



This project is funded by the European Union

ENI SEIS II East

Implementation of the Shared Environmental Information System (SEIS) principles and practices in the ENP East region

***Regional Conference on the outcome of the CLC-Pilot project,
potential benefits and way forward in ENI-East countries***

Land accounting and hands on data exercise for indicator production Republic of Moldova

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1. Workshop goals

CIRAD, Montpellier, France, 2-6 September 2019; 18 experts from ENI East countries

Training on environmental accounting of land and hands on data for indicator production

- Raise awareness on environmental accounts feasibility with current information, technology and following the LEAC methodology of EEA.
- Providing participants the opportunity of understanding the usefulness of land accounts in national context.



2. Workshop methodology

Training on environmental accounting of land and hands on data for indicator production

- Creation of „illustrative products” for the 6 ENI partner countries (pseudo CLC2015 and pseudo CLC2000 data) by JRC
- Construction of a land accounting table from land cover change matrix
- Stock and change accounts
- Land cover flows
- Indicators
- Use for national statistics and national reporting
- Lessons learnt



3. Information sources

International sources:

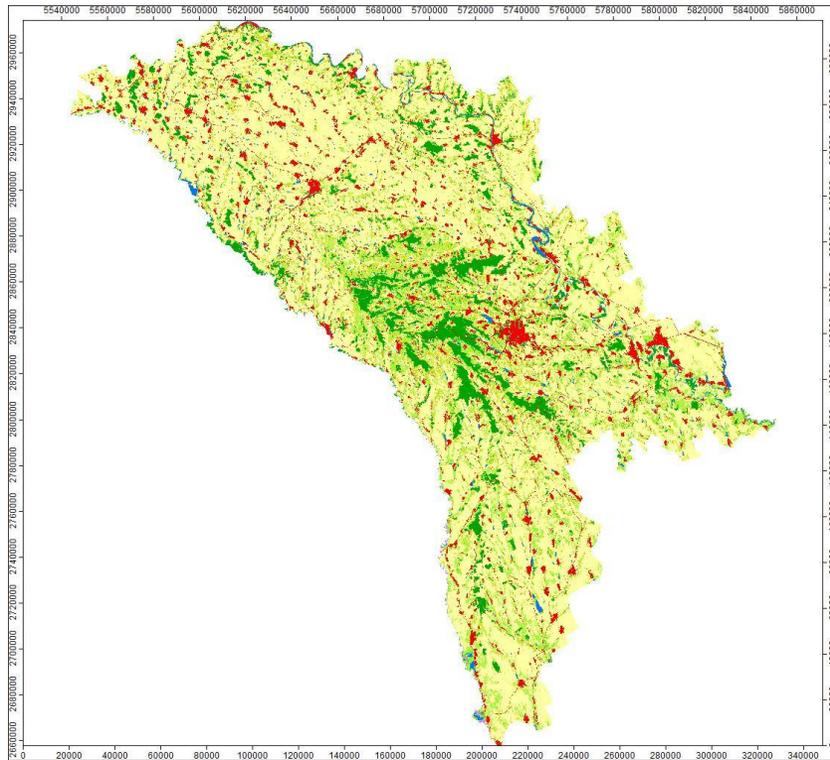
- Administrative divisions (downloaded from GADM, the Global Administrative Data Base)
- GlobeCover „translation” into a simplified pseudo CLC2000 and CLC2015, provided by JRC (Joint Research Centre)
 - Proba-V satellite (300 m pixel size) data used to create pseudo CLC2015
 - 15 thematic classes
 - Raster based digital classification

National sources (Moldova): Data provided by

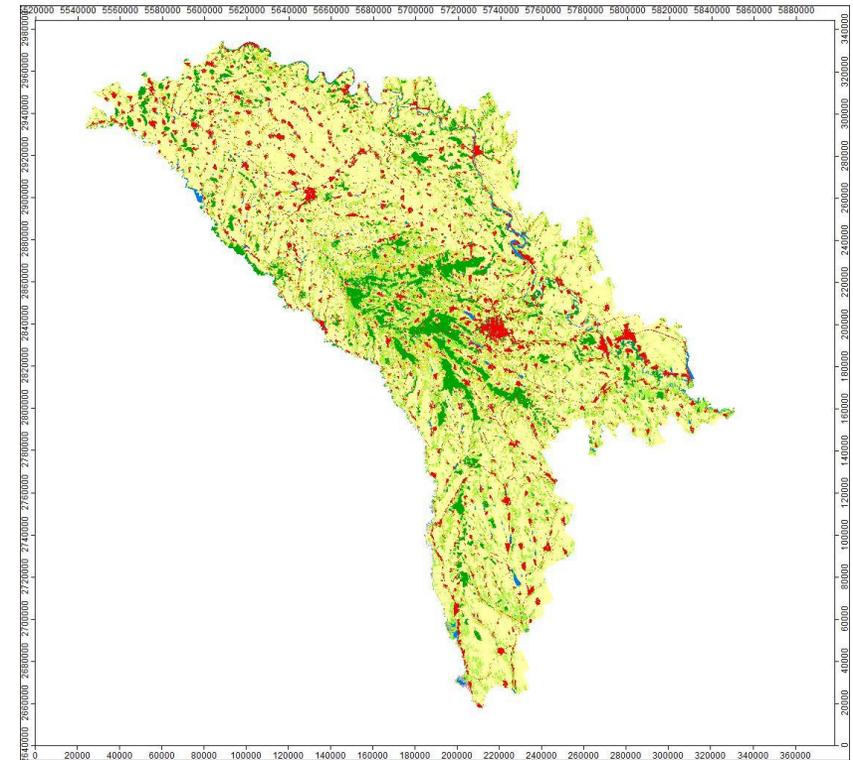
- Academy of Sciences
- Agency for Land Relations and Cadastre
- National Bureau of Statistics.



4. Moldova: simplified / pseudo CLC 2000 and CLC 2015



PSCLC2000



PSCLC2015

Land_cover_ProbaV_PS-CLC_MDA_EPSG3035_100m_2000

-  55 - Coastal & transitional water
-  51 - Inland water
-  41 - Open Wetlands
-  36 - Sparse vegetation areas
-  35 - Permanent snow & glaciers
-  34 - Mixed natural areas, transitions
-  33 - Bare rocks, sand, burnt areas
-  32 - Shrubland
-  31 - Forests
-  29 - Pastures & natural grassland
-  24 - Heterogeneous agriculture areas
-  22 - Permanent crops
-  21 - Agriculture arable land
-  10 - Urban/artificial

Note the reduced thematic information content of pseudo CLC (level-2 classes in general, level-1 for Urban/artificial)



5. Land accounting, basic terminology

See details in: Land accounts for Europe 1990-2000, EEA Report No. 11/2006

- **Land accounts** seeks to describe how resource stocks change over time
- Resource **stocks** in our case are represented by the CORINE Land Cover classes.
- **Consumption**: a given land cover can be modified, degraded or destroyed, giving rise to **formation** of new land cover. A consumption process is always accompanied by a formation process. Consumption and formation of land cover is similar to transformation of capital goods in the economy.
- **Land cover flows (LCF)**: transformations between different stocks over time. In CLC terminology: LCFs are derived from the matrix of CLC Changes over an accounting period.



6. Moldova: Land accounting table, 2000-2015

Land accounts computed from the Land Cover change matrix (intersect of two pseudo CLC classifications (2000, 2015):

- **Total stock** for year 2000 and 2015.
- **Total consumption** (losses of ecosystem extent) of initial (2000) Land Cover and **total formation** (gains of ecosystem extent) of new (2015) Land Cover.
- **Net loss** of Land Cover (= formation – consumption).
- **Net change in Land Cover** as % of initial year.
- **Land cover turnover** (consumption + formation) as % of initial year.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
		Urban & artificial areas	Agriculture arable land	Permanent crops	Heterogeneous agriculture areas	Pastures & natural grassland	Forest	Shrub cover/ bush/ heathland	Bare rocks/ sand/ burnt areas	Heterogeneous natural vegetation & transitions	Permanent snow & glaciers	Sparse vegetation areas	Open wetlands	Inland water	Coastal & transitional water/ intertidal areas	Sea (interface with land cover)	Total	
	total stock land cover 2000	216520	2117629	53206	252330	392687	248696	34182	1520	19393	0	27	3510	51096	0	0	3463404	
1	lcf1	Urban sprawl/Artificial development	0	19358	1427	4044	1323	349	598	24	112	0	0	1	389	0	0	27625
2	lcf2	Agriculture extention	0	0	0	0	0	17434	0	0	0	0	0	0	0	0	0	17434
3	lcf3	Internal conversions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	lcf4	Management and alteration of forested land	0	0	0	0	0	610	261	0	4122	0	0	0	0	0	0	4993
5	lcf5	Restoration and development of habitats	0	10088	200	5884	5658	0	0	0	0	0	0	0	0	0	0	21830
6	lcf6	Change due to natural and multiple causes	28	0	0	0	0	298	0	0	0	0	0	4	396	0	0	726
	total LC consumption 2000	28	29446	1627	9928	6981	18691	859	24	4234	0	0	5	785	0	0	72608	
9	lcf9	No observed change	216492	2088183	51579	242402	385706	230005	33323	1496	15159	0	27	3505	50311	0	0	3318188
1	lcf1	Urban sprawl/Artificial development	27538	0	0	0	0	0	0	0	0	0	0	0	87	0	0	27625
2	lcf2	Agriculture extention	0	15721	0	1713	0	0	0	0	0	0	0	0	0	0	0	17434
4	lcf4	Management and alteration of forested land	0	0	0	0	0	4383	0	0	610	0	0	0	0	0	0	4993
5	lcf5	Restoration and development of habitats	0	0	0	0	0	21830	0	0	0	0	0	0	0	0	0	21830
6	lcf6	Change due to natural and multiple causes	0	0	0	0	288	428	0	0	0	0	0	10	0	0	0	726
	total LC formation 2015	27538	15721	0	1713	288	26641	0	0	610	0	0	10	87	0	0	72608	
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	total stock land cover 2015	244030	2103904	51579	244115	385994	256646	33323	1496	15769	0	27	3515	50398	0	0		
	losses of ecosystem extent(SEEA)	28	29446	1627	9928	6981	18691	859	24	4234	0	0	5	785	0	0		
	Gains of ecosystem extent(SEEA)	27538	15721	0	1713	288	26641	0	0	610	0	0	10	87	0	0		
	urban land take (UNECE EEA)	27625																
	Net loss of land cover	27510	-13725	-1627	-8215	-6693	7950	-859	-24	-3624	0	0	5	-698	0	0		
	Net change of land cover% 2000	12,71%	-0,65%	-3,06%	-3,26%	-1,70%	3,20%	-2,51%	-1,58%	-18,69%	0,00%	0,00%	0,14%	-1,37%	0,00%	0,00%		
	Land cover turn over	12,73%	2,13%	3,06%	4,61%	1,85%	18,23%	2,51%	1,58%	24,98%	0,00%	0,00%	0,43%	1,71%	0,00%	0,00%		



7. Moldova: Land cover flows, 2000-2015

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
		Urban & artificial areas	Agriculture arable land	Permanent crops	Heterogeneous agriculture areas	Pastures & natural grassland	Forest	Shrub cover/ bush/ heathland	Bare rocks/ sand/ burnt areas	Heterogeneous natural vegetation & transitions	Permanent snow & glaciers	Sparse vegetation areas	Open wetlands	Inland water	Coastal & transitional water/ intertidal areas	Sea (interface with land cover)	Total
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3	lc3 Internal conversions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	lc4 Management and alteration of forested land	0	0	0	0	0	610	261	0	4122	0	0	0	0	0	0	4993
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Land cover flows in land accounting table provide information about the actual processes that have resulted the flows between different stocks. See rectangles in red.

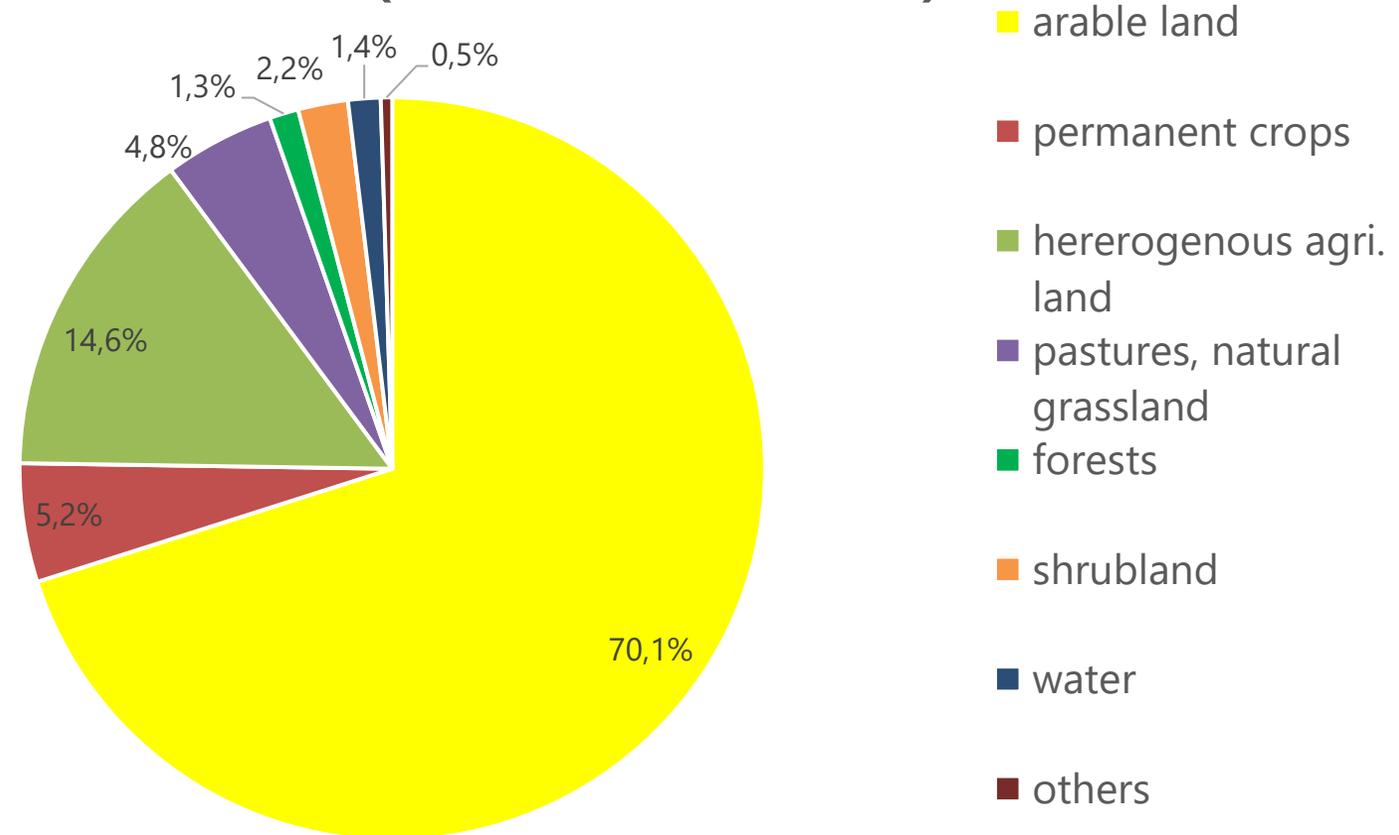
Some of the flows can be used to compute indicators to characterise important environmental processes, e.g. urban land take.



8. Urban land take indicator derived from LC flows

Components of urban land uptake	hectares
arable land	19358
permanent crops	1427
heterogeneous agri. land	4044
pastures, nat. grassland	1323
forests	349
shrub	598
water	389
others	137

Components of urban land uptake
(Moldova 2000 - 2015)



Indicators should be simple and easy to understand by decision makers !

9. Additional processes derived from the flow account

Additional processes revealed by this flow account:

- Agriculture extension (changing forest land to agriculture): 17434 ha
- Management and alteration of forested land: usually forest clear-cut and plantation: 4993 ha
- Restoration and development of habitats: 21830 ha



10. Results

Workshop results:

- Although „pseudo-CLC” data were used, the workshop could successfully demonstrate the strategy and usefulness of land accounting:
 - The use of satellite data in national land monitoring systems
 - The need for regular land cover mapping to support national accounting and reporting
 - The land accounting methodology is standardized and can provide indicators for decision makers.
 - Land accounts are fruitful tool to fulfil international reporting obligations.



11. Outlook to real CLC data

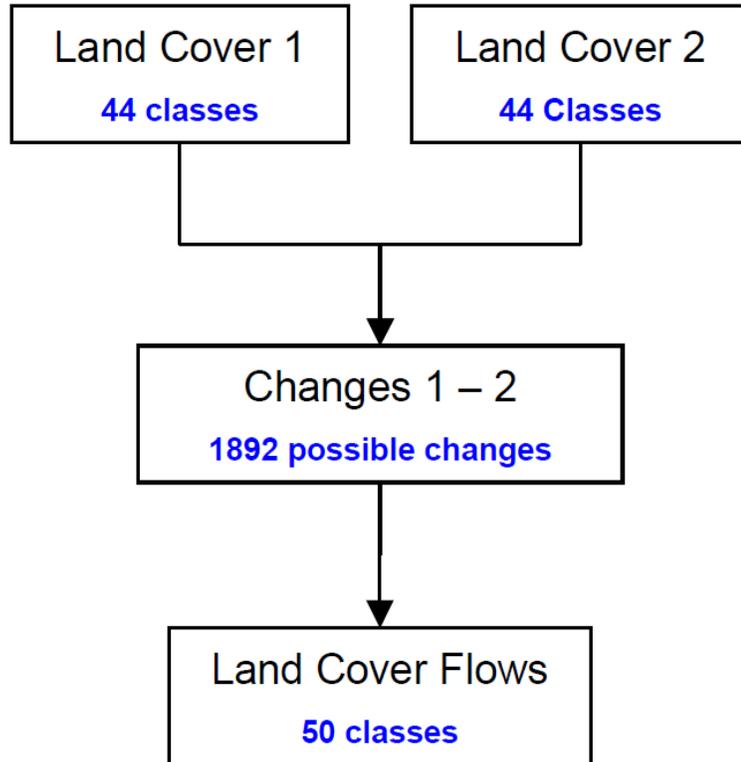
Pseudo-CLC data were used during the workshop.

Real CLC change data, like derived for a pilot area covering the period of 2000-2018 will provide better quality input to land accounting, because:

- Higher resolution input satellite imagery is used (10/30 m)
- Higher thematic resolution CLC maps (44 standard European classes) are produced
- CLC maps have higher thematic accuracy because of more input from national sources.



12. Outlook to real CLC data



50 different land cover flows exist on level-3

Land Cover flows on level-1 will characterise most of the major processes in the ecosystem. See: Land accounts for Europe 1990-2000, EEA Report No. 11/2006

- lcf1 Urban land management
- lcf2 Urban residential sprawl
- lcf3 Sprawl of economic sites and infrastructures
- lcf4 Agriculture internal conversions
- lcf5 Conversion from forested & natural land to agriculture
- lcf6 Withdrawal of farming
- lcf7 Forests creation and management
- lcf8 Water bodies creation and management
- lcf9 Changes of Land Cover due to natural and multiple causes



14. Conclusions

- Remote sensing data are comparable, easily available and cheap data source for land monitoring.
- Land accounting is a useful tool in describing land processes.
- Land accounting is a standardised and simple tool to be implemented by Moldova.
- For country-level monitoring to better understand the land evolution in Moldova the countrywide CLC database and its regular updating would be beneficial.
- The production of the national CLC database will support the accession process of Moldova to the European Union.



Thank you for your attention!

