association with land-based tenureships. The valuation approach suggests is **the combination** of income capitalization approach, cost approach, and development technique that could be summarized as the Financial Valuation Method (FVM). It is proposed with the arguments that a sea parcel (even though it is contained natural resources there in), the parcel remains “a dead capital” without human intervention or development.

The usage of the Capital Budgeting Method (CBM), as a tool in the financial valuation method (Dixon and Hufschmidt, 1986), which is still widely used today, is to calculate NPV (Net Present Value), B/C ratio, and IRR (Internal Rate of Return). The value of a sea parcel will be the NPV, obtained from the calculation as follows:

- C (investments): costs spent for all human activities and the structures built on the sea parcel;
- B (incomes): all revenues expected to be gained during the developments, activities, and uses of the sea parcel;
- Net Benefit = (Incomes – Investments)
- Today Value: the existing resources value of the sea parcel
- Cash Flow = (Net Benefit + Today Value)
- DR (Discount Rate) = %
- DF (Discount Factor) =  $\frac{1}{(1+DR)^{\text{year } th}}$
- PV (Present Value) = Cash Flow \* DR
- **NPV (Net Present Value):**

$$NPV_1 = \frac{(B_d - C_d) + (B_e - C_e) - M}{(1-r)^t}$$

$$NPV_2 = \frac{(B_0 - C_0)}{1} + \frac{(B_1 - C_1)}{(1+r)} + \frac{(B_2 - C_2)}{(1+r)^2} + \dots \frac{(B_n - C_n)}{(1+r)^n}$$

$$\text{– Net B/C (Benefit & Cost Ratio)} = B / C - \text{ratio} = t = \frac{\frac{B_t}{C_t}}{\frac{(1+r)^t}{(1+r)}}$$

$$\text{– IRR (Internal Rate of Return)} = IRR = i^+ + (i^+ - i^-) \frac{NPV^+}{NPV^+ - NPV}$$

## 2.3 Coastal and Marine Area Valuation

The sea parcel valuation discussed above is the parcel-based valuation approach, but when it moves towards the coastal and marine area valuation, then it is no longer parcel-based but area-based method. The valuation approach, therefore slightly different, meaning that the formula used is the same, but the components of the valuation consist

of wider items, not only takes into account the financial (market) values, but also non-market values. It does not only count the use values, but also non-use values as well.

Within the environmental studies, the method is called: Total Economic Value (TEV) applying the formula as follows: (Turner *et al.* 1998; Kusumastanto, 2002)

By using the same formula above, the NPV, as the value of coastal and marine area, could be calculated, as well as all other components, i.e. Net B/C-R and IRR.

$$(TEV) = (DUV + IUV + OV) + (EV + BV)$$

- DUV = Direct Use Value: output (goods and services) that could directly be used  
IUV = Indirect Use Value: goods and services that could not be directly used  
OV = Option Value: direct and indirect resources potencies that could be used in the future with the assumption that the resources will not permanently devastated;  
BV = Bequest Value: the value associated with protection and conservation (preservation) certain resources that could be inherited to the next generations, so that they are able to take the advantages from the resources that have been taken by the previous generations;  
EV = Existent Value: existing value of the resources, irrespective of whether the benefits of the resources could be taken directly or indirectly.

The TEV does usually not take the land value into consideration but socio-environmental and resource-economical ones. In case that the assessment acquire the land value as a part of the component, i.e. as a part of DUV, especially when assessing the coastal (shallow sea water) areas, then the method as well as the value is named: **Total Asset Value** (TAV).

### 3 A CASE STUDY

The main goals of the case study are two folds: *firstly*, to exercise the calculation of NPV as the value of the coastal and marine area, and *secondly*, to demonstrate how the simulation could give a picture that a marine cadastre is able to contribute to the sound management of coastal and marine spaces and resources.

Over thirty years since 1970's, the coastal and marine areas in Bintan Islands have been exploited for the development reasons and/or the impact of the developments. There had been under way the sea sand mining and the mangrove and coral reef devastations. Sea sands were exported to Singapore islands for "filling" the sea water (some say "reclamation" as a misleading term) of its shores, so the islands become wider. The Singapore's sea-sand imported needs are amazingly huge: i.e. (a) 1.1 trillion cubic meter for *Jurong Island*, (b) 900 million cubic meters for *Western Island*, (c) 400 million cubic meters for *North Island*, (d) 300 million cubic meters for *Changi Bay*, (e) 200 million cubic meters for *Pulau Tekong*; These number will be added by the needs for *Pasir Panjang Phase II* as many as 150 million cubic meters, *Tuas* needs 40 million cubic meters, *Pulau Sentosa* needs million cubic meters, and *Pungol* needs 10 million cubic meters (KOMPAS, 29 November 2002).

Twenty years ago, the total areas of Singapore lands = 527 kilometer squares, but in 1991 became 633 kilometer squares, in 1998 became 674 kilometer squares, in 2001 became

**Table1:** Analysis of existing TEV of coastal & marine policy; Bintan Island, Riau Islands Regency, Indonesia.

		C.3	BV (Bequest Value)	
		1	Mangrove preservation	19.25
		2	Coral reef preservation	25.10
TOTAL ECONOMIC COSTS	548.07		<b>TOTAL ECONOMIC BENEFITS</b>	477.88
NET BENEFITS	<b>-70.18</b>			
CASH FLOW	<b>-70.18</b>			
DR (r)	<b>0.08</b>			
DF=SOCC (8 %)	<b>1.0</b>			
PV	<b>-70.18</b>			
NPV(8%,B37:K37)	<b>-64.36</b>		<b>- 69.51</b>	SUM(B42:K42)
EIRR	<b>-1.18%</b>	(Neg)		
Net B/C	<b>0.01</b>			
NPV + 0.0	<b>-12.86</b>	(Neg)	Even though with DR (r) = 0%	
EIRR Simulation	<b>Void</b>		NPV is still negative	

No.	ECONOMIC COSTS	Million €	No.	ECONOMIC BENEFITS	Million €
A	<b>Program and development</b>	(the 0th year)	A	DUV: Direct Use Value	(the 0th year)
1	Fisheries & marine affairs	0.48	1	Landing fisheries	3.48
2	Tourism & telecommunication	0.87	2	Maritime industries	40.43
3	Environment & spatial planning	3.21	3	Eco-tourism	2.10
4	Industries	0.44	4	Sea transportation	4.30
5	Transportation & public works	9.07	5	Supported services	0.16
6	Transportation	0.88	6	Tourist spending	171.74
B	The Value of Resource Devastations		7	Investments on maritime industries	161.48
1	Mangroves	98.23	B	IUV (Indirect Use Value)	
2	Coral reefs	138.93	1	Mangrove functions	31.11
3	Sea sand mining	295.96	2	Coral reef functions	2.73
			C	NON-USE VALUE	
			C.1	OV (Option Value)	
			1	Biodiversity mangrove	0.05
			2	Biodiversity coral reef.	0.06
			C.2	EV (Existent Value)	
			1	Existent mangrove	7.07
			2	Existent coral reef	8.82

<sup>1</sup> DR = 8% (takes the inflation rates during 6 years lately (Bank of Indonesia 2000–2005)

760 kilometer squares, and up to the year of 2010 targeted to become 834 kilometer squares (*KOMPAS*, 21 October 2003; *WALHI Riau*, 10 September 2004). There are many questions remain: i.e. does any body may stop this? What are the environmental impacts caused by the change of the shore lines? How much is the (economic, environment, and social) lost suffered by the citizens and the states caused by the sea-sand mining? How does this changing of Singapore's shore lines affect the position of sea boundaries to Indonesian and Malaysian territorial seas? The last question can be answered directly. According the UNCLOS 1982, it is the sovereignty right of a coastal state to develop its shore up to its territorial sea boundary, but it will not affect the boundary. Once the boundary has been agreed and stated between two (or more) neighboring countries, then it won't change, unless otherwise agreed and stated by them.

The components of existing TEV are as follows:

1. Economic Costs, consist of:
  - a. Local Government Budget: APBD fiscal year 2005;
  - b. The total (economic, environment, and social) lost suffered by the citizens and the state since 1970s is approximately: – €290.9 million caused by the sea sand mining; – €98.2 million caused by the devastation of 10,600 hectares mangroves; and – €138.9 million caused by the devastation of 12,654 hectares coral reefs (Toeppler, 2005; DKP, 2003; WAHLI Riau, 2005, Bintan Islands Mining Division, 2005).
2. Economic Benefits, consist of:
  - a. **DUV:** *Direct Use Value*, is the Gross Domestic Products 2005 of the coastal and marine sectors; tourists spending in 2005; and maritime industries up to the year 2005;
  - b. **IUV:** Indirect Use Value, based on the research conducted by Global Environment Facility/ United Nations Development Program/International Maritime Organization (GEF/UNDP/IMO) Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas in the Malaka Straits (Chua, Thia-Eng, 1999), the values are: – The function value of spawning and nursery ground by mangroves = 50% total fish landings; – The function value of sequestration carbon by mangroves = €1,598.24/ hectare; – The function value of erosion prevention by mangroves = €172,374.00/ hectare; – The function value of organics and sequestration carbon in the coral reefs = €158.36/ hectare; – The function value of shore lines prevention by coral reefs = €469.68/km;
  - c. **OV:** *biodiversity values* of mangroves and coral reefs = €13.24/ hectare;
  - d. **EV:** €1,903.32/hectare for mangroves, €2,093.64/ hectare for coral reefs;
  - e. **BV:** €1,916.56/ hectare for mangroves, and = €2,093.64/ hectare for coral reefs.

From the TEV calculation, it is shown that with the existing coastal and marine policy, the value of the zone (NPV) is – €64.36 million (with DR = 8%). And even though the DR ( $r$ ) is reduced into 0%, the value is still – €12.86 million. Next, as a comparison, it will be simulated as if the concept of a marine cadastre was applied to the coastal and marine policy. The results are shown in Table 2 below.

**Table 2:** Simulation Analysis of TEV HBU (Highest & Best Use) of coastal and marine policy in Bintan Island, Riau Islands Regency, Indonesia.

No.	ECONOMIC COSTS	Million € (the 0 <sup>th</sup> year)	No.	ECONOMIC BENEFITS	Million € (the 0 <sup>th</sup> year)
A	<b>Program and development</b>		A	<b>DUV: Direct Use Value</b>	
1	Fisheries & marine affairs	0.48	1	Fisheries	3.48
2	Tourism & telecommunication	0.87	2	Maritime industries	40.43
3	Environment & spatial planning	3.21	3	Eco-tourism	2.10
4	Industries	0.44	4	Sea transportation	4.30
5	Transportation & public works	9.07	5	Supported services	0.16
6	Transportation	0.88	6	Taxes from Marine Cadastre	171.74
B	<b>Resource Devastations values</b>		7	Tourist spending	161.48
1	Mangroves	98.23	8	Investment on mar. industries	3.48
2	Coral reefs	138.93	9	Added value of Marine Cadastre implementation	3.15
3	Sea sand mining	295.96	B	<b>IUV (Indirect Use Value)</b>	
			1	Mangrove functions	31.11
			2	Coral reef functions	2.73
			C	<b>NON-USE VALUE</b>	
			C.1	OV (Option Value)	
			1	Biodiversity mangrove	0.05
			2	Biodiversity coral reef.	0.06
			C.2	EV (Existential Value)	
			1	Existent mangrove	7.07
			2	Existent coral reef	8.82
			C.3	<b>BV (Bequest Value)</b>	
			1	Mangrove preservation	19.25
			2	Coral reef preservation	25.10
	<b>TOTAL ECONOMIC COSTS</b>	548.07		<b>TOTAL ECON. BENEFITS</b>	481.01

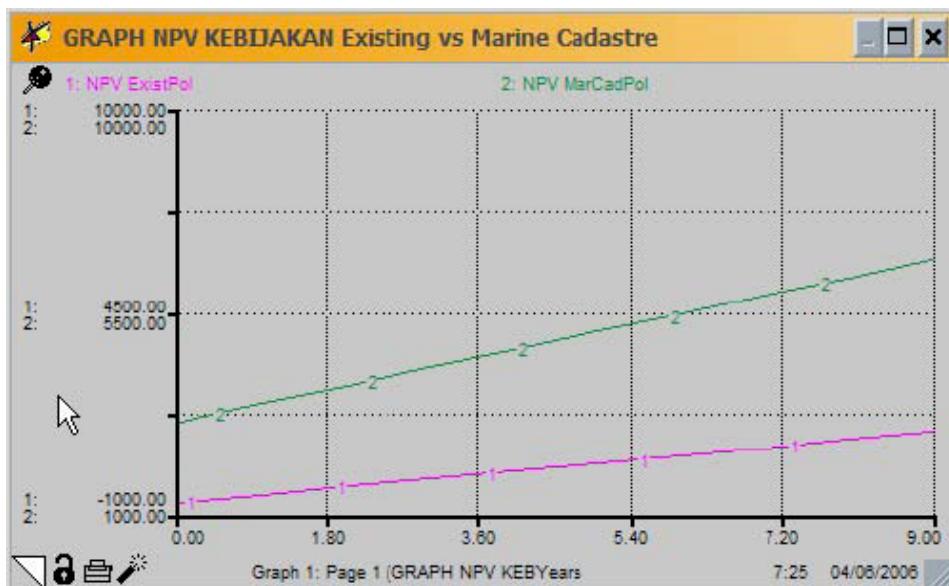
NET BENEFITS	-67.00		
CASH FLOW	-67.00		
DR (r)	0.08		
DF = SOCC (8 %)	1.0		
PV	-67.00		
<b>NPV(8%,B37:K37)</b>	277.93	300.16	SUM(B42:K42)
EIRR	33.03 %		
Net B/C	5.48		
NPV + 33.0	0.11		
NPV - 33.1	(0.23)		
EIRR Simulation	33.00 %		

Interpretation of "ex-post" (existing coastal and marine policy) and "ex-ante" (coastal and marine policy with a marine cadastre):

- The existing coastal and marine policy is inconsistent to the spatial planning, it is only good in the paper but it is bad in the implementation. Within this policy, there is no control on the use of coastal and marine spaces. On the other hand, through the administering and law enforcement of 3R: rights, restrictions, and responsibilities on coastal and marine spaces (the implementation of a marine cadastre), it is shown the distinct tracks towards the achievement of "good ocean governance": the EES: economical objectives, ecological objectives, and social objectives;
- NPV 2005 values €277.93 million and €300.16 using different formulas. This values continue increase as they are represented by NB and PV values, although they start with initial negative value (-) €67.00 million at the 0<sup>th</sup> year (2005), but by the 9<sup>th</sup> year (2014) each value reaching €198.94 million and €96.34 respectively (the complete TEV assessment that demonstrates the ten years calculation periods is not shown/attached in this paper).

- c. EIRR (*Economic Internal Rate of Return*) value reaches 33.03 % together with EIRR simulation = 33.00 %, and Net B/C value = 5.48;
- d. Result conclusions: NPV > 0, B/C-R > 1, and EIRR > DR ( $r$ ), therefore the simulation approves that running the coastal and marine policy through implementing the marine cadastre concept is strongly feasible.

By using a dynamic modeling tool, STELLA™ v.4.2, the two NPVs are then simulated as it is shown in the Figure 2 below. During ten years of the policy implementations, the graph of the NPV's existing policy (ex-post) indicates the negative values (below zero), whereas the Marine Cadastre policy (ex-ante) shows the positive values, even though the two PVs (Present Values) start with the same negative values from the 0<sup>th</sup> year (see Table 1 and 2).



**Figure 2:** The NPV graph: the existing policy's (ex-post) versus the policy with a marine cadastre's (ex-ante) simulated by STELLATM v.4.2 dynamic modeling.

## 4 CONCLUDING REMARKS

There are two things are often not considered in the discussion of a marine cadastre concept, those are: the **common elements** with the **land-based counterparts** and the **value** of sea parcel and the coastal and marine area. A broad sense of a marine cadastre concept should have: (a) a clear differentiation between "sea parcel" that has direct association with "landbased" tenureships system (i.e. sea parcel at the shore or shallow water, both the sea parcel that directly "stands" on the shore-water bed, and the sea parcel that becomes one inseparable part with the shore-land tenureships or ownerships); (b) a contain of the value of the sea parcel; and (c) a contain of the value of the coastal and marine area.

The method to assess the value of the sea parcel and the coastal and marine area could be offered as follows:

- (a) **Sales Comparison Approach**, or other three methods, for the **land-based sea parcel**;
- (b) **Financial Valuation Method** for the **sea parcel** that has no association with the land-based parcel or the land-based tenureships or ownerships; and
- (c) **Total Asset Valuation** (TAV) for **coastal areas** when takes the land value as a part of DUV components, and **Total Economic Valuation** (TEV) method for the **coastal and marine zones** when considers the socio-environmental and resource-economical values are the main components.

The simulation of the implementation of a marine cadastre concept in the case study region provides a picture, that the marine cadastre has forceful contribution in the sound management of coastal and marine resources and areas, which ends up to the three development objectives: economical objectives, ecological objectives, and social objectives.

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