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

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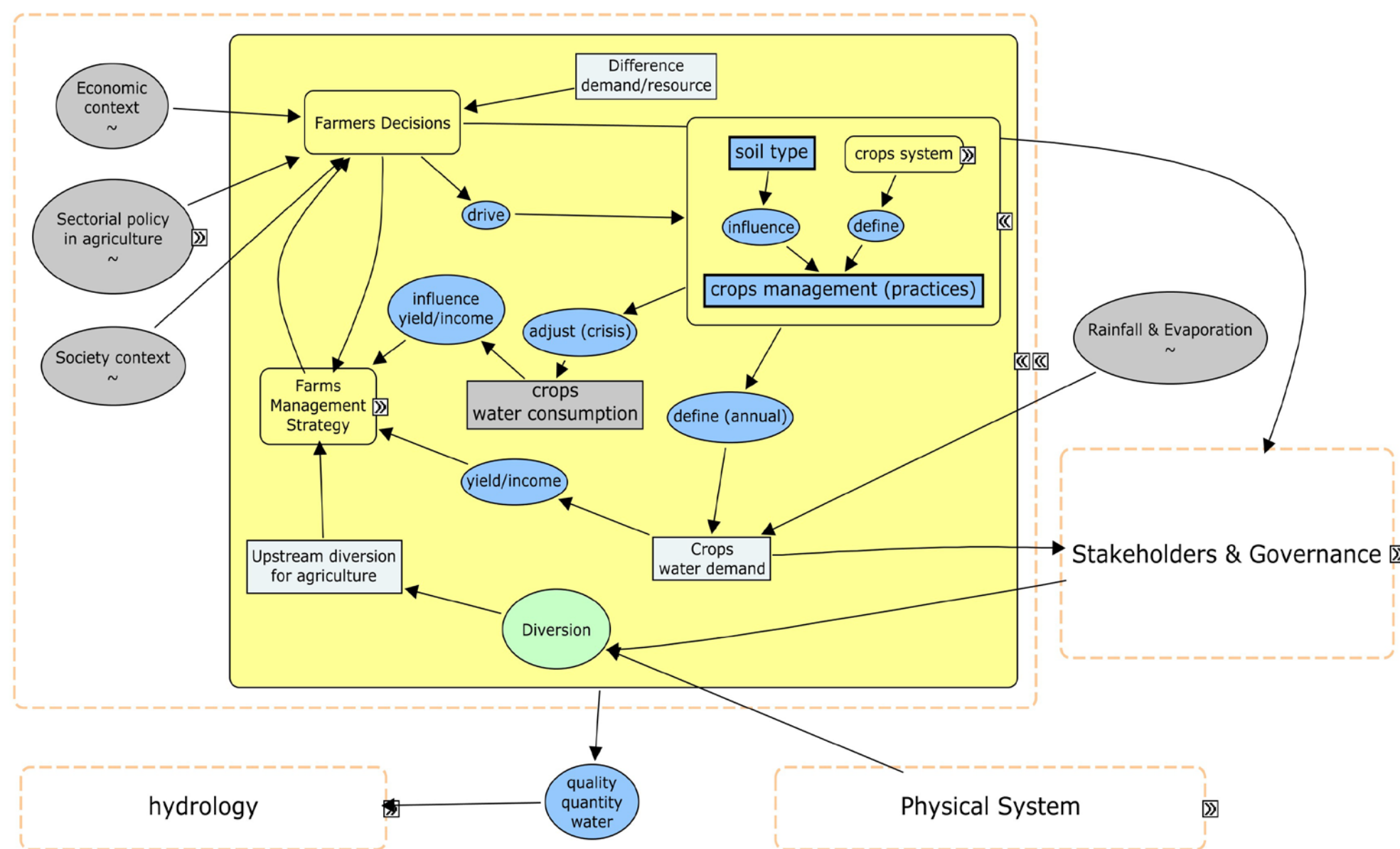
SCIENCE AND POLICY INTEGRATION FOR COASTAL SYSTEM ASSESSMENT

SSA n°10 – PERTUIS CHARENTAIS

FRESHWATER MANAGEMENT ON THE CHARENTE RIVER BASIN AND ITS COASTAL ZONE

The Charente river basin and the Pertuis Sea

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:

- 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

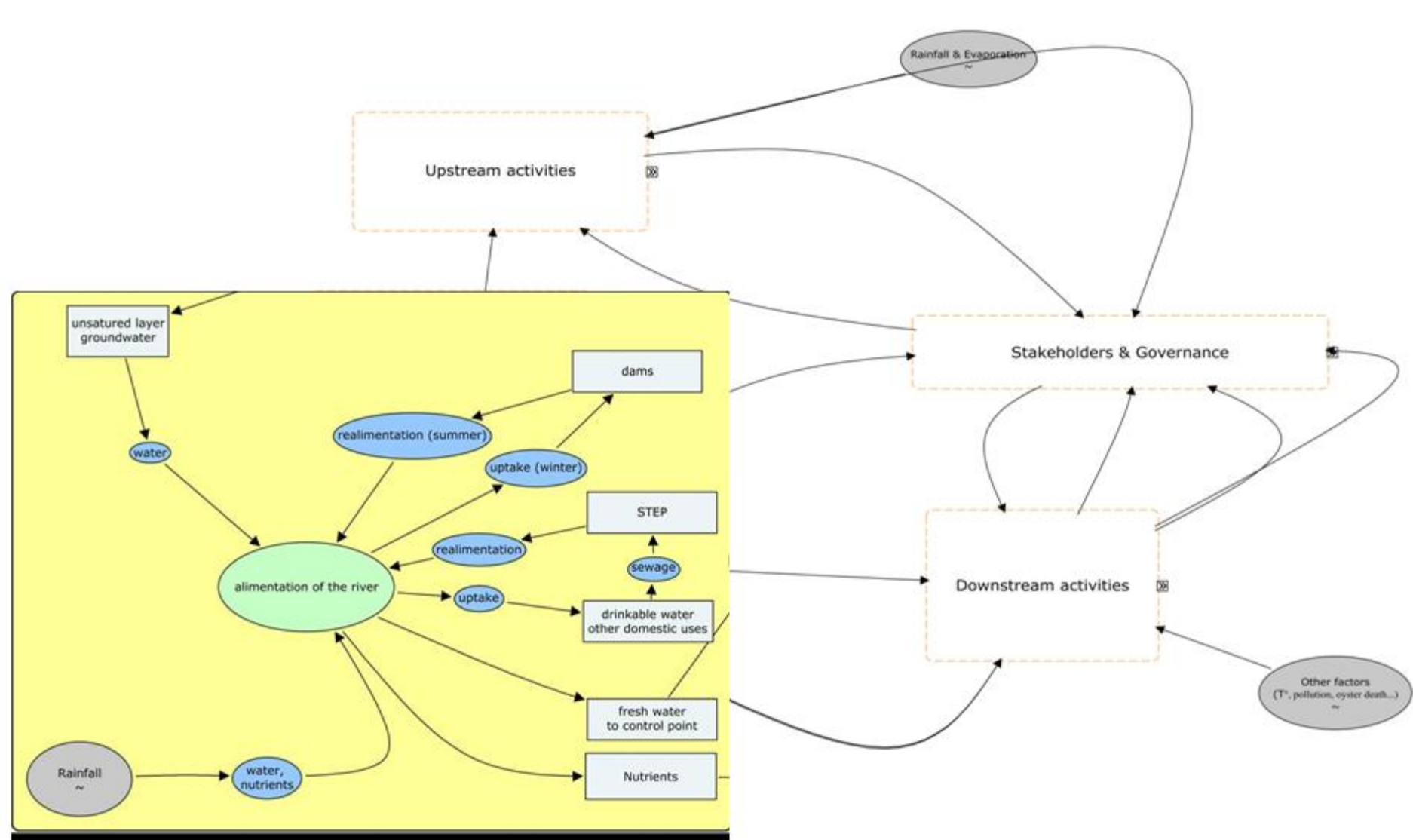
Outputs:

- 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

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

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 ($VTW_{y,t}$ For year y and ten days period t) reduced by the prior pumping from 1st April to 15th June (V_{cons}).

$$VTW_{y,t} = VTW_y - V_{cons}$$

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

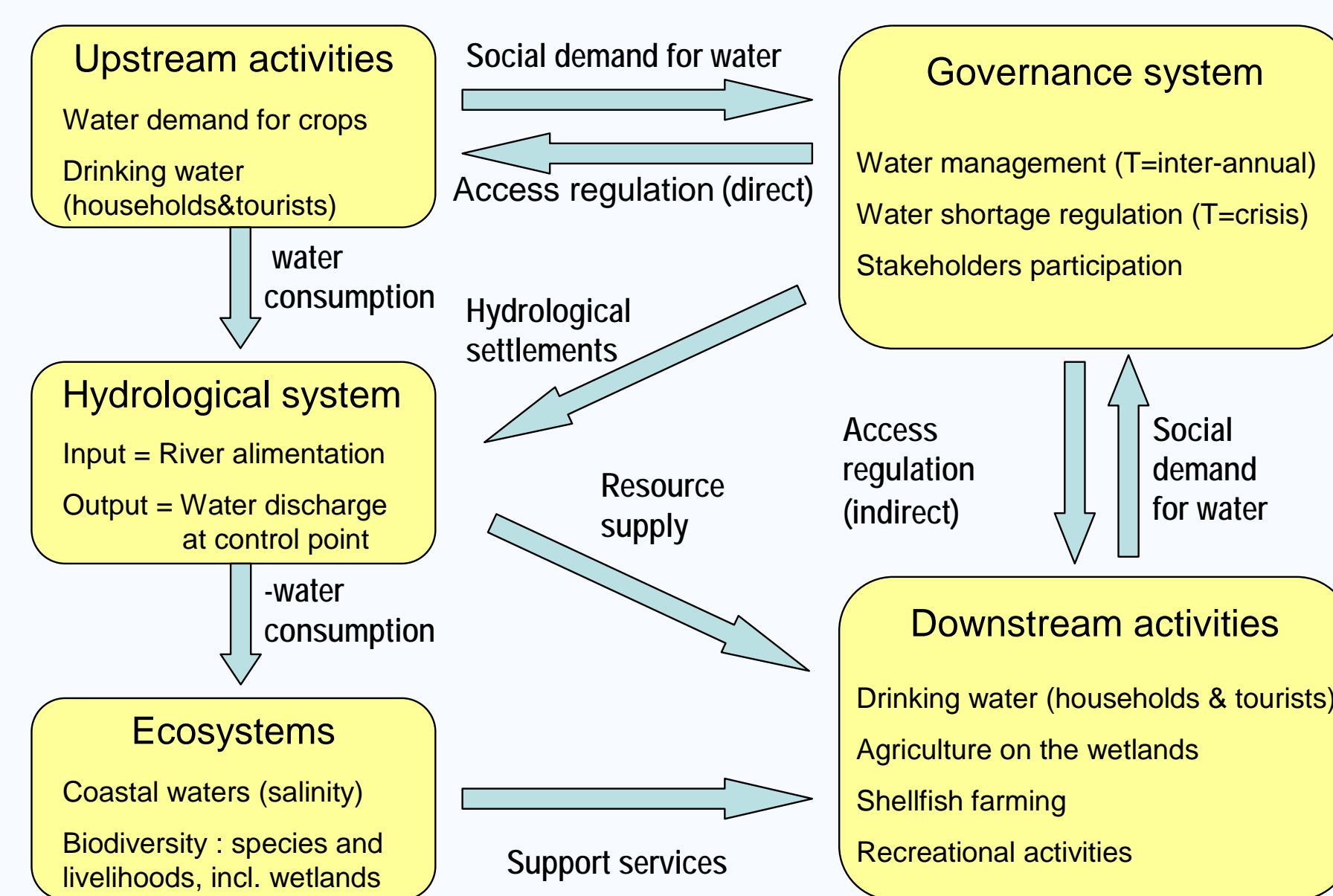
Restrictions are calculated as a decreasing percentage (α_t, β_t, μ_t) applied to the maximum authorized volume (VTW_y). α_t, β_t, μ_t are given each year by law and depends on the period (decreasing from 15th June to 1st September).

Table of restrictions on Volumes during summer

| Flow rates Thresholds | $VTW_{y,t}$ before exceeding thresholds | decreasing percentage | $VTW_{y,t}$ when exceeding thresholds |
|-----------------------|---|-----------------------|--|
| DSA | $VTW_{y,t}$ | α_t | $VTW_{y,t}(1 - \alpha_t)$ |
| DOE | $VTW_{y,t}(1 - \alpha_t)$ | β_t | $[VTW_{y,t}(1 - \alpha_t)](1 - \beta_t)$ |
| DI | $VTW_{y,t}(1 - \alpha_t)(1 - \beta_t)$ | $\mu_t = 1$ | 0 |
| DCR | | | |

The SSA10 formulation approach

Freshwater allocation on the Charente river basin



BIODIVERSITY

Biodiversity issue "species"

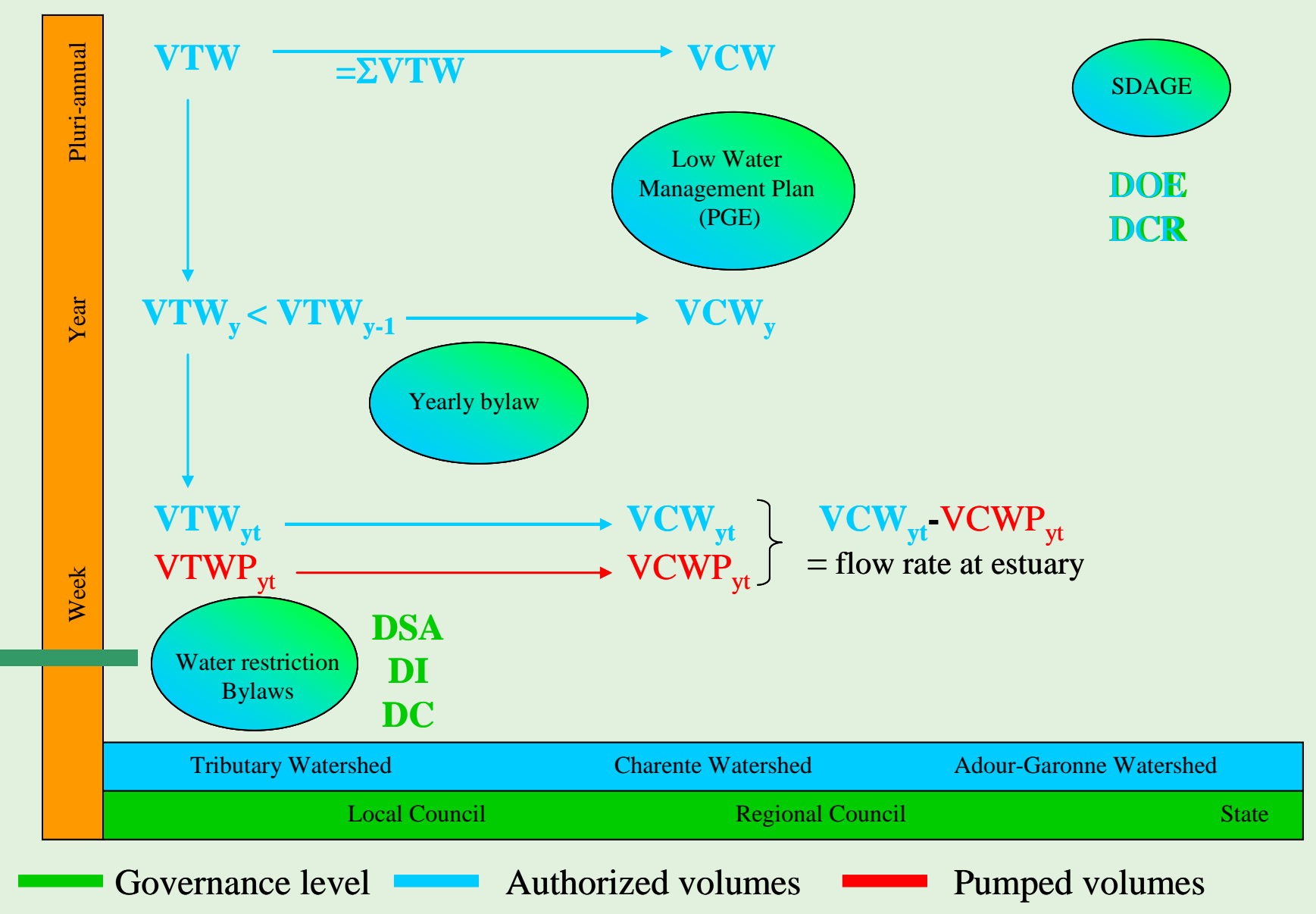
Input : Water volume
Output : Abundance of eels, salmon, shad and lamprey. Surface of wetlands.
Processes : If the volume of water is under a certain threshold, abundance of species decrease.

Biodiversity issue "wetlands"

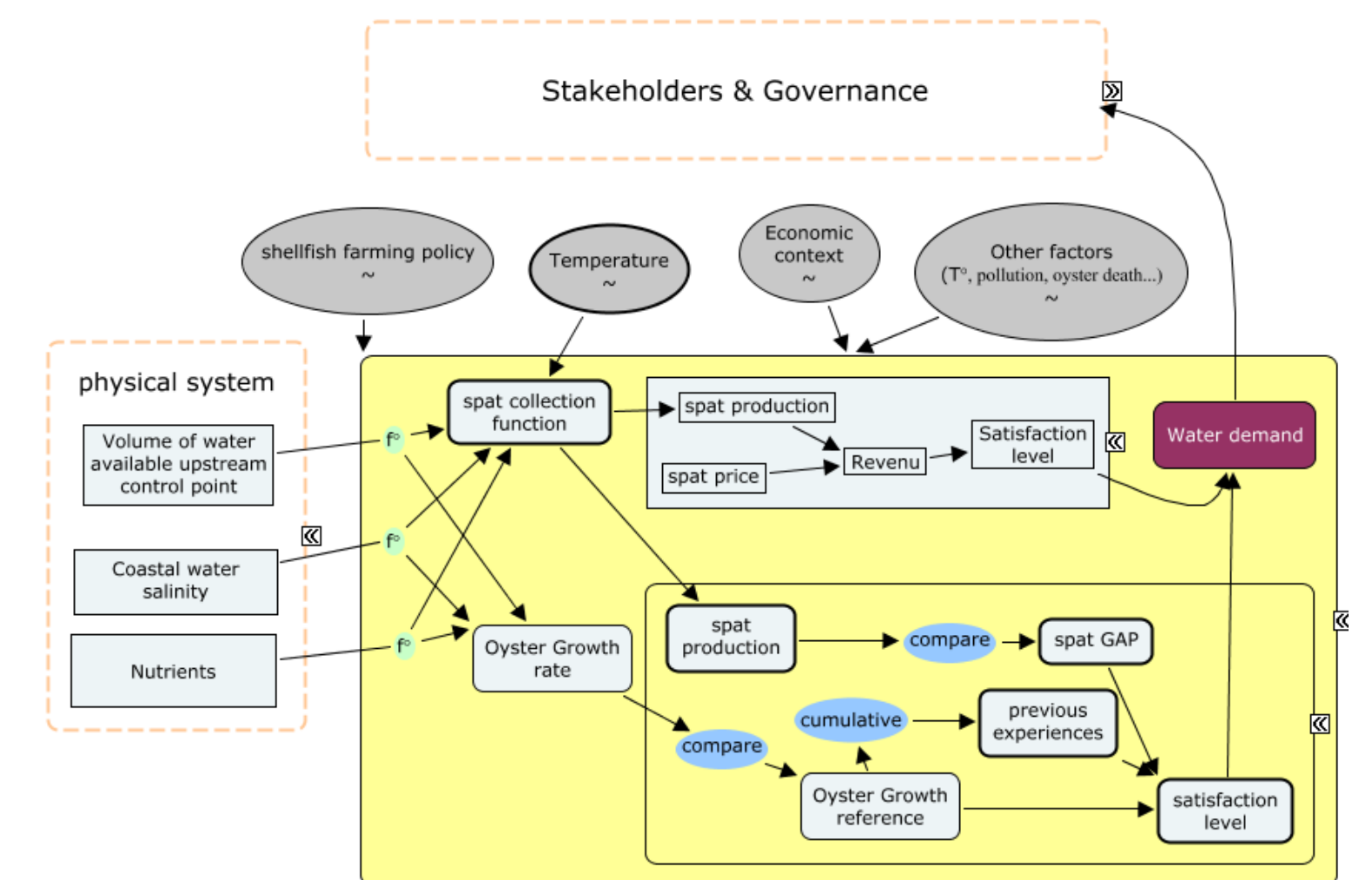
Input : Water volume
Output : Regulation services (buffering and filtering)
Processes : If the volume of water is under a certain threshold, regulation services decrease.

Biodiversity indicators

Regulation system of freshwater uses



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

- direct impacts in real time for spat collection if penury in summer (in July-August)
- Shifted impacts on oyster growth if lack in summer (because no growth in reproductive period)

- For the other companies : 2 possibilities

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

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