Implementation of SEEA in Brazil: Water Accounting and Land Use Change Accounting

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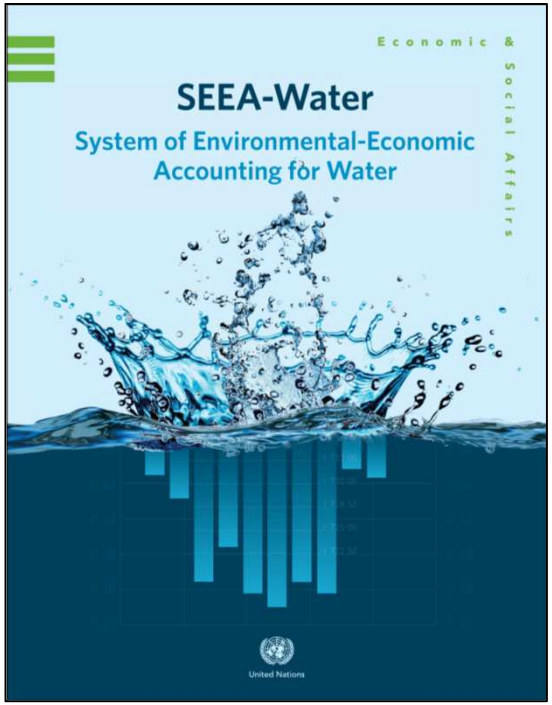
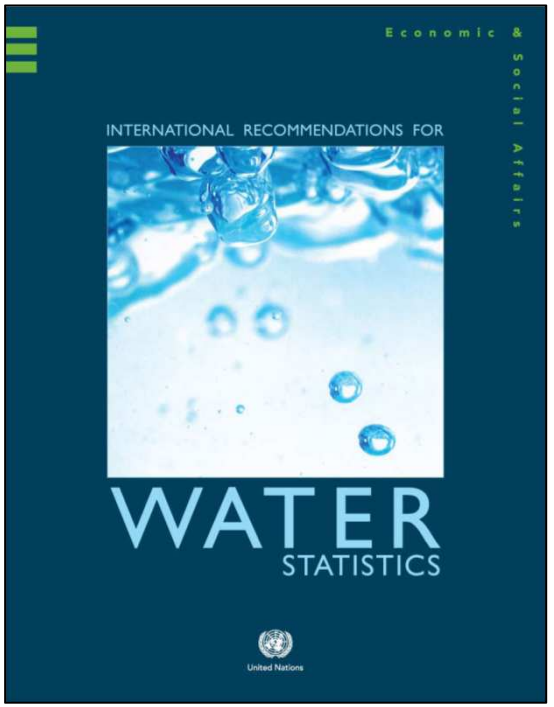
June 2014

METHODOLOGICAL FRAMEWORK

- **UNSD – SEEA Central Framework 2012, SEEA- Water anda IRWS-Methodological References.**
- **Result of multidisciplinar studies.**





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Progresses in the implementation of Water Accounting in Brazil

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Linkages between national programs and plans and SEEA accounting standard

- IBGE and National Water Agency – ANA are implementing environmental accounting of water.

- Brazilian government - broader assessments and policy decision on the basis of IBGE's information

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Provisioning of surface water (ecosystem services)

- **Internal Renewable Water Resources (IRWR)** : 7.182.601 hm^3/year
- **Total Renewable Water Resources (TRWR)**: 9.676.480 hm^3/year
- **Dependency ratio**: 26%
- 81% in the Amazon Basin

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Water Accounts - Strategy **phases**

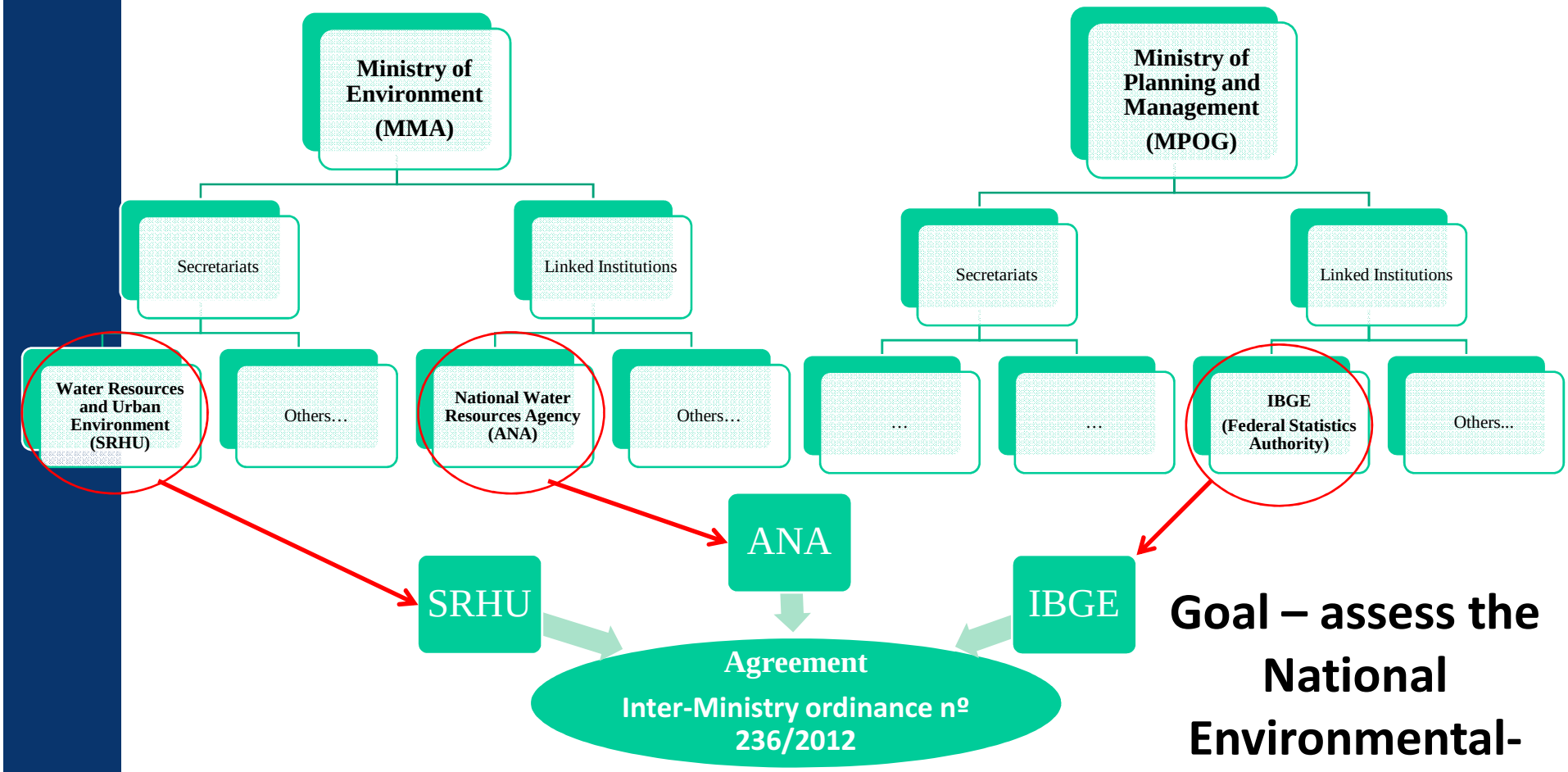
First phase – establish national institutional arrangements

Second phase – self assessment using diagnostic tool

Third phase – data quality assessment

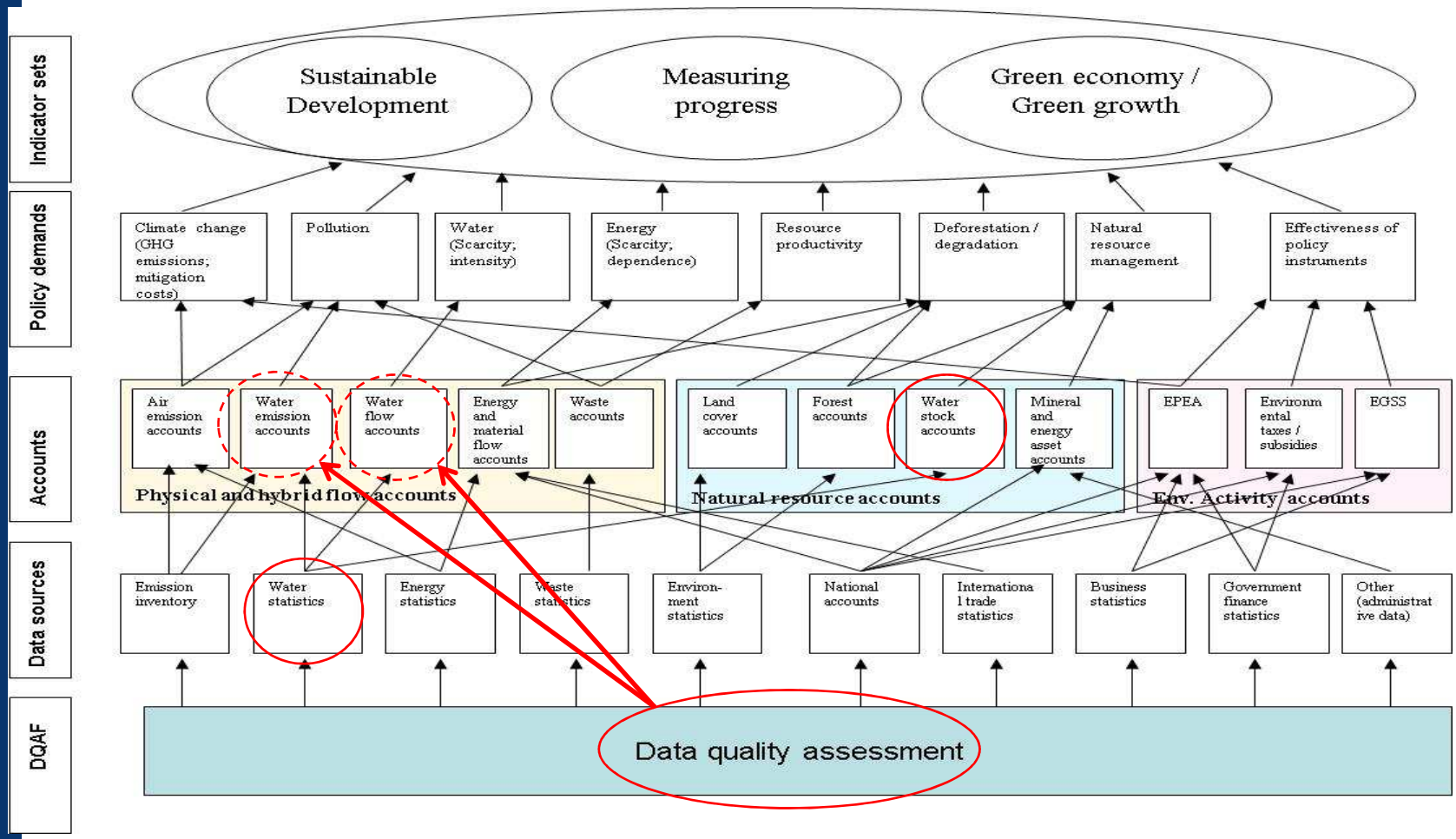
Fourth phase – preparation of strategic development Plan

First phase – establishment of national institutional arrangements



Goal – assess the National Environmental-

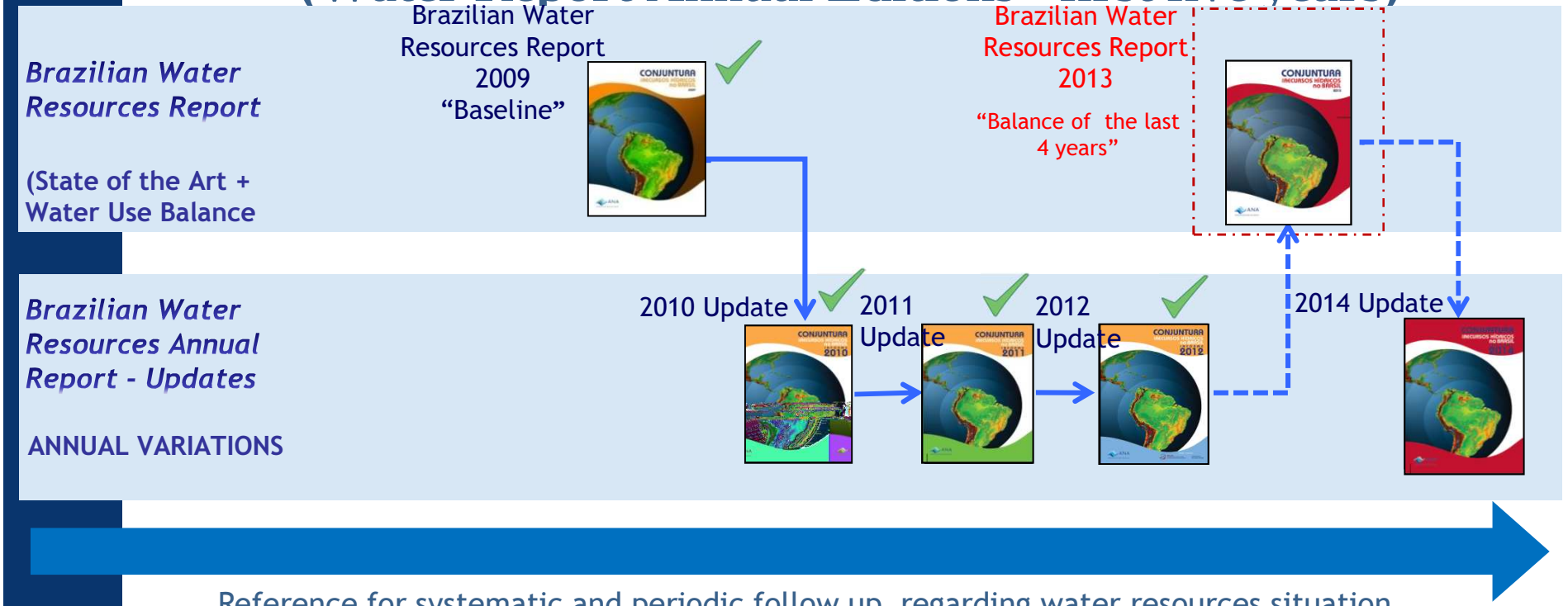
Second phase – self assessment using diagnostic tool



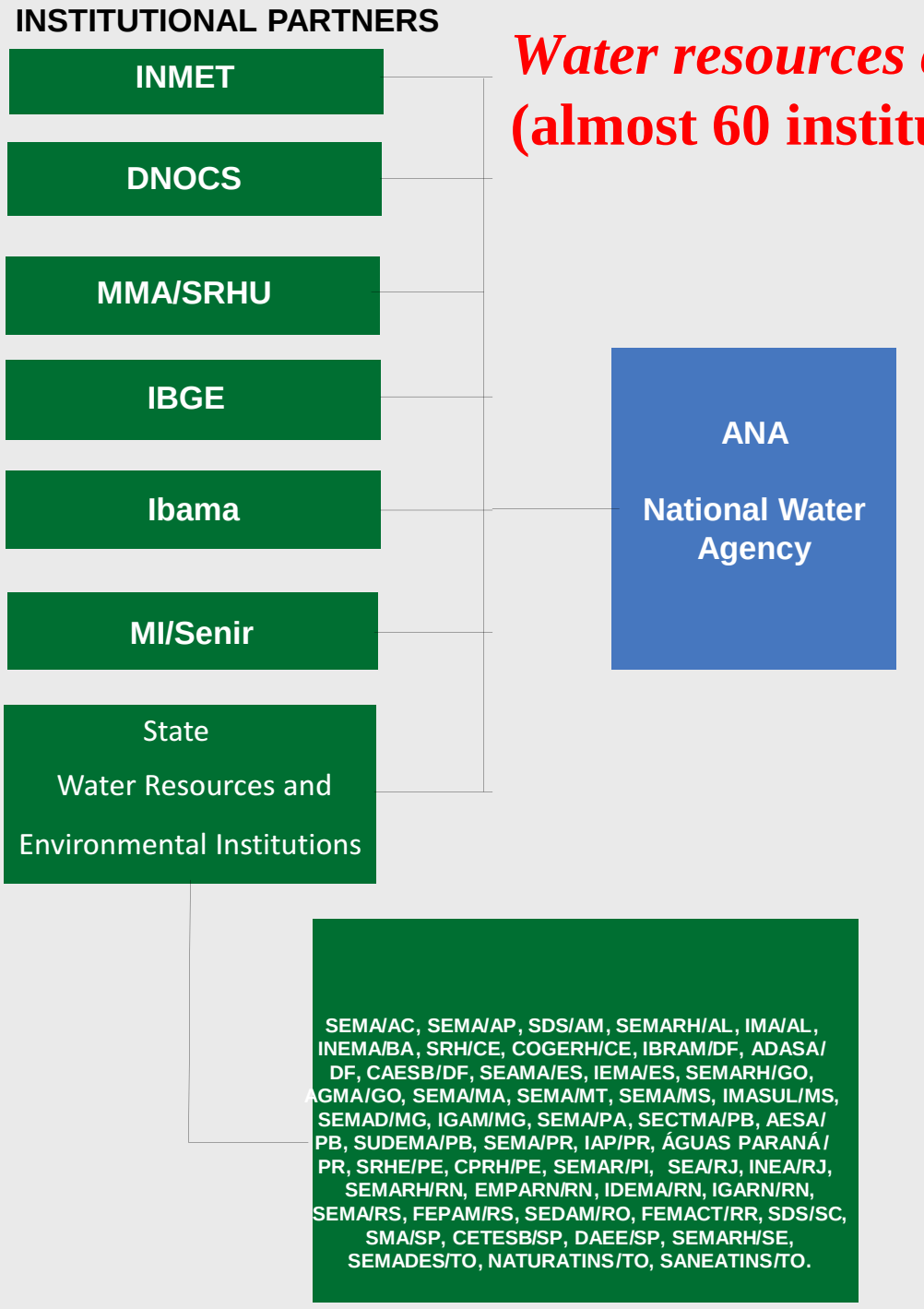
Third phase – data quality assessment (and data collection)

Water resources data collection and data quality assessment process

(Water Report Annual Editions - first five years)



Reference for systematic and periodic follow up regarding water resources situation and management in Brazil, as well as National Water Resources Plan implementation status.



Water resources data collection partnership (almost 60 institutions)

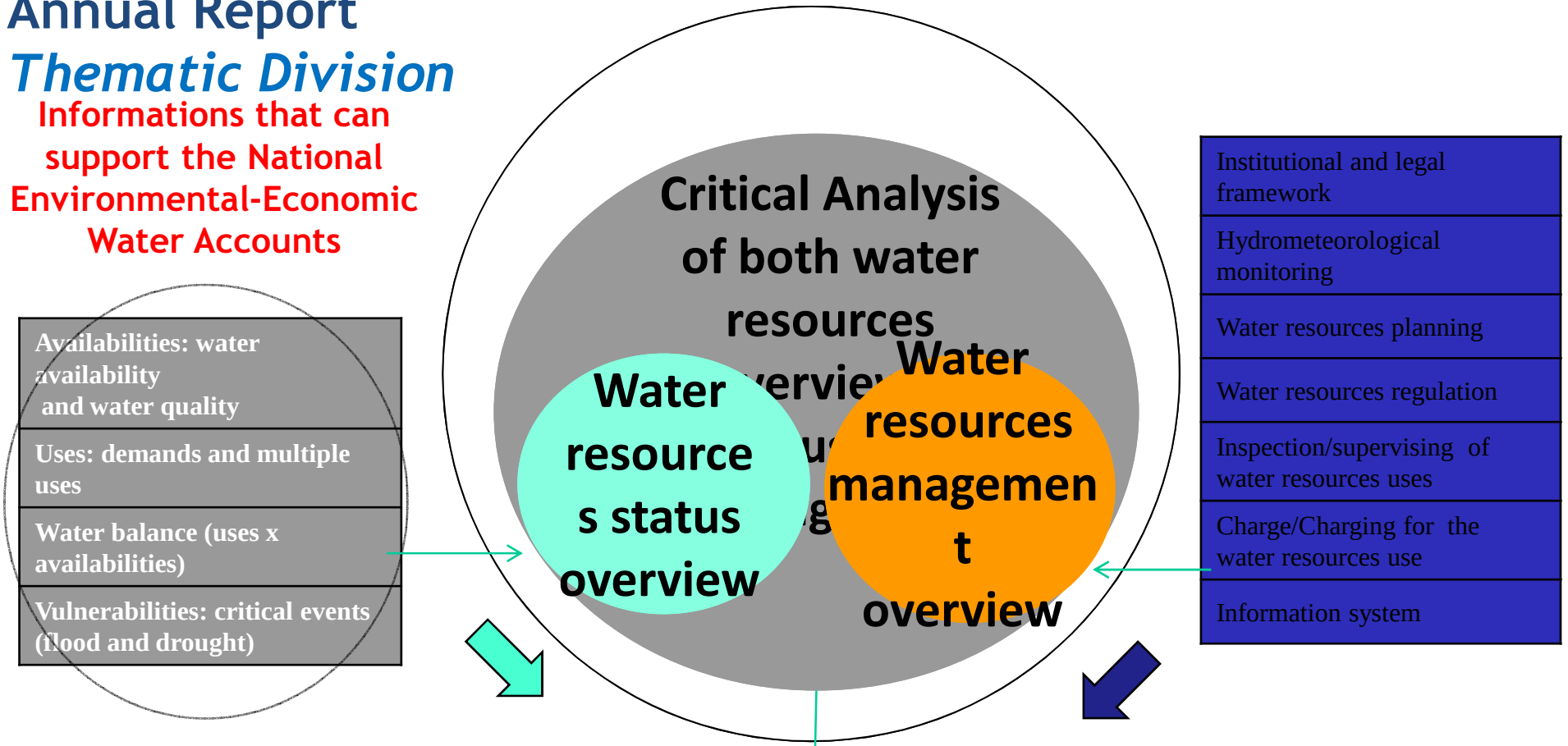
Context of the 2013 R

- Result of the integration of multiple institutional partners in a complex process of information appropriation
  - Federal – SRHU/MMA, Inmet, DNOCS, SBF/MMA, Ibama/MMA, ICMBio/MMA, IBGE
  - Over 50 state water resources and environment institutions
- Use of the results of the 2008 National Survey on Water Supply and Sanitation - PNSB, 2010 Demographic Census (IBGE) 2006 Agricultural and Live Stock Census (IBGE)
- Use of the results of recent river basin plans (MDA, Verde Grande, Doce, Tocantins-Araguaia e Paranaíba) and Atlas Brazil: Urban Water Supply.

Annual Report

Thematic Division

Informations that can support the National Environmental-Economic Water Accounts



Water Availability and Water Quality	Precipitation Anomalies
	Precipitation Effect at Fluviometric Stations
	Superficial Water Availability
	Water Quality
Water Demands and Multiple Uses	Consumptive Uses
	Non-consumptive Uses
Water Balance	Quantitative Water Balance
	Qualitative Water Balance
	Quali-Quantitative Water Balance
Vulnerabilities	Extreme Events
	Reduction of Native Vegetation
	Climatic Change

National approach

Systematization by Hydrographic Region and by State

Intitutional and Legal Framework	History of Water Resources Management
	Institutional and Legal Modifications
	Performance of River Basin Organisms
Water Resources Planning	Water Resources Planning
	Water Quality Classification
Regulation of Water Use	Water Use Permitting
	Water Allocation Negotiation
	Certificate of Water Works Sustainability Assessment (Certoh)
	National Registration of Water Use (CNARH)
Inspection of Water Use	Water Users Inspection
	Dam Safety Inspection
Charging for the use of water resources	Results of Water Charging at Rivers under Federal Jurisdiction
	Summary of the amount charged for the use of water resources
	Use of Financial Resources
Hidrometeorological Monitoring	Water Quantity Monitoring
	Water Quality Monitoring
Water Resources Information System	

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Fourth phase – Preparation of development Plan (Work Plan 2013-2014)

Face-to-face meetings and video conferences involving IBGE, ANA and SRHU/MMA (2012-2013)

- ✓ Analysis of the International Recommendations for Water Statistics (IRWS)
- ✓ Identification of the institutional framework necessary to the assessment of the National Environmental-Economic Accounting for Water
- ✓ Work Plan approved by Environmental-Economic Water Accounts Committee in August, 2013

Water **flow accounts**

Data sources: Annual Water Report, National Survey on Water Supply and Sanitation – PNSB, National Information System on Water Supply and Sanitation – SNIS, Demographic Census, Agricultural and Live Stock Census, etc. (Partnership to water data collection)

Accounts: Physical supply and use tables for water

Indicators: Relative water stress index, Proportion of water resources used – $MDG_{7.5}$, water use intensity, water productivity, water pollution intensity, water inter-states/national dependency ratios, etc.

Analyses: Decoupling water use economic growth, structural decomposition analyses for water use, etc.

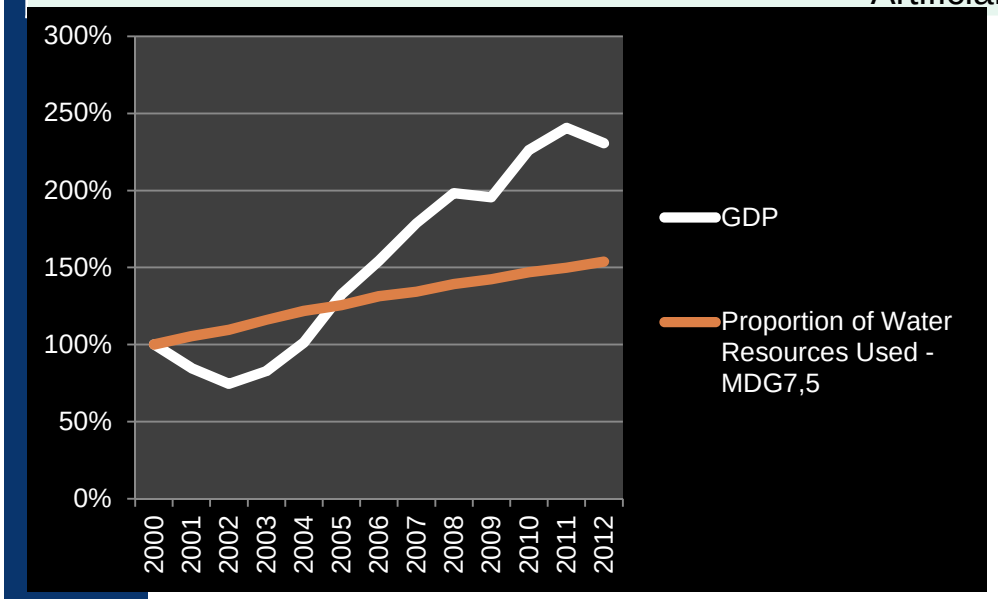
Policy areas served: water dependence (inter-states), water scarcity, water efficiency, adaptation to climate change, etc.

Implementation of SEEA-Water in Brazil - initial outputs

DATA ITEM	UNITS	2012
Contextual Information		
Mid-year population of the country (1st January)	inhabitant	199.242.462
GDP	Million U$	2.252.628
Continental surface area	km^2	8.515.767
26. Land area irrigated	ha	5.800.00
Irrigated area	Km^2	58.000
Electric energy generated	GWh/year	550.000
Hydroelectricity generated	GWh/year	450.000
Hydrologic Information (with IRWS code)		
B.1. Precipitation. In volume	hm^3/year	15.232.021
C.1. Evapotranspiration from inland water resources	hm^3/year	7.918.321
B.1.a. Surface runoff	hm^3/year	6.228.452
D.6.Aquifer recharge	hm^3/year	1.085.248
B.1 Inflow from neighboring territories	hm^3/year	2.674.822
C.2.1 Outflow to neighboring territories	hm^3/year	632.041
C.2.2. Outflow to the sea	hm^3/year	8.271.233
1.1 Number of large artificial reservoirs	unidades	128
2. Artificial reservoir capacity	hm^3	557.809

DATA ITEM	UNITS	2012
Water in the economy (with IRWS code)		
E.1. Water abstracted by ISIC 36 (no agriculture) (drinking water)	hm^3/year	16.456
E.1. Water abstracted by ISIC 5-33, 38,39, 41-99 (3510 to be separated)(self supplied industries)	hm^3/year	12.453
E.1. Water abstracted for ISIC 1-3 (agriculture)	hm^3/year	44.830
E.1. Water abstracted by ISIC 3510 (only cooling)	hm^3/year	ND
E.1. Water abstracted by ISIC 3510 (only hydropower)(turbinated water)	hm^3/year	ND
I.1. Losses of water by utilities (ISIC 36 no agriculture) (water utilities)	hm^3/year	ND
I.1. Losses of water in distribution (in agriculture)	hm^3/year	ND
G.1 Water received by households connected to the water supply network	hm^3/year	ND
G.1. Water received by industries connected to the water supply network	hm^3/year	ND
Pollution related data items (with IRWS code)		
G.3. Wastewater collected by sewerage (ISIC 37)	hm^3/year	4.491,01
H.a. Returns from sewerage after treatment	hm^3/year	3.086,96
15. Number of wastewater treatment plants	units	6.040
H.a. Returns from ISIC 5-33, 38,39, 41-99 (3510 to be separated) after treatment	hm^3/year	ND
K+J.1 Gross emissions by industries connected to ISIC 37	ton DBO_5	ND
K+J.1 Gross emissions by industries NOT connected to ISIC 37	ton DBO_5	ND
10. Wastewater treated by ISIC 37 (emissions collected)	hm^3/year	ND

INDICATOR OR INTERMEDIATE DERIVED DATA	UNITS	LONG TERM AVERAGE
Contextual Information		
Population density	Inhab/km^2	22
Hydroelectricity as proportion of energy generated	%	82%
Electricity generated per capita	KWh/inhab	2.379
Hydrologic Information		
Precipitation in height	mm/year	1.775
Evapotranspiration as a proportion of precipitation	%	52%
Internal Renewable Water Resources (IRWR)	hm^3/year	7.182.601
Total Renewable Water Resources (TRWR)	hm^3/year	9.676.480
Dependency ratio	%	26%
Total Renewable Water Resources per capita	m^3/inhab/year	51.761
Artificial reservoir capacity as proportion of surface runoff and inflows from neighboring countries	%	6%
Artificial reservoir capacity per capita	m^3/inhab	2.813



Comments

- Agreement signed by IBGE-SRHU/MMA-ANA in 2012 was an important step to the ***Brazil SEEA-Water*** Project and an approved Work Plan is under implementation.

- The ***Brazil SEEA-Water*** and related outputs (indicatores that express the relationships between the environment and the economy) is an important input not only for the decision-making concerning water resources management but also to public policies process

- SEEA-Water outputs as a contribution to water related SDG (pos2015 Agenda). ANA has a particular interest concerning this matter.

Economic Data: IBGE (Industries and Families)

INDUSTRIAL SECTOR

• Application of Technical Coeficient Matrix to evaluate and estimate the use of water in industrial processes:

- Application Exercise of T.C.M. flow rates, consumption and effluent available data in the Annual Industry Survey.

-Possibility to include new questions in the next A.I.S.

Economic Data: IBGE (Industries and Families)

AGRICULTURE

- Evaluation of T.C.M. by the IBGE and National Water Agency.

- December 2013: representant of N.W.A participate in the preparation of 2016 National Agrarian Census of IBGE with intention to put issues related to the economic value of water in the main survey of the agricultural census.

- Efforts concentrated on the estimation of area and irrigated crops in Brazil

Economic Data: IBGE (Industries and Families)

FAMILIES/SANITATION SECTOR

- Available information through the Demographic Census, National Survey on Sanitation and National Survey of Household Samples.

- There is a deficiency in treatment and compliance of the information.

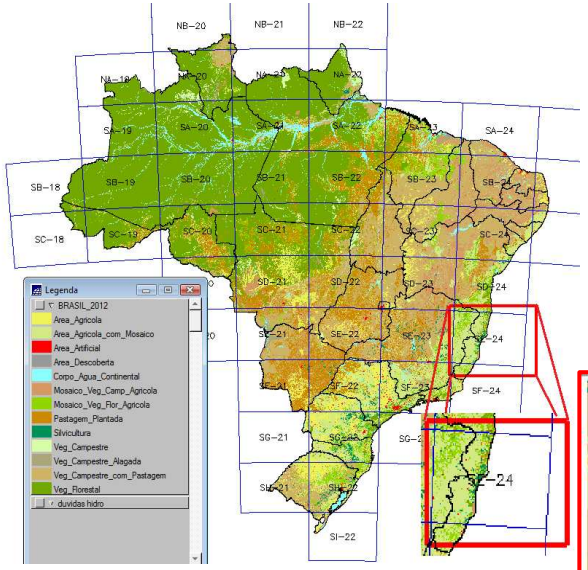
- Need for new partnerships with the Ministry of Cities and other spheres of government: states and municipalities.

LAND USE CHANGE

INTEGRATION OF STATISTICAL DATA WITH SATELLITE IMAGE

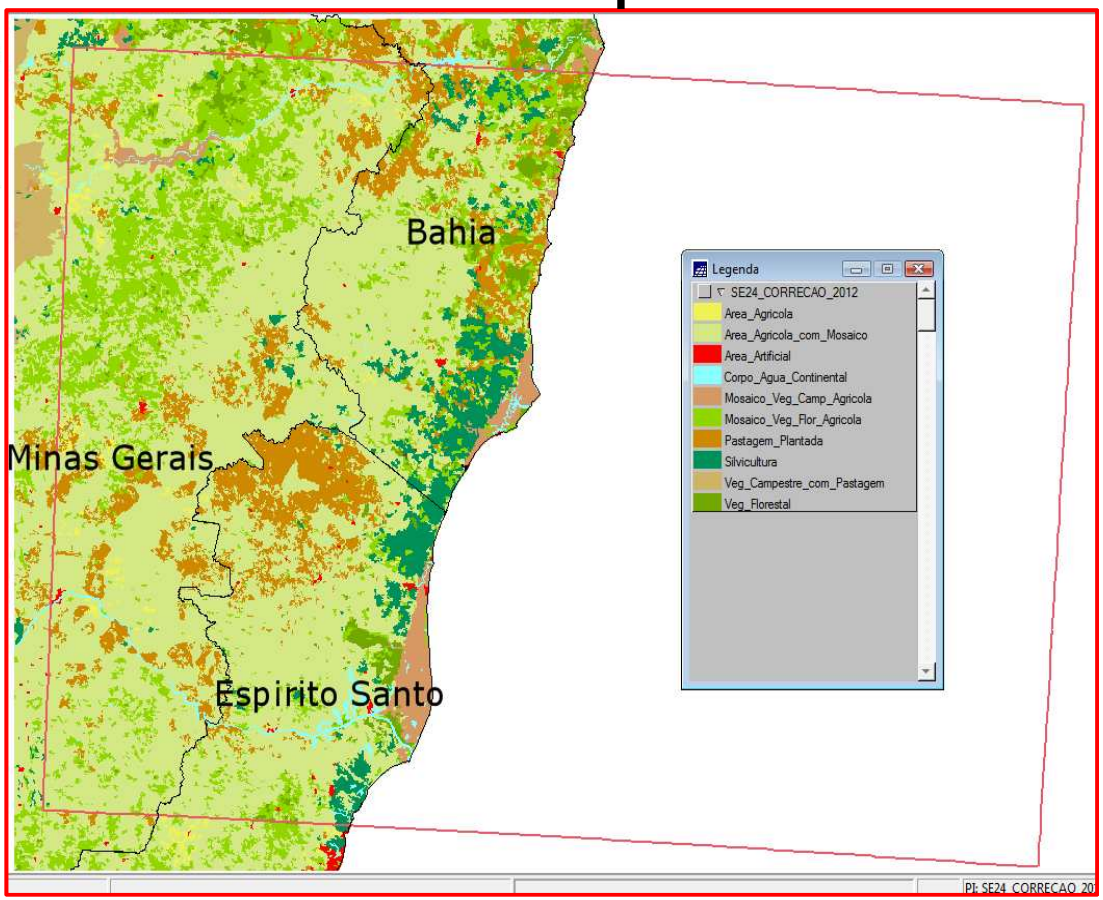
PROCEDURE AND REFERENCE GRID

PROCEDURES



Integration – Statistical Information and Satelite Image through the GIS environment

Example



STATISTICAL DATA:

PPM – Pesquisa da Pecuária Municipal

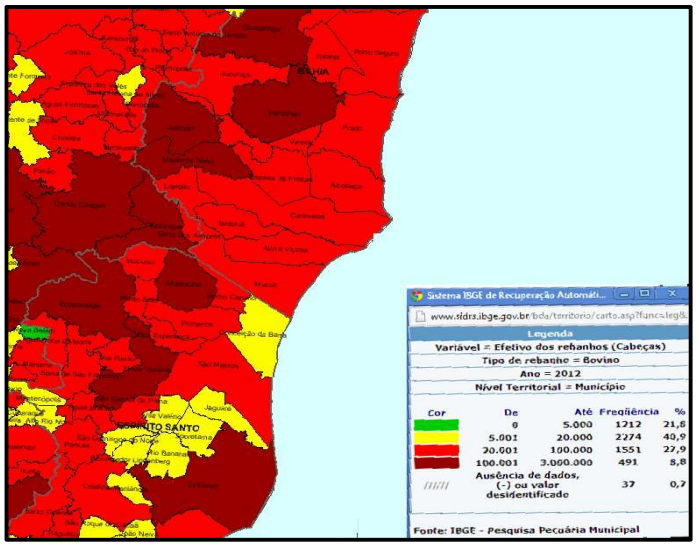
Censo Agropecuário

SATELLITE IMAGES :
MODIS / LANDSAT

PROCEDIMENTOS

Statistical Data

P
P
M



PPM - Pesquisa da pecuária Municipal: data on cattle number by municipalities carried on every year.

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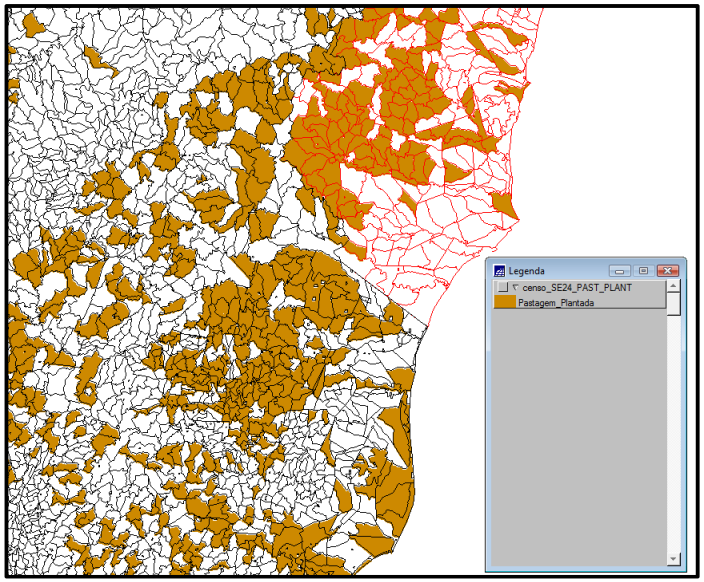
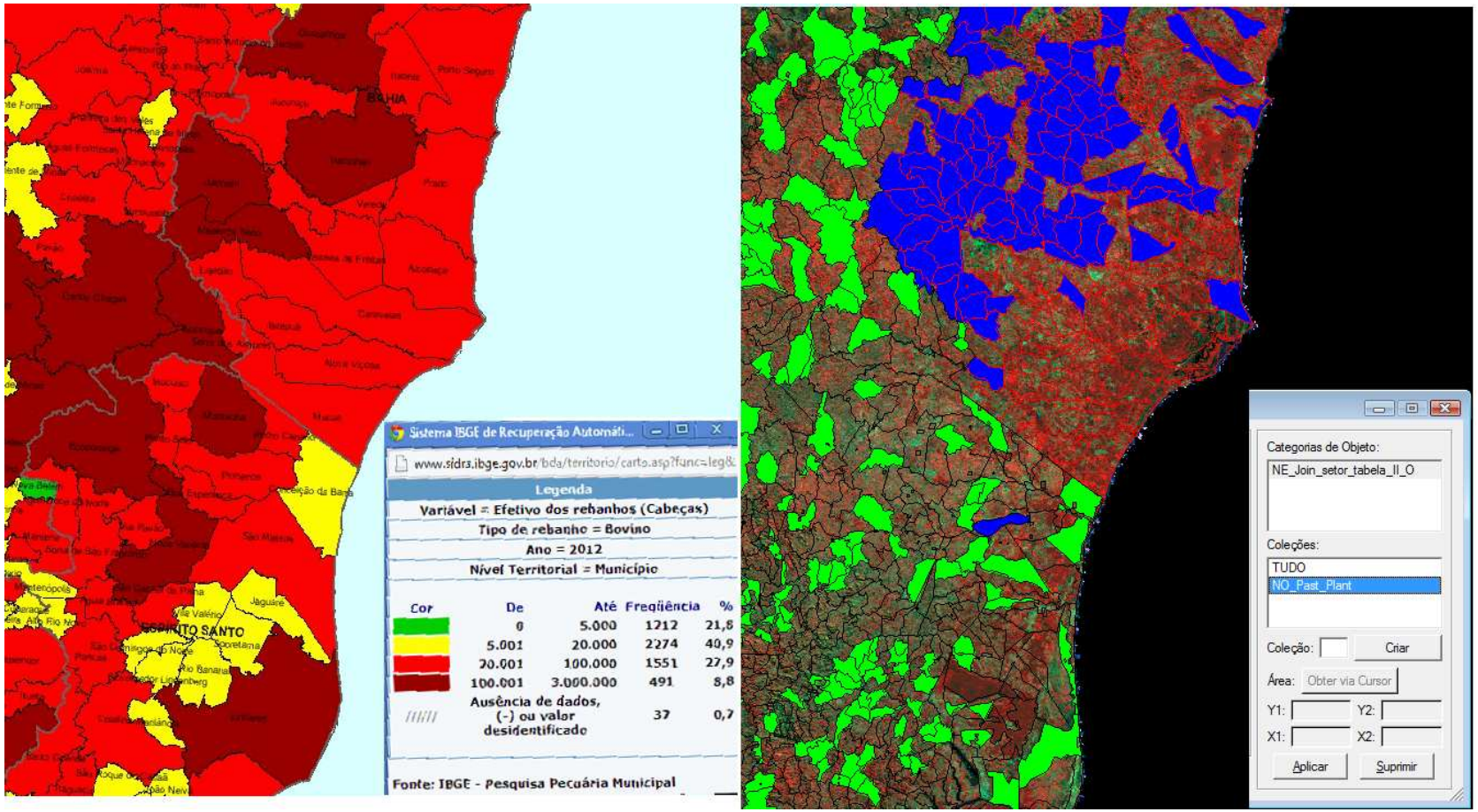


Agrarian Census: data about sort of pasture in farms by census cells each 10 years.

STATISTICAL DATA – PPM X CENSUS

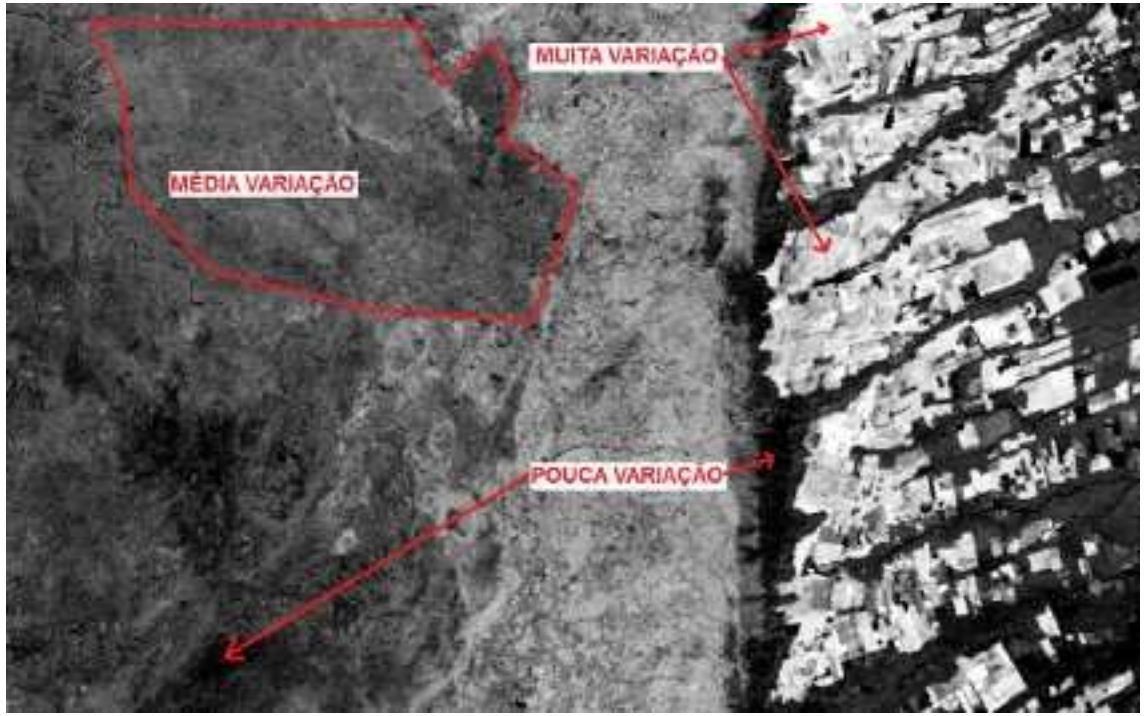
Data on the size of the cattle (Annual Survey) are crossed with census data of grazing area.



PROCEDURES

Satellite Images

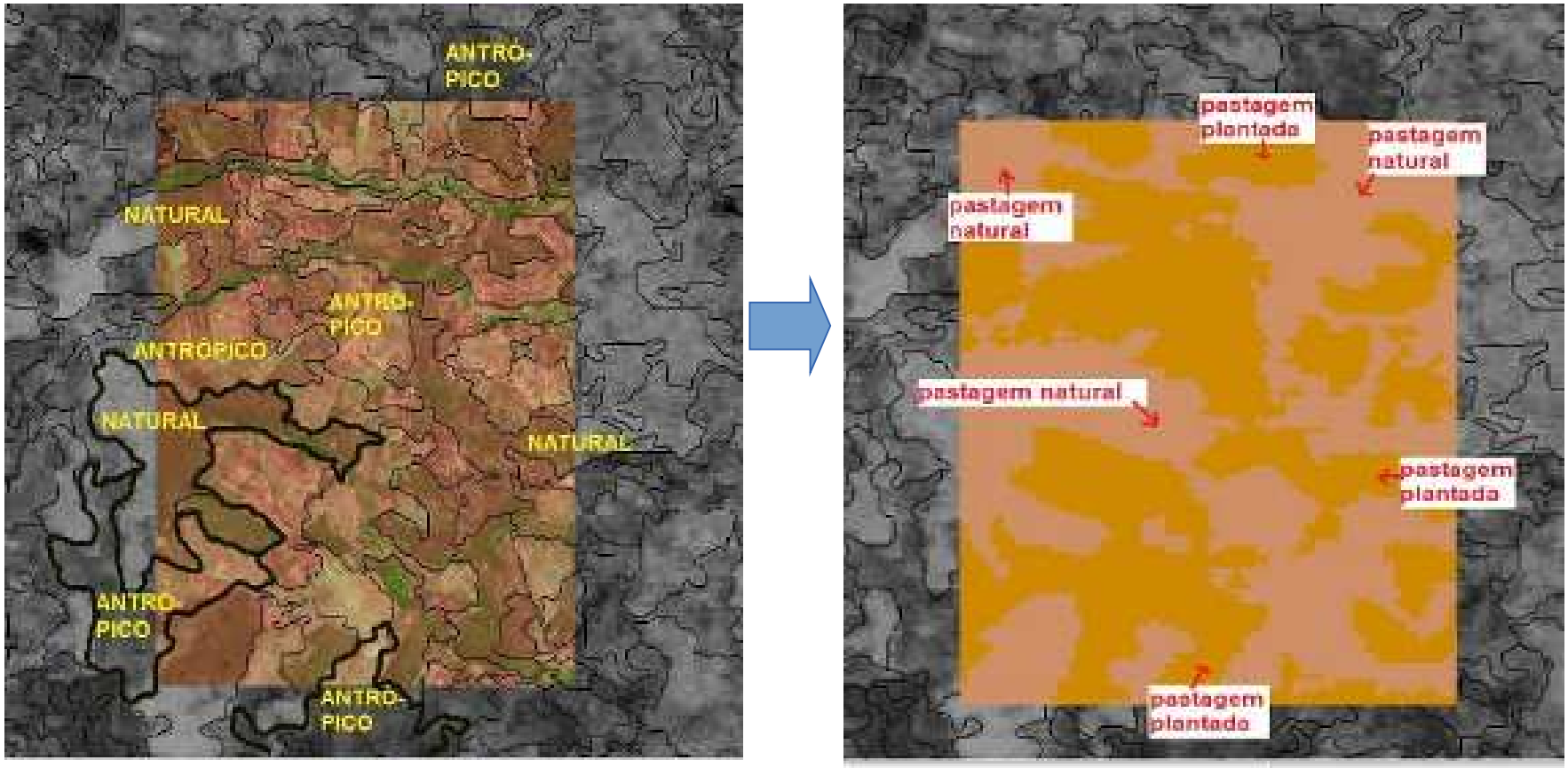
Use of Normalized Difference Vegetation Indtex - NDVI (MODIS), multitemporal, to detect the variation in the vegetation index over the period. The multitemporal analysis procedure allows to differentiate the agricultural land and grazing areas from areas of natural grazing in grassland environment with low management intensity.



PROCEDURES

SATELLITE IMAGES

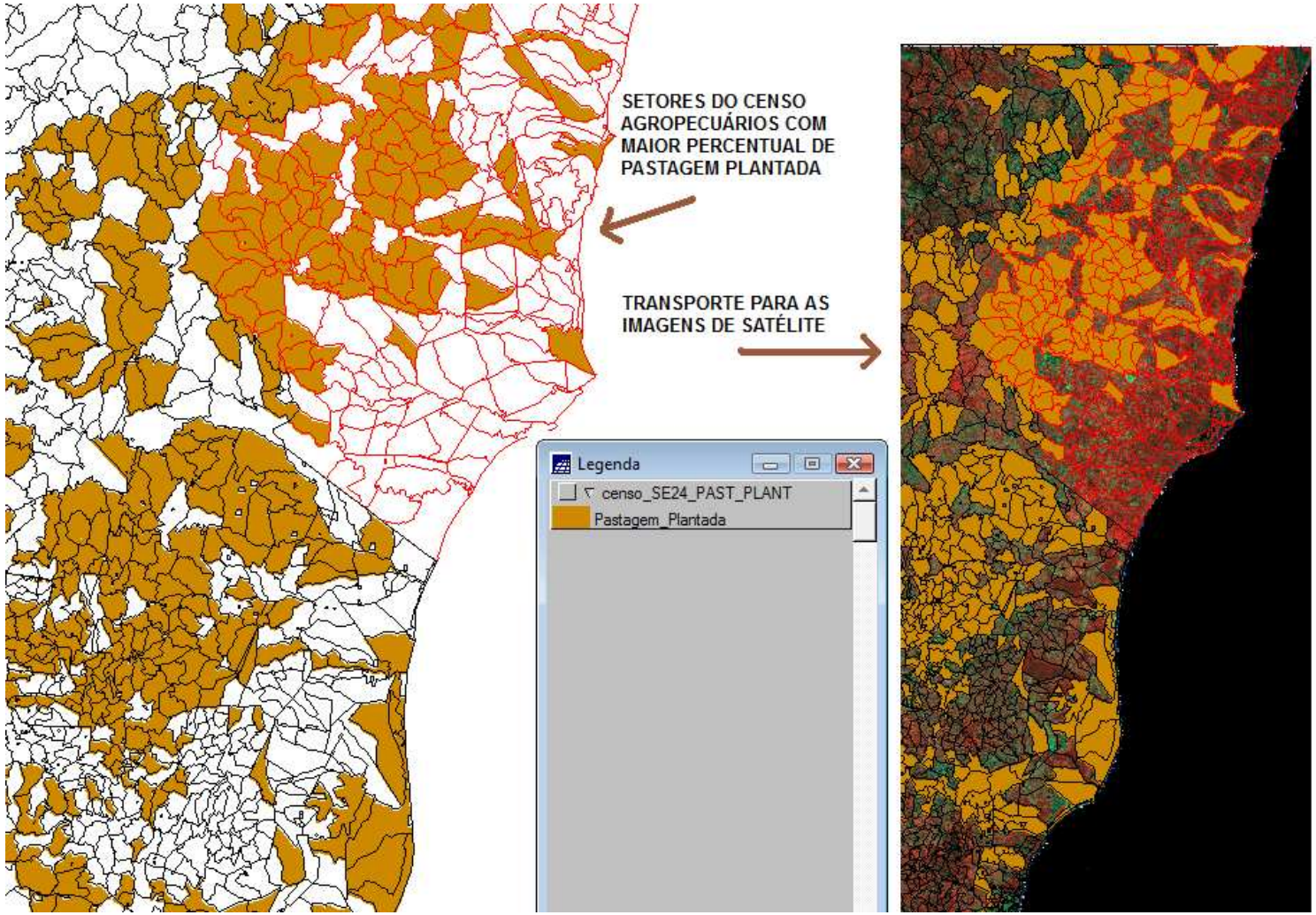
Areas with little or no variation are represented with shades of black and gray and very dark areas of high variation among dates were represented in white or very light gray. The planted pasture is darker than natural pastures.



PROCEDURES

Statistical Data and Satelite Images

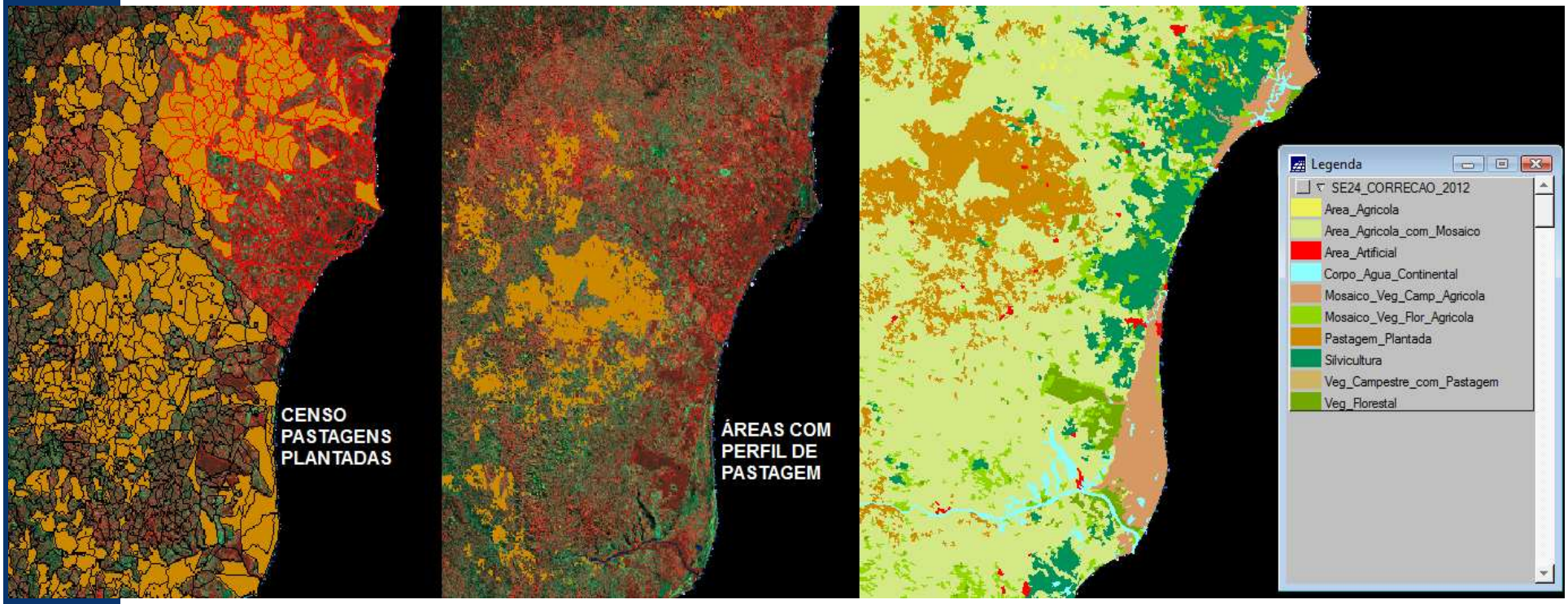
In GIS enviroment the selected áreas from censos are crossed with MODIS images



PROCEDURES

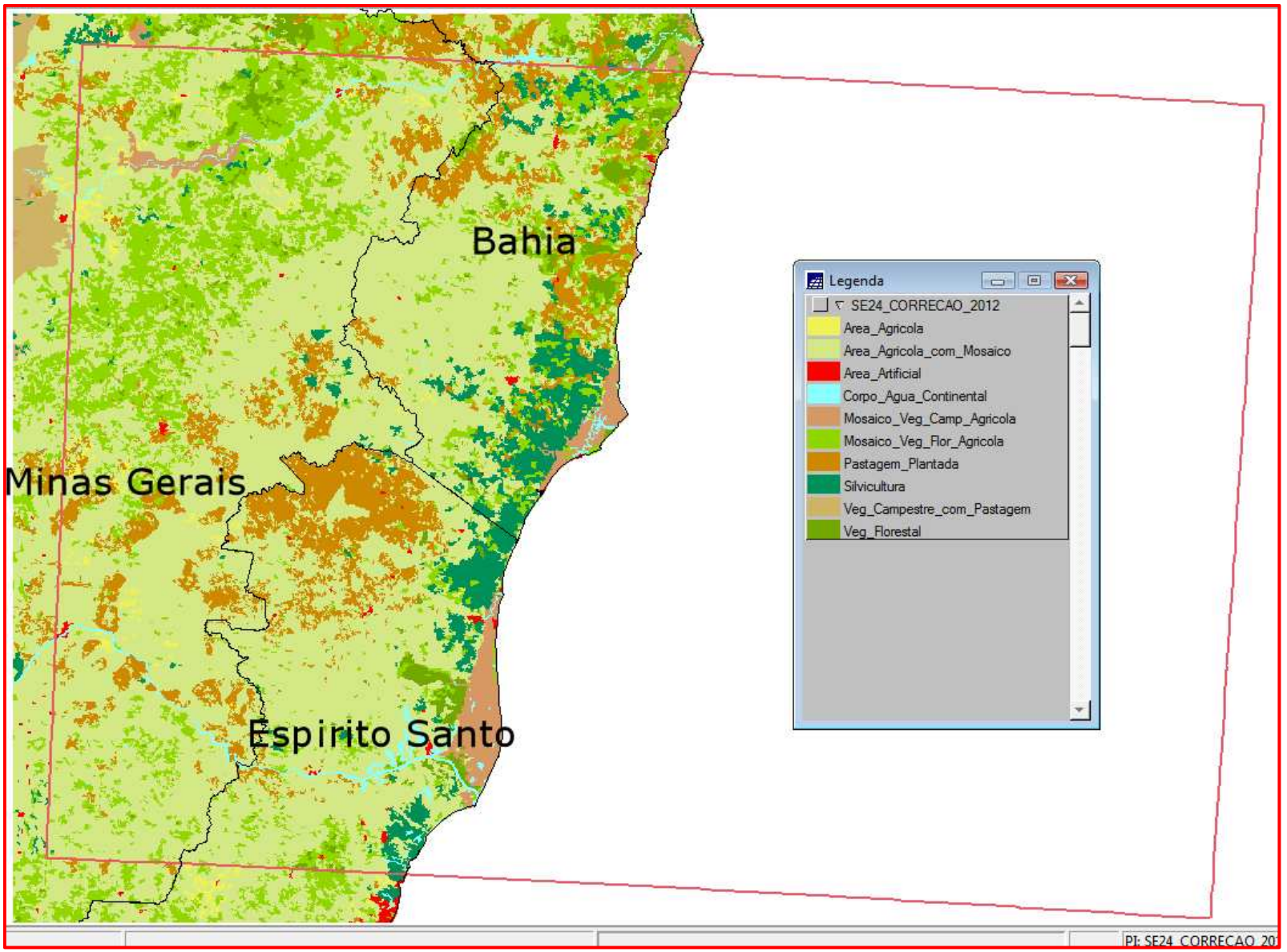
Statistical Data and Satellite Image

Selected areas in statistical surveys are crossed with areas that had these characteristics in satellite images. Is classified as pasture planted the common areas of the two sources.



PROCEDURES

Final Tematic Map



Land Use and Land Use Change Classification – Standards and Hierarchy

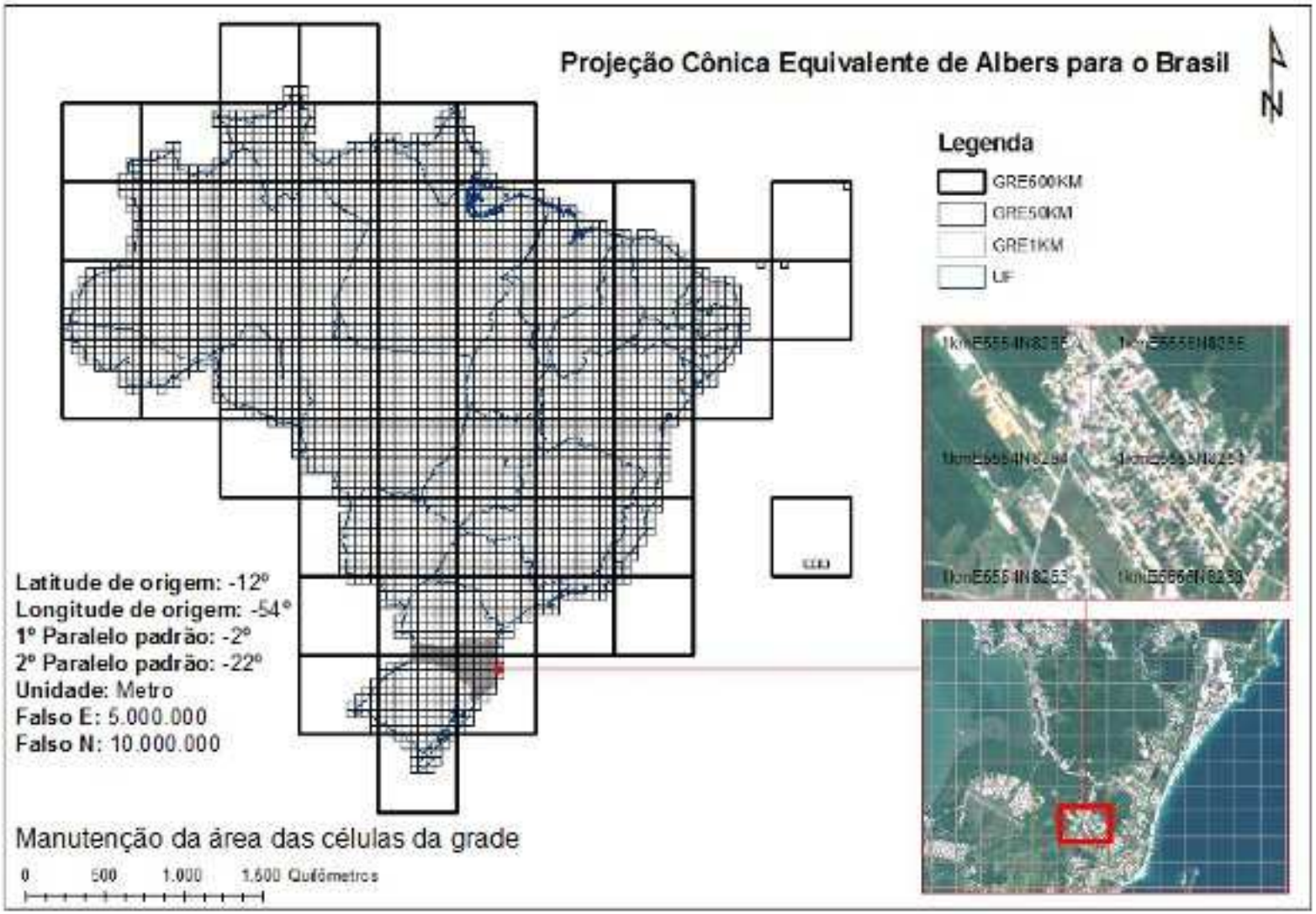
CATEGORIAS HIERARQUIZADAS	CLASSES DE MUDANÇAS DE COBERTURA E USO DA TERRA
Áreas Antrópicas não Agrícolas	Área artificial
Áreas Antrópicas Agrícolas	Área agrícola
	Pastagem Plantada
	Área agrícola com mosaicos
	Silvicultura
Áreas de Vegetação Florestal	Vegetação florestal
	Mosaicos de vegetação florestal e atividade agrícola
Áreas de Vegetação Campestre	Vegetação campestre
	Vegetação campestre com pastagens
	Vegetação campestre alagada
	Mosaicos de vegetação campestre e atividade agrícola
Água	Corpo d'água Continentais
	Corpo d'água Costeiros
Espaços Abertos com Pouca ou Nenhuma Vegetação	Áreas descobertas

Referências: Land Classification Function Units/EEA; Sistema de Classificação de Uso da Terra – SCUT/IBGE e CNAE- Classificação Nacional de Atividades Econômicas

CHANGES in Land Cover and Land Use - Processes

YEAR 1 CLASS	YEAR 2 CLASS	PROCESS
Área Artificial	Área Artificial	Manutenção
Área Agrícola com Mosaicos	Área Agrícola	Expansão Agrícola sobre área florestal
Silvicultura	Pastagem Plantada	Expansão pecuária
Mosaico Vegetação Florestal com Atividade Agrícola	Vegetação Florestal	Regeneração Florestal
Silvicultura	Vegetação Campestre	Regeneração Campestre
Pastagem Plantada	Mosaicos de Vegetação Campestre com Atividade Agrícola	Expansão Agrícola
Área Agrícola	Área Descoberta	Retração Agrícola

Incorporation to the GRID for Statistical Purposes



Land Cover Classification (LCCS)	Land Cover Classes IBGE	LAND COVER FUNCTIONAL UNITS (LCFU) CLASSIFICATION
Artificial surfaces (including urban and associated areas)	**Áreas urbanizadas**	**Urban and associated developed areas**
Herbaceos crops	**Área agrícola**	**Homogeneous fields rainfed herbaceous cropland; Homogeneous fields irrigated herbaceous cropland; Permanent crops, agriculture plantations**
Woody crops	**Reflorestamento**	
Multiple or layered crops	**Área agrícola com remanescente ou regeneração florestal**	**Agriculture associations and mosaics**
	Vegetação campestre com atividade agrícola	
	Vegetação florestal com atividade agrícola	**Natural vegetation associations and mosaics**
Tree covered areas	**Vegetação florestal**	**Forest tree cover**
Mangroves		
Shrub covered areas	**Vegetação campestre**	**Pastures and natural grassland** **Shrubland, bushland, heathland**
Shrubs and/or herbaceos vegetation, aquatic or regulalry flooded		**Sparsely vegetated areas**
Sparsely natural vegetated areas		
Grassland		
Terrestrial barren land	**Outra áreas**	**Barren land**
Inland water bodies and inter-dital areas	**Corpo d'água**	**Inland water bodies; Coastal water bodies; Open wetlands**
Permanent snow and glaciers		**Permanent snow and glaciers**
		Sea (per memory)

RESULTS FROM INTERNAL DISCUSSION TABLE IN IBGE

HIERARQUIZAÇÃO, COMPATIBILIZAÇÃO E DEFINIÇÃO DAS CLASSES DE MUDANÇAS NA COBERTURA E USO DA TERRA			
CATEGORIAS PROPOSTAS	**CLASSES DE MUDANÇAS DE COBERTURA E USO DA TERRA**	**DEFINIÇÃO DA NOMENCLATURA**	**Classes de Uso Atual da Terra – Nível II**
Áreas Antrópicas não Agrícolas			
A esta nomenclatura estão associados todos os tipos de uso da terra de natureza não-agrícola, tais como: áreas urbanizadas, industriais, comerciais, redes de comunicação e áreas de extração mineral.	**Área artificial (antiga Área Urbanizada)**	Mais de 75% do polígono ocupado com uso urbano, estruturado por edificações e sistema viário, onde predominam superfícies artificiais não-agrícolas. Estão incluídas nesta categoria as metrópoles, cidades, vilas, áreas de rodovias, serviços e transporte, redes de energia, comunicações e terrenos associados, áreas ocupadas por indústrias, complexos industriais e comerciais e edificações que podem, em alguns casos, encontrar-se isoladas em áreas peri- urbanas. As áreas urbanizadas podem ser contínuas, onde as áreas não-lineares de vegetação são excepcionais, ou descontínuas, onde as áreas vegetadas ocupam superfícies mais significativas.	**Área Urbanizada**
Áreas Antrópicas Agrícolas			
Áreas Antrópicas Agrícolas: No sentido amplo, a terra agrícola pode ser definida como terra utilizada para a produção de alimentos, fibras e outras *commodities* do agronegócio. Inclui todas as terras cultivadas, caracterizadas pelo delineamento de áreas cultivadas ou em descanso, podendo também compreender áreas alagadas. Podem se constituir em zonas agrícolas heterogêneas ou representar extensas áreas de "plantations". Encontram-se inseridas nesta categoria as lavouras temporárias, lavouras permanentes, pastagens plantadas e silvicultura.	**Área agrícola**	Mais de 75% do polígono é ocupado com lavouras temporárias e lavouras permanentes, irrigadas ou não. Pode ser definida como terra utilizada para a produção de alimentos, fibras e commodities do agronegócio. Inclui todas as terras cultivadas, caracterizadas pelo delineamento de áreas cultivadas ou em descanso, podendo também compreender áreas alagadas cultivadas. Podem se constituir em zonas agrícolas heterogêneas ou representar extensas áreas de "plantations".	**Lavoura temporária + Lavoura permanente**
	Pastagem Plantada (novo)	Área predominantemente ocupada por vegetação herbácea cultivada destinada a pastagem de rebanhos. São áreas destinadas ao pastoreio do gado, formadas mediante plantio de forragens perenes. Nessas áreas o solo está coberto por vegetação de gramíneas ou leguminosas, cuja altura pode variar de alguns decímetros a alguns metros.	**Pastagem**
	Área agrícola com mosaicos (antigo agrícola com remanescente ou regeneração florestal)	Considera-se como área agrícola com mosaicos a área que contenha mais de 50% a 75% do polígono ocupado com área agrícola e o restante do polígono com remanescentes, regeneração florestal, pastagens. Podem ocorrer, em menor proporção, outras formações vegetais (herbáceas e arbustivas).	
	Silvicultura (antigo Reflorestamento)	Considera-se como área de Silvicultura aquela com atividade de cultivo de florestas plantadas com espécies exóticas. A área desta classe deverá conter mais de 75% do polígono ocupado como silvicultura.	**Silvicultura**
Áreas de Vegetação Florestal			
Áreas de Vegetação Natural: Conforme o sistema de classificação adotado, a vegetação natural compreende um conjunto de estruturas florestal e campestre, abrangendo desde florestas e campos originais (primários) e alterados até formações florestais espontâneas secundárias, arbustivas, herbáceas e/ou gramíneo-lenhosas, em diversos estágios sucessionais de desenvolvimento, distribuídos por diferentes ambientes e situações geográfi cas.	**Vegetação florestal**	Mais de 75% do polígono ocupado com florestas. Consideram-se como florestais as formações arbóreas, incluindo-se aí as áreas de Floresta Densa (estrutura florestal com cobertura superior contínua), de Floresta Aberta estrutura florestal com diferentes graus de descontinuidade da cobertura superior, conforme seu tipo (com cipó bambu, palmeira ou sororoca), de Floresta Estacional (estrutura florestal com perda das folhas dos estratos superiores durante a estação desfavorável – seca e frio) além da Floresta Ombrófila Mista (estrutura florestal que compreende a área de distribuição natural da *Araucária angustifolia*, elemento marcante nos estratos superiores, que geralmente forma cobertura contínua).ém inclui outras feições em razão de seu porte ser acima de 5m de altura, como a Savana florestada campinaranas florestada e a arborizada, manguezais.	**Florestal**
	Mosaicos de vegetação florestal e atividade agrícola (antigo com atividade agrícola)	Considera-se como vegetação florestal com mosaicos a área que contenha mais de 50% e menos de 75% do polígono ocupado com vegetação florestal e o restante do polígono com mosaicos de lavouras temporárias irrigadas ou não, lavouras permanentes, pastagem e/ou silvicultura.	

CORRELATION LCFU AND IBGE

LandCover-LandUse Change Classes	Land Cover Functional Units (LCFU) Classification															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	Urban and associated developed areas	Homogeneous fields rainfed herbaceous	Homogeneous fields irrigated herbaceous	Permanent crops, agriculture plantations	Agriculture associations and mosaics	Pastures and natural grassland	Forest tree cover	Shrubland, bushland, heathland	Sparsely vegetated areas	Natural vegetation associations and mosaics	Barren land	Permanent snow and glaciers	Open wetlands	Inland water bodies	Coastal water bodies	Sea (per memory)
Área artificial (antiga Área Urbanizada)	A															
Área agrícola		B	C	D												
Pastagem Plantadas (novo)		B														
Área agrícola com mosaicos (antigo agrícola com remanescente ou regeneração florestal)					E											
Vegetação florestal com mosaicos (antigo com atividade agrícola)					E											
Vegetação campestre com mosaicos (antigo com atividade agrícola)					E											
Vegetação campestre com pastagens (novo)						F										
Vegetação florestal							G									
Silvicultura (antigo Reflorestamento)							G									
Vegetação campestre								H								
Mosaicos de Vegetação Natural com Pastagem (nova)										J						
Áreas descobertas (antiga classe outras áreas)											K					
Vegetação campestre alagada (novo)													M			
Corpo d'água Continentais (antigo Corpo d'água)														N		
Corpo d'água Costeiros (antigo Corpo d'água)															O	

Thank you!

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