SSA 17 - IZMIT BAY
SYSTEM FORMULATION

SPICOSA

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1. EVALUATION OF FORMULATION

Step 1- Starting with the Design Step Results

In order to bridge the gaps between general public, science and management, the first stakeholder meeting was organized at the beginning of the design step. The Bay has been suffered from industrial pollution since 1970s, so it was reached an agreement on Policy Issue(s) as "How to deal with PAH contamination of mussels". Then the first conceptual model was focused on "the concentration of PAHs in mussels close to natural levels". The wild mussels growing near discharges have not an economical value in terms of low quality and quantity for the region. However they are important indicator organisms for a healthy Izmit Bay ecosystem.
In this first version; the water circulation and nitrate, DO, mussel and phytoplankton, turbidity blocks were agreed to be modeled. The water quality parameters such as turbidity and dissolved oxygen was added in order to has an economical results. We decided to find the relation with water quality parameters to estimate real estate values.

Step 2-

Since the wild mussels have not an economical value we had difficulties to model the economical consequences. However the fish stocks are quite remarkable and the fishing activities have social and economical benefits. Then a small SSA meeting with the fish expertes was organized in September 2008. Fish experts suggested us to focus on economic fishes like Horse mackerel (*Tracharidae Trachurus*) which is one of the most common fish in the Bay.

2. CHALLENGES in FORMULATION

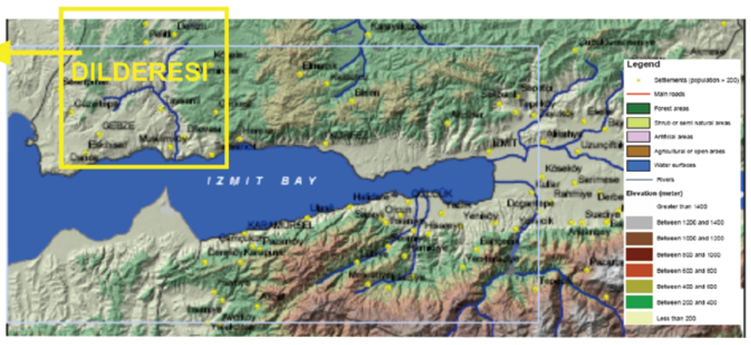
Quality and Quantity of Data

- The modeling time scale is a day. However only the meteorological data (temperature, rain, wind) is available in daily time scale.
- Validation data available in seasonal interval (Nitrate, DO, PAH, Chlorophyll, Salinity).
- POM measurement is not available and could be estimated thorough TSS.
- Illegal sewage water discharge is calculated roughly by considering the coastline population of the settlement area having no sewage.
- Due to the limited research on fisheries in Izmit Bay, the required modeling parameters are not available.

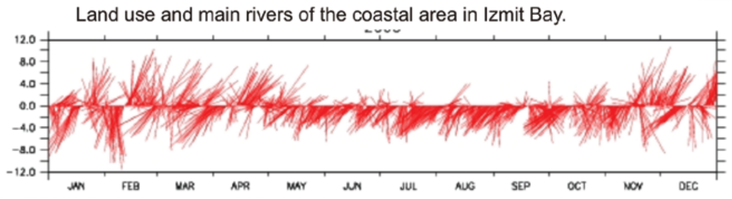
Wind Driven Dynamics

While the region is exposed to quite permanent strong North Easterly winds, the sporadic strong South Westerly winds blow in winter time. The southerly wind is very important interms of the leading changes in circulation dynamics of the region.

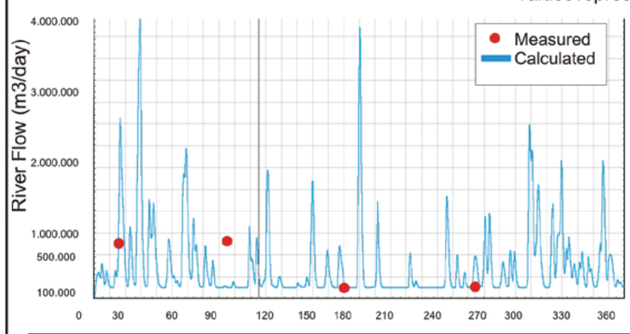
The Dilderesi river is the major river (%20 of total river flow) in the western boundary of the Middle Izmit Bay. Therefore when the Southeasterly winds takes place the fresh water flowing through the Dilderesi enters inside the Bay and leads changes in the circulation dynamics. Moreover Dilderesi river has also high nitrate load which is also expected to high influence in the ecosystem.



Land use and main rivers of the coastal area in Izmit Bay.

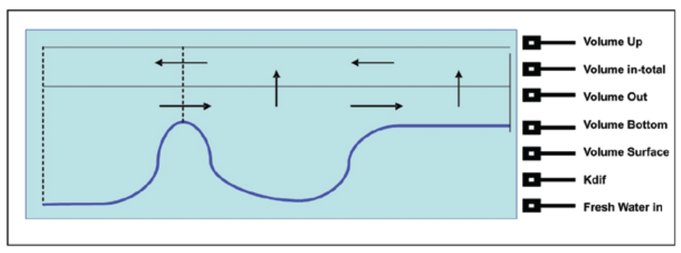


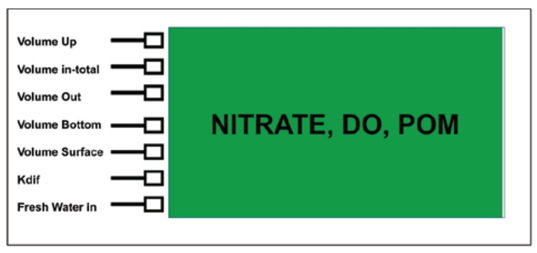
The ECMWF wind data for 2005 while the y-axis shows the speed of a wind, the positive values represent Southerly winds and the negative values represent Northerly winds.



River Flow Calculation

River flow rate measurement available in seasonal interval. Daily change of river flow is calculated using the meteorological conditions and considering watershed area of Izmit Bay.





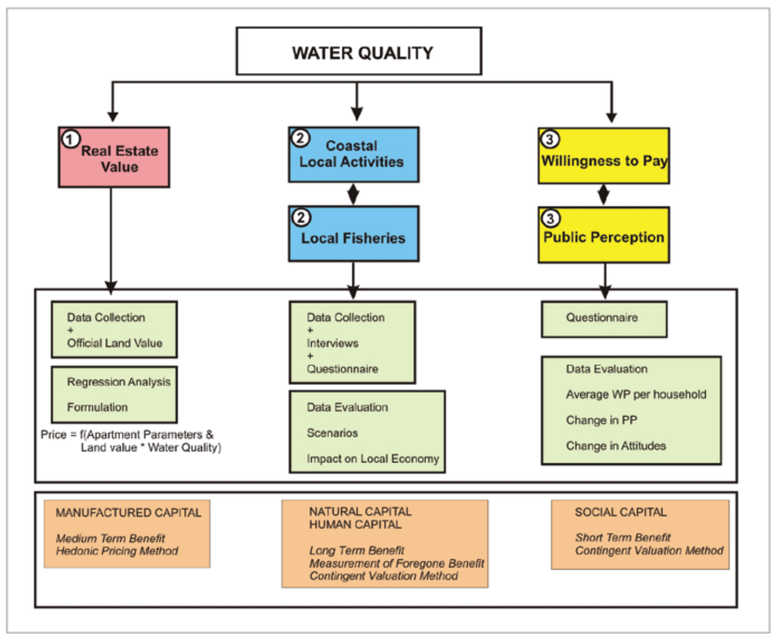
Izmit Bay shows very strong vertical stratification. Two layer circulation dynamics of the Izmit Bay is modelled using the fresh water exchange. The bottom dense water (38.5 ppt) enters from the Marmara Sea Basin, mixes with the surface less saline water (27 ppt) governed by the meteorological conditions and river supplies. Based on the circulation dynamics; Nitrate, DO, cycles are being modeled.

Data	Variable	Symbol	Units	Duration	Delta T	Dynamic Link	Comments
Physical	River flow rate	RW	unspecified		Seasonally		Based on Insitu measurements
	Sedimentation	Sed	unspecified				Information unavailable, estimation will be used
	Resuspendion	Res	unspecified				Information unavailable, estimation will be used
	Wind, air temperature, rain	W,T,R	m/sec, C, mm/day		Daily	FW	Meteorological measurements
	Fresh water volume	FW	m3				Bathmetry
Internal bio-chemical	Chlorophyll-a (phytoplankton growth)	Chl-a	µg/l	2 years	Seasonally	Phytoplankton, organic matter	Based on Insitu measurements On site
	Nitrate	N	µM	2 years	Seasonally	Phytoplankton	Based on Insitu measurements On site
	PAH	PAH	µM	2 years	Seasonally	Phytoplankton, PM	Based on Insitu measurements On site
	Particulate Matter	POM	µg/l	-	-		Information unavailable, estimation will be used
	Phytoplankton	Ph	Cells/l	2 years	Seasonally	PM	Based on Insitu measurements On site
	Dissolved Oxygen	DO	mg/l	2 years	Seasonally	PM, N, P	Based on Insitu measurements On site

Data	Variable	Symbol	Units	Duration	Delta T	Dynamic Link	Comments
External	Nitrate from Eastern Channel	N	µM, kg/year	2 years	Seasonally	Nitrate species, phytoplankton	Will be calculated from TN and TKN data
	Nitrate from Dilderesi river	N	µM, kg/year	2 years	Seasonally	Nitrate species, phytoplankton	Will be calculated from TN and TKN data
	Nitrate from other domestic inputs	N	µM, kg/year	2 years	Seasonally	Nitrate species, phytoplankton	Will be calculated from TN and TKN data
	Nitrate from Dilderesi river	N	µM, kg/year	2 years	Seasonally	Nitrate species, phytoplankton	Will be calculated from TN and TKN data
	PAH from Eastern Channel	PAH	mg/l, kg/year	2 years	Seasonally	Nitrate species, phytoplankton	Based on Insitu measurements On site
	PAH from Dilderesi river	PAH	mg/l, kg/year	2 years	Seasonally	Nitrate species, phytoplankton	Based on Insitu measurements On site
	PAH from Industrial Discharges	PAH	mg/, kg/year	2 years	Seasonally	Nitrate species, phytoplankton	Based on Insitu measurements On site
	PAH from Atmosphere	PAH	mg/l, kg/year	-	-	Nitrate species, phytoplankton	Information unavailable. Literature estimations will be used
	PAH from Urban runoffs	PAH	mg/, kg/year	2 years	Seasonally	Nitrate species, phytoplankton	Based on Insitu measurements On site
	PAH from Maritime Activities	PAH	mg/year	-	-	Nitrate species, phytoplankton	Information unavailable. Literature estimations will be used

3. SOCIO-ECONOMIC ISSUES

Cost Benefit Analysis will be conducted using three different methods :



1) Hedonic Pricing Method :

In this method, **data is collected** on prices of houses for sale at different locations of the bay with different pollution levels. Then **a regression analysis** will be conducted. The price of a house is determined as follows :

Price = *Characteristics of the house (square meter, age etc) * Land Values * Environmental factors (water pollution, Industry etc)*

The SSA will find the correlation between the price and the environmental factor (water pollution in this case). Then it will be possible to say, how the value of real estates will be affected by the abatement of the water pollution.

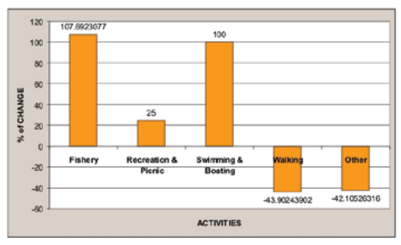
2) Measurement of Foregone Benefit from fish catch and sales :

Due to industrial pollution, the fish population has decreased in the Bay. By looking at available data and by talking to fishermen, the SSA team will try to estimate, what the impact of pollution abatement can be on fish species and population and how this may affect the economics of fish sales.

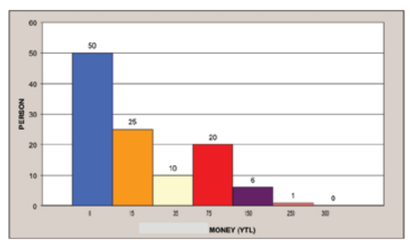
3) Contingent Valuation method :

The method is applied using a **questionnaire** where people's perception of water pollution is being measured. The questionnaire aims to evaluate, how the water pollution has changed people's habits and how it will change with pollution abatement. Also, people are directly asked to state their willingness to pay for clean water which is the price people are ready to pay for this good.

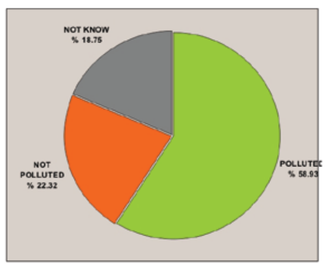
The SSA team is at the stage of evaluating the results obtained from the questionnaire. Once the average willingess to pay per household is known, this will be generalized for the whole region and the value the inhabitants put on clean water will be estimated.



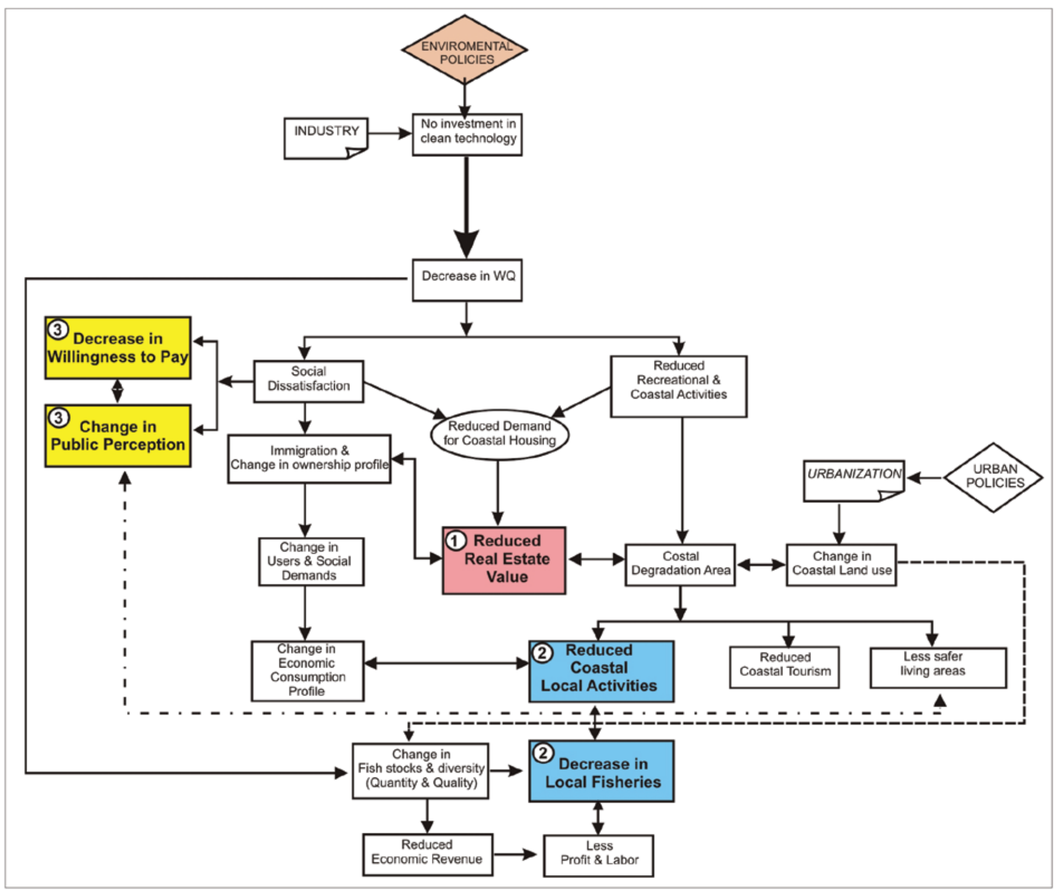
Change in activities with more clean water



Willingness to pay



Local people opinion about Izmit Bay



Socio-Economic Conceptual Model

Discussion:

The economic dimension of the system based on the indirect relationship between water quality and real estate values in the coastal areas surrounding the Bay. To consolidate the economic dimension, the relationship between `water quality` and `fish quality and/or quantity`will be considered if required data is available. **The social dimension** of the model will be based on `Public Perception of the Water Quality` and `Willingness to Pay`.

SIXTH FRAMEWORK PROGRAMME

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