SPICOSA SSA n°10 Pertuis Charentais: freshwater management on the Charente river basin and its coastal zone

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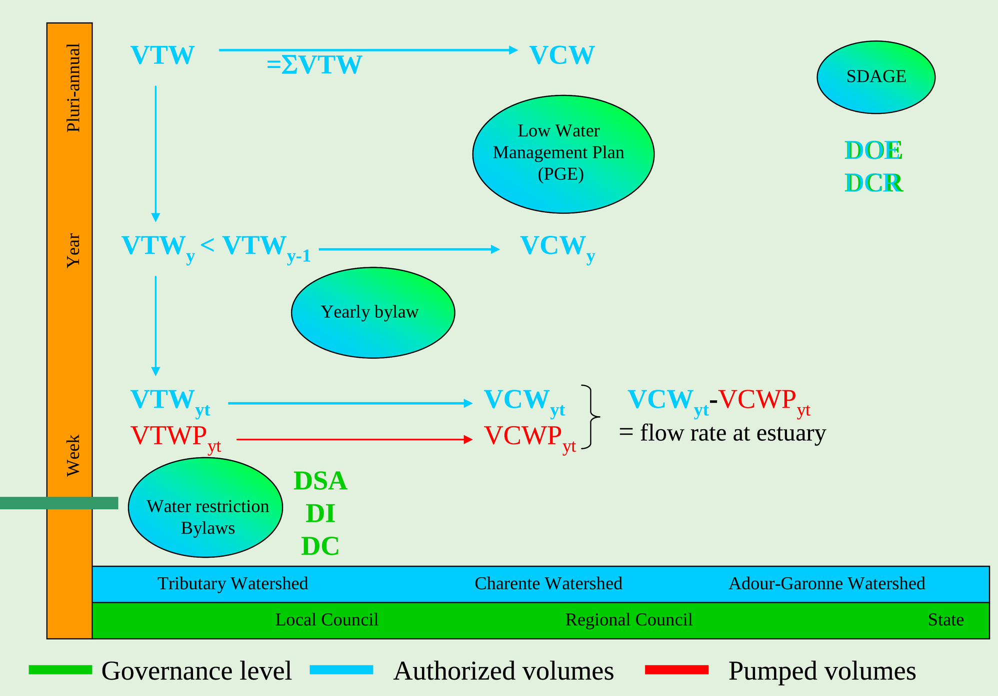
SCIENCE AND POLICY INTEGRATION FOR COASTAL SYSTEM ASSESSMENT

SSA n°10 – PERTUIS CHARENTAIS

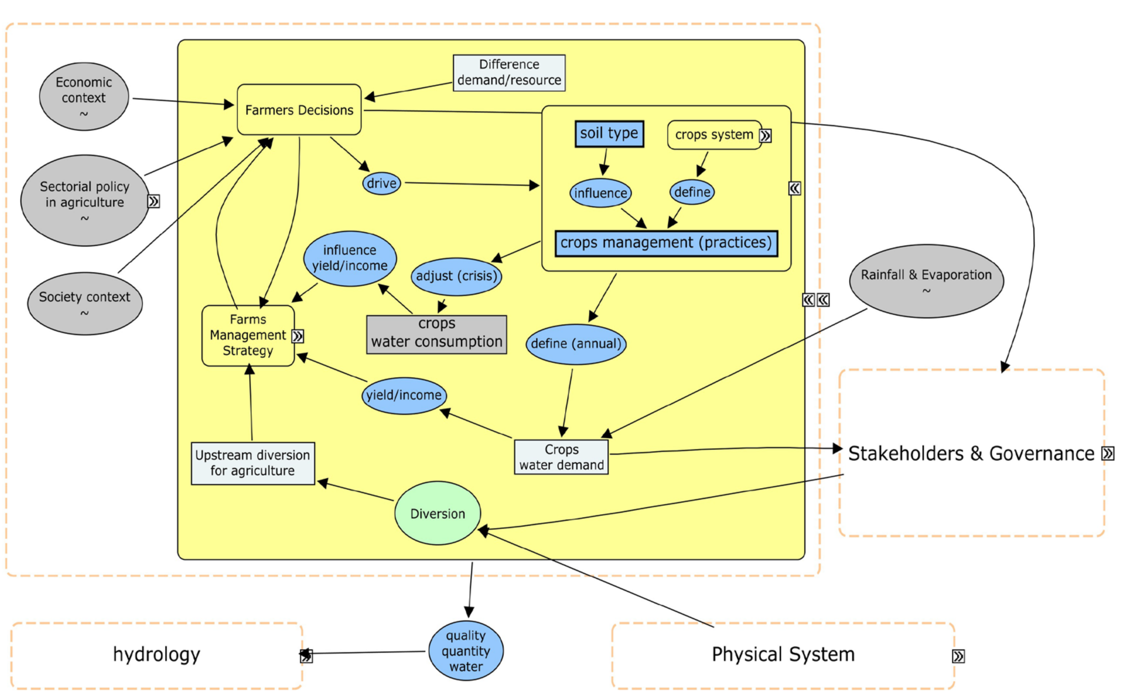
The Charente river basin and the Pertuis Sea

FRESHWATER MANAGEMENT ON THE CHARENTE RIVER BASIN AND ITS COASTAL ZONE

Regulation system of freshwater uses



AGRICULTURE



Agriculture

Aim: Because of an important increase of irrigated areas since the 70s, Charente river basin face important imbalance between the available water resources and uses. The relationships between agricultural activities and the water resources (water demand for crops, diffuse pollution pressure) must be characterized upstream (main irrigated area) and downstream.

Processes:

Several temporal scales need to be addressed:

- An inter-annual management: which type of crops in which area (risk assessment)? Depending on the climate of previous years, the market, the previous results of the farmer (satisfaction of the water demand for crops, yield, profit)
- A day-to-day management during low-flow periods (no irrigation or limitation depending on bylaws) :

If the water demand for crops not satisfied **then** decreasing of yield and profit (no possibility to change the crop area during the crisis period)

If the water demand for crops satisfied (rainy climate or dams) **then** maximisation of profit

Inputs: SAU (crops area), irrigated SAU, type of crops, technical management, climatic conditions (ETR rainfall)

Necessary data:

Agricultural practices/ crop system /geographical area

Outputs:

Water demand for crops

Pressure indicators (spatialized or aggregated)

Technical and economical results/year (depending on the satisfaction of the water demand)

Scenarios:

Decreasing the irrigated area

Substitution with new crop rotations (less water needed)

Policies (taxes for irrigation, funding for sustainable systems)

First results: classification of ZH hydrological areas (8 types = f(soil occupation, slopes, soils, drainage, crops) and calculation of pressure indicators on the area

Analysis of statistical data (Agricultural Census and CAP) to define a typology of agricultural practices/crop system

GOVERNANCE SYSTEM

Summer restrictions on water pumping for irrigation

Farmers are allowed to pump a maximum annual volume ($VTW_{y)}$ of freshwater for irrigation. At the beginning of summer (16th June), a yearly bylaw authorizes farmers to pump a maximum volume (VTW_{yt} – For year y and ten days period t) reduced by the prior pumping from 1st April to 15th June (V_{cons}).

$$VTW_{yt} = VTW_y – V_{cons}$$

At each ten days period t, measured flow rates of each tributary is compared to thresholds defined by law each year. Restriction are applied on pumping allowance if flow rate are under threshold.

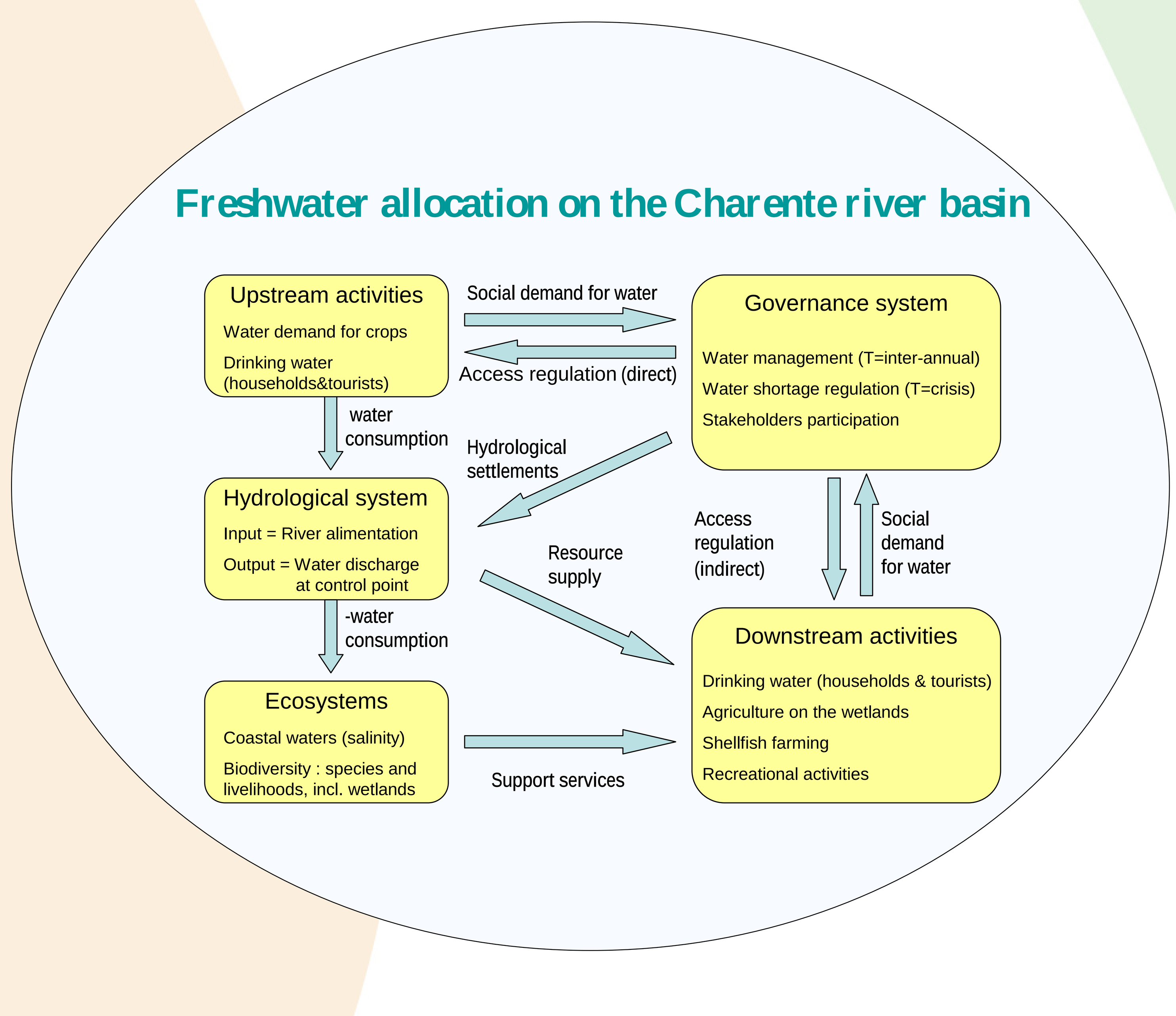
Flow rates Thresholds	Objective
Objective Thresholds	
DOE : Low Flow	drinking water, wildlife and all uses preserved
DCR : Crisis	drinking water, wildlife not preserved
Retriction thresholds	
DSA : Alert	prevents DOE, restriction
DI : Intermediary	prevents DCR, restriction
DC : cut	no more pumping allowed

Restrictions are calculated as a decreasing percentage (α_t, β_t, μ_t) applied to the maximum authorized volume (VTW_{yt}). α_t, β_t, μ_t are given each year by law and depends on the period (decreasing from 15th June to 1st September).

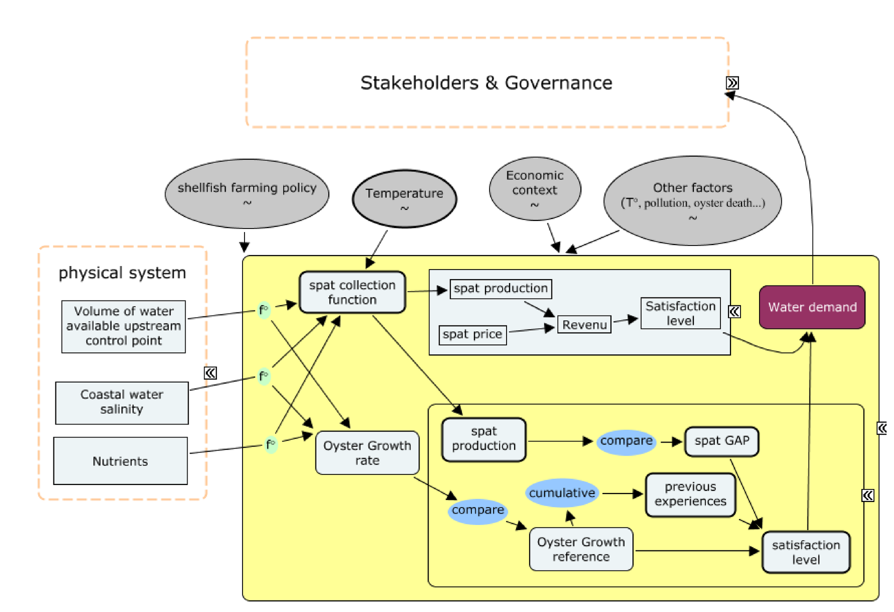
Table of restrictions on Volumes during summer

Flow rates Thresholds	VTW_{yt} before exceeding thresholds	decreasing percentage	VTW_{yt} when exceeding thresholds
DSA	VTW_{yt}	α_t	$VTW_{yt} (1 – \alpha_t)$
DOE			
DI	$VTW_{yt} (1 – \alpha_t)$	β	$[VTW_{yt} (1 – \alpha_t)](1 – \beta_t)$
DC	$[VTW_{yt} (1 – \alpha_t)](1 – \beta_t)$	$\mu_t = 1$	0
DCR			

The SSA10 formulation approach



SHELLFISH FARMING



Aim

This economic activity is concerned by the water management by the fact that water represents an economic production factor for the oyster cultures (spat and adults).

Basic segmentation of companies :

- Companies specialised on spat collection (collect and sell spat)
- Other companies (produce and/or sell oysters at collect a part of their spat needs)

Inputs: water availability, coastal water salinity, temperature, shellfish farming policy

Necessary data :

Shellfish farming practices/ growth and spat collection functions

Outputs :

Binomial decision in terms of water demand

If 1 = demand

If 0 = no demand

Pressure indicators (spatialised or aggregated)

Technical and economical results/year (depend on the satisfaction of the water demand)

Processes

- Water and ecosystem factors determine spat collection and growth of oyster functions
- Spat collection function determines the spat production of all companies
- For companies specialised on spat collection: if revenue issue from spat production lower of a fixed level, then insatisfaction and then fresh water claim
- In case of water lack then

a) direct impacts in real time for spat collection if penury in summer (in July-August)

b) Shifted impacts on oyster growth if lack in summer (because no growth in reproductive period)

- For the other companies : 2 possibilities

a) If expected spat production is lower than observed then fresh water claim (same period)

b) If the oyster growth rate is lower than a fixed level, then insatisfaction. A cumulative situations of insatisfaction drive toward a fresh water claim. If cumulative effects in several years then possibility to anticipate water claims

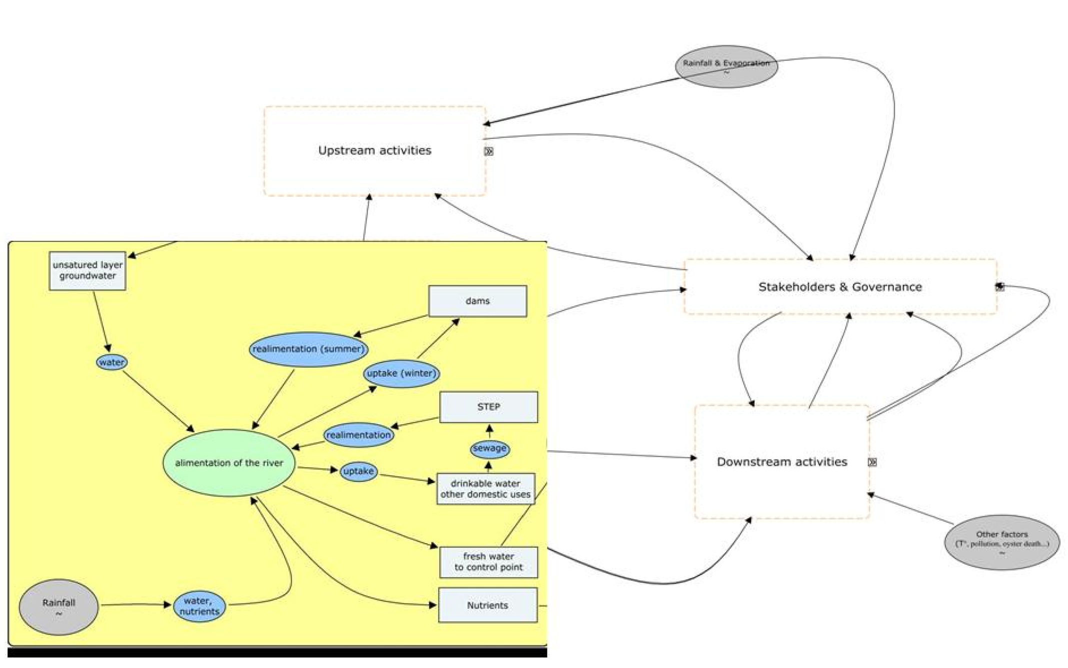
Scenarios :

Changes in water availability (climatic changes, farming practices, etc.)

Changes in spat collection strategies

Changes in oyster growth rates

HYDROLOGICAL SYSTEM



Aim: preserving balanced water uses at the scale of the Charente hydrosystem first for the good natural functioning of aquatic ecosystems and the supply in drinkable water, then for other domestic uses, industries and crops irrigation

Inputs:

Climatic forcing variables (precipitations, sun irradiance, PET)

Soil occupation (urban areas, agriculture,...)

Necessary data:

Stock of water in dams, daily dam management data

Uptakes (drinkable water, irrigation,…)

Outputs:

Groundwater daily levels at sub-basin key-points

Daily mean flow of Charente at the downstream key-point (Beillant)

Indicators: annual duration of low-flow under the threshold, annual duration of pumping interdiction …

Processes: the catchment water stocks increase during winter due to precipitation. Some of the water stocks in soils, wetlands and underground aquifers and a part of the flow is stored in dams. Some water demands occur all along the year (drinking water, other domestic uses, industrial water, minimum needs for natural functioning of aquatic ecosystems) other ones are more seasonal during low-flow periods (irrigation=80% of the uptakes in summer). Two kinds of regulation have been set-up :

a inter-annual participatory negotiation leading to the allocation of quotas to the different uses

A day-to-day monitoring during low-flows by respect to thresholds ("crisis" management) : crisis regulations are gradually set-up

if flow > low-flow threshold **then** pumping allowed (limit = uptake authorization)

If flow < low-flow threshold **then** pumping interdiction for secondary uses (crop irrigation, other domestic uses…)

Scenarios:

Increasing the minimum freshwater discharge (DOE)

Increasing the substitution storage volumes

BIODIVERSITY

Biodiversity issue "species"

Input : Water volume

Output : Abundance of eels, salmon, shad and lamprey. Surface of wetlands.

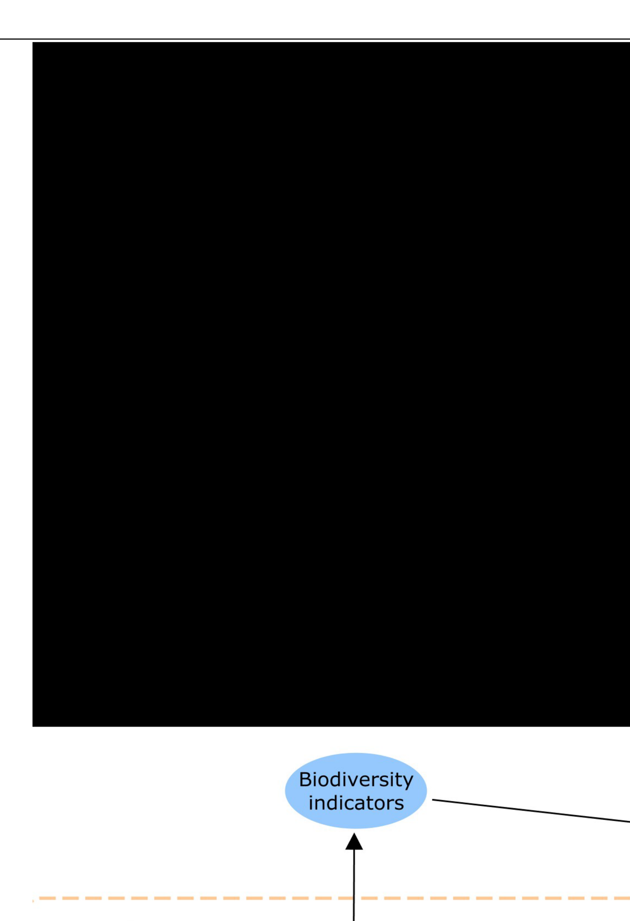
Processes : If the volume of water is under a certain threshold, abundance of species decrease.

Biodiversity issue "wetlands"

Input : Water volume

Output : Regulation services (buffering and filtering)

Processes : If the volume of water is under a certain threshold, regulation services decrease.



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SIXTH FRAMEWORK PROGRAMME

An integrated project under the EU´s 6th Framework Programme for Research (FP6) of the European Commission

Partners of Study Site n°10 – Pertuis Charentais:

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