Documentation Report for Formulation Step

SSA 14 Mar Piccolo of Taranto Version 1.0 <D7.3>

Mar Piccolo of Taranto (Southern Italy)

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- Have you constructed a custom extend library? YES/NO

No, we have constructed hierarchical blocks which could easily be submitted to a library, but they are not yet fully completed.

- Folder of the SPICOSA ftp file system where you have put the Extend model(s), the custom Extend libraries (if any), and the rest of the Formulation Summary Report.

2 General model description

Provide a short description of your model using your updated conceptual model diagrams. The focus is on the linkages between the different ESE components.

2.1 Conceptual model diagram (Fig. 1)

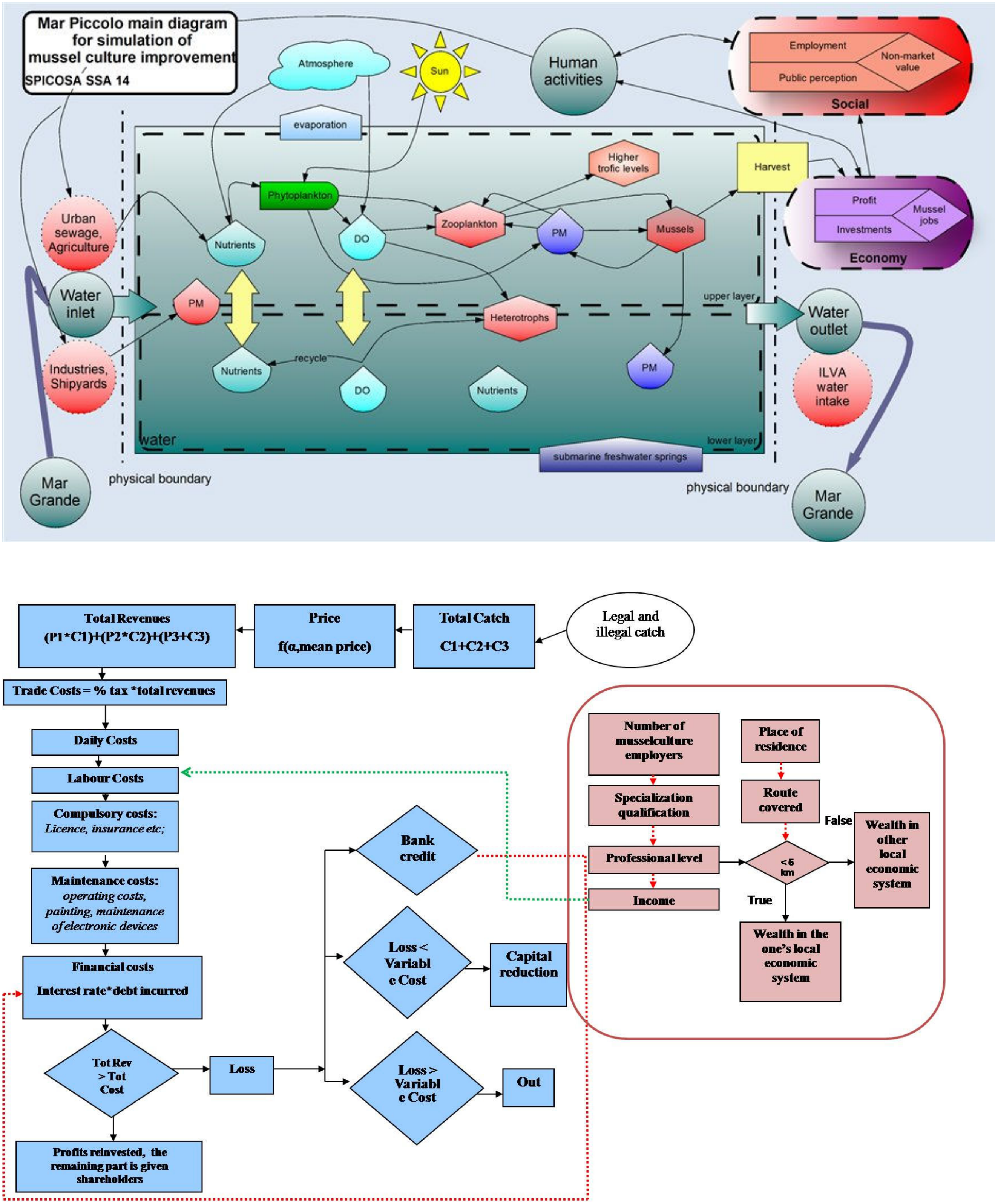


Fig. 1 Conceptual models of the Natural and Socio-Economic Components

2.2 Documentation

- Insert a brief explanation of the conceptual diagrams here.

Respect to the Design Step, we have made our Conceptual models more simple, by taking into account the availability of all data (natural, economic and social).

Concerning NC, Mar Piccolo has been considered so far as a unique basin (we have planned to improve the model during the Appraisal Step, considering the 2 basins). The model tries to conceptualize the interaction among main functional components, i.e. phytoplankton, zooplankton and mussels. Certain data inputs (primary productivity, salt, volume, nitrogen and oxygen exchange) are approximated just like the thermoaline exchange model. The focus of the VS is the Mussel component with the links among ESE components.

The **Economic** model comes out from a bio-economic model referred to fishing (see Lleonard J. 2003). We have hypothesized three different percentages and each catch has a different price due to the quality level. We have determined the market price by using a *formula* which combines the quality index (condition index) and the mean price.The revenue is given by multiplying the price and quantity of each catch. Moreover, we have considered the total costs derived from the mussel farm. If total revenues are higher than total costs the mussel farm have had a profit, on the contrary it have had a loss. The objective the economic model is to reproduce the economic conditions in which the mussel farms occur. This is done by carrying out simulations, starting from the current situation and analysing the behaviour of the mussel farm under different economic conditions. The two economic *scenarios* are:

Scenario 1: increase subsides and reduction of catches (sustainable mussel growth) In this scenario we will try to calculate how changing the income of a mussel farm when the catches are reduced and increase subsidies.

Scenario 2: reduction in tax; in this scenario we will try to calculate how changing the income of a mussel farm when the catches are reduced and tax are reduced.

As regards **SC**, the conceptual model considers, as parameters to value the level of life's quality of mussel farmers, the specialization/qualification from which derive the professional level of an employee and his income. The income of mussel farmers represents the Labour cost of the economic model. Moreover, it wants to evaluate, considering where the employees live and the route that they cover everyday to arrive to the working destination, the environmental impact of the long travelling and the repercussions in the market. In fact, if the most part of mussel farmers don't live in Taranto, they're going to spent their money elsewhere, putting away the wealth from one's local economic system. The route that they cover is calculated by considering the space between their home and Mar Piccolo. By means of the questionnaries, we'll know however the employees go to work. The travel cost is obtained by the gasoline cost multiplied to the covered kilometres, if the employee travels by car and alone. Instead, if the employee travels by car but with other collegues, the cost will be divide between the people. If the employee travels by bus, the cost will be represent only by the ticket cost. About the environmental impact, it will calculate using as parameter the quantity of equivalent CO_2 emitted during the travelling.

- Provide a short description any of the complicated interactions (e.g. feedback loops, ESE links) that are not obvious in the diagram. Make reference to any longer description of the same interactions in the SR.

Natural Component

Mar Piccolo has been considered as a whole ecosystem, to simplify our models. We know that it is a very complex ecosystem, and in the future we'll considered the two Inlets of the mar Piccolo as separate ecosystems, characterized by their own hydrological and biological features. The link between the NC and the EC and SC is represented by the "Mussels".

Economic Component

The link between the Natural and Economic model is determined by the quantity and quality of the mussels. In the economic simulation we have hypothesized the whole Mar Piccolo as a one mussel farm. We considered one farm because mussel farms in Mar Piccolo are rather homogeneous (the same technology, the same production cycle, etc.), being differentiated only by the size of the cultivation system.

Social Component

As regards Social Component we have assumed that an unfavorable public perception has consequences to the local demand. The unfavorable public perception, that we'll calculate using questionnaires and interviews, as mentioned before, would cause a lowering of local economy and then a worsening of the life quality. We have decided to work with two types of Social Analysis: the first one uses the Extend model and the second one is a traditional analysis. Our goal was the knowledge of the best type of mussel farm. For this reason, we have divided them in three types using as parameter the dimension (small, medium and large). About mussel farmers, we would calculate the most important costs for the employees represented above all by travel, sanitary and family expenses including also the illegal workers. As regards the traditional analysis, based on the public perception of the local economy and of own quality life, we have considered: Number of mussel culture employers, Age, Professional level (administrator or worker), Type of job (permanent or non permanent position), Type of contract (part-time or full-time, number of paid days), Possible specialization/qualifications, Income, Civil state and family composition. In the interpretative analysis, that we will do with the aid of questionnaires and interviews to mussel farmers and administrators divided in the 3 different type of farms, we will try to establish a link between the obtained data.

2.3 Spatial extent

Fig. 2. Map of the Mar Piccolo of Taranto (Southern Italy)

Fig. 3. Map of the Gulf of Taranto (Ionian Sea)

- Is the model spatially differentiated: YES/NO. If YES, explain briefly and note where discussed in SR.

Yes, the model is spatially differentiated.
Mar Piccolo is a very heterogeneous ecosystem. Particularly, the First Inlet shows chemico-physical features similar to those observed in the near Mar Grande, a semi-enclosed sea. These features are connected to the hydrodynamic regime, sustained by the presence of the connecting channels (Canale Navigabile and Canale Porta Napoli) and the industrial water scooping machine. The Second Inlet is characterized by a scarce hydro-dynamism and a reduced water exchange with the nearby basin which determine, mainly in summer, an outstanding water stratification. In the Second Inlet, anoxia phenomena and phytoplankton blooms are more frequent, respect to the first one.
Also the vertical distribution of the main variables is conditioned by the hydrodynamic regime. The Mar Piccolo hydro-dynamism is conditioned also by the presence of the submarine springs, the sewage pipes and the water-scooping machine of the heavy industry.
In sediments, intense chemical activities are connected to the oxidation of the organic matter and the immobilization of the chemical contaminants.

- Have you linked your Extend model to spatial data in the GIS software PCRaster? YES/NO. If YES, explain briefly and note where described in SR.

No, we haven't linked our Extend model to spatial data in the GIS software PCRaster, because we don't know how to do it.

We have GIS data (shape files) concerning the distribution of:

- the Natural Parks and Protected Areas
- the Hydrological Features
- the Territorial Uses
- the Administrative Limits.

3 Technical model documentation

3.1 Natural Component

3.1.a Data input

In every model, requires different types of data. Most common types of data input are (1) parameters, (2) boundary conditions, (3) forcing functions or variables that change during the course of the model but are not modeled but read from a table, (4) initial values.

- Insert here a table with per record at least the following information – similar to that in WT4.1.
- Name of the data and the symbol or abbreviation used in the Extend model
- Data type (parameter, boundary condition, forcing function, initial value, other)
- Units
- Indicate the number of the Extend block number[1] or the Extend database where the data is stored.
- Source of data – refer to entry in DR sect. 4
- Identify the Data analysis preformed and refer to entry in SR

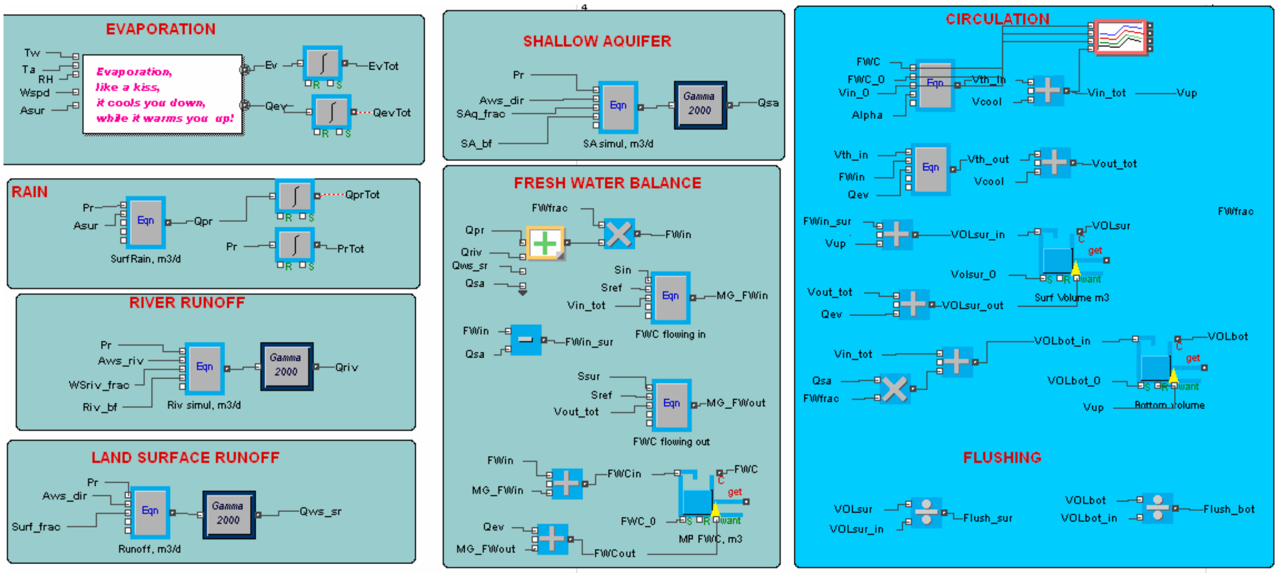
[1] Every extend block that is put on the model sheet receives a number. You can view this number by sliding your mouse over the block

	Activity rating				Hindcast = 10 years		Conversion		Relevance	Feasibility			
	1 = nat ext 2 = nat int 3 = hum ext 4 = hum int						1=time-space 2=proxy 3=simulate 4=empirical		1=most rlv 2=av rlv 3=least rlv	1=OK 2=Possible 3=NO			
Name	**Activity**	**Type**	**Variable**	**Units**	**Delta T**	**Duration**	**Conversion**	**Source**	**Level**	**Availability**	**Data purpose**	**Name in Extend**	**Extend block**
Weather	Atmospheric												
		1	rain	cm d^{-1}	3 hrs	10 yrs	1	local data	1	1	Input	Pr	1-5
		1	wind	km h^{-1}, dir	3 hrs	10 yrs	1	local data	1	1	Input	Wspd	1-5
		1	air temp	°C	3 hrs	10 yrs	1	local data	1	1	Input	Ta	1-5
		1	cloud	%	3 hrs	10 yrs	1	local data	1	1	Input	Cld	1-5
		1	deposition	gr	3 hrs	10 yrs	1	local data	1	1	Input	N/A	1-5
		1	rel-humidity	%	3 hrs	10 yrs	1	local data	1	1	Input	RH	1-5
M Piccolo Basin	Circulation	**2**	Temperature	°C	3 hrs	10 yrs	1	IAMC-CNR	3	1	Calibration	Tw	1-5
		2	Salinity	psu	daily	10 yrs	1	IAMC-CNR	3	1	Calibration	Ssur/Sbot	6;7
		2	Density	Kg m^{-3}	daily	10 yrs	3	empirical	2	1	Calibration	Dsur/Dbot	6;7
		2	Mixed layer depth	m	weekly	10 yrs	3	empirical	2	1	Calibration	Mxldep	6;7
		2	H_2O inlet rate	m^3 d^{-1}	hourly	10 yrs	1	empirical	3	1	Calibration	MG_Fwin	1-5
		2	H_2O outlet rate	m^3 d^{-1}	hourly	10 yrs	1	empirical	3	1	Calibration	MG_Fwout	1-5
	springs	**2**	H_2O flow rate	m^3 d^{-1}	hourly	10 yrs	1	empirical	3	1	Calibration	VOLsur/VOLbot	1-5
	Bathymetry	**2**	Depth	m	none	none	1	empirical	3	1	Calibration	Depth	1-5
M Grande Basin	Circulation	**2**	Temperature	°C	daily	10 yrs	1	IAMC-CNR	2	1	Input	Tw	1-5
		2	Salinity	psu	daily	10 yrs	1	IAMC-CNR	2	1	Input	Ssur/Sbot	1-5
		2	Density	Kg m^{-3}	daily	10 yrs	3	IAMC-CNR	2	1	Input	Dsur/Dbot	1-5
		2	Mixed layer depth	m	weekly	10 yrs	3	empirical	2	1	Input	Mxldep	1-5
		2	H_2O inlet rate	m^3 d^{-1}	hourly	10 yrs	1	empirical	3	1	Input	MG_Fwin	1-5
		2	H_2O outlet rate	m^3 d^{-1}	hourly	10 yrs	1	empirical	3	1	Input	MG_Fwout	1-5
	Bathymetry	**2**	Depth	m	none	none	1	empirical	3	1	Input	Depth	1-5
Environmental components		**2**	Photosynthesis, Chlorophyll a	(μg l^{-1})	bi-monthly	10 yrs	1	IAMC-CNR	3	1	Input	PP_dia	11
		2	N,P,O	μg l^{-1}	bi-monthly	10 yrs	1	IAMC-CNR	3	1	Input	TopO,BotO	8;9;10
		2	Number of cysts	cell m^{-3} day^{-1}	monthly	10 yrs	1	IAMC-CNR	2	1	Input	cyst_rate	11
		2	Phytoplankton	cell day^{-1}	daily	3 yrs	1	IAMC-CNR	3	1	Input	Micro_grow	11
		2	Higher trophyc levels	cell day^{-1}	monthly	10 yrs	1	IAMC-CNR	3	1	Input	ZP_graze	11
		2	Mussel Abundance	ind l^{-1}	monthly	10 yrs	1	IAMC-CNR	3	1	Input	Diatoms; Dinos; Micros	11
		2	Mussel Shell length	cm	monthly	10 yrs	1	IAMC-CNR	3	1	Input	Juv_shell; Adu_shell	12
		2	Filtration rate, DOM, POM	mg l^{-1}	weekly	3 yrs	1	IAMC-CNR	3	1	Input	POM_eff	12

Mathematical formulation

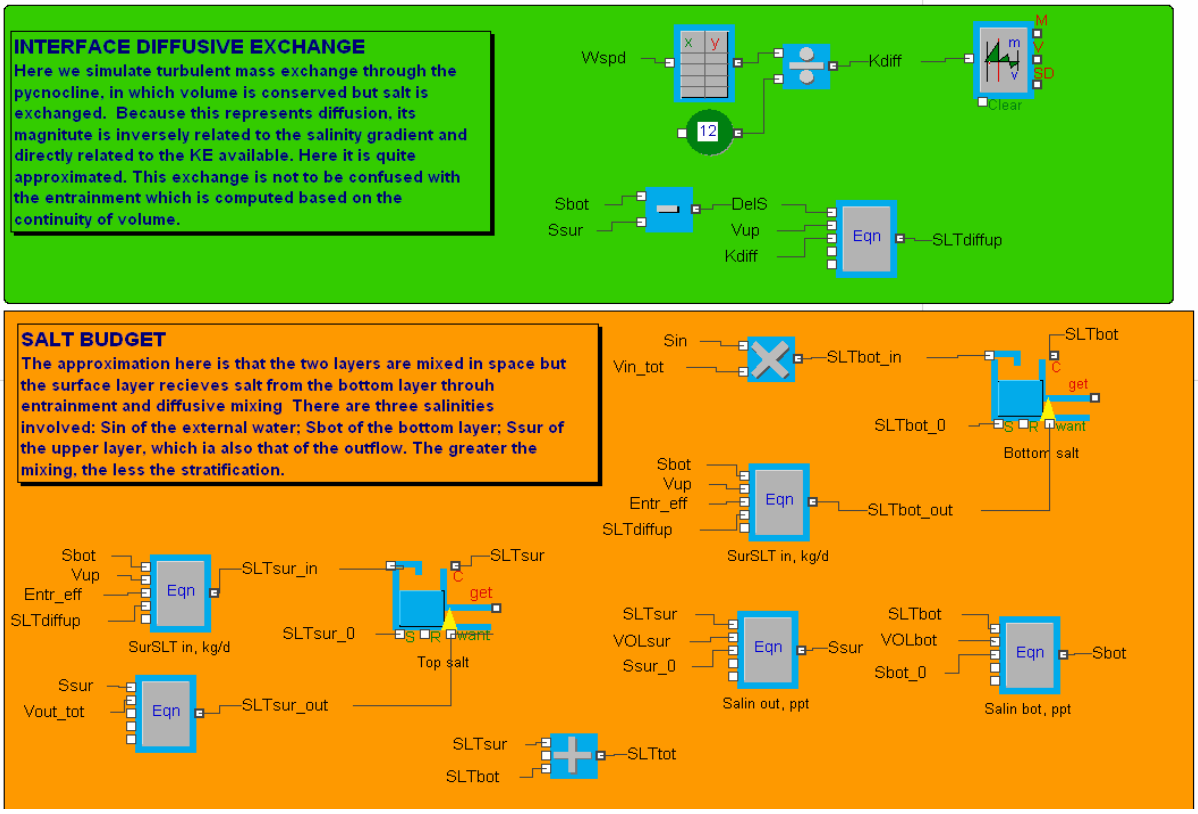
In every model, variables are calculated and updated at each time step using different equations. The whole model regarding the MP ecology is reproduced considering the following processes reproduced considering different model blocks:

1. **FRESH WATER CONTENT** - The amount of fresh water in the estuary is accounted for in order to define the salinity and the circulation. It is calculated with respect to an external salinity reference (Sref) based on MP data year 2003. The FW accumulation drives the estuarine circulation. This is an approximation of the Thermohaline Exchange Method – Hopkins 1999, 2001. This approximation assumes that the pressure gradient between the estuary and the sea is proportional to the relative accumulation of fresh water inside. It would not work if there were significant temperature differences, in which case the density gradient must be calculated. Adjusting the 'alpha' to match the salinity with observations forces it to provide the correct mass exchange with the exterior basin. Physical processes control the temporal and spatial variability of the freshwater is referred to Hopkins, 2002.
2. **EVAPORATION** - is referred to water air difference in temperature and also to wind velocity in order to calculate the surface of evaporation and the watervapor and airvapor saturation. Then the evaporation flux is calculated and integrated on whole basin.
3. **ESTUARINE INFLOW and OUTFLOW** - The bottom inflow is taken as proportional to the FWC in the estuary. The constant, alpha, depends on the friction and mixing in the inlet; and it is adjusted to achieve a long term calibration with the observed salinity in the surface layer. This is an approximation and in next versions the integrated density difference between the MP and MG will be used. The outflow is taken as equal to the sum of the Runoff and Inflow and the upwelling equal to the Inflow - conservation of volume.
4. **WATER VOLUME** –This model assumes that the pycnocline between the surface and bottom layers remains constant (5.2m). It allows for the entrainment of bottom waters through the pycnocline, i.e. the entrained waters upwell into the surface layer and combine with the Runoff to form the Outflow. It also allows for diffusion of mass between the two layers, but with no net water flux, i.e. the volume mixed up and down is equal.
5. **OTHER CIRCULATIONS** - Tidal and Wind effects are omitted in this model, but they will be added in refined versions. Both effect the mixing and thus only indirectly change the thermohaline function.
6. **FLUSHING TIMES** - A basin flushing time is defined by the length of time it would take to fill the basin with the inflow. In the plots both the flushing times for each layer is shown. When the flushing time is long, more time is given for the Oxygen Demand to decrease the DO in the bottom layer - see parameters prior to day 214, when there was a strong rain succeeding a dry period.

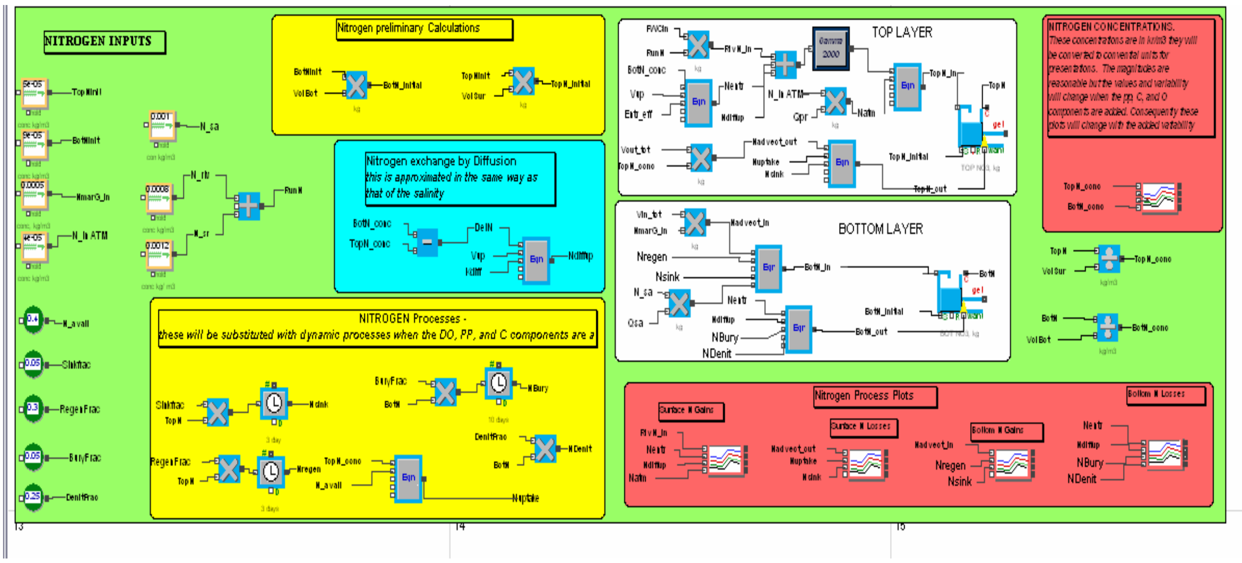


7. **INTERFACE DIFFUSIVE EXCHANGE -** Here we simulate turbulent mass exchange through the pycnocline, in which volume is conserved but salt is exchanged. Because this represents diffusion, its magnitude is inversely related to the salinity gradient and directly related to the KE available. Here it is quite approximated. This exchange is not to be confused with the entrainment which is computed based on the continuity of volume. The energy available for the mixing is assumed to be proportional to the vertical entrainment flux and to influenced by the property gradient. It is dimensionalized as a diffusive flux (volume flow times Property Difference).

8. **SALT BUDGET -** The approximation here is that the two layers are mixed in space but the surface layer receives salt from the bottom layer through entrainment and diffusive mixing. There are three salinities involved: Sin of the external water; Sbot of the bottom layer; Ssur of the upper layer, which is also that of the outflow. The greater the mixing, the less the stratification. To predict salt budget in MP the model uses the Sin is an input, the other two are simulated.

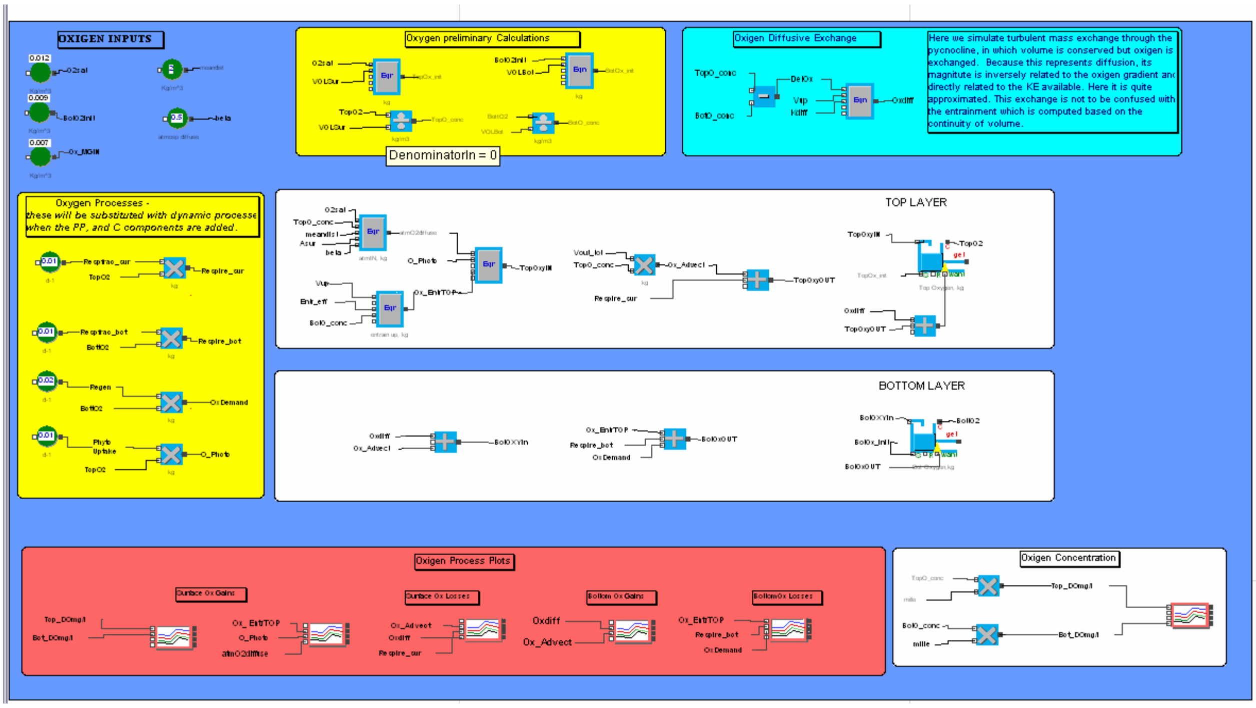


9. **NITROGEN** - Nitrogen processes are approximated in the Nitrogen budget of this model. The Nitrogen processes considered are: sinking, regeneration and uptake by phytoplankton in the TOP layer and finally burial and denitrification in the BOTTOM layer. The Nitrogen content in the two different layers depends also on diffusive exchange driven by physical processes.

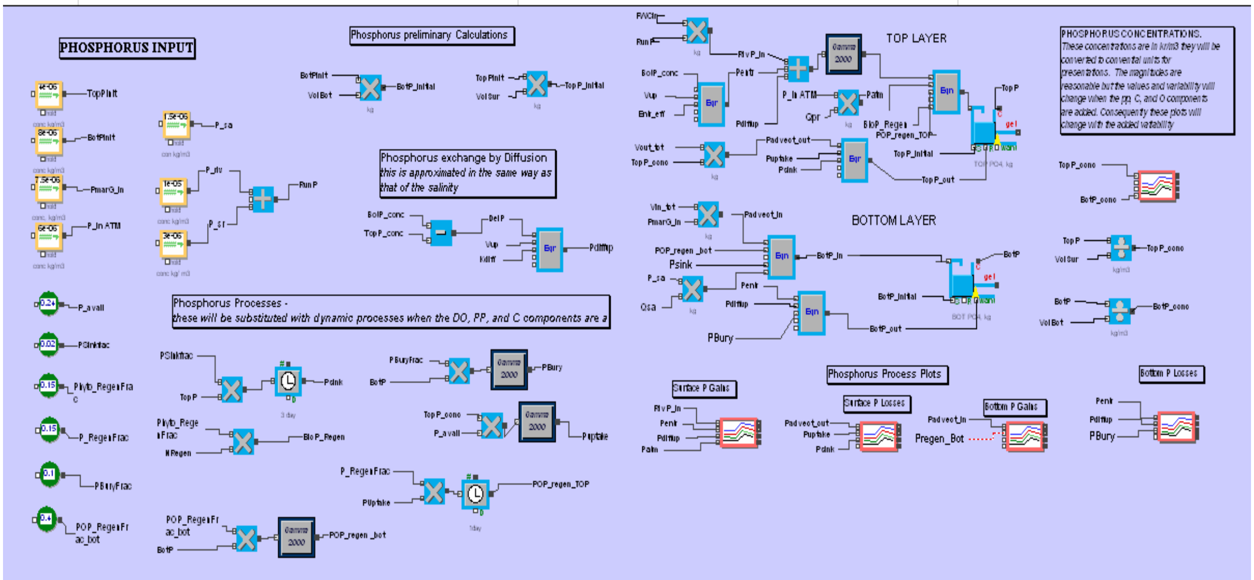


10. **OXYGEN** - Here we simulate turbulent mass exchange through the pycnocline, in which volume is conserved but nitrogen is exchanged. Because this represents diffusion, its magnitude is inversely related to the oxygen gradient and directly

related to the KE available. Here it is quite approximated. This exchange is not to be confused with the entrainment which is computed based on the continuity of volume. Oxygen processes considered are: assimilation and respiration by phytoplankton (TOP layer), regeneration and oxygen demand (BOTTOM layer).

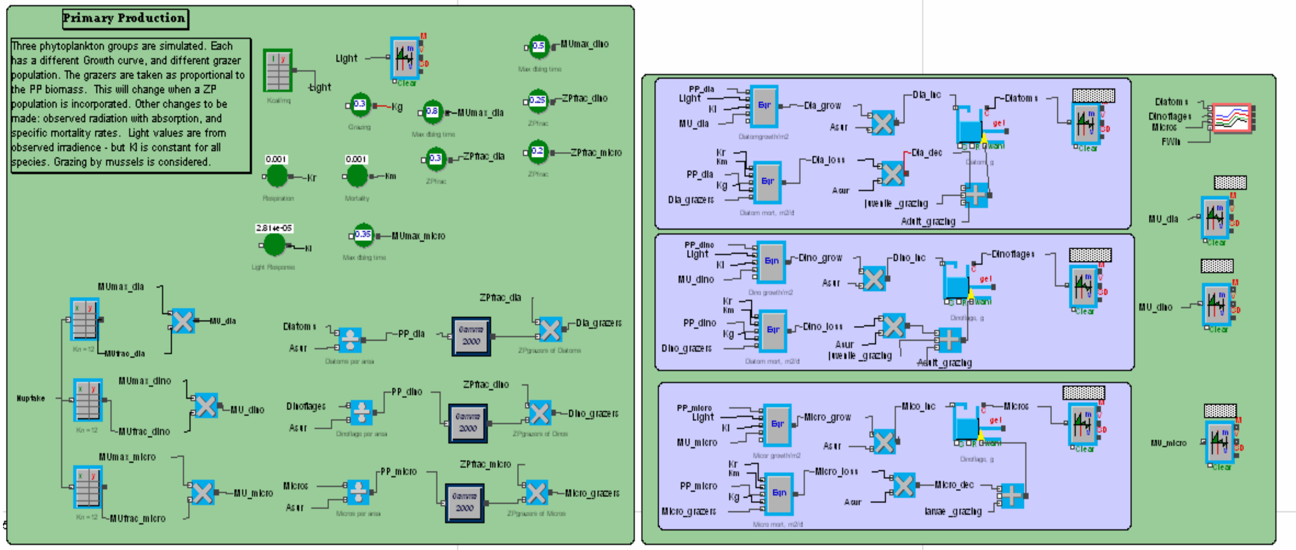


11. **PHOSPHORUS** – Phosphorus processes simulated are linked to primary production and physics. The model allows to reproduce: sinking from TOP to BOTTOM, regeneration, uptake and phytoplankton regeneration (TOP), POP regeneration both in TOP and BOTTOM layers, POP regeneration and burial in BOTTOM. Some of these processes will be refined considering also a link with oxygen processes.

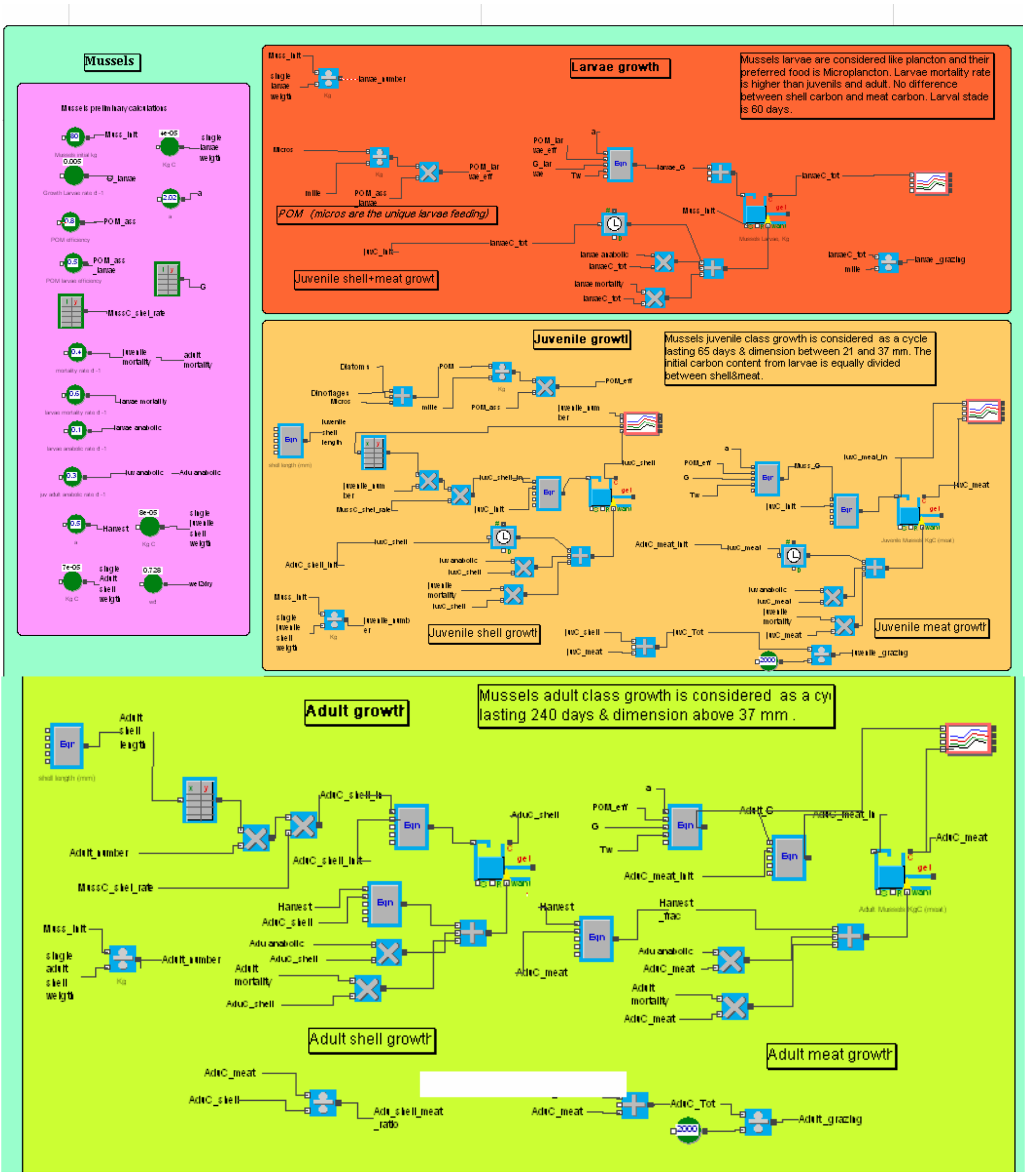


12. **PRIMARY PRODUCTION** - Three phytoplankton groups are simulated as in Lewis, 2005. Each has a different Growth curve, and different grazer population. The grazers are taken as proportional to the PP biomass. This will change when a ZP population is incorporated. Other changes to be made: observed radiation with

absorption, and specific mortality rates. Light values are from observed irradiance - but Kl is constant for all species. Grazing by mussels is considered depending on mussels' model.



13. **MUSSELS GROWTH** - Model Structure: 5 boxes (1 for Larvae, 2 (shell&meat) for Juvenile class, 2 (shell&meat) for Adult class. Mussels' larvae are considered like plankton and their preferred food is Microplancton. Larvae mortality rate is higher than juveniles and adult. No difference between shell carbon and meat carbon. Larval phase lasts 60 days. Mussels juvenile class growth is considered as a cycle lasting 65 days & dimension between 21 and 37 mm. The initial carbon content from larvae is equally divided between shell & meat. Mussels adult class growth is considered as a cycle lasting 240 days & dimension above 37 mm .Feedback on Primary Production by means of mussels grazing. Selective Feeding considered only for larvae. Shell growth was predicted using an empirical equation fitted on Mar Piccolo Mussels growth data (Corriero et al 2001). Meat growth (Temperature and POM dependent) was predicted using a growth equation as in Gangery et. Al. 2004. Carbon content per mussel as in Nalepa et al. 2003.Mussels physiological parameters as in Gragnery et al. 2004. The harvest will be reproduced considering the volume (surface area per depth) of the mussel nets relative to the volume of MP in order to get harvest estimate.



– Insert here the Table of Key Processes (WT4.2) with at least the following information

- Name of the variable and the symbol or abbreviation or name used in the Extend model
- Units of the variable
- Equation and include any approximations used with a reference to DR sect. 4.
- Include the number of the Extend block number in the model where the variable is calculated or copy and paste a screenshot (using the Print Screen key) of the blocks that were used to make the equation in Extend.

Components	Processes	Variables	Symbol	Dimensions	Units	Extend block
Phytoplankton	Light transmission	PAR, TSM	PAR, TSM	[E]/[L^2*T]	$\mu E\ m^{-2}\ s^{-1}$	1889
	Uptake	N, P, Si	N, P, Si	[X]/[L^3]	$\mu mol\ l^{-1}$	1627
	Stratifcation	Wind	Spd, Dir	[L]/[T], [degree]	m s-1,˚T	45-15
	Stratifcation	Vertical density gradient	Δρ/Δz	[M/L^3], L	m/L^4	45-15
	Mixed Layer Depth	Stratification	MLD	L	m	842-572
	Grazing	Zooplankton, Mussels	Gzoo,Gmss	[M]/[T]	$ml\ ind.^{-1}\ day^{-1}$	1751
	Mortality	Virus & Bacteria, Natural	M	[ncell]/[T]	$cell\ day^{-1}$	1781
	growth	Photosynthesis, chlorophyll	PP	[C]/[L^3*T]	$\mu g\ C\ m^{-3}\ s^{-1}$	1701
	Respiration	Metabolic rate	R	[C]/[L^2*T]	$\mu mol\ C\ m^{-2}\ d^{-1}$	1780
Mussels	Filter feeding	POM, size, DOM, larvae, filtration rate	Gmss	[M]/[T]	$ml\ ind^{-1}\ day^{-1}$	2588
	Life cycle	Reproduction	Lc	to be defined	to be defined	2488
	Growth	Feeding	MP	[C]/[ind*T]	$\mu g\ C\ ind.^{-1}\ day^{-1}$	2524
	Mortality	Natural, anoxia, starvation	Mmss	[ind]/[T]	$ind\ day^{-1}$	2554
	Excretion	DOM	Fpmss	[n pellet]/[ind	$pellet\ ind^{-1}\ h^{-1}$	2895
	Temperature	Physical inputs	Tw	Temp	°C	255
Oxygen	Temperature	Physical inputs	Tw	Temp	°C	255
	Vertical mixing	Physical inputs	Kz, Δρ/Δz, Tb	[L^2]/[T]	$m\^\ s^{-1}$	414
	Atmospheric input	Air temp, Osaturation, water temp	O2atm,Ta,Dosat	[O]	μmol O	756
	Respiration	Temperature, metabolic rate of biota	O2resp	[O]	μmol O	1589
	Photosynthesis	Photosynthetic quotient	O2prod	[O]	μmol O	1578
	Depth distribution	Oxicline	ΔO2	[O]/[L^3]	$\mu mol\ O\ m^{-3}$	1412
	Vertical mixing	Physical inputs	Kz, Δρ/Δz, Tb	[L^2]/[T]	$m\^\ s^{-1}$	414
	Runoff input	Air temp, saturation, water temp	O2atm,Ta,Dosat	[O]	μmol O	995
	Respiration	Temperature, metabolic rate of biota	O2resp	[O]	μmol O	1115
	Photosynthesis	Photosynthetic quotient	O2prod	[O]	μmol O	895

Components	Processes	Variables	Symbol	Dimensions	Units	Extend block
Phosphorus	Temperature	Physical inputs	Tw	Temp	°C	2293
	Vertical mixing	Physical inputs	Kz, Δρ/Δz, Tb	[L^2]/[T]	$m^{\wedge} s^{-1}$	2128
	River input	Air temp, Osaturation, water temp	O2atm,Ta,Dosat	[O]	µmol O	2094
	Respiration	Temperature, metabolic rate of biota	O2resp	[O]	µmol O	2354
	Uptake	Photosynthetic quotient	O2prod	[O]	µmol O	2381
	Sinking	Sinking process	ΔO2	[O]/[L^3]	µmol O m^{-3}	2130
External Inputs	Sunlight	Irradiance	PAR, TSM	[E]/[L^2*T]	µE m^-2 s^{-1}	1889
	Nutr loading	Nutrients	N, P, Si	[X]/[L^3]	µmol liter^-1	922
	Atmospheric	Wind,	W	[L]/[T]	m/s	619
	Atmospheric	Ta	Ta	Temp	°C	255
	Atmospheric	RH	RH	to be defined	to be defined	595
	Atmospheric	Pr	Pr	L/T	mm /h	598
	Atmospheric	Clouds	Cld	to be defined	to be defined	599
	Atmospheric	Nitrogen	Natm	[N]	µmol N m^{-3}	922
	Fresh Water Balance	Rain, evaporation, runoff, grnd water inflow	Runoff,	[L^3]/[T]	m^3 s^-1	30

3.1.c Model calibration

In simulation models, certain parameters are unknown and must be calibrated by adjusting the model output to observations. Long time series are preferred that cover a large range of variability in the output variables.

- Has the model been calibrated against a set of observations (hindcast)? YES/NO
- If YES, provide a brief explanation of the calibration set up identifying the parameters that were calibrated, the field observations that were used, and the cost function. In stead, you can also copy and paste the set up of the evolutionary optimizer if you have used that function to calibrate parameters.
- If NO, make a brief description of how the model was tested by other means, e.g. literature or empirical representations of model output variables, and make a reference to the location in SR where this testing is described more rigorously.

Yes, we have began the calibration of data only with those of salinity and referred to the 2003. We haven't done the Hindcast calibration.

3.2 Economic Component

3.2.a *Data input.* In every model, requires different types of data. The economic data should be added in separate section & format to the Data Input Table above, with at least the following information:

- Name of the data and the symbol or abbreviation used in the Extend model.
- Data type (parameter, boundary condition, forcing function, initial value, other).
- Units
- The number of the block[2] in the Extend model or the Extend database where the data is stored.
- Data source – refer to entry in DR sect. 4.
- Refer to data analysis preformed and refer to entry in SR.

[2] Every extend block that is put on the model sheet receives a number. You can view this number by sliding your mouse over the block

Name	Activity	Rating	Type	Variables	Units of the variable	Duration	Delta T	Conversion	Source	Level	Availability	Purpose	Name in Extend	Extend block number
Mussel Farm	Catch and mussels market	4	1	Legal catch	Kg	max 5 yrs	monthly	estimate date	Private data	1	2	input	Cat_leg	29
		4	1	Illegal catch	Kg	max 5 yrs	monthly	estimate date	Private data	2	3	input/simulation	Cat_illeg	124
		4	1	Catch first time	Kg	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Catch 1	1114
		4	1	Catch second time	Kg	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Catch 2	1134
		4	1	Catch third time	Kg	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Catch 3	1153
		4	1	Price due to quality a first time	€	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Price1	236
		4	1	Price due to quality a second time	€	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Price2	261
		4	1	Price due to quality a third time	€	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Price3	273
		4	1	Catch illegal first time	Kg	max 5 yrs	monthly	estimate date	Private data	2	3	input/simulation	Catch_illeg 1	223
		4	1	Catch illegal second time	Kg	max 5 yrs	monthly	estimate date	Private data	2	3	input/simulation	Catch_illeg 2	1155
		4	1	Catch illegal third time	Kg	max 5 yrs	monthly	estimate date	Private data	2	3	input/simulation	Catch_illeg 3	1193
		4	1	Market import	Kg	max 5 yrs	monthly	estimate date	Public data	1	2	input	Mark_import	52
		4	1	Total market	Kg	max 5 yrs	monthly	estimate date	Private data	1	2	input	Mark_tot	233
	Total cost	4	1	Revenues Taxes	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Revenues Taxes	254
		4	1	Maintence costs	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Maintence	15
		4	1	Labor cost	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Labor	48
		4	1	Insurance cost	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Insurance	18
		4	1	Daily cost	€	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Daily cost	57
		4	1	Vessels	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Vessels	62
		4	1	Equipment	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Equipment	874
		4	1	Trade costs	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Trade costs	148
		4	1	Amortization	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Amortization	733
	Loans	4	1	Capital borrowed	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Capital borrowed	434
		4	1	Max debt accept by bank	€	max 5 yrs	monthly	estimate date	Public data	1	2	input	Max debt accept by bank	275
		4	1	New Loans	€	max 5 yrs	monthly	estimate date	Private data	2	2	input	New Loans	544
		4	1	Loans	€	max 5 yrs	monthly	estimate date	Private data	2		input	Loans	196
		4	1	Other loans	€	max 5 yrs	monthly	estimate date	Private data	2		input	Other loans	83
	Financial managment	4	1	Credit	€	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Cred	651
		4	1	Backpay	€	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Backpay	715
		4	1	Supply debts	€	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	SuppyDebts	631
		4	1	Supply payments	€	max 5 yrs	monthly	estimate date	Private data	1	2	input/simulation	Supply payments	619
		4	1	Active interest rate bank	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Interest act bank	995
		4	1	Passive interest rate bank	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Interest pas bank	1043
		4	1	Reserve	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Reserve	732
		4	1	Part of profits reinvested	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Part of profits reinvested	764
		4		Subsidies	€	max 5 yrs	monthly	estimate date	Public data	2	2	input	Subsidies	59
		4		New Contributions	€	max 5 yrs	monthly	estimate date	Private data	2	2	input	New Contributions	220
		4	1	Profits distribuited among shareholders	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Profits distribuited among	785
		4	1	Initial Capital	€	max 5 yrs	monthly	estimate date	Private data	1	2	input	Capital_Initial	102

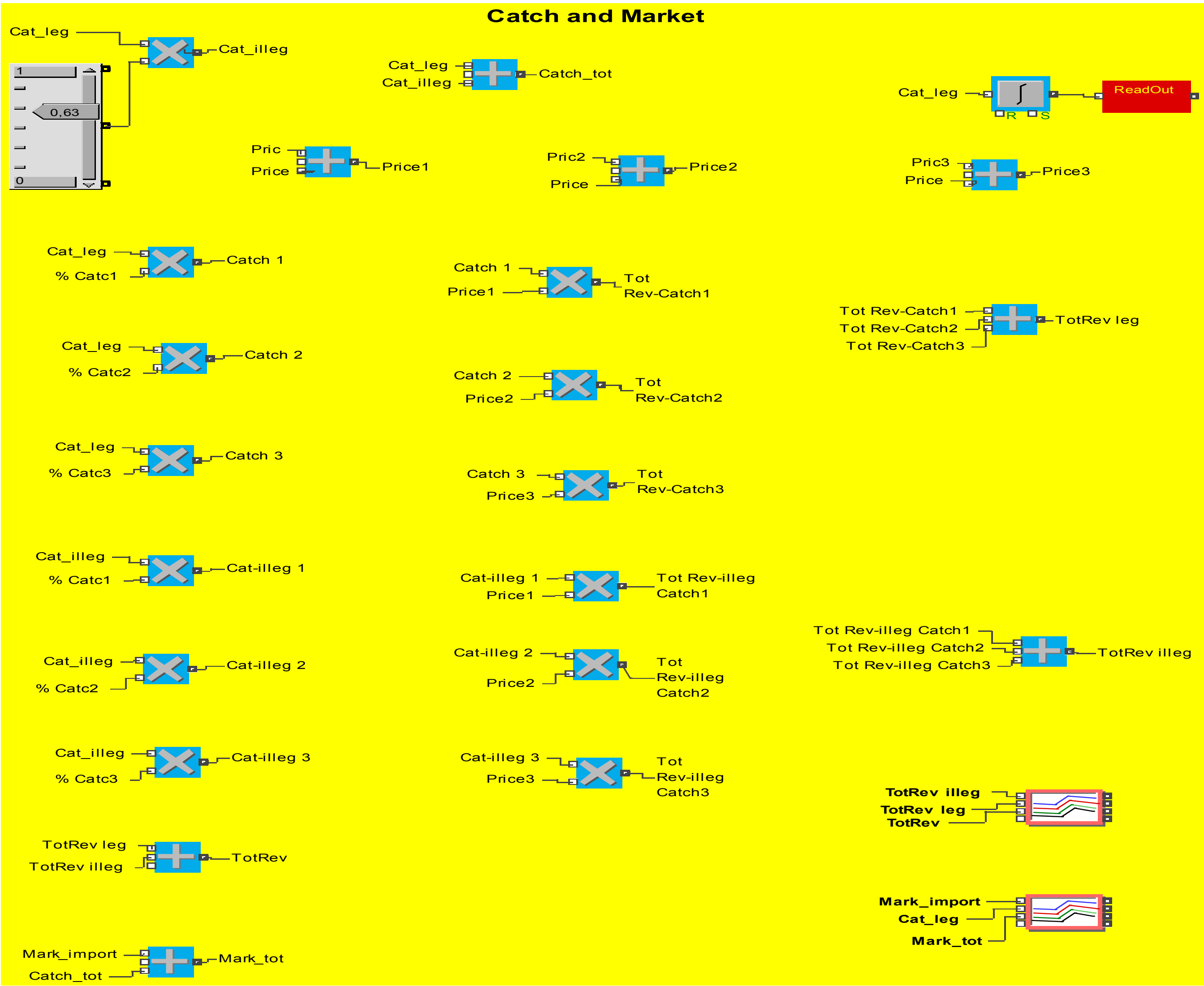
3.2.b *Mathematical formulation.*

- If your Economic Component has a different time step, explain your approach to linking outputs from the NC Model as inputs to EC Model.

- Insert here the Table of Key Processes (WT4.2) with at least the following information.
- Name of the variable and the symbol or abbreviation or name used in the Extend model
- Units of the variable
- Equation and include any simple approximations used with a reference to DR sect. 4 or, for more complicated approximation, to SR.
- Refer to number of the Extend block where the variable is calculated, or copy the equation and paste it as a screenshot (using the Print Screen key) of the blocks that were used to make the equation in Extend.

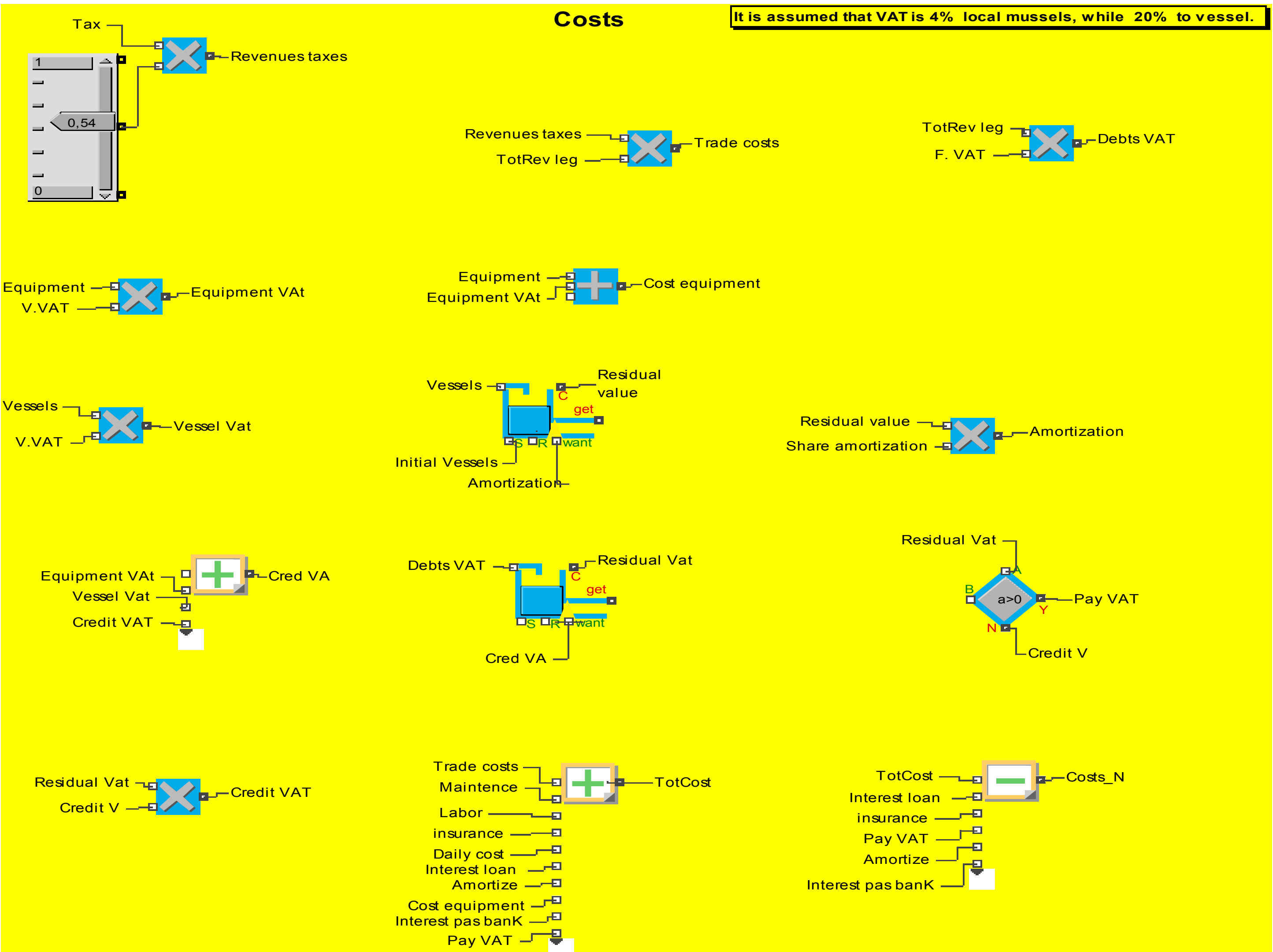
Functional components/Process	Output variable	Output Units	Delta T	Duration	Reference	Level of reference	Name in Extend	The number of the block
Catch and mussels market	Legal catch	Kg	monthly	max 5 yrs	Private data	2	Cat_leg	29
	Illegal catch	Kg	monthly	max 5 yrs	Private data	3	Cat_illeg	124
	Total catch	Kg	monthly	max 5 yrs	Private data	2	Catch_tot	137
	Catch first time	Kg	monthly	max 5 yrs	Private data	2	Catch 1	1114
	Catch second time	Kg	monthly	max 5 yrs	Private data	2	Catch 2	1134
	Catch third time	Kg	monthly	max 5 yrs	Private data	2	Catch 3	1153
	Price due to quality a first time	€	monthly	max 5 yrs	Private data	2	Price1	236
	Price due to quality a second time	€	monthly	max 5 yrs	Private data	2	Price2	261
	Price due to quality a third time	€	monthly	max 5 yrs	Private data	2	Price3	273
	Total revenue catch 1	€	monthly	max 5 yrs	Private data	2	Tot Rev-Catch1	1123
	Total revenue catch 2	€	monthly	max 5 yrs	Private data	2	Tot Rev-Catch2	1142
	Total revenue catch 3	€	monthly	max 5 yrs	Private data	2	Tot Rev-Catch3	1161
	Total revenue legal	€	monthly	max 5 yrs	Private data	2	Tot Rev leg	157
	Catch illegal first time	Kg	monthly	max 5 yrs	Private data	2	Catch_illeg 1	223
	Catch illegal second time	Kg	monthly	max 5 yrs	Private data	2	Catch_illeg 2	1155
	Catch illegal third time	Kg	monthly	max 5 yrs	Private data	2	Catch_illeg 3	1193
	Total revenue illegal catch 1	€	monthly	max 5 yrs	Private data	2	Tot Rev-illeg Catch1	837
	Total revenue illegal catch 2	€	monthly	max 5 yrs	Private data	2	Tot Rev-illeg Catch2	1182
	Total revenue illegal catch 3	€	monthly	max 5 yrs	Private data	2	Tot Rev-illeg Catch3	1198
	Total revenue illegal	€	monthly	max 5 yrs	Private data	2	Tot Rev illeg	202
	Total revenue	€	monthly	max 5 yrs	Private data	2	Tot Rev	1191
	Total market	Kg	monthly	max 5 yrs	Public data	2	Mark_tot	233
Total Cost	Revenues Taxes	€	monthly	max 5 yrs	Private data	2	Revenues Taxes	254
	Trade costs	€	monthly	max 5 yrs	Private data	2	Trade costs	148
	Debts VAT	€	monthly	max 5 yrs	Private data	2	Debts VAT	321
	Equipment VAT	€	monthly	max 5 yrs	Private data	2	Equipment VAT	879
	Cost Equipment	€	monthly	max 5 yrs	Private data	2	Cost equipment	814
	Vessel VAT	€	monthly	max 5 yrs	Private data	2	Vessel VAT	366
	Residual Value	€	monthly	max 5 yrs	Private data	2	Residual Value	640
	Amortization	€	monthly	max 5 yrs	Private data	2	Amortization	733
	Credit VAT	€	monthly	max 5 yrs	Private data	2	Credit VAT	407
	Credit VA	€	monthly	max 5 yrs	Private data	2	Credit VA	356
	Residual VAT	€	monthly	max 5 yrs	Private data	2	Residual VAT	329
	Pay VAT or Credit VAT	€	monthly	max 5 yrs	Private data	2	Pay VAT or Credit VA	391
	Total cost	€	monthly	max 5 yrs	Private data	2	TotCost	248
	Total net cost	€	monthly	max 5 yrs	Private data	2	Costs_N	256
Economic account	Net Revenue	€	monthly	max 5 yrs	Private data	2	Net Rev	791
	Profits	€	monthly	max 5 yrs	Private data	2	ProfAvail	774
	Loss	€	monthly	max 5 yrs	Private data	2	Loss	781
Loans	Capital borrowed	€	monthly	max 5 yrs	Private data	2	Capital borrowed	434
	Istallment of the loan	€	monthly	max 5 yrs	Private data	2	Istallment of the loan	565
	Interest loan	€	monthly	max 5 yrs	Private data	2	Interest loan	485
	Share Capital	€	monthly	max 5 yrs	Private data	2	Share capital	371
	Residual Debt	€	monthly	max 5 yrs	Private data	2	Residual Debt	475
	Total Debts	€	monthly	max 5 yrs	Private data	2	Debts Tot	511
	Max debt accept by bank	€	monthly	max 5 yrs	Public data	2	Max debt accept by bank	275
	New Loans	€	monthly	max 5 yrs	Private data	2	New Loans	544
	Variable costs	€	monthly	max 5 yrs	Private data	2	Variable costs	438
	Loss covered capital	€	monthly	max 5 yrs	Private data	2	Loss covered capital	451
Financial managment	Bank Input	€	monthly	max 5 yrs	Private data	2	BankIN	611
	Credit	€	monthly	max 5 yrs	Private data	2	Cred	651
	Backpay	€	monthly	max 5 yrs	Private data	2	Backpay	715
	Consumer debts	€	monthly	max 5 yrs	Private data	2	Consumer debts	582
	Supply debts	€	monthly	max 5 yrs	Private data	2	SuppyDebts	631
	Supply payments	€	monthly	max 5 yrs	Private data	2	Supply payments	619
	Debts to supplier	€	monthly	max 5 yrs	Private data	2	Debts to supplier	621
	Costs	€	monthly	max 5 yrs	Private data	2	Costs	620
	Badget Bank	€	monthly	max 5 yrs	Private data	2	Badget Bank	590
	C/C Positive	€	monthly	max 5 yrs	Private data	2	C/C Positive	1012
	C/C Negative	€	monthly	max 5 yrs	Private data	2	C/C Negative	1034
	Active interest rate bank	€	monthly	max 5 yrs	Private data	2	Interest act bank	995
	Passive interest rate bank	€	monthly	max 5 yrs	Private data	2	Interest pas bank	1043
	Reserve	€	monthly	max 5 yrs	Private data	2	Reserve	732
	Part of profits reinvested	€	monthly	max 5 yrs	Private data	2	Part of profits reinvested	764
	Profits distribuited among shareholders	€	monthly	max 5 yrs	Private data	2	Profits distribuited among shareholders	785
	Capital	€	monthly	max 5 yrs	Private data	2	Capital	661
Patrimony	Assets	€	monthly	max 5 yrs	Private data	2	Assets	919
	Liabilities	€	monthly	max 5 yrs	Private data	2	Liabilities	931

The **economic model** comes out from a bio-economic model referred to fishing (see Lleonard J. 2003). In the economic simulation we have hypothesized the whole Mar Piccolo as a one mussel farm. We considered one farm because mussel farm in Mar Piccolo are rather homogeneous (the same technology, the same production cycle, etc), being differentiated only by the size of the system of cultivation. In particular, the harvest is due to the function growth which determines the quantity as well as the quality of mussels. We have hypothesized three period with different percentage of catch, where each catch has a different price due to the quality level. We have determined the market price by using a formula which combines the quality index (conversion index) and the mean price. The revenue is given by multiplying the price and quantity of each catch and the total revenues were referred to the real cash money period. We have assumed that revenue are 90% for cash while the remaining 10% are loans to customers.

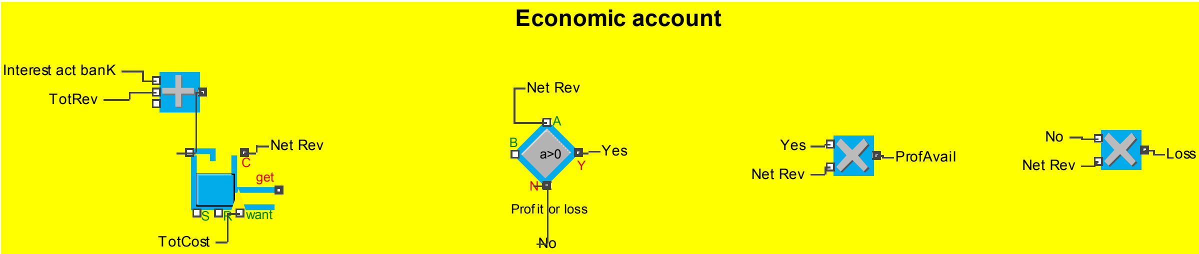


Moreover, We have considered the total costs borne by the mussel farm; which were referred to the real disbursement money period. We have also considered the possibility to immediately bear 90% of costs and to pay the remaining costs through debts to suppliers.
The costs are:

- ✓ **Trade cost:** all costs that are possible to express as a percentage of the total revenues, for example VAT, local taxes and sale process;
- ✓ **Daily costs**: these are the costs caused by activity (fuel, net mending) excluding labour cost;
- ✓ **Labour costs;**
- ✓ **Compulsory costs: these are the fixed costs (license, insurance);**
- ✓ **Maintenance costs:** costs that are indispensable to meet to remain in activity;
- ✓ **Financial costs:** Interest and capital return on bank loans. In case of loss, debts arise and any further investment necessitates bank loans. This cost depends on banking interest rates and the individual debts incurred.

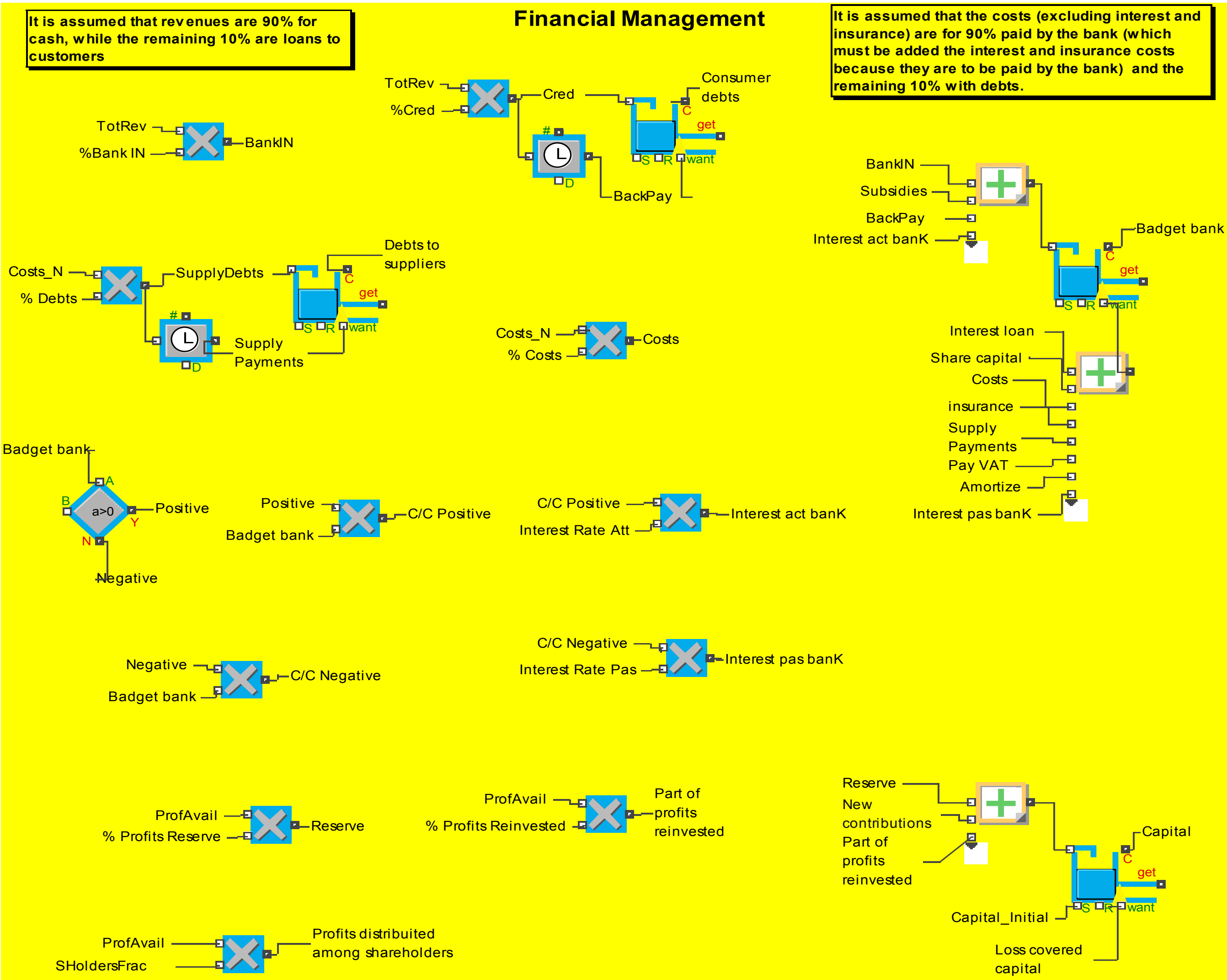


If total revenues are higher than total costs the mussel farm will have a profits, on the contrary it will have a loss.



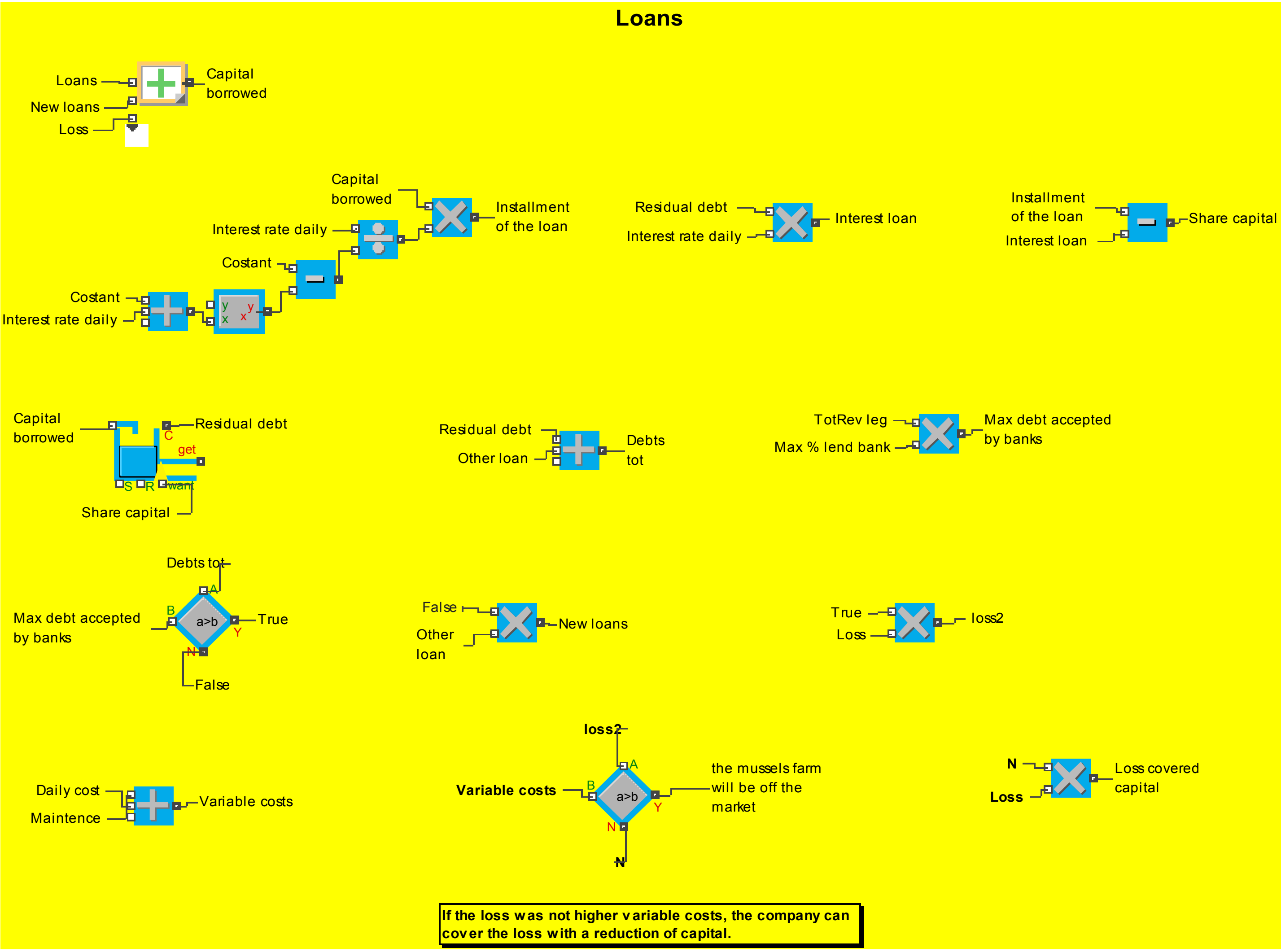
If the economic outcome is a profit:

- ✓ part of the profit is reinvested;
- ✓ a portion is allocated to the reserve;
- ✓ the remaining part is given to shareholders.



If the economic outcome is a loss:

- ✓ The mussel farm can ask another loans in case it has not exceeded the maximum amount the bank can grant.
- ✓ When the total debts are higher than maximum debts accept by the bank, and if the loss is higher than variable costs, the mussels farm will be off the market.
- ✓ If loss is lower than variable costs, the company can cover the loss by reducing the capital.



3.2.c Model calibration

In simulation models, certain parameters are unknown and must be calibrated by adjusting the model output to observations. Long time series are preferred that cover a large range of variability in the output variables. Finding this data may be more difficult for the Social and Economent Component models and time period may not match, which is why they are calibrated separately.

- Has the model been calibrated against a set of observations, as a hindcast in WT 4.3a? YES/NO
- If YES, provide a brief explanation of the calibration set up and identify the parameters that were calibrated, the field observations that were used, and the cost function. Instead, you can also copy and paste the set up of the evolutionary optimizer if you have used that function to

calibrate parameters. Please refer to any relevant entries in the SR.

- If NO, make a brief description of how the model was tested by other means, e.g. literature or empirical representations of model output variables, and make a reference to the location in SR where this testing is described more rigorously.

No. The economic model comes out from a bio-ecologic model referred to fishing. One of the main problem which we have encountered is the lack of data, so we had to use data of uncertain source.

A questionnaire is being formulated such that these values will be completed and improved.

3.3 Social Component

3.3.a *Data input.* In every model, requires different types of data. The social data should be added in separate section & format to the Data Input Table above, with at least the following information:

- Name of the data and the symbol or abbreviation used in the Extend model
- Data type (parameter, boundary condition, forcing function, initial value, other)
- Units
- The number of the block[3] in the Extend model or the Extend database where the data is stored
- Data source – refer to entry in DR sect. 4.
- Data analysis preformed – refer to entry in SR.

[3] Every extend block that is put on the model sheet receives a number. You can view this number by sliding your mouse over the block

		Type	Variable	Units	Delta T	Duration	Conversion	Source	Level	Availability	Data purpose	Extend block
Mussel farmers	Typology	**4**	legal	N	Monthly	5 yrs	4	INPS	1	1	Input data	72, 84,
		4	illegal	N	Monthly	5 yrs	4	Empirical	1	3	Input data	131,140, 149
		4	tarantine mussel farmers	%	Monthly	5 yrs	4	Registry Office	1	3	Input data	361
		4	outside mussel farmers	%	Monthly	5 yrs	4	Registry Office	1	3	Input data	429
	Income	**4**	legal	€	Monthly	5 yrs	4	INPS	1	1	Input data	177
		4	illegal	€	Monthly	5 yrs	4	Calculate	1	3	Input data	181
	Expenses	**3**	sanitary cost	%	Monthly	5 yrs	4	ASL	1	2	Input data	263
		3	travel cost	€	Monthly	5 yrs	4	Calculate	1	3	Input data	480
		3	family cost	%	Monthly	5 yrs	4	Empirical	1	2	Input data	56
Public Perception	Local Economy	**3**	Mussels consumption	Without	Sporadic	none	4	Empirical	1	1	Analysis	Not yet modeled
	Perception of own quality life	**4**		Without	Sporadic	none	4	Empirical	1	1	Analysis	Not yet modeled

3.3.b Mathematical formulation

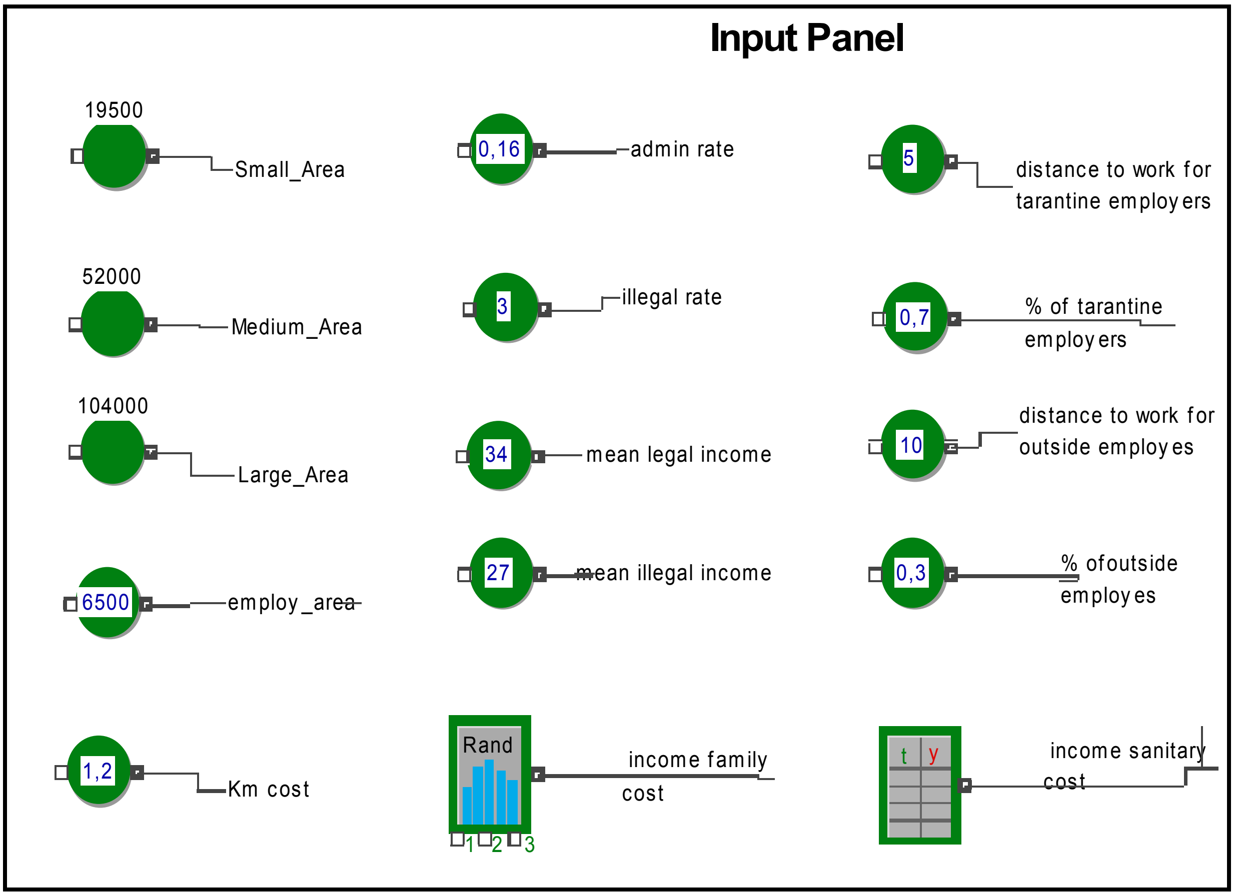
In every model, variables are calculated and updated at each time step using an equation.

- Insert here the Table of Key Processes (WT4.2) with at least the following information
- Name of the variable and the symbol or abbreviation or name used in the Extend model
- Units of the variable and time step.
- Equation and include any approximations used with a reference to section 4.
- The number of the block in the Extend model where the variable is calculated or copy and paste a screenshot (using the Print Screen key) of the blocks that were used to make the equation in Extend

Because of the difficult to apply mathematical formulas to the Social Components, we have simulated only a little part of SC building a very simple model with only one block and without equations but with calculations showed in the table 3.2.c. We haven't tried an other social model to whom referred or used for the calibration.

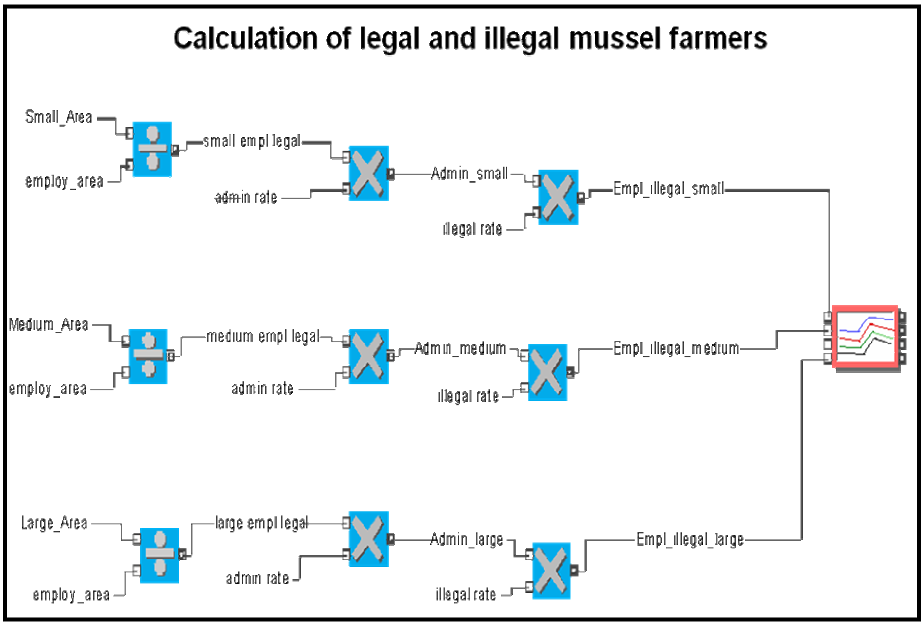
The most important part is the **input table** in which are several constants represented as follows:

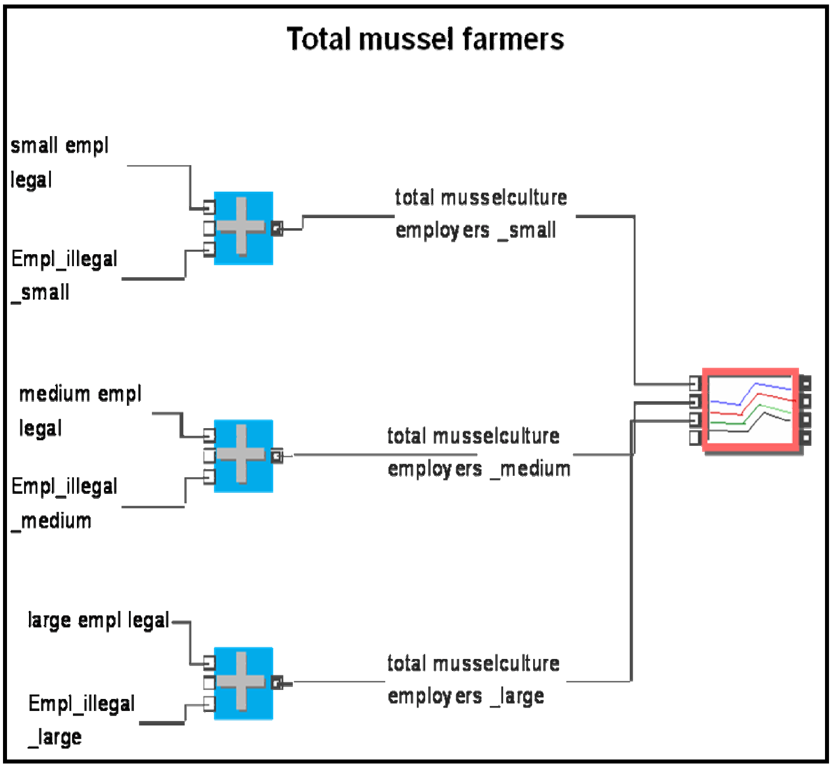
- We have divided the farms in three types using as parameter the dimension: until 19.500 mq, until 52.000 mq and until 104.000 mq. These is the extens meter given in grant by the Port Authority.
- We know that in average there is one legal worker each 6500 mq (employ_area).
- The number of illegal employees was calculated on the base of the number of administrators of the cooperatives. We have assumed the presence of 3 workers for 1 admin (illegal rate).
- The legal income is calculated for each day.
- The illegal income was calculated considering the legal income. It is necessary to subtract the tax that the admin pays for their employees (about 20%) to the legal income .
- Moreover we are trying to calculate the most important costs for the employees. Travel, sanitary and family costs. About the travel cost, we have assumed that 70% of employees lives in Taranto and 30% lives in the neighborhood and we have assumed also that the distance to cover is around 5 and 10 km for the two categories respectively. About family costs we have used an Input Random Number with a definite range. About sanitary costs we have assumed a peak in summer~~y~~ period, i.e. the catch period during which most accidents could happen.



The effective **number of employees** was calculated in base of the mq given in grant using the constant “employ_area” because the data of the total number of employees that work in a farm include also the fishers and we need only of mussel farmers.

The illegal number of mussel farmers, instead, is obteined using the constant “illegal rate”.

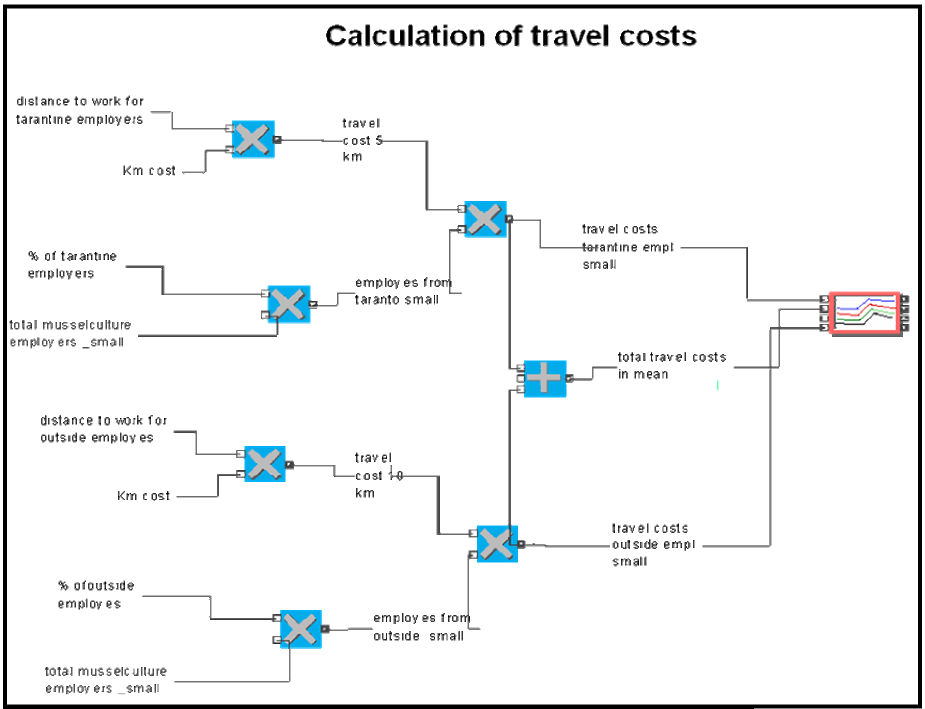


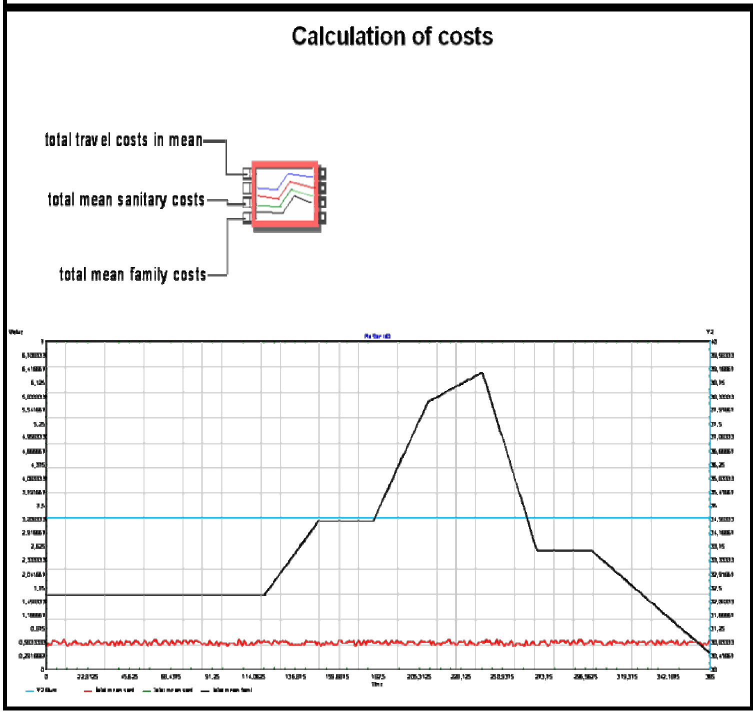


Here we have the **total number of mussel farmers**, including the illegal employees.

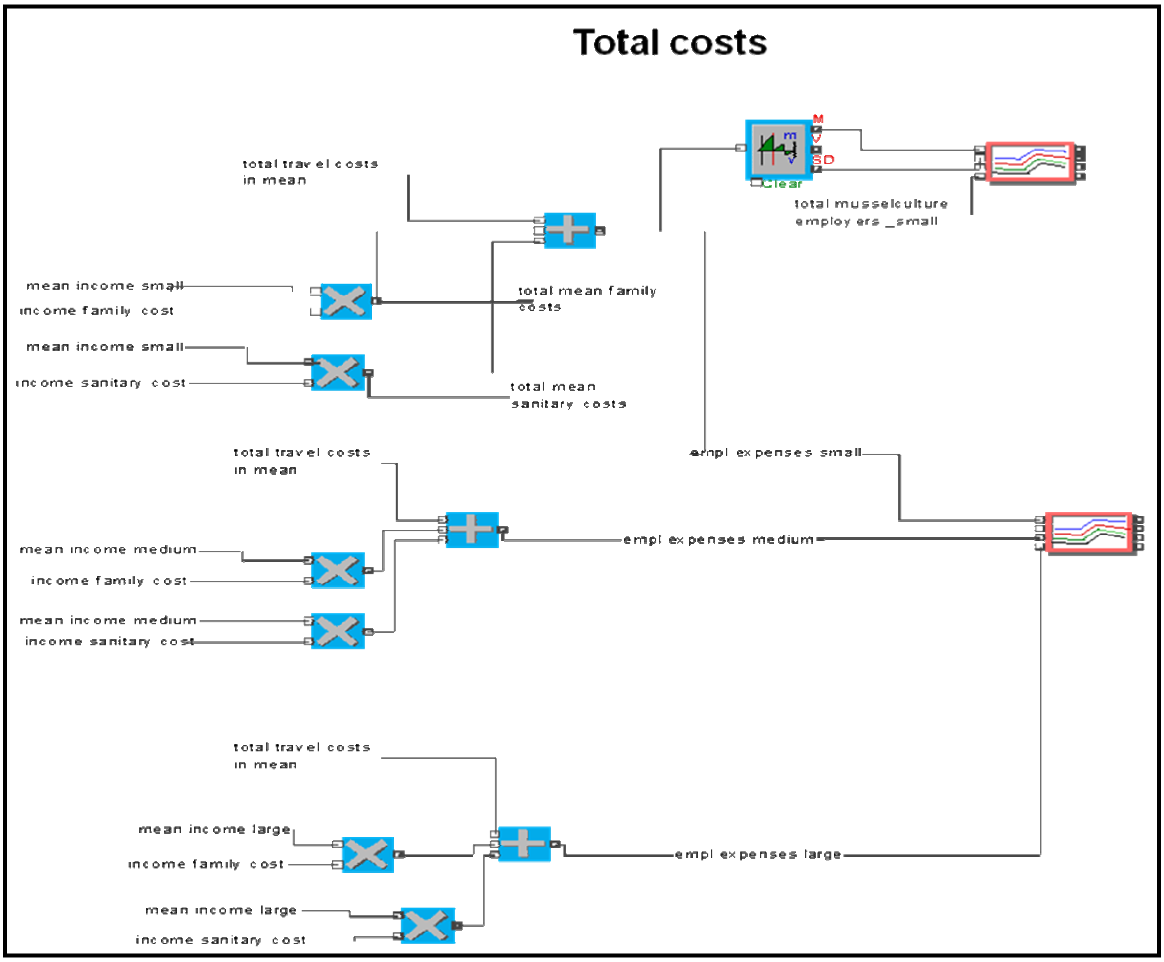
To **calculate travel cost** for all the employees for each type of farms, we multiply the distance to work for local and for outside employees for the km cost and we sum them. So we have the cost for tarantine mussel farmers, the cost for outside mussel farmers and the mean cost.

Summing the mean cost we have this representation with the **costs** calculated singularly.

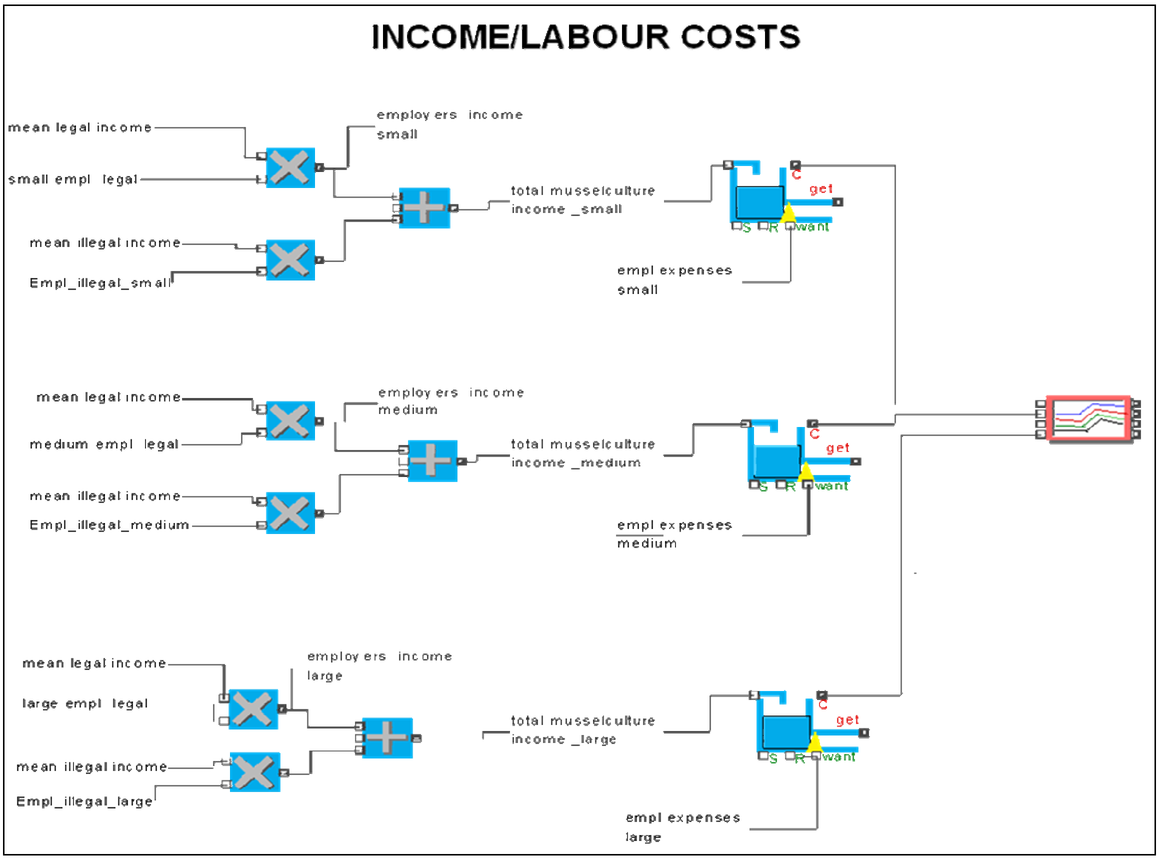




To have **total costs** we have to sum the total mean family costs, total mean sanitary costs and total mean travel cost for every type of farm (small, medium and large) and summed each other.



To calculate the **income**, that represents the **labour cost** of Economic part, we sum the mean legal income and the mean illegal income and multiply for every category of farms. The results are in the holding tank in which we'll put on the different cost for each type of farm.


INCOME/LABOUR COSTS
mean legal income
small empl legal
employers income small
mean illegal income
Empl_illegal_small
total musselculture income _small
get
want
empl expenses small
mean legal income
medium empl legal
employers income medium
mean illegal income
Empl_illegal_medium
total musselculture income _medium
get
want
empl expenses medium
mean legal income
large empl legal
employers income large
mean illegal income
Empl_illegal_large
total musselculture income _large
get
want
empl expenses large

Components	Processes/Variables	Symbol	Calculates	Units	Extend block
Mussel farmers	Small farm area	small_area	/	mq	52
	Medium farm area	medium_area	/	mq	60
	Large farm area	large_area	/	mq	61
	Employees rate per area	employ_area	/	N	71
	0.16 illegal people per each administrator	admin rate	/	N	8
	Relationship between illegal and legal rate	illegal rate	/	N	127
	Mean legal income	mean legal income	1120/26	€	177
	Mean illegal income	mean illegal income	(1120/26)-20%	€	181
	Legal employees of small farm	small empl legal	Small_area/employe_area	N	72
	Legal employees of medium farm	medium empl legal	Medium_area/employe_area	N	84
	Legal employees of large farm	large empl legal	Large_area/employe_area	N	94
	Illegal employees of small farm	empl_illegal_small	admin_small*illegal rate	N	131
	Illegal employees of medium farm	empl_illegal_medium	admin_medium*illegal rate	N	140
	Illegal employees of large farm	empl_illegal_large	admin_large*illegal rate	N	149
Expenses	Cost per km	km cost	/	€	290
	Income family cost	income family cost	/	€	56
	Income sanitary cost	income sanitary cost	/	€	263
	% of tarantine employees	% of tarantine employes	N of tarantine employees/N of tarantine employees+N of outside employees	%	361
	Route covered to arrive to work for tarantine employees	distance to work for tarantine employes	/	km	289
	Route covered to arrive to work for outside employees	distance to work for outside employes	/	km	366
	% of outside employees	% ofoutside employes	N of outside employees/N of tarantine employees+N of outside employees	%	429
	Total travel cost in mean	total travel cost in mean	km cost*distance to work	€	480
	Total mean family cost	total mean family cost	mean income*income family cost	€	256
	Total mean sanitary cost	total mean sanitary cost	mean income*income sanitary cost	€	269

3.3.c Model calibration

In simulation models, certain parameters are unknown and must be calibrated by adjusting the model output to observations. Long time series are preferred that cover a large range of variability in the output variables. Finding this data may be more difficult for the Social and Economic Component models and time period may not match, which is why they are calibrated separately.

- Has the model been calibrated against a set of observations? YES/NO

If YES, provide a brief explanation of the calibration set up identifying the parameters that were calibrated, the field observations that were used, and the cost function. Instead, you can also copy and paste the set up of the evolutionary optimizer if you have used that function to calibrate parameters.

- If NO, make a brief description of how the model was tested by other means, e.g. literature or empirical representations of model output variables, and make a reference to the location in SR where this testing is described more rigorously.

No. As reported for the EC, one of the main problem which we have encountered is the paucity of data. Also in this case, a questionnaire is being formulated to complete the set of informations.

4 Data for archives

4.1 Data Source files. This is to provide WP9 a preview of data archiving needs)

In reference to entries in Data Input table (item 3.1) provide the

- Data file name
- Size of file
- Data format (e.g. text, ASCII, excel, etc.)
- Number of variables

In the following table we are reporting a list of the variable used in the model, the reference of the literature, the source of the information, the working team which had produced such data and the net and e-mail address of the responsible researcher. The use of these data would be allowed only and only under the authorization of the source.

Name	Activity	Variables	Reference	Source	Working team	Responsible e-mail address and/or net address
Meteorological data	Atmospheric	Wind, Irradiance, Atmospheric pressure, Relative humidity, Cloud		Regional Source: Assocodipuglia (Associazione Regionale Consorzi Regione Puglia)		www.agrometeopuglia.it
		Precipitation, Air temperature		Regional Source: Istituto Idrografico e Mareografico Settore Protezione Civile Regione Puglia		www.idrografico.puglia.it
Environmental components	Marine	**2003**: Water temperature, salinity, pH, turbidity, dissolved O2, N, P, Si, TSM, POM, Chlorophyll a		IAMC-CNR, Section of Taranto: Alabiso G.	Alabiso G., Milillo M., Ricci P.	giorgio.alabiso@iamc.cnr.it
		1991-1992: Water temperature, salinity, dissolved O2, N, P, Si, Chlorophyll a	1	IAMC-CNR, Section of Taranto: Caroppo C. & Cardellicchio N.		carmela.caroppo@iamc.cnr.it, nicola.cardellicchio@iamc.cnr.it
Biological components	Phytoplankton	**1996-1997;2002-2003:** abundance and species composition	2	IAMC-CNR, Section of Taranto: Saracino O.D., Rubino F.		fernando.rubino@iamc.cnr.it
		1991-1994; 2001; 2007: abundance and species composition	1,3,4	IAMC-CNR, Section of Taranto: Caroppo C.	Caroppo C., Bisci P.	carmela.caroppo@iamc.cnr.it
	Plankton cysts	**1996-1997; 2002-2003; 2004-2005; 2006; 2007:** cyst bank composition and dynamics	10,11,12, 13	IAMC-CNR, Section of Taranto: Rubino F.	Rubino F., Belmonte M.	fernando.rubino@iamc.cnr.it
	Mussels	**1975; 2008**: Biometry and Growth	5,6,7	IAMC-CNR, Section of Taranto: Pastore M.	Pastore M., Prato E., Biandolino F.	michele.pastore@iamc.cnr.it; linda.prato@iamc.cnr.it;
		2004-2005: Biometry and Growth	9	IAMC-CNR, Section of Taranto: Cecere E., Fanelli G.	Cecere E., Fanelli G., Petrocelli A., Portacci G.	ester.cecere@iamc.cnr.it; giovanni.fanelli@iamc.cnr.it

Name	Activity	Variables	Reference	Source	Working team	Responsible e-mail address and/or net address
Urban Drainings	Sewages	**1995:** N, P, BOD, COD, POM, Discharge rate	8	IAMC-CNR, Section of Taranto:Cardellicchio N.	Cardellicchio N., Di Leo A, Giandomenico S., Annichiarico C.	n.cardellicchio@iamc.cnr.it, dileo@iamc.cnr.it
		1999-2006: N, P, Si, BOD, COD, POM, TSM, Discharge rate		Province of Taranto - Ecology and Environment; Regional Agency for the Environmental Protection		www.provincia.taranto.it; www.arpa.puglia.it
Contaminants	Chemical contaminants	Heavy metals, PCBs, PAHs			Cardellicchio N., Di Leo A, Giandomenico S., Annichiarico C.	n.cardellicchio@iamc.cnr.it, dileo@iamc.cnr.it; santina.giandomenico@iamc.cnr.it
	Biological contaminants	Harmful Algal Blooms species			Caroppo C., Rubino F., Belmonte M., Bisci P.	carmela.caroppo@iamc.cnr.it; fernando.rubino@iamc.cnr.it
		Bacteria			Cavallo R.A., Stabili L., Narracci M., Acquaviva M.	rosanna.cavallo@iamc.cnr.it
Economic data	Mussel Farm	Catch and mussels market		Interviews with operators in the sector; ISMEA (Istituto di Servizi per il Mercato Agricolo Alimentare)		http://www.ismea.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/2292
		Total cost, total revenue, loans, financial managment		Interviews with operators in the sector; Camera di Commercio of Taranto		http://www.camcomtaranto.com/
Social data	Farm area	Space (m2)		Port Authority		http://www.port.taranto.it/
	Musselculture Employees	Number, age, administrators, workers, family composition		INPS (Istituto Nazionale Previdenza Sociale): Baldassarre A.		http://www.inps.it/home/default.asp
		Provenance		Registry Office		antonio.baldassarre@inps.it;http://www1.agenziaentrate.it/indirizzi/agenzia/uffici_locali/
	Income	Qualification, type of job, type of contract, contractual hour, number of paid days, income		INPS (Istituto Nazionale Previdenza Sociale): Baldassarre A.		antonio.baldassarre@inps.it; http://www.inps.it/home/default.asp

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[2] Caroppo C., Saracino O.D., Alabiso G., Giacomini M. (2005). Phytoplankton assemblages and environmental variability in the Mar Piccolo of Taranto (Southern Italy, Ionian Sea). 2nd International conference "European lagoons and their watersheds: function and biodiversity", Klaipeda, Lithuania, October 4-9, 2005. Abstract book.

[3] Caroppo C., Cardellicchio N., Cavallo R. 1994 - Ciclo annuale del fitoplancton nei mari di Taranto: influenza della qualità delle acque. Biol. Mar. Medit., 1 (1): 201-206.

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[13] Santese N. 2007. La banca di cisti del plankton nei mari di Taranto: uno studio su differenti scale spaziali di osservazione. Tesi di Laurea Università di Lecce.

4.2 Data Analysis. This may overlap with the Science Report – present here only the technical details and refer to section in SR for the more complete discussion.

- Synthesize the analysis needed to define system: e.g. needed to understand the vertical or horizontal structure of estuary, selection of dominant phytoplankton groups, number of employees in an activity, variability of tourist population, relevant governance, etc
- Analysis needed to convert inputs, as explained in WT4.1.
- Approximations used to adapt available data to that required in the model formulation, see WT 4.1. This should include conversion tables, empirical constants, etc.

5 Questions, remarks, or other information necessary to describe your Simulation models (optional)

References of economic methods

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Tibor Neugebauer*"Bioeconomics of sustainable harvest of competing species: a comment"* http://129.3.20.41/eps/othr/papers/0503/0503012.pdf

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