Ecosystem Accounting

An update of experiences gained at Wageningen University

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Reflecting work undertaken with Bram Edens (CBS), Roy Remme, Matthias Schröter, Elham Sumarga, Confidence Duku, Aritta Suwarno (all WU), Sander Zwart (AfricaRice), David Barton (NINA, Norway).

Wageningen University

The Netherlands

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- Progress in relation to the different Ecosystem Accounts
- Mapping intermediate ecosystem services

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Introduction of Ecosystem accounting

Guidelines for Experimental Ecosystem Accounting have been prepared under coordination by UNSD, as part of the overall System for Environmental Accounting (SEEA) framework

Ecosystem accounting is a tool to understand and monitor **the contributions of ecosystems to economic activity**.

Ecosystem accounting aims to measure both the contribution of ecosystems to economic production, and to household consumption.

Ecosystems include natural as well as man-dominated systems such as croplands or intensive pastures

Ecosystem accounting is developed so that the approach is aligned with the System of National Accounts (SNA)

Policy applications of ecosystem accounts

- Understanding the contribution of ecosystems to economic activities (and the monetary value of these ecosystems)
- Measuring and monitoring sustainability: what are the changes in ecosystem capital / ecosystem assets from one year to the next
- Identifying ecosystem types/ areas / services under particular threat
- The spatial approach of ecosystem accounting makes it also suitable to support resource management and land use planning

Key elements of Ecosystem accounts

Ecosystem accounting aims to measure the contributions of ecosystems to economic activity in a national accounting framework by recording – in *physical* and *monetary* units:

- **Ecosystem condition**
- **Flows of 'ecosystem services'**
  - **Provisioning services**: the products that can be harvested or extracted from ecosystems
  - **Regulating services**: the regulation of biological, hydrological and climate processes
  - **Cultural services**: the non-material benefits of ecosystems e.g. related to tourism or cultural experiences
- **Ecosystem Assets**

The ecosystem accounts

The full set of Ecosystem accounts could include, in its most comprehensive form, the following:

- Ecosystem condition account
- Ecosystem production account
- Ecosystem asset account
- Biodiversity account
- Supply-Use account

All accounts include tables and maps, except the User-Supply account which is in the form of a table only (given the complexity of the spatial relationships involved)

The ecosystem condition account

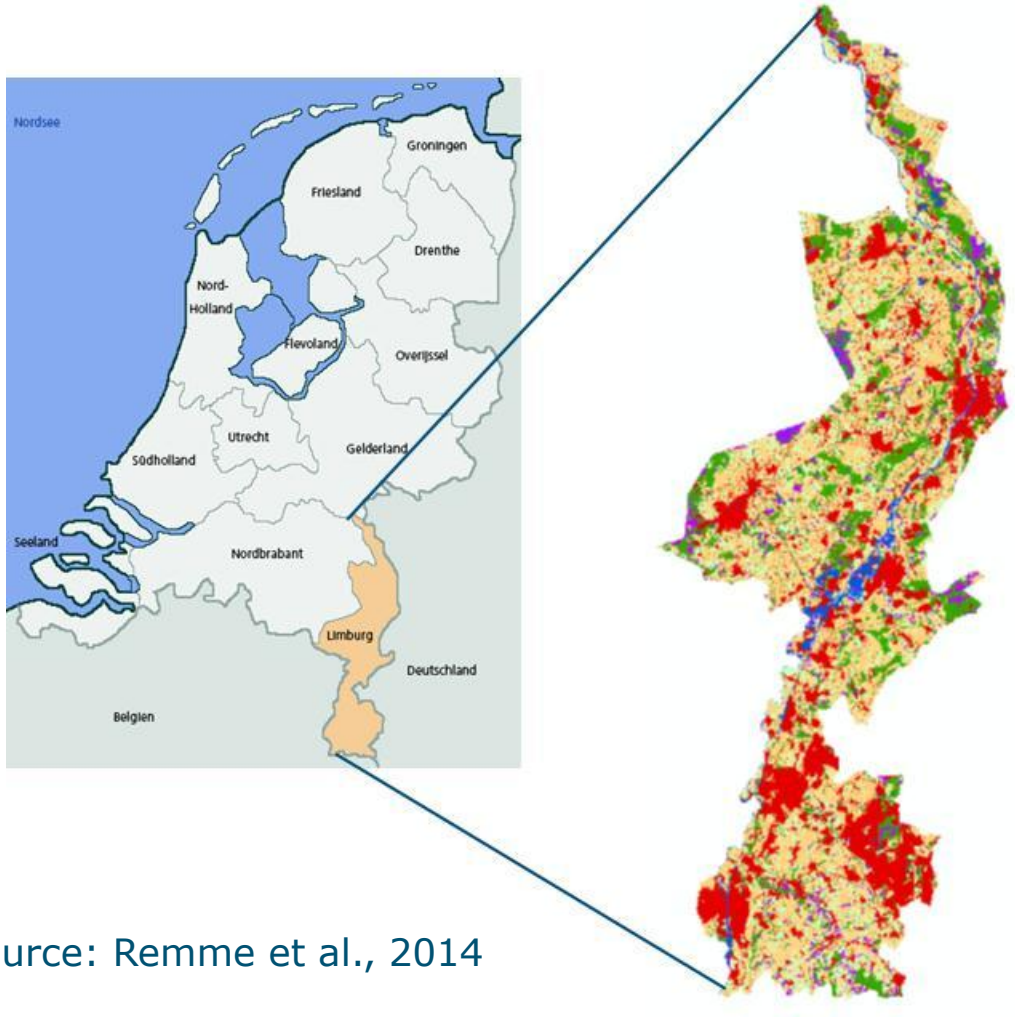
- Contains indicators that reflects the **condition/state** of the ecosystem
- Indicators are specific to countries and ecosystems but may include such aspects as:
    - Land cover
    - Physical condition, e.g. soil fertility, water table, (ground)water quality
    - Biological condition, e.g. crown cover, standing biomass
    - Processes: e.g. Net Primary Production (of the vegetation)
    - The presence of species that indicate ecological quality, e.g. species sensitive to pollution
- Information would be provided in maps and synthesised in tables

Ecosystem Production account

- Expresses the supply of **ecosystem services** in physical and monetary terms
- Using maps, the supply of each ecosystem service is calculated for each grid cell (termed 'Basic Spatial Unit')
- Information can be synthesised in a table, for instance per land cover / ecosystem unit (LCEU) or per administrative unit
- With GIS, the spatial variability can be calculated

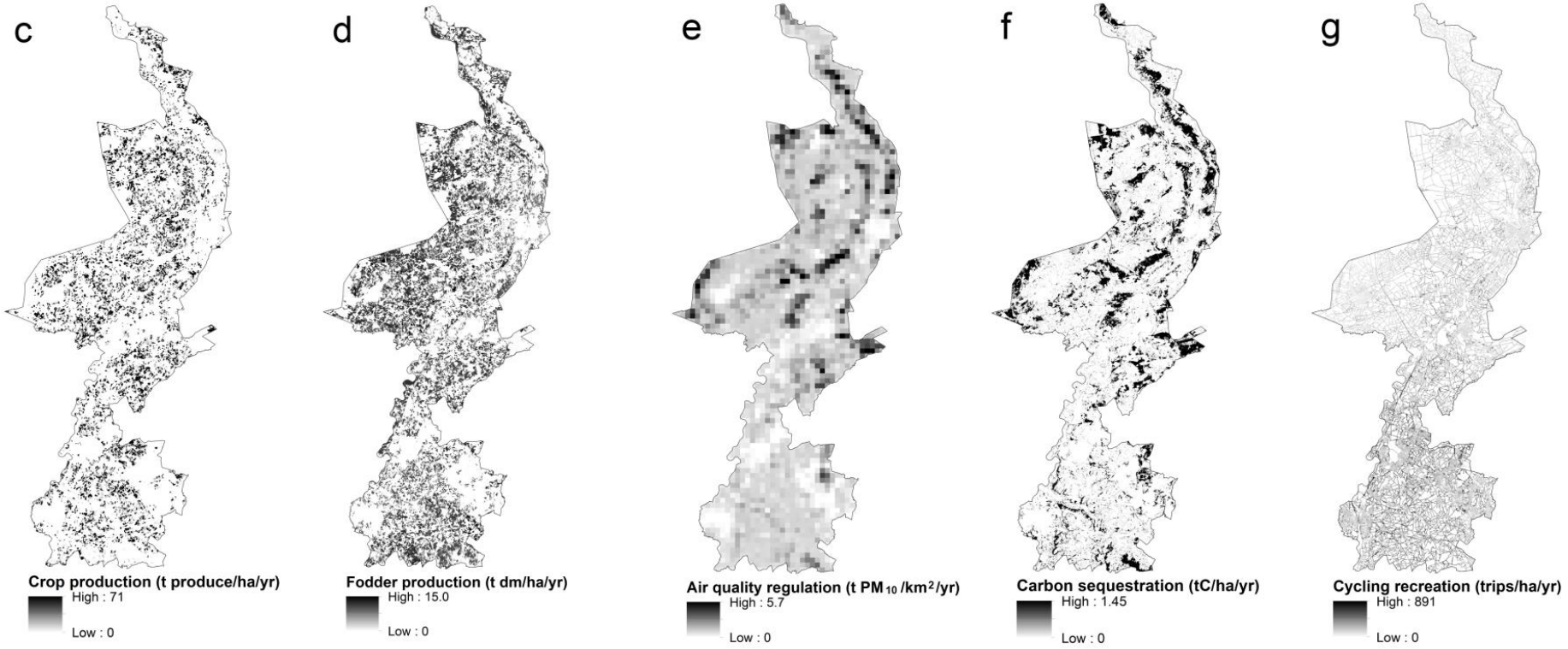
Ecosystem production account example: Limburg province the Netherlands

- Biophysical ecosystem account developed for Limburg Province, the Netherlands
- 2200 km^2, 1.1 million inhabitants
- Analysis of 7 ecosystem services



Source: Remme et al., 2014

Ecosystem production accounts Limburg, NLs



Source: Remme et al., 2014

Ecosystem production account table Limburg

LCEU	Ecosystem service													
	Crop production		Fodder production		Drinking water extraction		Hunting		Air quality regulation		Forest carbon sequestration		Recreational cycling	
	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)	Total	Mean (SD)
	Mtons MEQ	kg MEQ ha^{-1} yr^{-1}	ktons dm	kg dm ha^{-1} yr^{-1}	10^3 m^3 water	m^3 water ha^{-1} yr^{-1}	kg meat	kg meat km^{-2} yr^{-1}	tons PM_{10}	kg PM_{10} km^{-2} yr^{-1}	ktons C	kg C ha^{-1} yr^{-1}	10^3 trips	trips ha^{-1} yr^{-1}
Pasture	-	-	521	12,041 (1,573)	9,110	3,099 (2,231)	9,100	21 (17)	405	911 (532)	-	-	1,872	103 (78)
Cropland	2.46	36,314 (1,785)	-	-	14,855	3,082 (2,422)	14,732	20 (17)	715	956 (534)	-	-	2,631	99 (73)
Forest	-	-	-	-	4,577	3,214 (2,624)	8,100	24 (20)	686	2,040 (1,221)	55	1,563 (263)	1,472	126 (94)
Water	-	-	-	-	3,289	9,460 (3,698)	-	-	40	624 (569)	-	-	147	110 (92)
Urban	-	-	-	-	7,862	4,321 (3,527)	-	-	285	547 (562)	-	-	2,735	70 (57)
Heath	-	-	-	-	219	1,293 (821)	678	32 (25)	45	2,062 (1,111)	-	-	30	82 (59)
Peat	-	-	-	-	0	0 (0)	70	13 (3)	7	970 (345)	-	-	3	92 (44)
Other nature	-	-	-	-	1,187	3,093 (2,567)	1,513	25 (20)	69	1,155 (710)	-	-	226	128 (93)
Provincial total	2.46		521		41,099		34,193		2,252		55		9,116	

Source: Remme et al., 2014

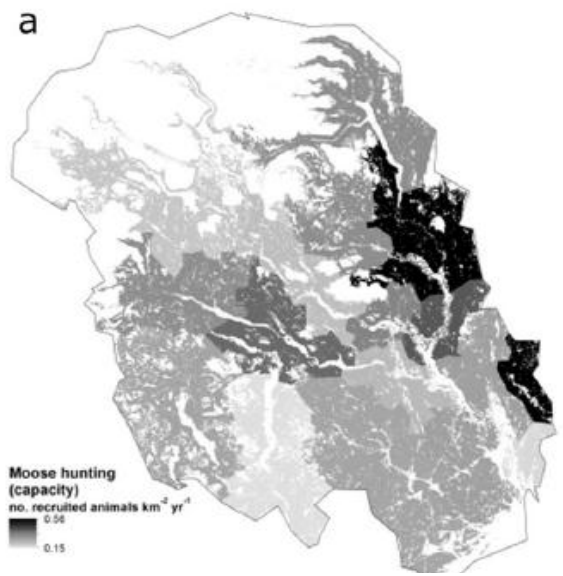
Ecosystem asset account, principal components:

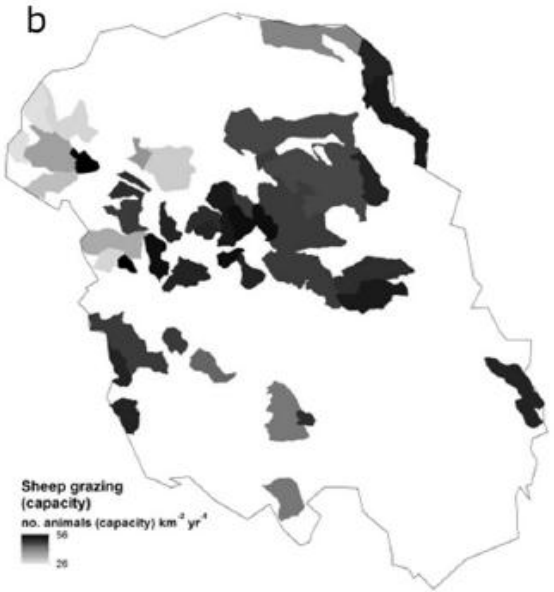
- In order to record changes in ecosystem assets
- This account includes maps and a table reflecting:
  - Opening stocks
  - Changes in stocks due to economic activity (e.g. harvest)
  - Changes in stocks due to natural processes (e.g. regrowth)
  - Changes in stocks due to reclassification
  - Closing stocks
- Straightforward to define these aspects for provisioning services, but not for all regulating or cultural services
- Aspects to include in the Ecosystem Asset account to be determined depending on the country and its ecosystems

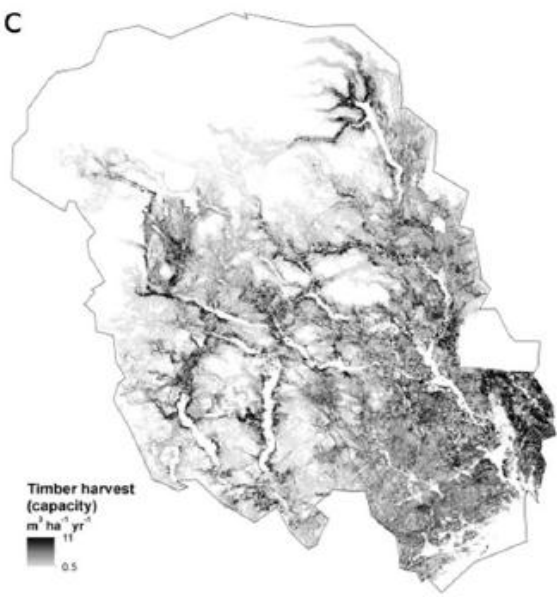
Analysing assets requires modelling regrowth of stocks /i.e. capacity to support ecosystem services use

Capacity to support ecosystem use was modelled, jointly with NINA Norway, by M. Schröter for Telemark County, Norway (15.000 km2)

M. Schröter et al. / Ecological Indicators 36 (2014) 539–551



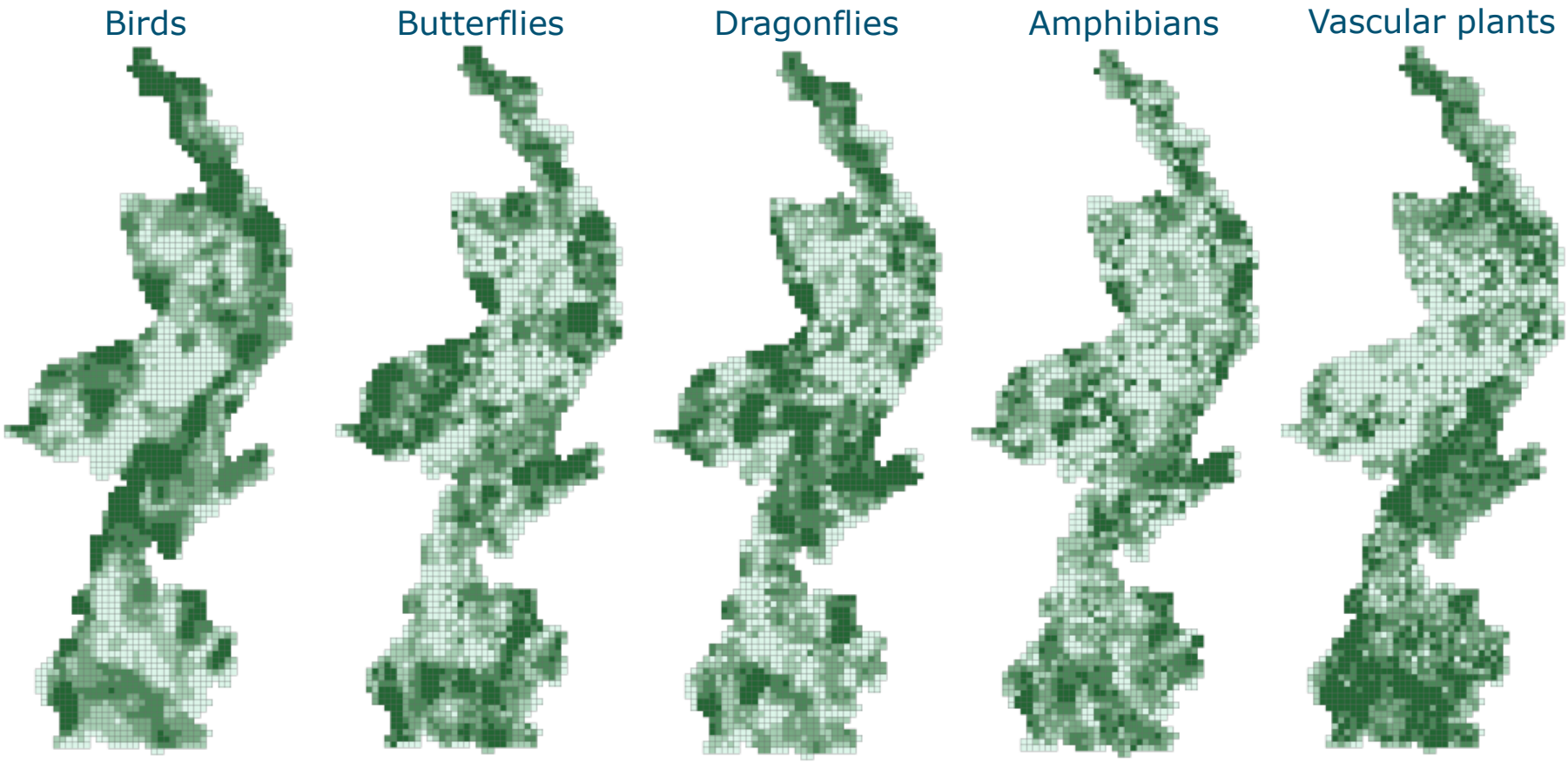




Biodiversity account

- Useful in order to capture biodiversity, of interest for environmental management and policy making
- Complementary to the other ecosystem accounts, since many aspects of biodiversity are not reflected otherwise in the accounts.
- Relevant indicators depend on the country and ecosystem, but may include aspects such as species diversity, species numbers, red list species, mean species abundance, occurrence of specific flagship species, habitat quality etc.
- Requires a spatial approach, i.e. a map expressing the selected indicators per pixel, complemented with summary tables organised as per the requirements of the user (e.g. per administrative unit, or land cover unit) – also to express trends over time

Biodiversity account: species richness



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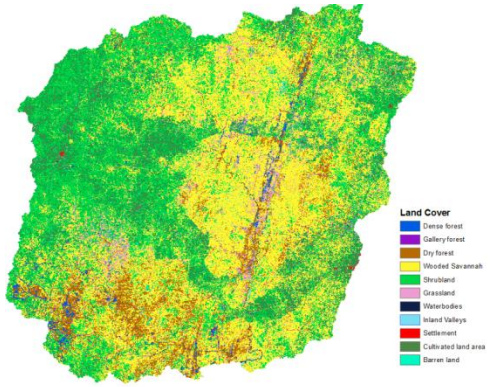
Work in progress shows little correlation between species richness of different species groups in Limburg, the Netherlands, and a range of different indicators are being tested

Ecosystem Supply-Use account

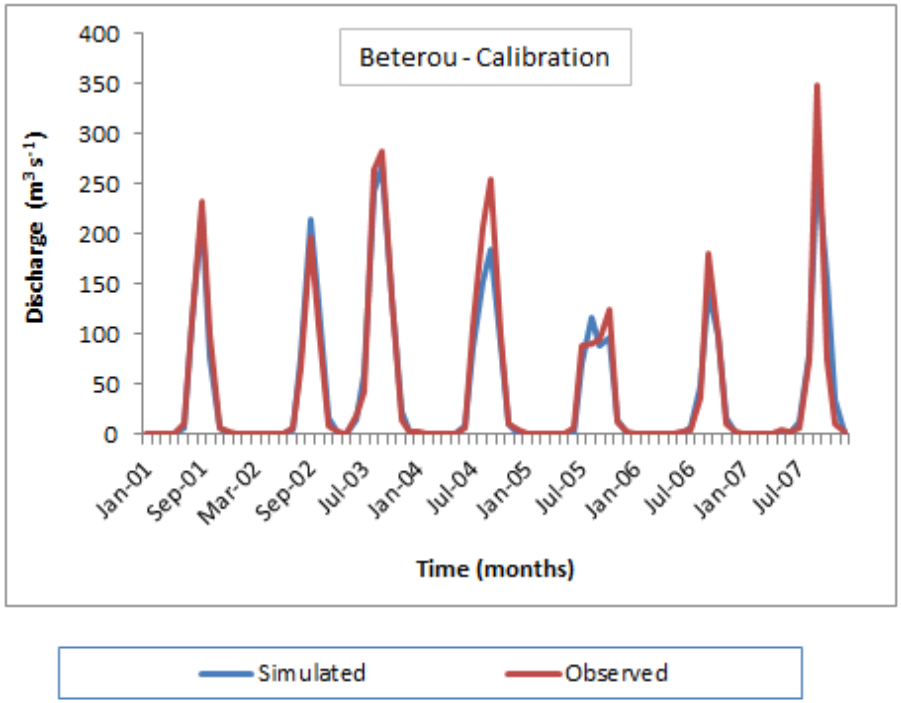
- Reflecting the use of ecosystem services by ISIC sector including non-financial and financial co-operations, central government, households and Not for Profit Institutes Serving Households.
- The suppliers of the service are the land owners (in case of private goods) or alternatively the 'ecosystem sector' (in the case of intermediate or final regulating services)
- Only a table can be prepared in view of the complex spatial interactions involved.

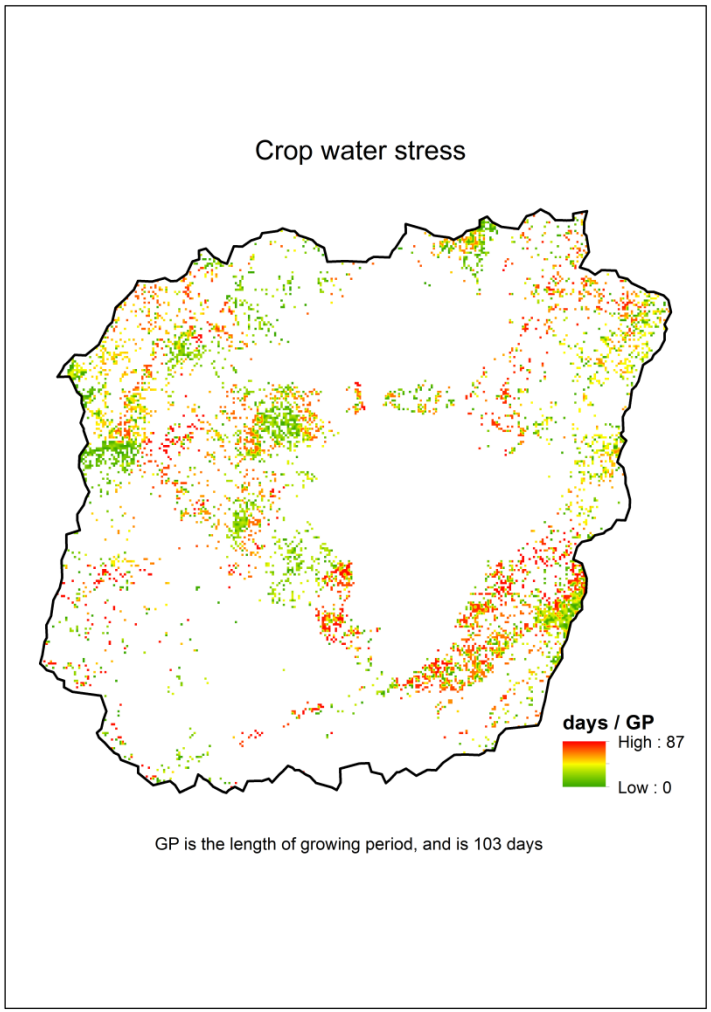
Modelling hydrological services

- Hydrological services can both be a final (e.g. drinking water, flood control) and an intermediate service (e.g. sustaining irrigated agriculture)
- Focus in Experimental Ecosystem Accounting is on final services, yet intermediate services may be very relevant for environmental management (e.g. in the case of deforestation reducing dry-season water availability below stream)
- Modelling approach being tested in Wageningen to analyse final and intermediate hydrological services, focussing on Upper Ouémé Watershed (15,000 km2) in Benin, using 12 years of data.



Results Benin





All key hydrological processes underpinning four hydrological services are mapped (crop water supply, household water supply, water purification and erosion control), at 1 hectare resolution

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Next steps

- Jointly with partners including CBS, NINA, WAVES and UNSD: testing different approaches to developing the Biodiversity Accounts, further developing the approach to defining the Asset accounts
- With CBS (Bram Edens) further development of the Ecosystem Accounts for Limburg (among others linking to sectors in order to develop Supply-Use account).
- New work in Uganda (wetland ecosystem services)
- Continued support to WAVES Philippines (with Stefanie Sieber, Gem Castillo and Sofia Ahlroth).

Thank you.

Publications:

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- Edens and Hein (2013). Towards a consistent approach to ecosystem accounting. *Ecological Economics.*
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- Sumarga and Hein (2013) Mapping ecosystem services for landscape planning, the case of Central Kalimantan. *Environmental Management.*
- RP Remme, M Schröter, L Hein (2014). Developing spatial biophysical accounting for multiple ecosystem services. *Ecosystem Services, 2014*