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**Wetland Preservation *versus* Wetland Conversion to Industrial Use:
a Cost-Benefit Analysis Applied to the Seine Estuary (France)**

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Context

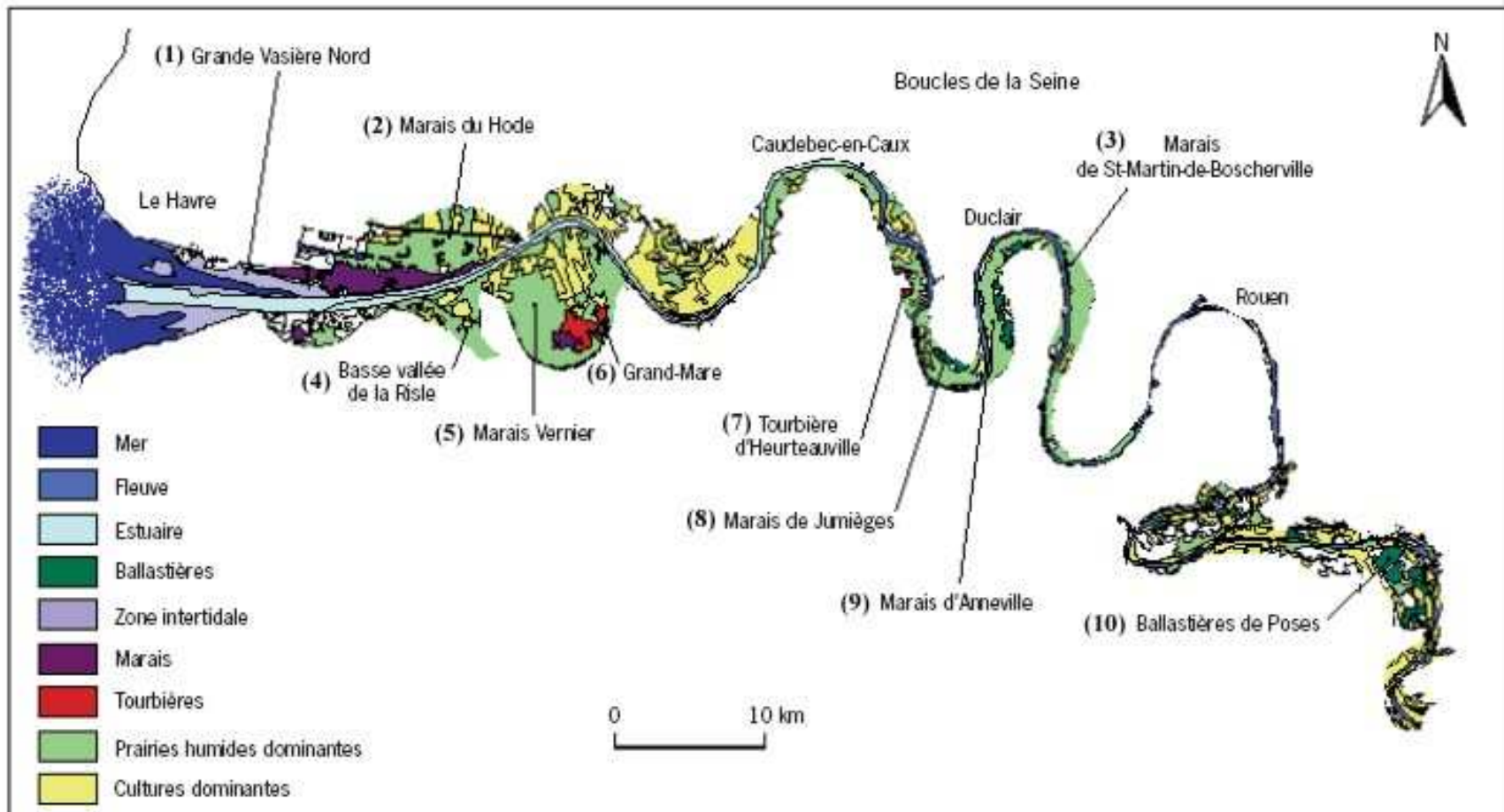
- There is now a substantial literature on wetland valuation (Brander *et al.*, 2006). This literature relies on various methods, including the contingent valuation method, hedonic pricing, travel cost method, etc.
- de Groot *et al.* (2006) identify three situations in which it is particularly important to carry out valuation studies : assessment of total economic value of wetlands, trade-off analysis and impact assessment.
- Very few studies have attempted to conduct such trade-off analysis. Balmford *et al.* (2002) find only five studies amongst 300. Two of them are dealing with wetlands and show that conversion to human uses does not make economic sense once external costs are accounted for.
- The call for more research studies which encompass a range of uses of a given site, as expressed by Turner *et al.* (2003) in their concluding remarks, is still topical.

Objectives and sketch of the talk

- **The aim of this article is precisely to contribute to respond to this call by combining the contingent valuation method with a firm-level approach of the benefits generated by wetland conversion to industrial use.**
- **Part 1 shows that local authorities give top priority to wetlands conversion to human uses through development of the industrial harbour complex. In this part, we also describe the specific characteristics of the Seine estuary wetlands and their functions.**
- **Part 2 presents the monetary valuation of the Seine estuary wetlands using the contingent valuation method.**
- **Part 3 allows us to compare benefits of wetland conversion to industrial use with the opportunity costs of their destruction.**

The Seine estuary wetlands

The Seine estuary wetlands



Characteristics of wetlands

Wetlands	Number of ha
Wet meadows	8,790
Mudholes	2,064
Reeds	1,280
Alluvial plain	772
Peat forest	360
Others	1.013
<i>Total</i>	<i>14,279</i>

- **Many ecological functions can be identified but three appear very important:**
 - Firstly, the *hydrological functions* relate to the ability of ecosystems to alleviate the impacts of disruptive natural events.
 - Secondly, wetlands have *biological functions*. Wetlands provide living space for wild plants and animal species and are essential to the maintenance of biological and genetic diversity on Earth.
 - Thirdly, wetlands have *climatic functions*. The services provided by this function relate to the maintenance of a favorable climate, both at local and global scales.
- **Wetlands have productive functions.** These ecosystems provide many resources, ranging from oxygen, water, food, medicinal and genetic resources to sources of energy and materials for building.
- **Wetlands provide many opportunities for recreational activities such as walking, bird watching, hunting, fishing, and nature study.**

Wetlands losses

- Many hectares of wetlands were destroyed because of conversion to agriculture, urban or industrial uses.
- From the 19th century, humans use the Seine Estuary mainly to develop an industrial harbor (Beaumais and Laroutis (2007)).
- Urbanization and agricultural development had as consequences the loss of 24,467 ha and now the total surface of the Seine estuary wetlands covers 14,274 hectares (38,741 hectares one century ago).

Wetlands losses

	Number of hectares	
Industrial and harbor uses	9,000	36.78%
Agriculture use	8,267	33.79%
Urban use	3,712	15.17%
Orchards	2,850	11.65%
Poplar plantations	638	2.61%
<i>Total</i>	<i>24,467</i>	<i>100.00%</i>

Contingent valuation method

Survey design

- **We worked with other scientists (of Seine-Aval program) in order to very precisely describe services of the Seine estuary wetlands.**
- **The original questionnaire was pre-tested on 21 respondents from Seine estuary residents to sort out any misinterpretation of questions and any lack of clarity in the visual aids.**
- **The resulting questionnaire consists of a total of 47 questions.**
- **The sampling involved households living within Seine estuary. Face-to-face interviews were carried out for each of the 300 people of the sample.**
- **Main statistical results:**
 - **40% of the respondents understood the concept of biodiversity and wetlands.**
 - **Only 18% (55 persons) had already visited wetlands in order to practice leisure activities.**
 - **92% were favorable to the conservation program.**
 - **Only 42.39% were willing to pay for a conservation program.**

Results

Tobit Model

Variables	Coef.	Std. Err.	t	P> t
Intercept	-117.4605	33.60016	-3.50	0.000
Freq	24.27875	11.06979	2.28	0.022
Age2655	24.42827	11.06979	2.21	0.027
City	19.84529	8.789219	2.26	0.024
Educ	39.15437	22.98618	1.70	0.088
Don	64.04625	24.79001	2.58	0.010

Log likelihood=-786.33914

Pseudo R²=0.0227

Part 3

Trade-off analysis

Wetlands services benefits

Variable	Obs	Median	Mean
WTP	300	14.50	18.46
WTP>0	129	43.77	46.26

➤ **Two WTP have been calculated:** the first represents a conservative estimate of WTP like Zhongmin *et al.* (2003). The second represents a higher estimate of WTP like Loomis *et al.* (2000) and a mean WTP was calculated from all positive WTP.

➤ **Results in accordance with European and French ecosystems conservation studies** (Bonnieux *et al.*, 1995; Le Goffe, 1995; Gauthier, 2000) but lower than USA results (Brouwer *et al.* 1999).

➤ **Haneman (1984) advocated the use of median WTP as a measure of economic welfare.**

➔ **7.25 millions <Wetlands functions<€21.88 millions**
 €518/ha/year €1560/ha/year
 (for 14 000ha with 500 000 households)

4,66 millions<Opportunity costs*<€14,07 millions
 *for 9000 ha

➤ **Subsidies given to farmers by French government for wetlands conservation: €400/ha/year**

Industrialization benefits

- Taking into account limited available data, we chose a conservative view using only direct jobs and income.
- We have identified industrial activities on estuary wetlands. Next, starting from Sessi data base (which provides us branches of industry, location, jobs), we carried out a map localization of these companies. This work allowed us to identify 576 establishments on former wetlands of the Seine estuary.
- Each ha of wetlands is equivalent to an average amount of **€182,360** (wages).

	Number of production units	Number of jobs	Total wages (millions €)
Food processing industries	39	1,569	38.60
Consumer goods industries	84	5,963	156.23
Car industries	20	12,023	409.98
Capital goods industries	161	11,279	324.84
Intermediate goods industries	269	19,988	545.67
Refined petroleum products	3	3,743	105.55
Harbors		2,137	60.26
Total	576	56,702	1,641.23

Negative externalities

- Air pollution costs were valued *via* EcoSenseLe model (research project of the European Commission: ExternE).
- Data about air pollution emissions for each firm are not available, so estimates are made using share coefficients computed from regional data.
- EcoSenseLe model value air pollution costs of 576 production units at €368 millions per year and the benefits of wetlands industrialization would be now €1, 273 billion (€141, 470/ha/year).
- Water pollution costs are not taken into account in our study because of available data are limited in particular about Suspended Solids (SS) and Chemical Oxygen Demand (COD) and data on monetary valuation of water pollution are not available.

Conclusion

- **Our work shows that the Seine estuary wetlands are considered by residents like an important natural asset:**
 - **92% were favorable to a conservation program even if only 42% would participate financially.**
 - **Residents reveal a median WTP between €14.50 and €4.77 for a conservation program.**

- **Three conclusions can be made from our paper.**
 - **Firstly, WTP of the Seine estuary inhabitants is in accordance with other French studies and underlines the importance of wetlands for residents.**
 - **Secondly, subsidies given to farmers by the French government for wetlands conservation (€400/ha/year) are lower than €520 that residents declare.**
 - **Thirdly, our trade-off analysis shows that the conversion of 9000ha of wetlands to industrial use clearly outweighs the loss of non-marked services provided by these wetlands. So, an industrialized hectare reveals a very high value (more than €140000/year, net of air pollution costs).**