Building an Ecosystem Satellite Account based on the Ecosystem Services Approach: a Marine Experiment

J.C. Martin, R. Mongruel*, H. Levrel***

FAERE workshop on Marine Ecosystem Services – Villefranche-sur-mer, 26/11/2015

* UMR M101 AMURE, Marine Economics Unit, Ifremer Centre de Brest, CS10070 F-29280 Plouzané .
** AgroParisTech, CIRED, 45 bis, avenue de la Belle Gabrielle, 94736 Nogent-sur-Marne Cedex.

Study context

- VALMER project (www.valmer.eu)
  - 11 partners including research institutes, universities and stakeholders (marine managers)
  - Co-funded by the EU program INTERREG IV
- Objective of the project: to improve marine ecosystem services (ES) assessments and their use for operational management purposes (mainly for MPA management)
- Ecosystem services are the “benefits people obtain from ecosystems” (MEA, Chapt1, pp.27, 2003)
  - Provisioning services
  - Regulation and maintenance services
  - Cultural services
- 6 case studies

Valmer case studies

In the Gulf of Saint-Malo, the creation of a MPA is considered. An ecosystem satellite account has been built as part of an initial diagnosis for the future MPA.

A brief history of the SEEA 1/2

- 1992 : Rio summit => the statistic division of the United Nations should create a System of Environmental-Economic Accounting (SEEA).

- 3 main approaches of environmental accounting already existing:
  - Dutch approach: NAMEA (De Haan and Keuning, 1996; Keuning et al., 1999, following the work by Hueting et al., 1992)
  - North-american approach: Asset account based on welfare accounting (Peskin, 1976; Weitzman, 1976; Hartwick, 1990; Mäler, 1991)
  - Eurostat approach : SERIEE (European System for the Collection of Economic Information on the Environmentfunctional account (Environmental protection expenditure account) (Eurostat, 1994)

- Bartelmus et al. (1991): propose a methodological framework of what could be a SEEA => Asset accounts for adjusting the macroeconomic indicators to environmental degradation

A brief history of the SEEA 2/2

- Main publications concerning the SEE
  - 1993 : 1st handbook
  - 2003 : 2nd version
  - 2014 : the SEEA-CF and the SEEA-EEA
- Four accounts are included in the SEEA-CF:
  - physical stock and flow accounts,
  - physical accounts (ex.: physical input-output table),
  - functional accounts (ex.: environmental protection expenditure account)
  - asset accounts, focusing on the depletion of exploited natural resources used for economic activities.
- A synthesis of the different approaches ?

Main debates regarding the SEEA

- Many aspects of the SEEA were highly criticized by both economists and accountants (Aaheim and Nyborg, 1995; Bos, 1997; El Serafy, 1997, Bartelmus 2014) :
  - consistency with the SNA principles
  - feasibility of its implementation
  - focus on monetary asset account, only few attention paid to environment degradation *per se*
- *Which vision of sustainability ?*
  preference for asset accounts
  monetary valuation of natural capital

Methodological limits of the SEEA and the SEEA-EEA

- Using Net Prevent Value (NPV) concept to value the economic returns coming from ES => this requires to estimate the resource rent by using the residual method
  - Difficulties to estimate the value of resource rent (Nauroy, 2011)
  - This method is based on strong and unrealistic assumptions (Aaheim and Nyborg, 1995; El Serafy, 1997; Vanoli, 2002)
- Issue of finding a valuation method consistent with the SNA to incorporate the non-material benefits coming from ES => modelling exchange value ? (Campos and Caparrós, 2006)
  - Strong criticisms of the use of non-market valuation methods for ecosystem (El Serafy, 1998; Venkatachalam, 2004 ; Levrel et al., 2014)
  - No sense to estimate a price for ES, since no consensus between suppliers and consumers (Aaheim and Nyborg, 1995)
  - Differences in concepts (hypothetical transactions based on competitive market vs current transactions incorporating market failures ; hicksian vs current income)

Conceptual limits

- An ecosystem asset does not fulfill the 3 properties of an economic asset to be part of the SNA, unless internalizing all the externalities coming from ES
  - Vanoli (2002) : accounts should not incorporate benefits or costs that the society has decided not recognized
- Issue concerning the macroeconomic indicators adjusted by the value of ecosystem degradation
  - monetary accounting framework: not suitable to estimate the ecosystem degradation (El Serafy, 1997)
  - SEEA and SEEA-EEA combine in fact two values based on two different economic states, when considering the degradation state of the environment or the ecosystem (Aaheim and Nyborg, 1995; Vanoli, 2002).

Our experiment…

Building an ecosystem satellite account based on the ES approach 1/2

- Rationale : this ecosystem satellite account aims at supporting ecosystem conservation policies
(cf Vanoli's vision of operational accounting)
- Strong sustainability (the policies to be supported are part of a strong sustainability vision: marine conservation)
- Understanding the interactions between social systems and ecosystems rather than searching for the monetary value of ecosystems (the purpose is not to use monetary estimates of Ecosystem Services for valuing Natural Capital)
- Focusing on ecosystem status and human activities related to ecosystems:
Physical account + Resource-use account

Building an ecosystem satellite account based on the ES approach 2/2

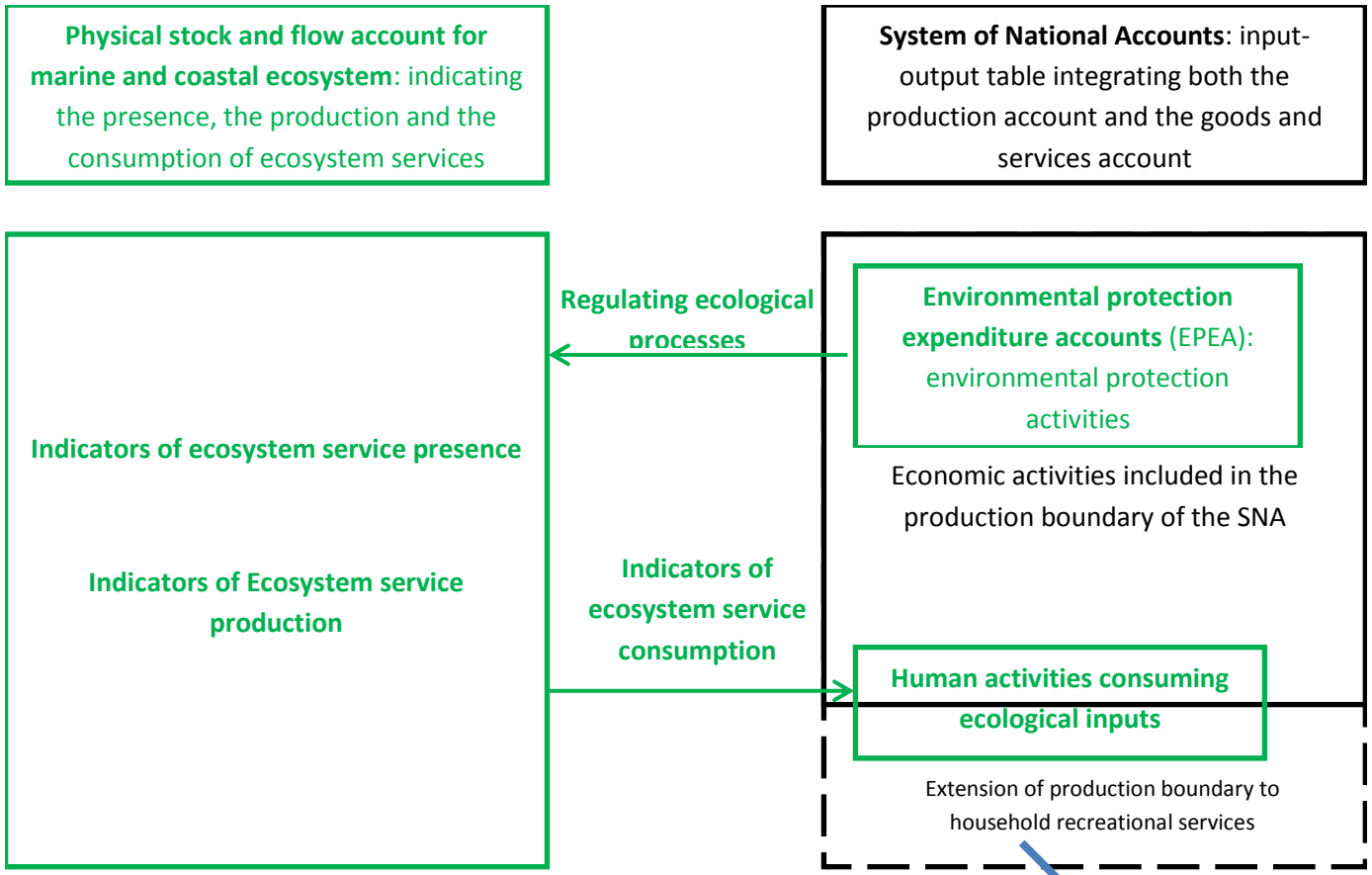
- This satellite account is based on the ecosystem services approach
- Use of a single and coherent valuation principle: assessing the means that economic agents implement in order to benefit from ecosystem services or for maintaining them in a “good status”.
- The estimated values are expected to be more robust, since based on current transactions and observed values and not on hypothetical values.

Methodological framework of an ES-based ecosystem satellite account

- Alternative approach to the SEEA EEA, using ES approach for building the links between ecosystems (physical account) and human activities (R-U account)
- Estimating both monetary and physical flows related to ES (the 1st two accounts presented in the SEEA CF)
- Institutional units (public bodies, firms, households) interact directly or indirectly with ecosystems thanks to economic activities
- 2 types of human activities are distinguished:
  - Activities consuming ecological inputs
  - Activities aiming at regulating the output of ecological processes in order to maintain or to increase ES potential and flows
- The SNA boundary of production is extended to incorporate the recreational household production activities for own use
- The achievement of these **activities** requires **means** (human and economic means), measured by the **value of the production**: this gives an estimate of the means implemented for maintaining or consuming ES (not an estimate of the value of ES themselves).

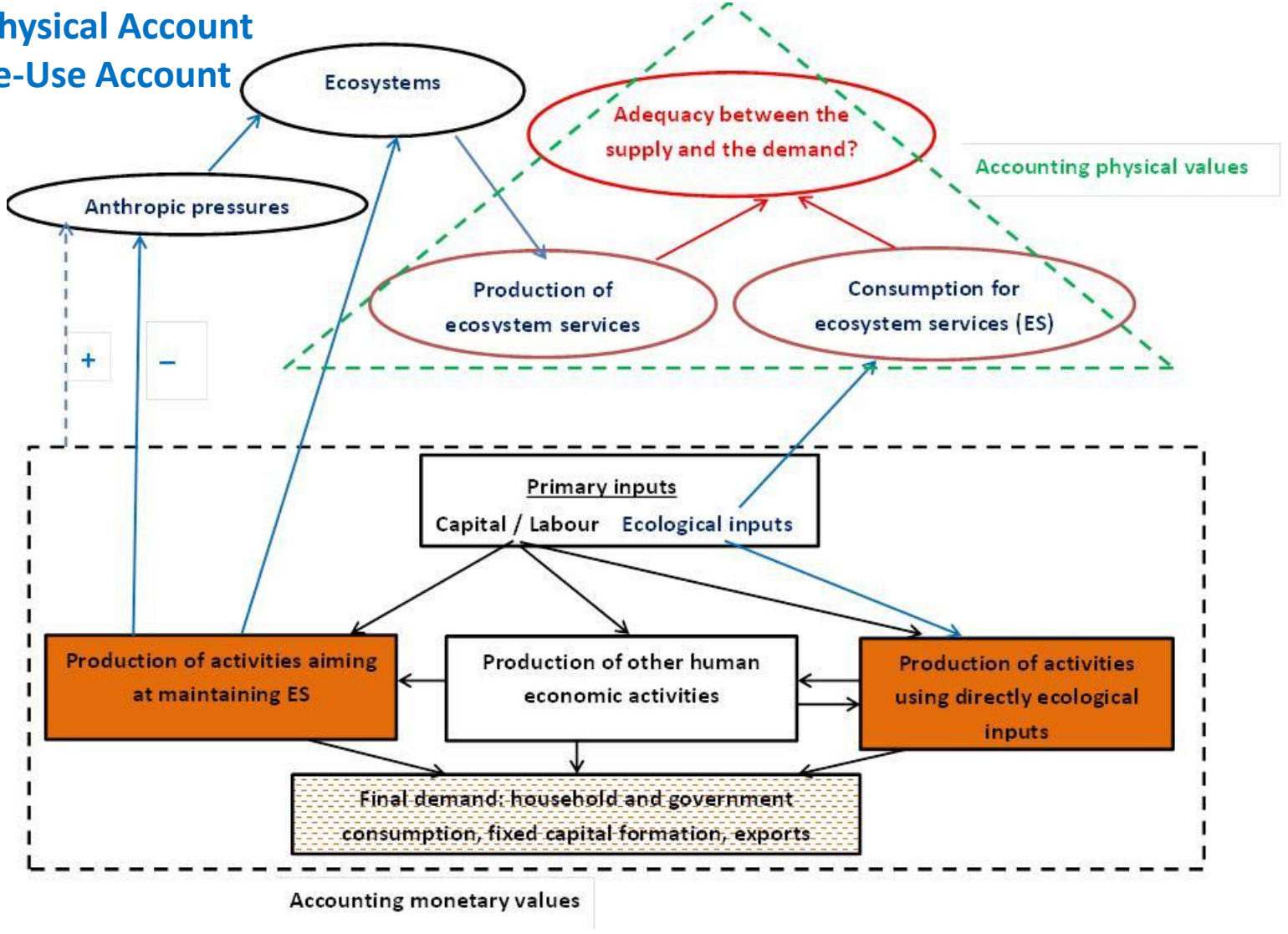
Accounting framework of an ES-based ecosystem satellite account (1/3)

Linking ES to the SNA



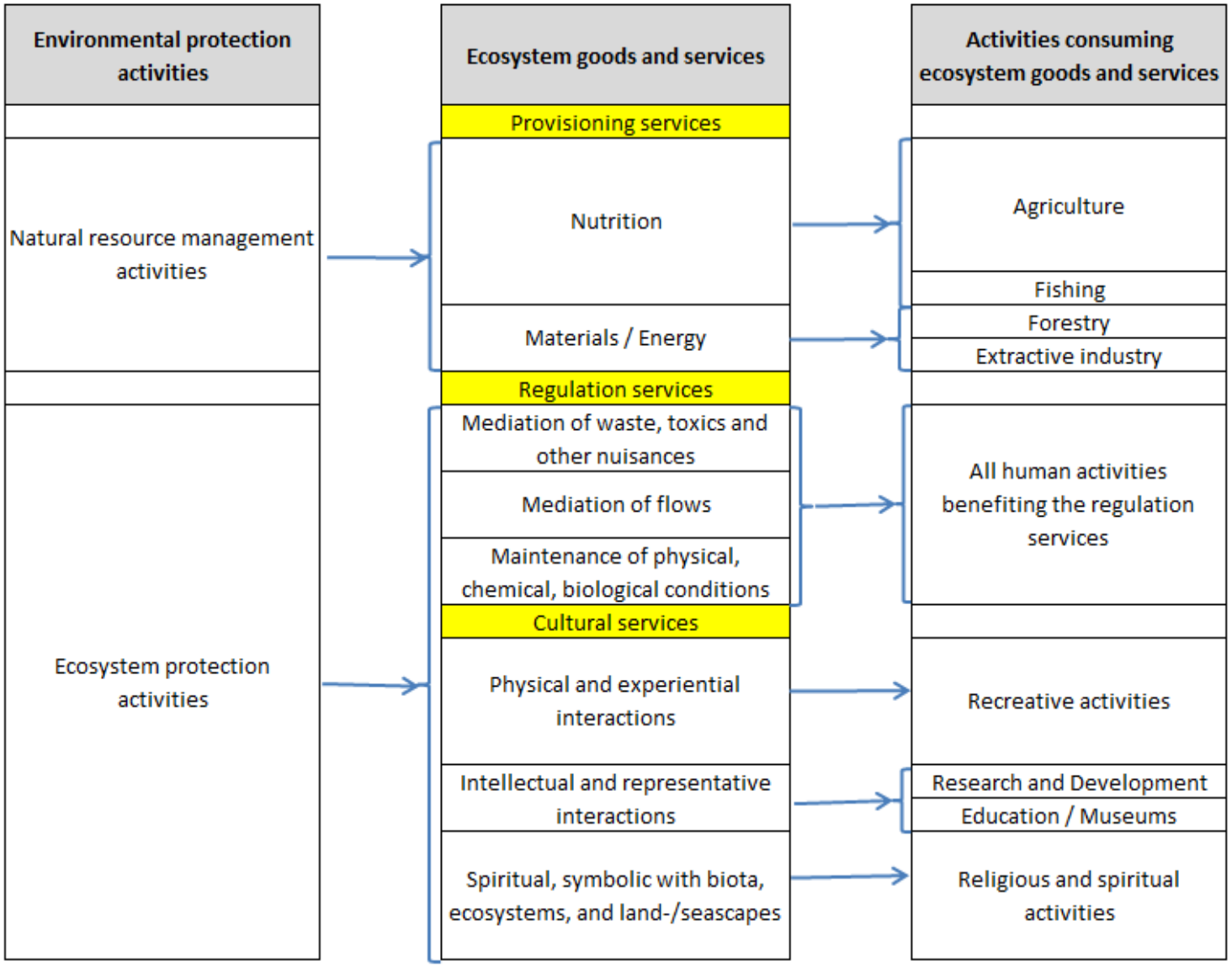
Accounting framework of an ES-based ecosystem satellite account (2/3)

Combining a Physical Account and a Resource-Use Account



Accounting framework of an ES-based ecosystem satellite account (2/3)

Building a Resource-Use account based on the ES approach



Accounting framework of an ES-based ecosystem satellite account (2/3)

The ES approach is an analytical framework which is used to sort, for each kind of ecosystem to be managed and considering the issues at stake and the social demand,

1) the components of the ecosystems to be assessed by state indicators in the Physical account

2) the human activities to be included in the Resource-Use account

Results – Gulf of Saint-Malo ecosystem satellite account

Production indicators for Activities producing Ecological Outputs	Ecosystem Goods and Services	Production Indicators for Activities using Ecological Inputs	Consumption Indicators for Products from Activities using Ecological Inputs	Outlet of Products from Activities using Ecological Inputs
	Provisioning services			
	Fish and shellfish accessible to the commercial fishing sector	Fishing activity : intermediate consumptions, value added; enterprises and employment	Sale value of the products coming from fishing activity (fish and shellfish landed)	Directly or indirectly (via trade sector) to individuals ; to economic sectors in order to be transformed (agro-industry sectors)
	Algae accessible biomass	Algae extracting activity: intermediate consumptions, value added; enterprises and employment	Sale value of algae, own use of algae	To economic sectors : agriculture, chemical industries, ...
	Maerls, shell sand accessible for extraction	Other extracting sectors: intermediate consumptions, value added; enterprises and employment	Sale value of maerls and shell sand	To economic sectors : agriculture, chemical industries, ...
	Regulation and maintenance services			
Sewage industry: intermediate consumptions, value added; enterprises and employment	Primary productivity	Shellfish farming: intermediate consumptions, value added; enterprises and employment	Sale of the products coming from the shellfish farming (oysters, mussels)	Directly or indirectly (via trade sector) to individuals ; to economic sectors in order to be transformed (agro-industry sectors)
	Water quality			
Biodiversity management bodies: labour and running costs	Biodiversity support			
	Biochemical cycles, carbon sequestration			
	Cultural services			
Budget allocated to water quality and biodiversity maintenance costs	Recreational services	Recreational activities: intermediate consumptions, value added; enterprises and employment (in associations and firms) or households	Household consumption for recreational activities (time spent for recreation activities)	Directly (via household production for own use) or indirectly (via associations or firms) to individuals
Consumption indicators for Activities producing Ecological Outputs	Aesthetic and symbolic values	Museums and cultural events: value of production factors, employment	Household consumption for recreational activities (time spent for cultural activities)	Directly to individuals

A survey has to be implemented for estimating these activities

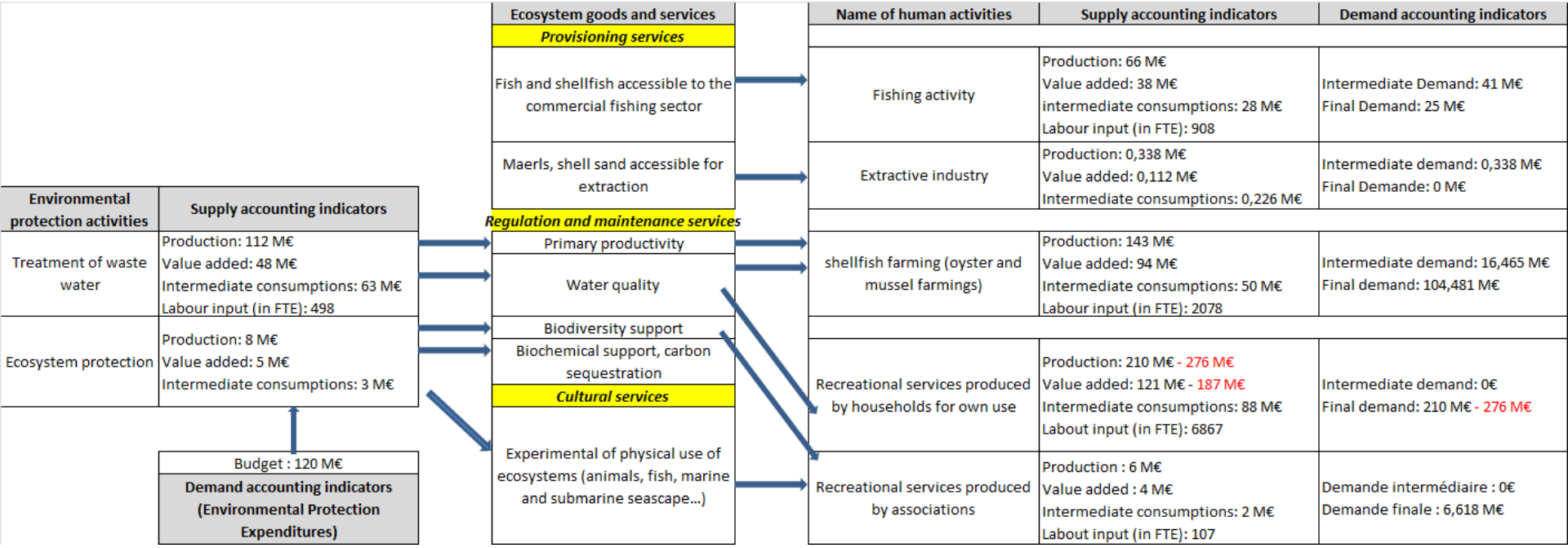
Results – estimating the means dedicated to cultural ES

Percentage of consumption time dedicated to:

	Sport	Pêche	Paysage marin	Paysage sous-marin
Pêche récréative à pied et/ou pêche au bord de mer		57%	41%	2%
Randonnée pédestre en bord de mer		0%	66%	0%
Plaisance et/ou pêche embarquée		52%	41%	2%
Kayak et/ou canoë en mer		6%	56%	2%
Voile légère		0%	42%	0%
Plongée sous-marine et/ou pêche sous -marine		26%	9%	45%

Based on consumption time, separation of 'joint products' (sport) from cultural ES

Results – monetary indicators



Consuming cultural ecosystem services through recreational activities in the Saint-Malo Gulf necessitates as much economic means as the production of provisioning services. Cultural ES may concern more than 500,000 people. However, this includes people who have done an activity linked to cultural ES at least once during the year 2013. Of course, the social roles of activities linked to provisioning services, regulating services or cultural services are completely different; this is the reason why monetary indicators should not be considered alone.

Results – physical indicators

Type of ecosystem services	Ecosystem services		State indicators	Indicators of ecosystem service production	Indicators of ecoystem service consumption
Provisioning services	fish, shellfish and crustaceans accessibles to fisheries	Scallop		5 672 t	7 920 t
		black seabream		863 t	894 t
		cuttlefish		2 212 t	2 685 t
		clam		1 154 t	421 t
		whelk		6 748 t	9 038 t
		common sole		234 t	180 t
		ray		527 t	160 t
		european lobster		110 t	207 t
		european spider crab		1 877 t	2 134 t
		other species			3 972 t
	Cultivated oysters and mussels	oysters			25 301 t
		mussels			28 700 t
	Maerls and shell sand accessibles to extractive	Maërls			214 920 t
		shell sand			119 330 t
Cultural services	aesthetic services: seascape landscape	recreational fishing	Surface : 484 km^2		2 113 k-hours
		Hiking	Distance of littoral paths: 520 km		8 659 k-hours
		Recreational boating	Surface : 2 322 km^2		2 158 k-hours
		Kayaking	Distance of paths for kayaking: 341 km		1 116 k-hours
		Voile légère	Surface : 4 376 km^2		1 111 k-hours
		Scuba-diving and underwater fishing	Surface : 17 km^2, 123 points for scuba-diving		79 k-hours
	aesthetic services: submarine landscape	recreational fishing	Surface : 484 km^2		103 k-hours
		Recreational boating	Surface : 2 322 km^2		105 k-hours
		Kayaking	Distance of paths for kayaking: 341 km		20 k-hours
		Scuba-diving and underwater fishing	Surface : 17 km^2, 123 points for scuba-diving		394 k-hours
	recreative services : extraction of halieutic resources	recreational fishing	Surface : 484 km^2		2 938 k-hours
		Recreational boating	Surface : 2 322 km^2		2 738 k-hours
		Kayaking	Distance of paths for kayaking: 341 km		117 k-hours
		Scuba-diving and underwater fishing	Surface : 17 km^2, 123 points for scuba-diving		228 k-hours
Regulation services	Climate change				
	Reducing polluant matters				
	Prevention / protection against perturbations				
	Preventing erosion				

For some provisioning services, the current consumption level is far much higher than the potential production level

Physical estimates for regulating services are not available yet

Conclusion

- This accounting approach provides a series of improvements in relation to accounting issues:
  - It avoids the problem of ES and NC valuation (no use of non-market valuation techniques) => the results are more robust and the conventions used are more consistent with the SNA
  - The results have a great interest for the managers :
    - The economy dependence to ES at the local level is estimated
    - Equilibrium or not between ES consumption and ES production? => disequilibrium : revealing where to make the efforts
- Limits :
  - difficulties for estimating all indicators, especially as regards physical ecological indicators (production of ecological outputs)
  - the valuation of the means implemented by households for consuming ES necessitate a survey which may be expensive

Thank you very much for your attention