Experimental Ecosystems / National Capital Accounts for Mauritius 2000-2010

Second Expert Group Meeting on Biodiversity for Poverty Eradication and Development

Convention on Biological Diversity

4 – 6 December 2013

Chennai, India

Prepared by: Mr. Anand Sookun
(asookun@gmail.com),
Mr. Jean Louis Weber,
Independent Consultant
(jlweber45@gmail.com)

Presented by: **Mr. Anand Sookun**
Researcher/PhD candidate

Contents

- Introduction
  - Need for Ecosystem Accounts
  - Accounting Manuals
- Types of Ecosystem Natural Capital
  - Landscape/Biomass/Carbon
  - Water
  - Biodiversity
- Way forward
- Conclusion

Introduction

The Natural Capital/Ecosystem Capital Accounting (ECA) project for Mauritius

- The demand for ECA came in support to various assessments such as **TEEB** (The Economics of Ecosystems and Biodiversity - UNEP), **WAVES** (Wealth Assessment and Valuation of Ecosystem Services – The World Bank), and last but not least, the 2010 **Aichi-Nagoya Strategy** adopted by the Parties of the CBD which states that 'ecosystem and biodiversity values should be incorporated into national accounts' by 2020. **The Future We Want – RIO+20**

Reference manuals

- FDES 2013,
- SEEA CF 2012
- The SEEA-Water
- Int. Recc for Water Stats,
- Int. Stand. Indis. Classi - ISIC
- and Central Prod. Classif - CPC

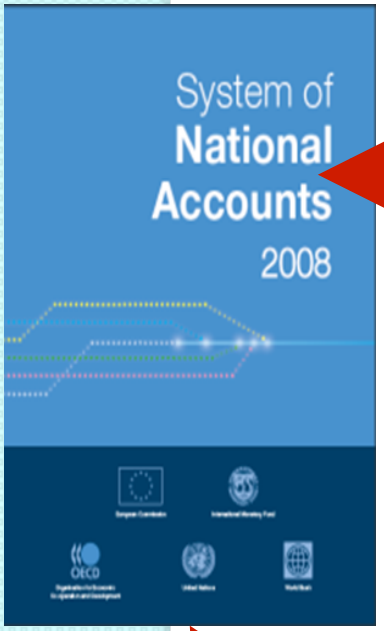
National Accounts: SNA and SEEA

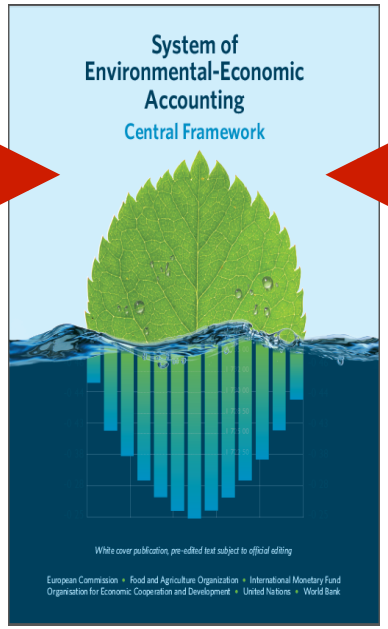
The System of Environmental-Economic Accounts adopted by the UN Statistical Commission in 2012 (SEEA 2012) has been supplemented in 2013 by a volume on "Experimental Ecosystem Accounting". The "Ecosystem Capital Accounts" (SEEA-ECA) under implementation in Europe are one of these experimentations.

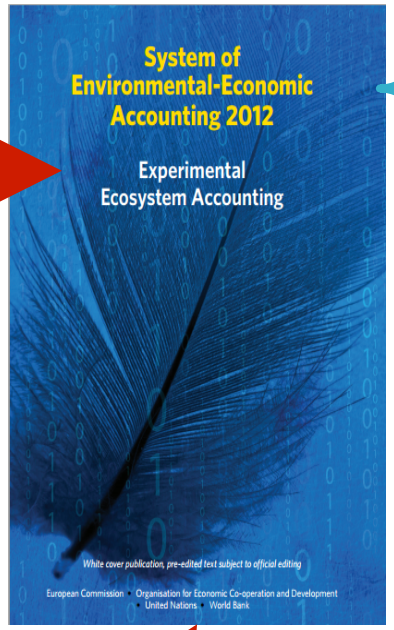
SNA

SEEA Part 1 "Central Framework"

SEEA Part 2 "Experimental Ecosystem Accounting"







SEEA-EEA XXX

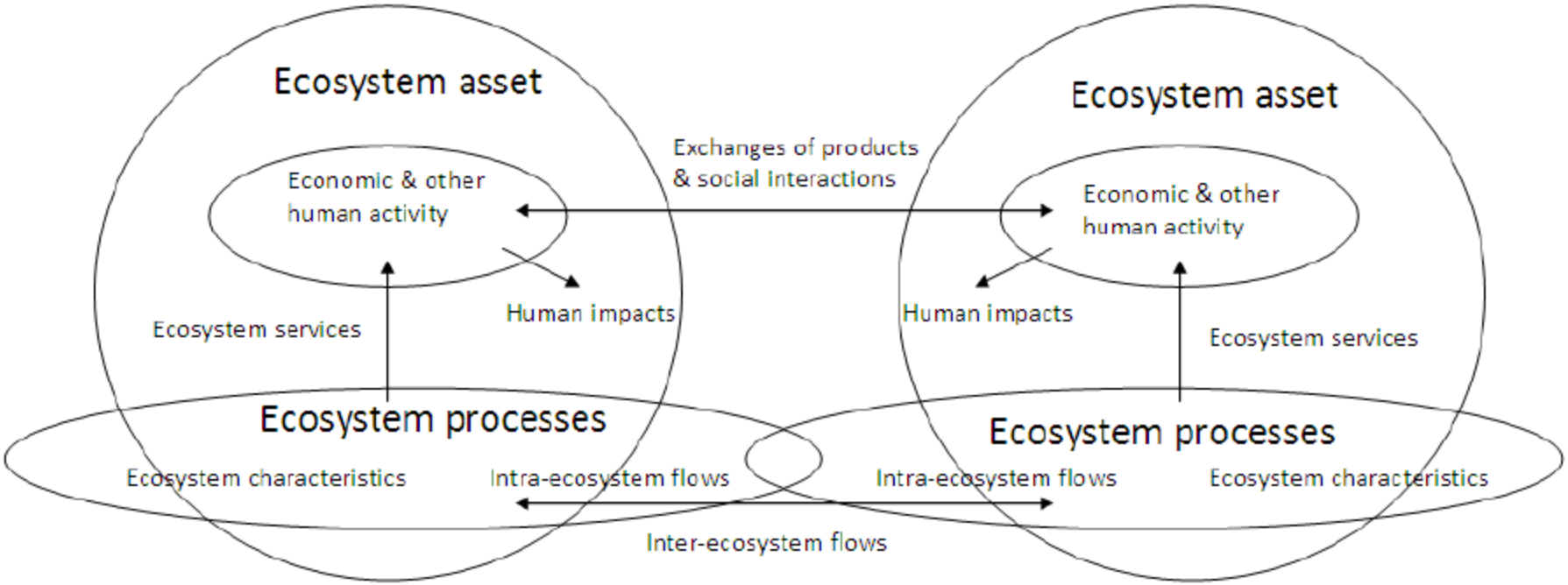
SEEA-EEA YYY

SEEA-ECA

Ecosystem Capital Accounts

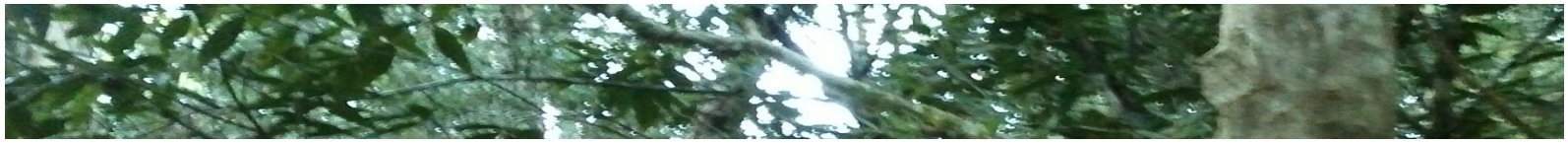
Basic Model

Figure 2.1 Basic model of ecosystem stocks and flows



Source: System of Environmental-Economic Accounting 2012 - Experimental Ecosystem Accounting (SEEA Experimental Ecosystem Accounting), UNSD

Physical flows of ecosystem services



	Type of LCEU				
	Forest tree cover	Agricultural land*	Urban and associated developed areas	Open Wetlands	…
Type of ecosystem services					
Provisioning services	e.g. tonnes of timber	e.g. tonnes of wheat			
Regulating services	e.g. tonnes of CO_2 stored/released	e.g. tonnes of CO_2 stored/released	e.g. tonnes of CO_2 stored/released	e.g. tonnes of P absorbed	
Cultural services	e.g. number of visitors/hikers		e.g. hectares of parkland	e.g. hectares of duck habitat	

* Medium to large fields rainfed herbaceous cropland

Accounting Matrix – Supply and use

ENVIRONMENT

CPC

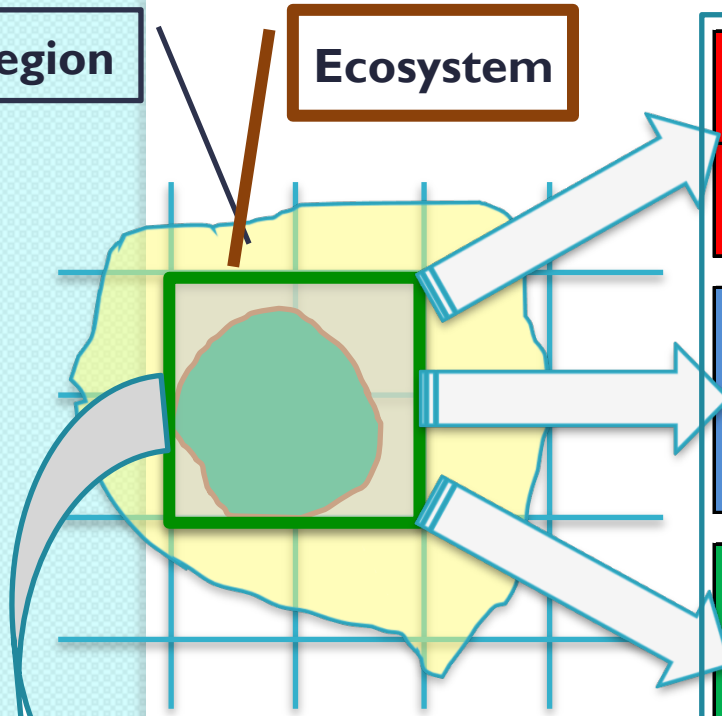
ECONOMY

ISIC

Items as per SEEA central Framework	SUPPLY	Agriculture	Manufacture and services	Hydroelectricity	Cooling (thermoelectricity)	Water utility (drinking water)	Sewerage (sewage collection and treatment)	House-holds	Environment to Economy	TOTAL
		ISIC 01-03	ISIC 05-33, 41-43,38,39,45-99	ISIC 3510	ISIC 3510	ISIC 3600	ISIC 3700			
	(I) Sources of abstracted water									
Natural inputs	Surface water								629.8	629.8
Natural inputs	Groundwater								121.5	121.5
	Total								*751.3*	*751.3*
	(II) Abstracted water									
CPC 18000	Drinking water					96.6				96.6
	Total					96.6				96.6
	(III) Wastewater and reused water									
Residuals	Sewage to sewers		5					32		37
	Total		*5*					*32*		*37*
	(IV) Return flows of water									
Residuals	Losses of water					107.8				107.8
Residuals	Water returns	1		181						295
	Sewage to environment							28		28
Residuals	Treated wastewater		20				37			57
	Total	*114*	*20*	*181*		*107.8*	*37*	*28*		*487.8*
	(V) Evaporation, transpiration, incorporation in products									
Residuals	Evaporation, transpiration, incorporation in products	243.5	6.4	0	0	0	0	13.7		263.6
	TOTAL	**357.5**	**31.4**	**181**	**0**	**204.4**	**37**	**73.7**	751	1 636

Calculation of Ecological Values in ECU & Total Ecosystem Potential (TEC)

Adapted from Aoyama Yukiko, Oguro Michio, and Yano Tohru, 2011
Tohoku University, Sendai, Japan, November 2011



95	100
107	103

Indexes of Accessible Carbon/ Biomass

98	100
100	94

Indexes of Accessible Water

94	103
97	93

Indexes of Accessible Landscape/ Biodiversity Services

SUM / 3

751	433
920	615

Basic resource (e.g. tons of Carbon/ Biomass)

X

95.7	101.0
101.3	96.7

ECU-Prices

=

71846	43733
93227	59450

ECU values per 1 km2 grid-cells

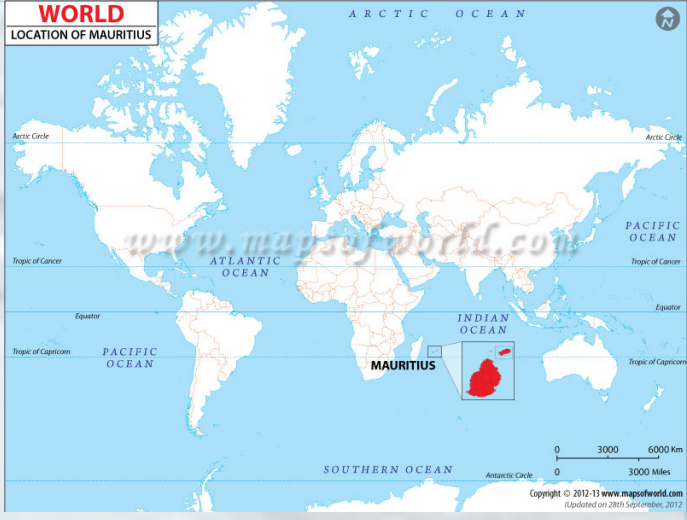
SUM

268255

TEC: Total Ecosystem Capability (ECU)

Ecosystem Accounts in Mauritius:

Background of Mauritius



- Location
- Population : 1.27 Million
- Area of Republic of Mauritius:
  - Land: 2,040 km^2
  - Ocean (Exclusive Economic Zone – EEZ): 1.9 million km^2
- Major Climatic Conditions: Sub Tropical Summer & winter
- Average annual rainfall : approx. 2000 mm
- Population Density:650 inhabitants/km^2

Mauritius

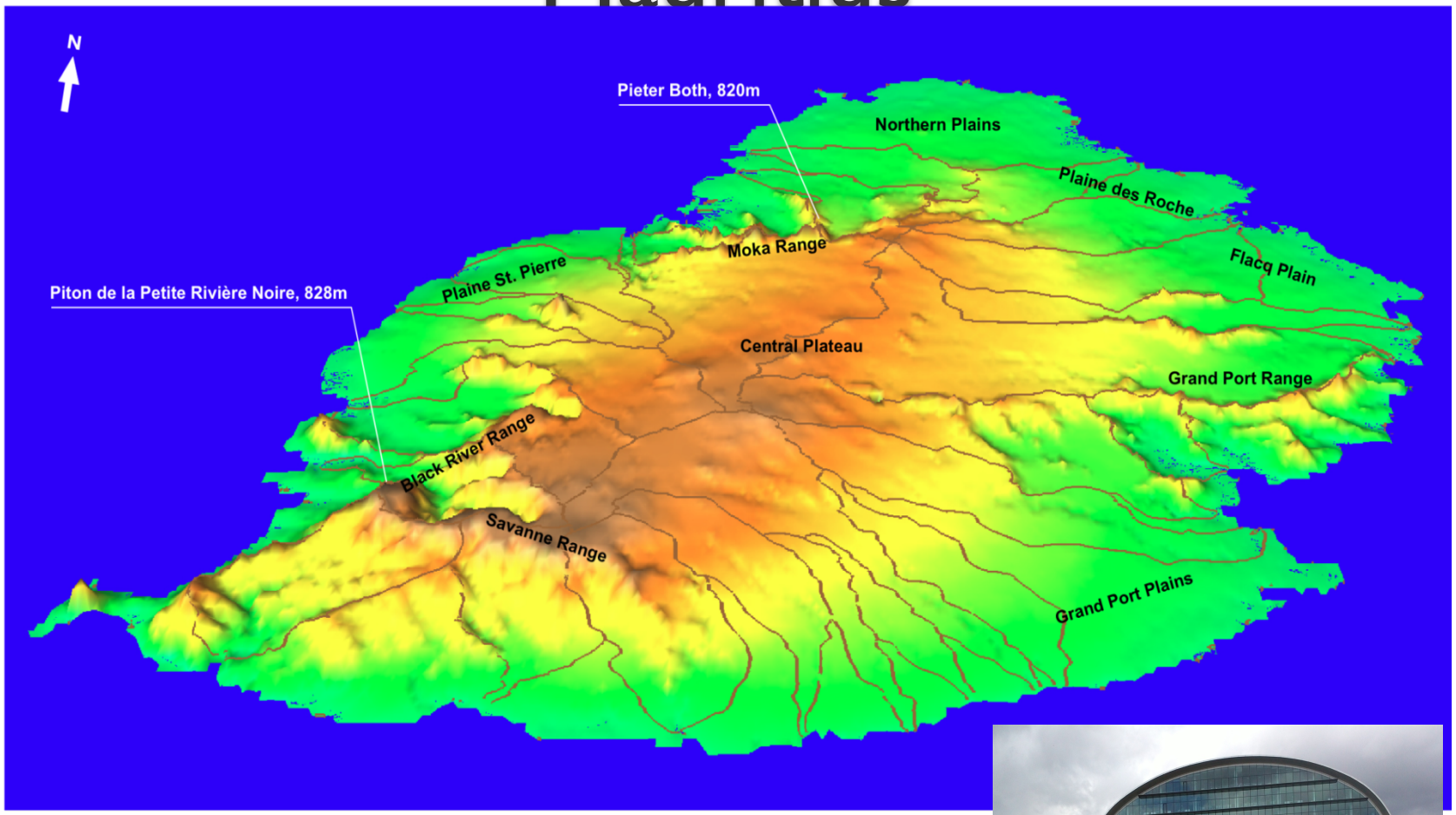


Fig. 2: Digital elevation model (DEM) of Mauritius seen from So

The need for environmental accounting under the policy contexts in Mauritius

In Mauritius, the environmental issues are a matter of concern with population rise, economic developments in tourism and manufacturing, among others.

The need for and use of proper statistics and accounts have been clearly felt in studies carried out such as:

The National Self Capacity Assessment for Environment (2005), The National Assessment Report on the Mauritius Strategy for Implementation of Sustainable Development in SIDS (2010), and The Mauritius Environment Outlook Report (2011).

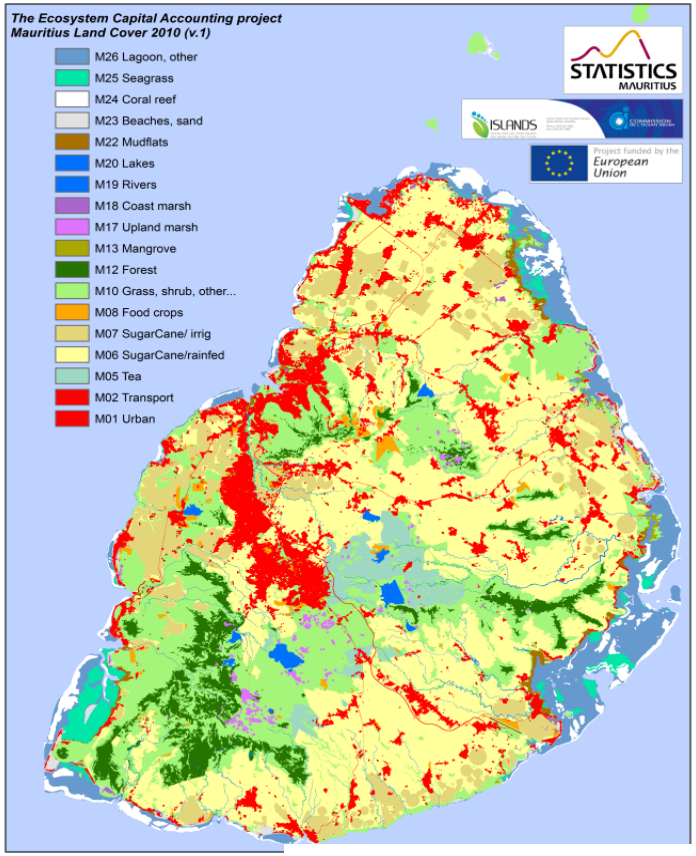
Maurice Ile Durable

The need for environmental accounting under the policy contexts in Mauritius

- Because **ecosystem resilience** is a central component of **sustainable development** and **adaptability to climate change,** the Government of Mauritius and the Indian Ocean Commission have decided to launch an experiment of ecosystems/natural capital accounts in the context of Implementation of the Small Island Developing States 'Mauritius Strategy' in the Eastern and Southern Africa and Indian Ocean (ESA-IO) region.

Results *for ECA* : Land cover and changes from 2000 to 2010

(provisional and illustrative)



The land cover data are stored using geographical datasets which use grids (10m x 10m and 100m x 100m) at the most detailed level. These grids allow computing statistics and producing ecosystems/natural capital accounts for various statistical units such as municipal and village council areas, districts, coastal zones, river basins, socio-ecological landscape units and any relevant zoning.

Land cover stock and change account/ urban sprawl **2000 2010 - km2**

	Rivière du Rempart	Pamplemousses	Flacq	Moka	Grand Port	Plaines Wilhems	Black River	Savanne	Port Louis	TOTAL
District AREA SQKM	14703	18019	29826	23512	26134	19839	25558	24758	3976	186325
M01 Urban land cover 2000 v0	747	705	405	282	406	2060	334	266	2667	7872
M01 Urban land cover 2000 v1, adjusted	1225	1172	667	510	549	2456	542	379	3284	10782
If1 Urban sprawl	478	467	263	228	143	396	208	112	616	2911
M01 Urban land cover 2010	1704	1639	930	738	691	2852	749	491	3900	13693

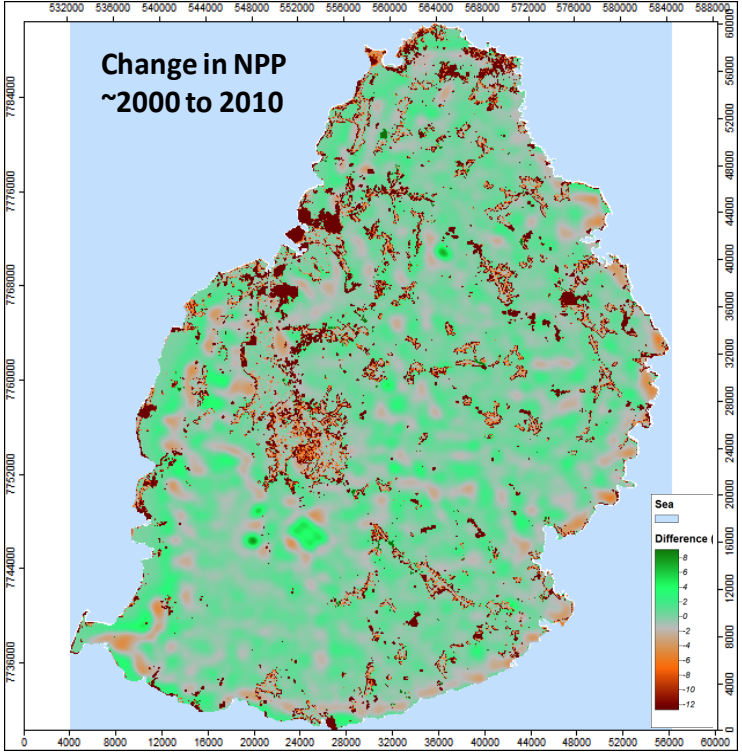
Carbon Accounts Shows the capacity of the ecosystems to produce biomass and the way it is used by harvests or sometimes sterilised by artificial developments or destroyed by soil erosion or forest fires

Net Primary Production, NPP, **is the net amount of primary production after the costs of plant respiration are included. Therefore, NPP = GPP - R**
Gross Primary Production, GPP, is the total amount of CO2 that is fixed by the plant in photosynthesis.

*** Respiration, R**

Results *for ECA* : The biomass-carbon account

In the biomass/bio-carbon account, flows explain changes in stocks, the most important of them being trees (and to a smaller extent shrubs) and soil. The stocks of woody biomass have been estimated by combining satellite observations (MODIS VCF) and FAO forest statistics (FRA2010).



Land cover stock and change account/ urban sprawl **2000 2010 - km2**

	Rivière du Rempart	Pamplemousses	Flacq	Moka	Grand Port	Plaines Wilhems	Black River	Savanne	Port Louis	TOTAL
District AREA SQKM	14703	18019	29826	23512	26134	19839	25558	24758	3976	186325
M01 Urban land cover 2000 v0	747	705	405	282	406	2060	334	266	2667	7872
M01 Urban land cover 2000 v1, adjusted	1225	1172	667	510	549	2456	542	379	3284	10782
lf1 Urban sprawl	478	467	263	228	143	396	208	112	616	2911
M01 Urban land cover 2010	1704	1639	930	738	691	2852	749	491	3900	13693

(provisional and illustrative)

Status of Latest Water Accounts

This report is the first comprehensive one to show the relationship between the environment (water) and the economy

Water accounts are mainly presented in physical terms and some monetary values are as well presented but in summarised forms.

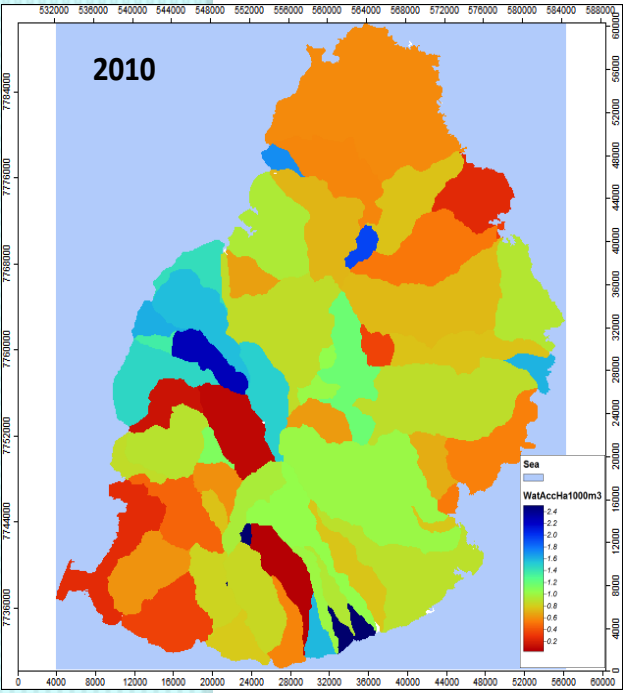
Republic of Mauritius

Water Statistics and Accounts for Mauritius 2012

Statistics Mauritius, Ministry of Finance and Economic Development

Results for ECA: the ecosystem water account

Accessible water, mean amount by ha, 10^3 m3



(provisional and illustrative)

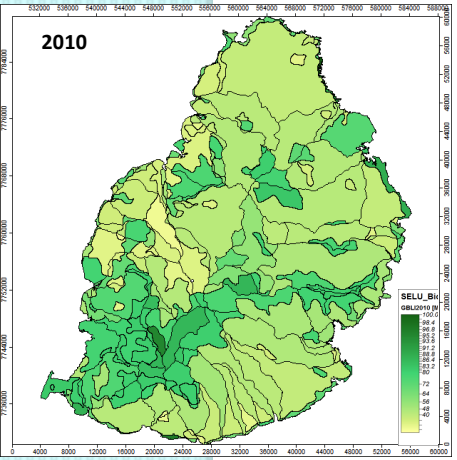
Simplified water accounts by Districts, 2010 — Mm3

2010	Riviere du Rempart	Pamplemousses	Flacq	Moka	Grand Port	Plaines Wilhems	Black River	Savanne	Port Louis	Total
AREA_ha	*14703*	*18019*	*29826*	*23512*	*26134*	*19839*	*25558*	*24758*	*3976*	*186325*
Boreholes_nb	*105*	*164*	*100*	*83*	*110*	*146*	*131*	*30*	*12*	*881*
River runoff districts coeff	*35*	*20*	*150*	*150*	*100*	*100*	*80*	*100*	*20*	*755*
Lake 2010 ha	*0*	*103*	*0*	*468*	*41*	*511*	*109*	*19*	*0*	*1251*
Stocks	**3345**	**5231**	**3189**	**2681**	**3510**	**4687**	**4183**	**961**	**383**	**28170**
Aquifers	3343	5222	3184	2643	3503	4649	4171	955	382	28052
Lakes/reservoirs	0	7	0	32	3	35	7	1	0	86
Rivers	2	2	5	6	5	3	4	4	1	32
Soil/vegetation										
Net Inflows	**75**	**176**	**292**	**342**	**355**	**293**	**155**	**353**	**12**	**2052**
Rainfall	173	236	579	633	629	484	302	603	49	3688
EvapoTranspitation (actual), total	155	199	367	290	338	224	308	326	40	2247
EvapoTranspitation (actual), spontaneous	109	115	310	268	294	207	167	269	40	1779
Net transfers surface - groundwater	11	14	23	18	20	15	20	19	3	143
Transfers between basins		41		-41						0
Abstraction and Uses	**63**	**109**	**80**	**36**	**63**	**83**	**152**	**69**	**23**	**678**
Municipal Water Production	17	23	23	13	18	64	11	11	22	202
Use of water	*8*	*12*	*11*	*7*	*9*	*32*	*5*	*6*	*11*	*101*
Loss of water in distribution	*8*	*12*	*11*	*7*	*9*	*32*	*5*	*6*	*11*	*101*
Irrigation	46	85	57	22	44	17	141	57	0	468
Other	1	1	1	1	1	3	0	0	1	8
Waste water to rivers	**6**	**8**	**8**	**5**	**6**	**22**	**4**	**4**	**8**	**70**
Outflow to the sea	**78**	**46**	**324**	**318**	**217**	**212**	**172**	**213**	**50**	**1632**
Rivers runoff	74	42	318	318	212	212	170	212	42	1602
Waste water to the sea	4	4	6	0	5	0	2	1	8	30
Induced ETA, Evaporation	**46**	**85**	**57**	**22**	**44**	**17**	**141**	**57**	**0**	**468**
Net Flows	-103	-52	-156	-29	41	2	-304	19	-46	-626
Closing stocks	**3242**	**5179**	**3034**	**2652**	**3551**	**4690**	**3879**	**980**	**337**	**27544**
Accessible renewable water	**83**	**124**	**217**	**200**	**219**	**187**	**228**	**213**	**36**	**1507**
Water use intensity (1): Average/ha	**132**	**114**	**270**	**561**	**345**	**224**	**150**	**310**	**155**	
Water use intensity (2): 1st decile	**90**	**90**	**118**	**203**	**148**	**114**	**110**	**222**	**143**	

The ecosystem water accounts are established by river basins and sub-basins where the hydrological system can be described consistently. Stocks of water are mainly aquifers and lakes/reservoirs, which play important role in Mauritius

Results for ECA: The systems and species biodiversity account

Green Background Landscape Index (GBLI)2010



The systems and species biodiversity account is made of two accounts which describe the state of ecosystems green infrastructure (landscapes, rivers and sea coastal zones) on the one hand and changes in species biodiversity on the other hand.

Highest GBLI values can be found in SELUs where forests, shrubs, grass and natural habitats are predominant, in particular in mountainous and land coastal areas. Low GBLI values correspond to urbanised areas and intermediate score reflect agriculture dominated catchments.

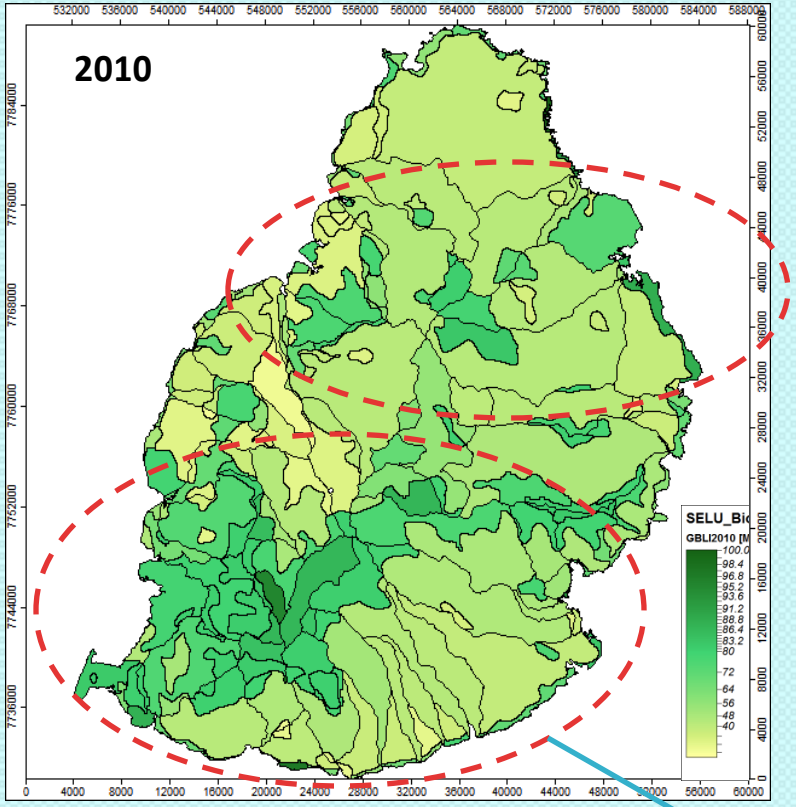
Green Infrastructure Accounts (provisional and illustrative)

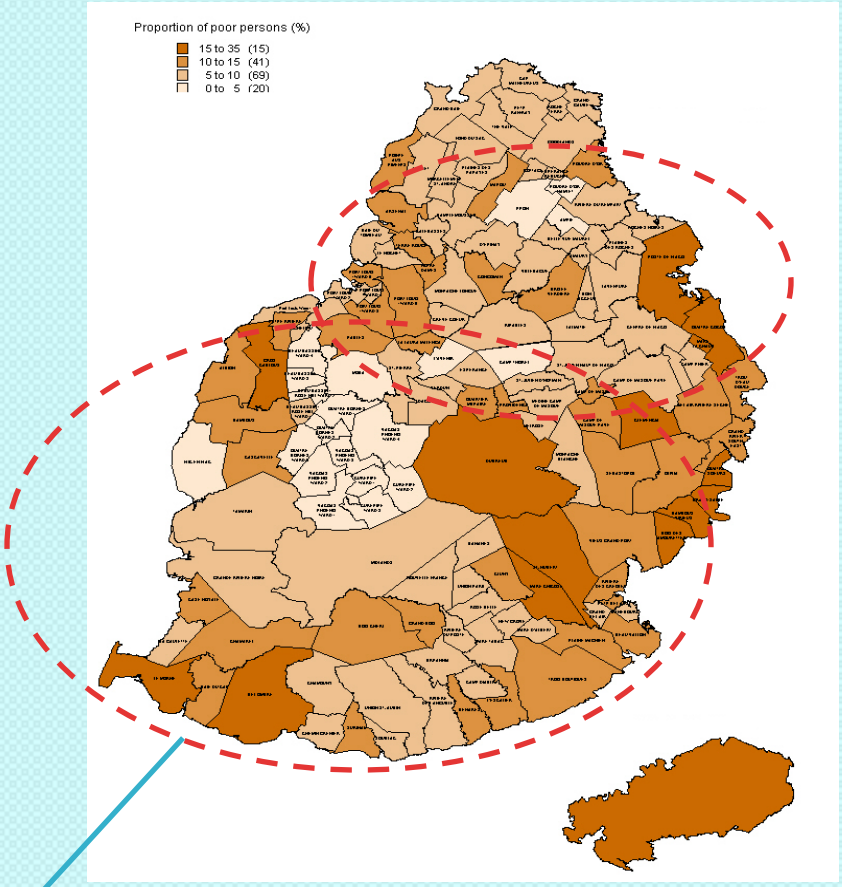
	Riviere du Rempart	*Pamplemousses*	*Flacq*	*Moka*	*Grand Port*	*Plaines Wilhems*	*Black River*	*Savanne*	*Port Louis*	**Total** / *Mean values*
AREA_ha	14703	18019	29826	23512	26134	19839	25558	24758	3976	186325
Indexes (0-100 value per ha)										
GBL 2000 index	*43.4*	*41.7*	*49.7*	*55.6*	*50.1*	*53.4*	*61.0*	*53.7*	*58.6*	*51.9*
Fragmentation index	*8.6*	*9.8*	*7.3*	*6.2*	*6.9*	*7.9*	*5.1*	*5.1*	*6.9*	*6.9*
nLEP 2000 index	*39.7*	*37.6*	*46.0*	*52.1*	*46.6*	*49.2*	*57.9*	*51.0*	*54.5*	*48.4*
Green Infrastructure Account										
GBL 2000 / weighted ha	638105	751152	1481482	1307506	1309039	1060139	1559660	1330151	232911	9670145
nLEP 2000 / weighted ha	583021	677761	1373059	1226033	1218167	976061	1479992	1262700	216727	9013521
Indexes (0-100 value per ha)										
GBL 2010 index	*42.0*	*40.6*	*49.2*	*55.1*	*49.8*	*52.4*	*60.5*	*53.5*	*50.7*	*51.1*
Fragmentation index	*8.6*	*9.8*	*7.3*	*6.2*	*6.9*	*7.9*	*5.1*	*5.1*	*6.9*	*6.9*
nLEP 2010 index	*38.4*	*36.7*	*45.6*	*51.6*	*46.4*	*48.2*	*57.4*	*50.8*	*47.2*	*47.7*
Green Infrastructure Account										
GBL 2010 / weighted ha	617999	732184	1468542	1294945	1301938	1039397	1547086	1324150	201660	9527900
nLEP 2010 / weighted ha	564651	660647	1361066	1214254	1211558	956963	1468060	1257003	187648	8881851
Change in nLEP 2000-2010	**-18370**	**-17114**	**-11993**	**-11779**	**-6608**	**-19097**	**-11932**	**-5697**	**-29079**	**-131670**
Change in nLEP index % 2000-2011	**-3.2**	**-2.5**	**-0.9**	**-1.0**	**-0.5**	**-2.0**	**-0.8**	**-0.5**	**-13.4**	**-1.5**

POVERTY AND BIODIVERSITY

Darker Areas have higher proportions of poor people (relative poverty defined by income distributions by deciles). (Year 2006/2007)

Greener areas denote rich biodiversity





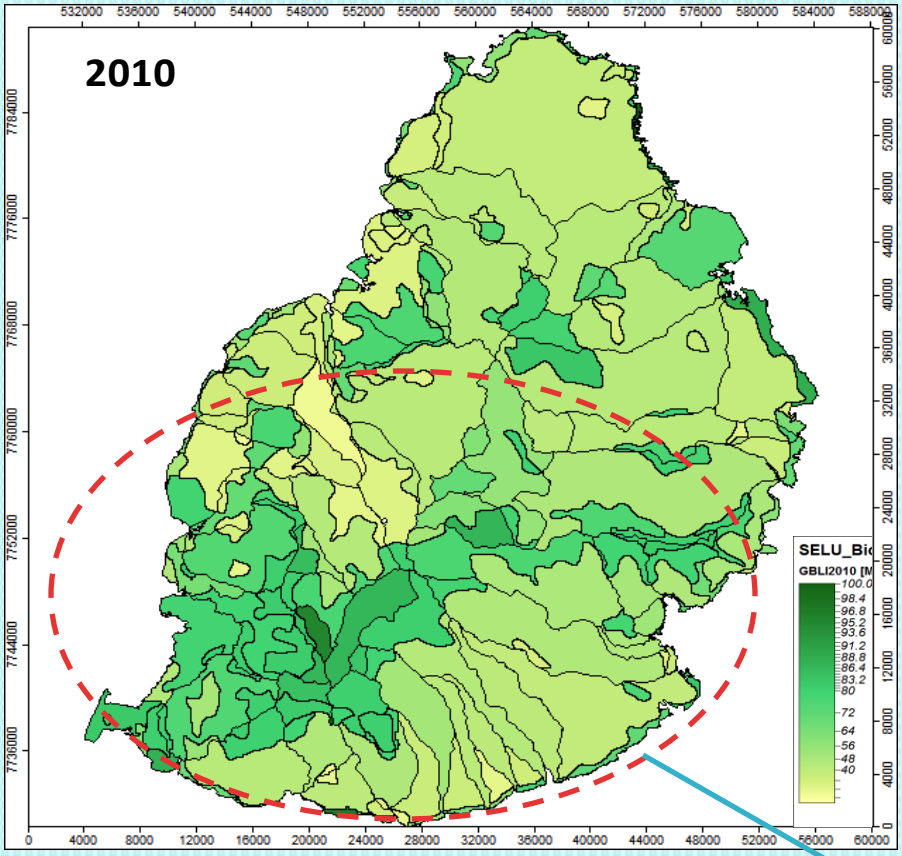
Poor areas appear to have rich biodiversity – to be studied further!

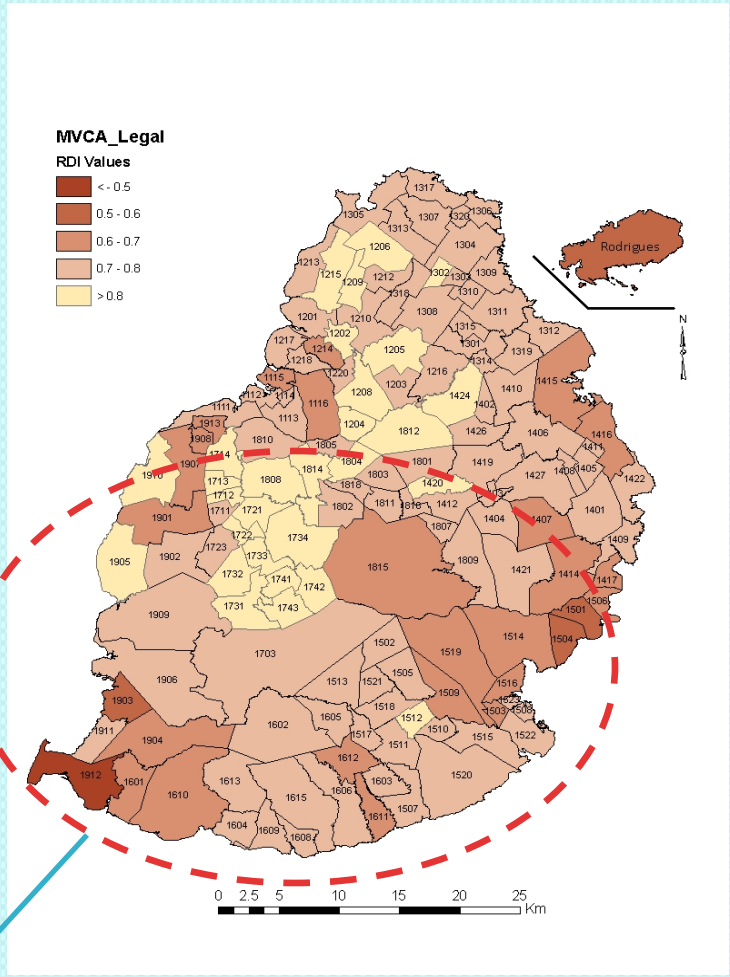
(provisional and illustrative)

POVERTY AND BIODIVERSITY

Greener areas denote rich biodiversity

Relative Development Index (RDI) for year 2011 as an indicator for poverty which is a composite index incorporating education level, income, infrastructure etc)





Greener areas denote rich biodiversity

Darker areas denote more poverty

Poor areas appear to have rich biodiversity – to be studied further!

(provisional and illustrative)

Way forward

- Time series data
- Satellite data for ECA and water accounts

Thank You..