Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
of the Federal Republic of Germany

Status of REDD+ Activity Data for Zambia:

A case of the SADC REDD+ MRV Mapping of Degradation in the Transboundary Test Site with Malawi

"Concepts and Costs of Measuring and Monitoring Forest Degradation"

Abel M. Siampale, Thomas Haeusler and Sharon Gomez

BMZ-DLR International Conference on MRV of REDD
Stadthalle Bad Godesberg - Bonn, September 2015

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SOUTHERN AFRICAN DEVELOPMENT COMMUNITY
TOWARDS A COMMON FUTURE

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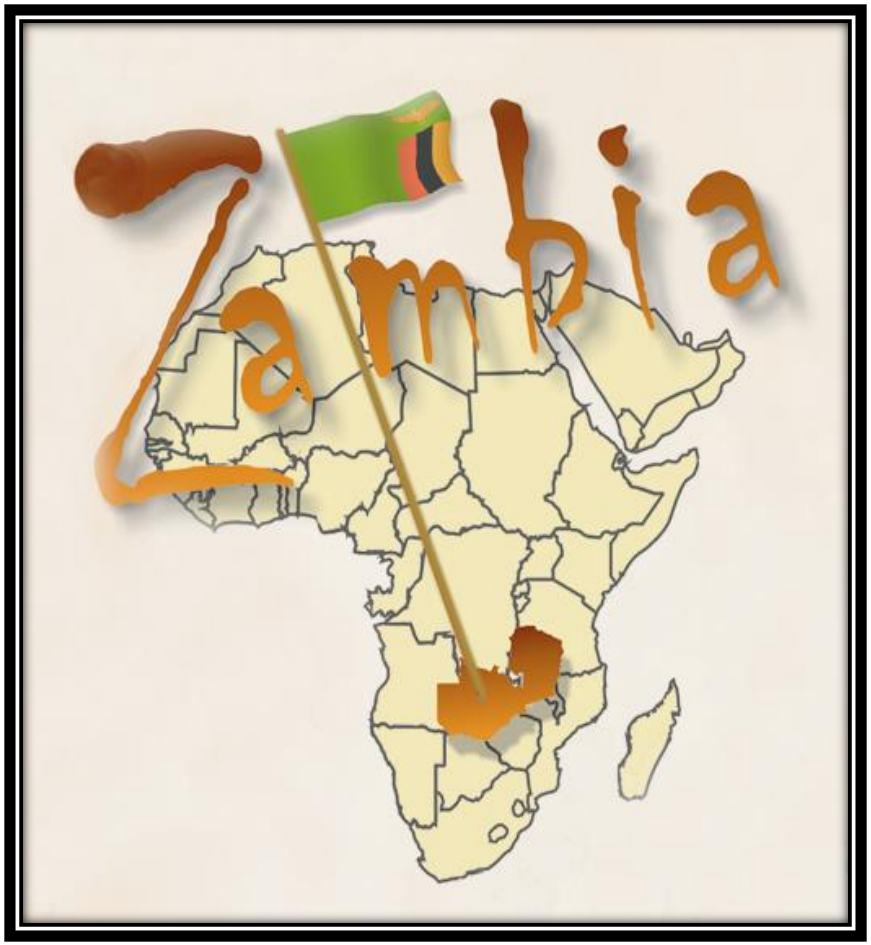
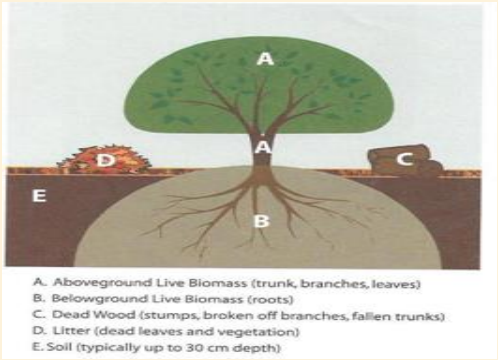
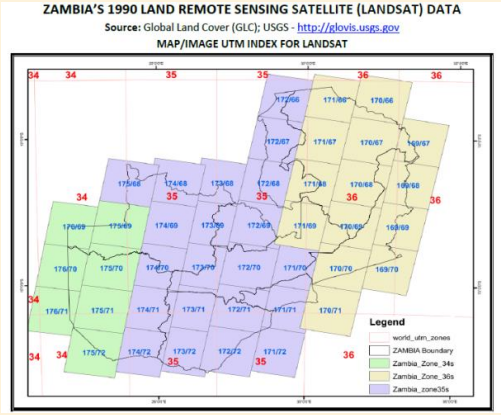
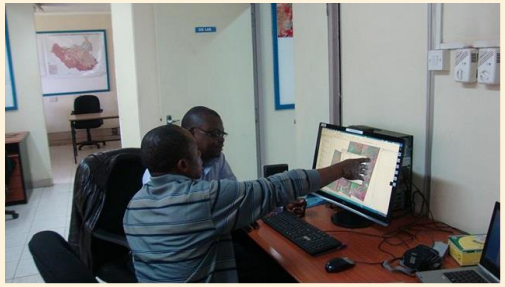




A. Aboveground Live Biomass (trunk, branches, leaves)
B. Belowground Live Biomass (roots)
C. Dead Wood (stumps, broken off branches, fallen trunks)
D. Litter (dead leaves and vegetation)
E. Soil (typically up to 30 cm depth)





REDD+ READINESS IN ZAMBIA

PROGRAMME GOAL: To Prepare Zambian institutions and stakeholders for effective nationwide implementation of REDD+ mechanism

PROGRAMME DURATION: THREE (3) YEARS (2010 – 2013) – Now in extension

APPROVED BUDGET: US$4.49 Million

IMPLEMENTING AGENT: Ministry of Lands, Natural Resources and Environmental Protection

LEAD AGENT: Forestry Department - Zambia

TECHNICAL SUPPORT: UNDP, FAO and UNEP

REDD+ READINESS CONT'D

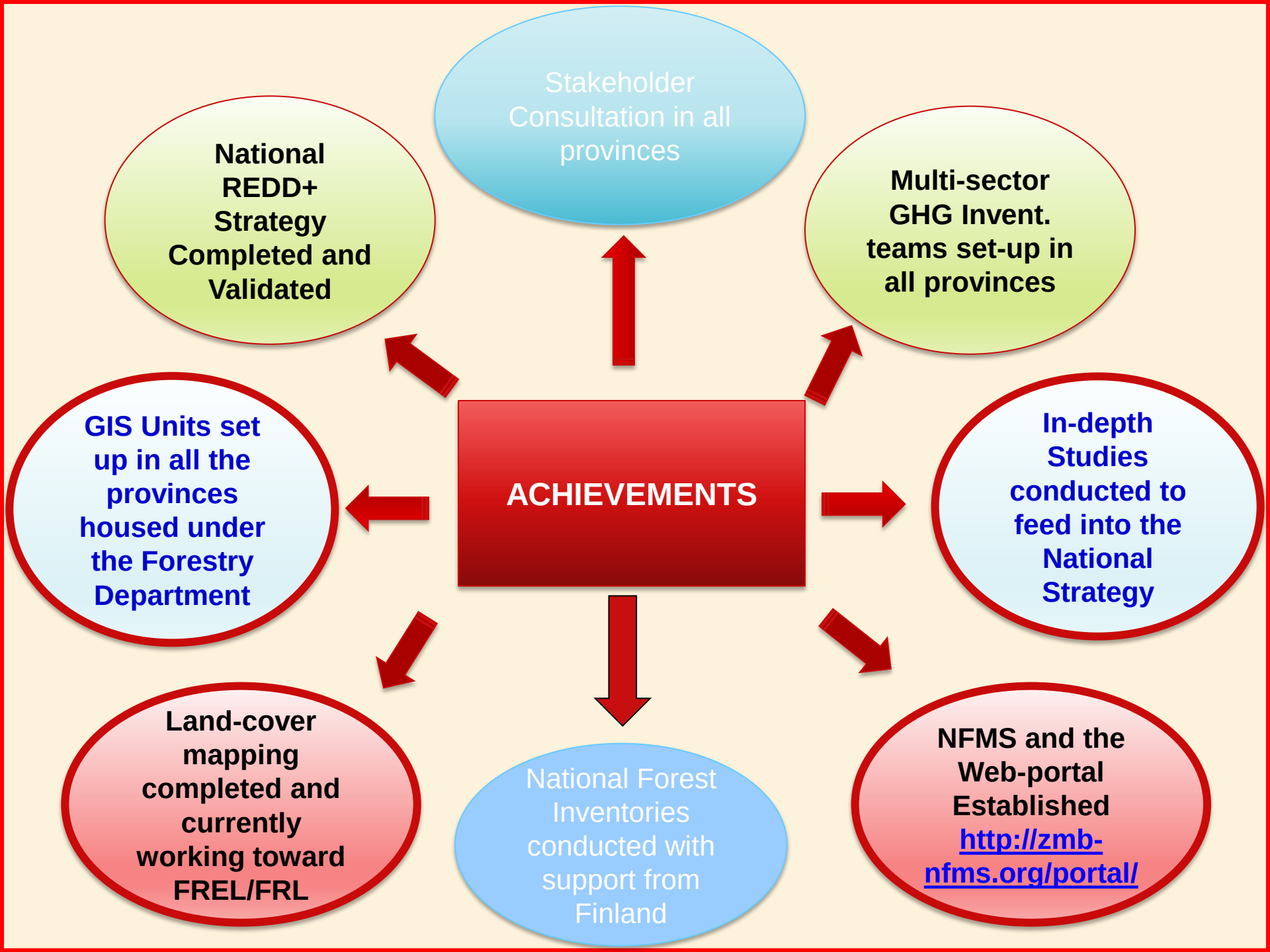
Officially the UN-REDD Program Ended in August 2013. However, there was a **Strategic Review** conducted for a **non-cost extension** (JSC endorsed it and was approved by UN-REDD Program Policy Board). Have almost successfully gone through the following steps (**but one**) to be read for REDD+ in Zambia

a) Prepare a **national strategy or action plan** aimed at reducing deforestation and forest degradation;

b) Setting-up the **reference emission level and/or forest reference level** (interim measure, sub national) in order to establish the national level of emissions

c) Develop a **robust and transparent national forest monitoring system** for the monitoring and reporting of the REDD+ activities (interim measure, sub national)

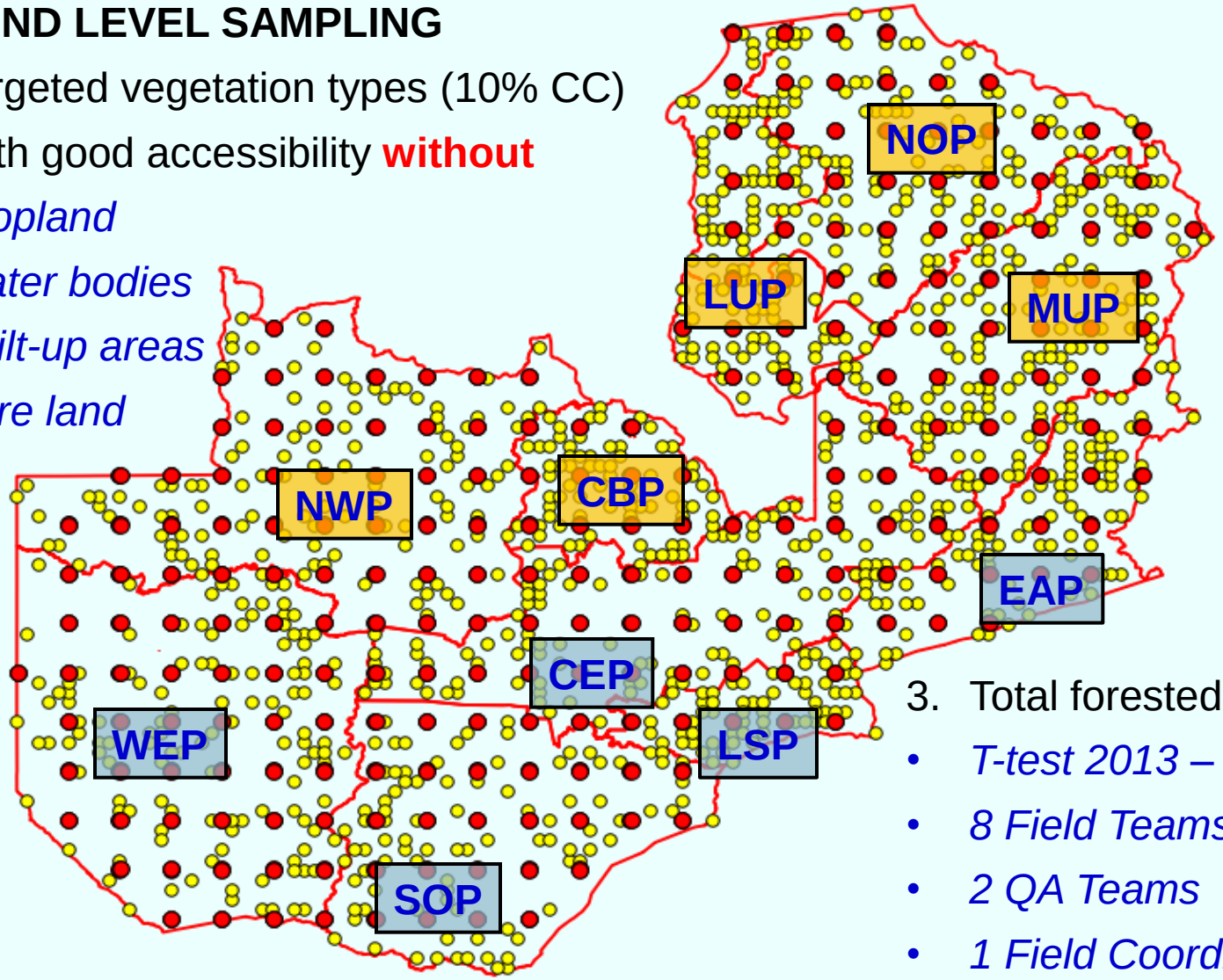
d) Develop a **system for providing information on how the safeguards** (environment and social) will be addressed and respected - **FLES**


Stakeholder Consultation in all provinces
National REDD+ Strategy Completed and Validated
Multi-sector GHG Invent. teams set-up in all provinces
GIS Units set up in all the provinces housed under the Forestry Department
ACHIEVEMENTS
In-depth Studies conducted to feed into the National Strategy
Land-cover mapping completed and currently working toward FREL/FRL
National Forest Inventories conducted with support from Finland
NFMS and the Web-portal Established http://zmb-nfms.org/portal/

SECOND LEVEL SAMPLING

1. Targeted vegetation types (10% CC)
2. With good accessibility **without**

- *Cropland*
- *Water bodies*
- *Built-up areas*
- *Bare land*



3. Total forested area 61.5%

- *T-test 2013 – 2014*
- *8 Field Teams*
- *2 QA Teams*
- *1 Field Coordination Team*

REDD+ MRV in Zambia

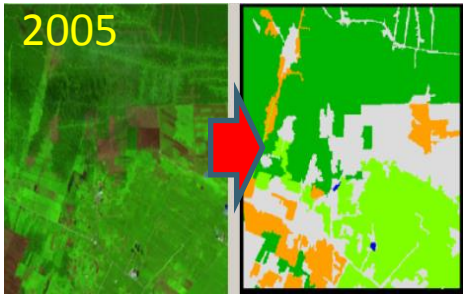
Land-cover mapping
1990, 2000, 2010 & 2014

ILUA II National Forest Inventory

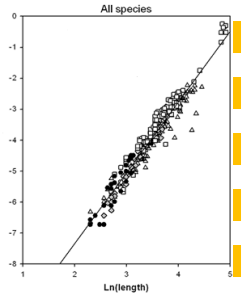
Capacity building on GHG reporting for Forest Lands

M

ACTIVITY DATA
(RS & NFMS)

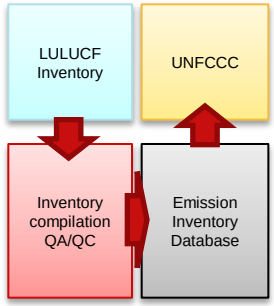


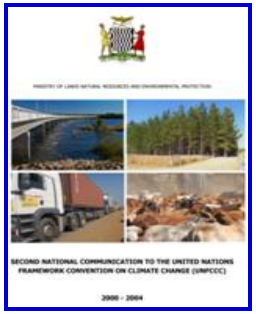
EMISSION FACTORS (National Forest Inventories)



R

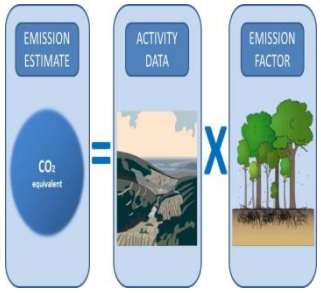
GHGs inventories





V

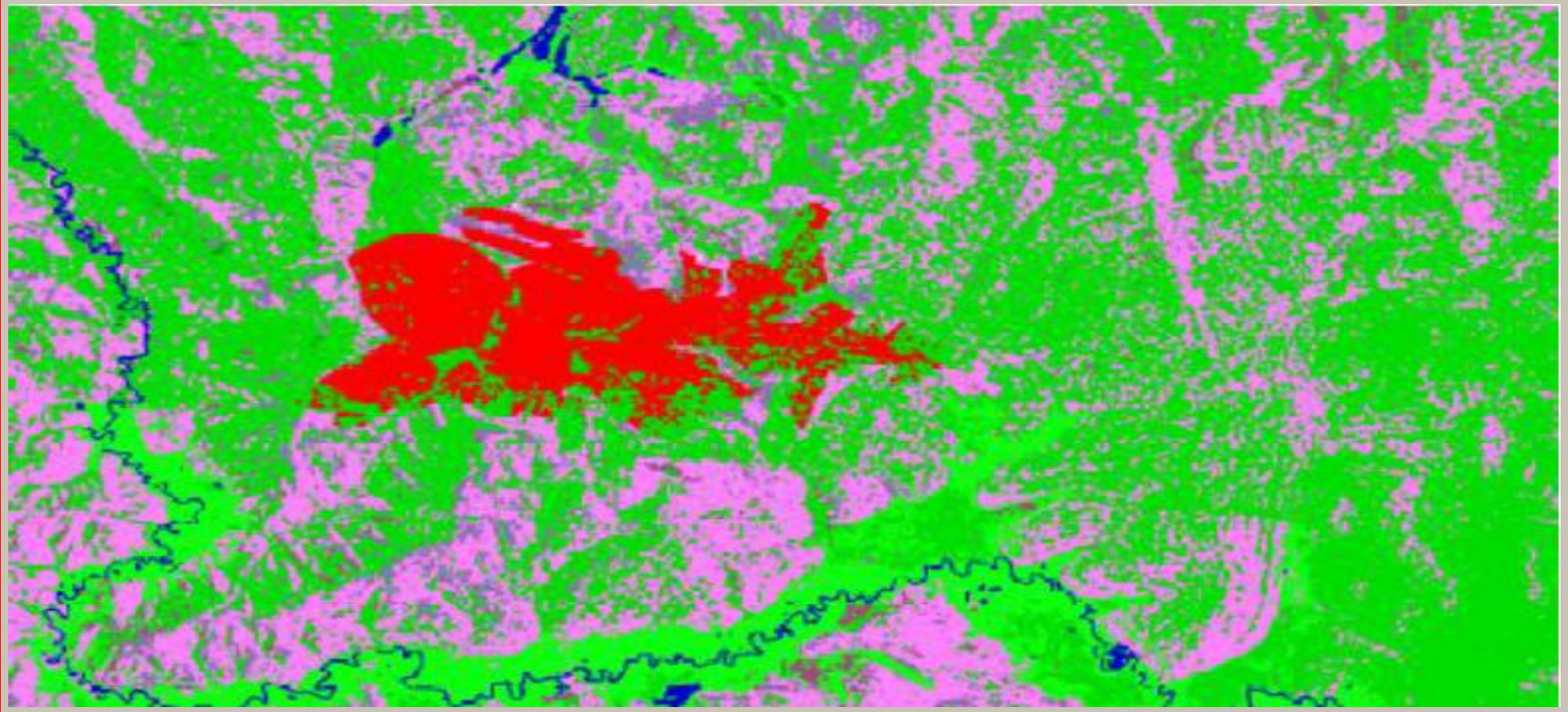
UNFCCC secretariat Roster of Experts



UN-REDD PROGRAMME

STATUS OF THE MAPPING ACTIVITY DATA FOR ZAMBIA

1. **Time Series (i.e. 1990 = FD, 2000 & 2010 = RCMRD and 2014 FAO)**
2. **Wall to wall Land-sat based**
3. **Pixel based classification (maximum likelihood)**
4. **Remote sensing software (Envi 5.0)**
5. **Preliminary map products (http://zmb-nfms.org/portal/)**



STATUS OF THE MAPPING ACTIVITY DATA CONT'D

Accuracy Assessment: Total Accuracy

- *Quantifying accuracy (Number of correct plots / total number of plots)*
- *Where diagonals represents sites correctly classified*
- *Off-diagonals were misclassified*

However, TOTAL ACCURACY is normally an average it does not reveal if error was evenly distributed between classes or if some classes were really bad / good. Therefore, we requested for:

- *User's accuracy*
- *Producer's accuracy*
- *Kappa coefficient*

2000 Schema 1 (89.05%)		Class types determined from **reference source**						
Class types determined from classified map	# Of Plots	Settlement	Cropland	Grassland	Forestland	Water bodies	Other-land	**TOTAL**
	Settlement	**5**	0	0	0	0	0	**5**
	Cropland	0	**105**	8	0	0	1	**114**
	Grassland	0	21	**482**	23	5	0	**531**
	Forestland	0	15	70	**626**	8	0	**719**
	Water bodies	0	2	7	1	**87**	0	**97**
	Other-land	0	0	0	0	0	**4**	**4**
	TOTALS	**5**	**143**	**567**	**650**	**100**	**5**	**1470**

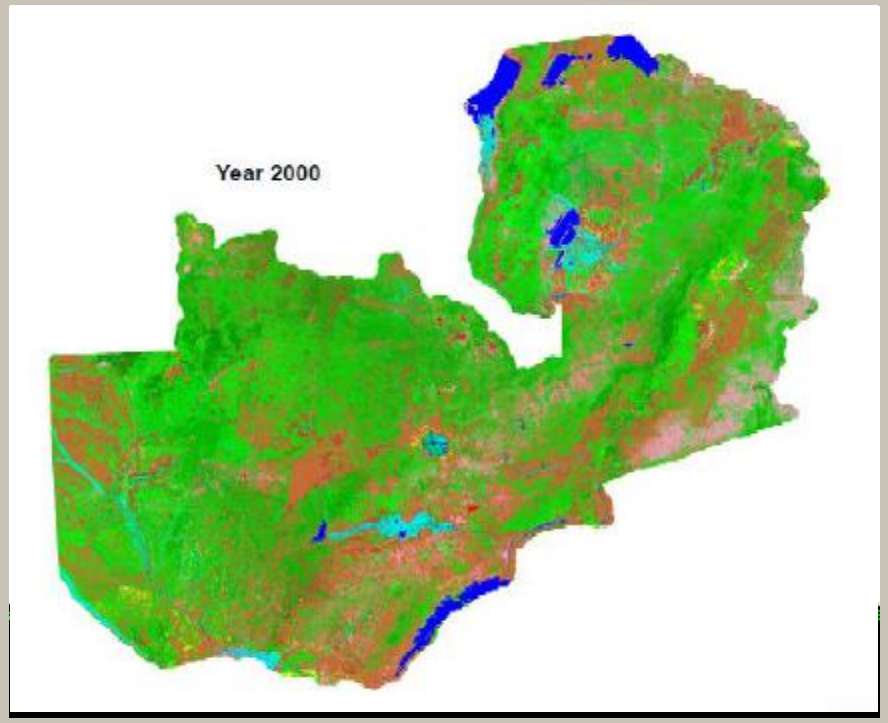
STATUS OF THE MAPPING ACTIVITY DATA CONT'D

Overall (summary) accuracy and kappa coefficient

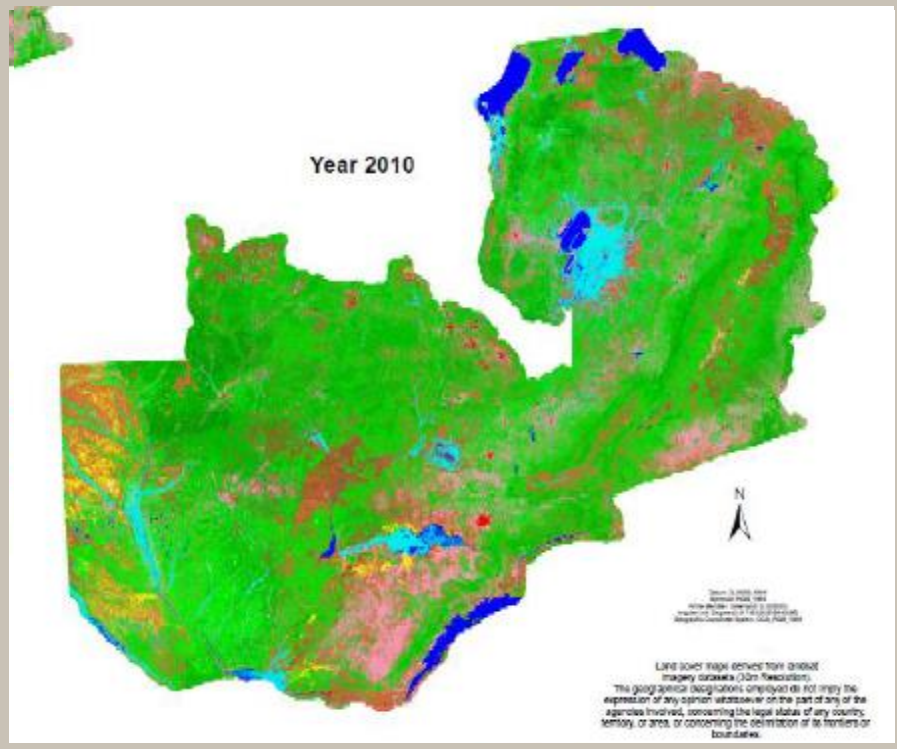
- *User's accuracy – errors of commission (inclusion)*
- *Producer's accuracy – errors of omission (exclusion)*
- *Summary accuracy was 1309/1470*100 = 89.05%*
- *Kappa coefficient = 0.8268*

2000 Schema 1		Class types determined from reference source							USER ACC %
	# Of Plots	Settled	Crops	Grasses	Forests	Waters	Others	TOTAL	
Class types determined from classified map	Settled	5	0	0	0	0	0	5	100
	Crops	0	105	8	0	0	1	114	92
	Grass	0	21	482	23	5	0	531	91
	Forests	0	15	70	626	8	0	719	87
	Waters	0	2	7	1	87	0	97	90
	Others	0	0	0	0	0	4	4	100
	TOTAL	5	143	567	650	100	5	1470	
PRODUCER ACC %		100	73	85	96	87	80		89.05

Zambia Land Cover Maps for GHG Inventory Development



Zambia Scheme 2 Land cover maps



Land Cover Categories

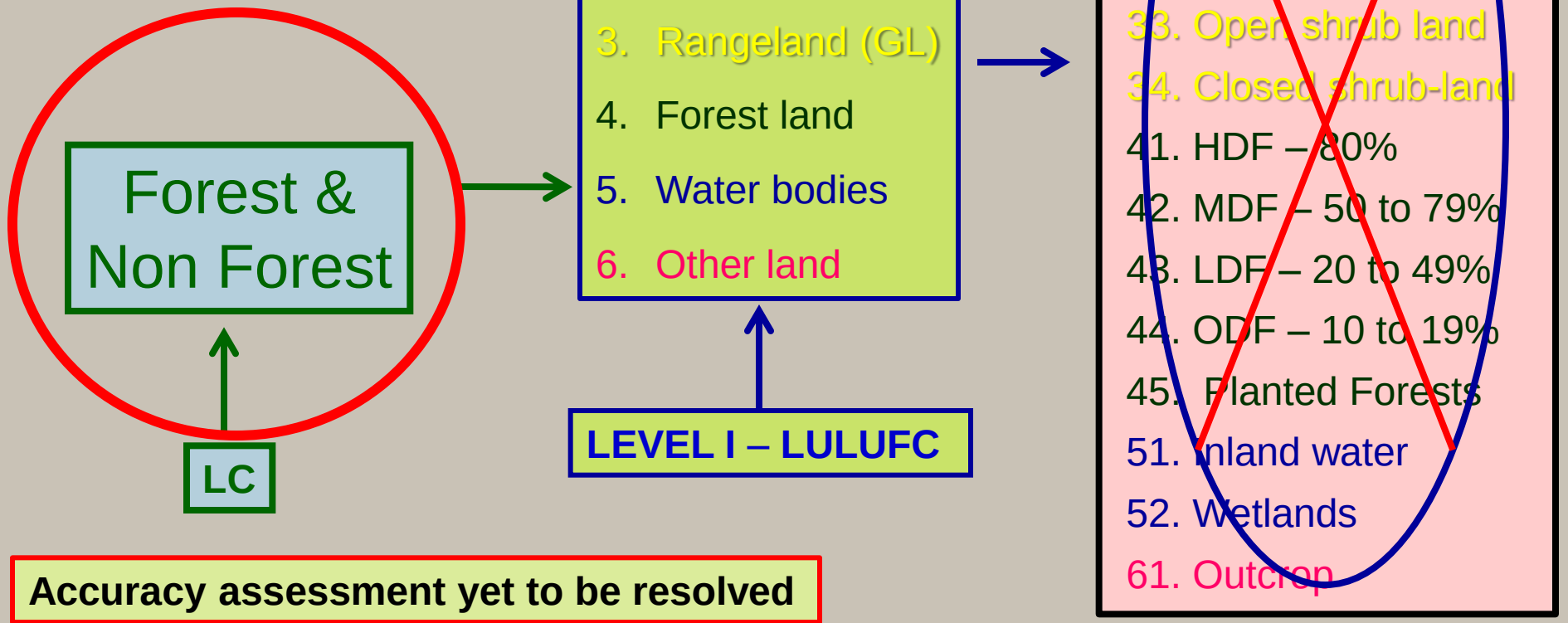
- Very Dense Forest
- High Dense Forest
- Moderate Forest
- Sparse Moderate Forest
- Sparse Forest
- Open Sparse Forest
- Planted Forest
- Woodlands
- Closed Grasslands
- Open Grasslands
- Closed Shrublands
- Open Shrublands
- Perennial Cropland
- Annual Cropland
- Wetlands
- Water Bodies
- Settlements
- Otherland

0 250 500 1,000

Kilometers

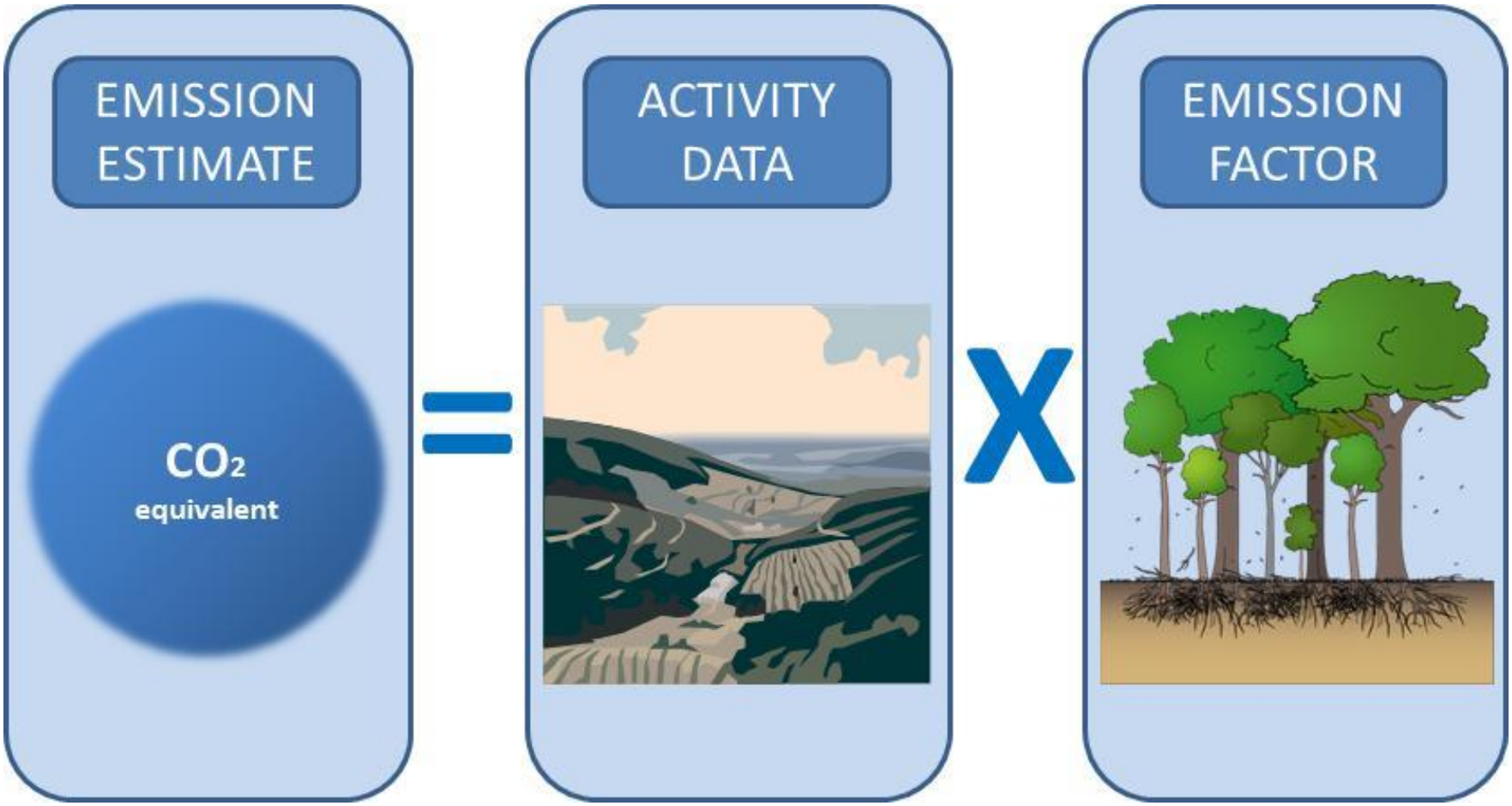
STATUS OF THE MAPPING ACTIVITY DATA CONT'D

1. **Cluster sampling with randomly selected "centroids" = 2700**
2. **Increased accuracy assessment points to 5700 from on-screen, local knowledge + Google earth**



Accuracy assessment yet to be resolved

STATUS OF THE MAPPING ACTIVITY DATA CONT'D



1. Biomass map
2. Carbon map
3. Land cover change maps
4. Annual burnt area maps (ZEMA)

5. Grass fuel load / ha (ILUA/FAO)
6. Gross & net emissions (ILUA/FAO)
7. Set the REL and RL
8. 3rd NC to the UNFCC

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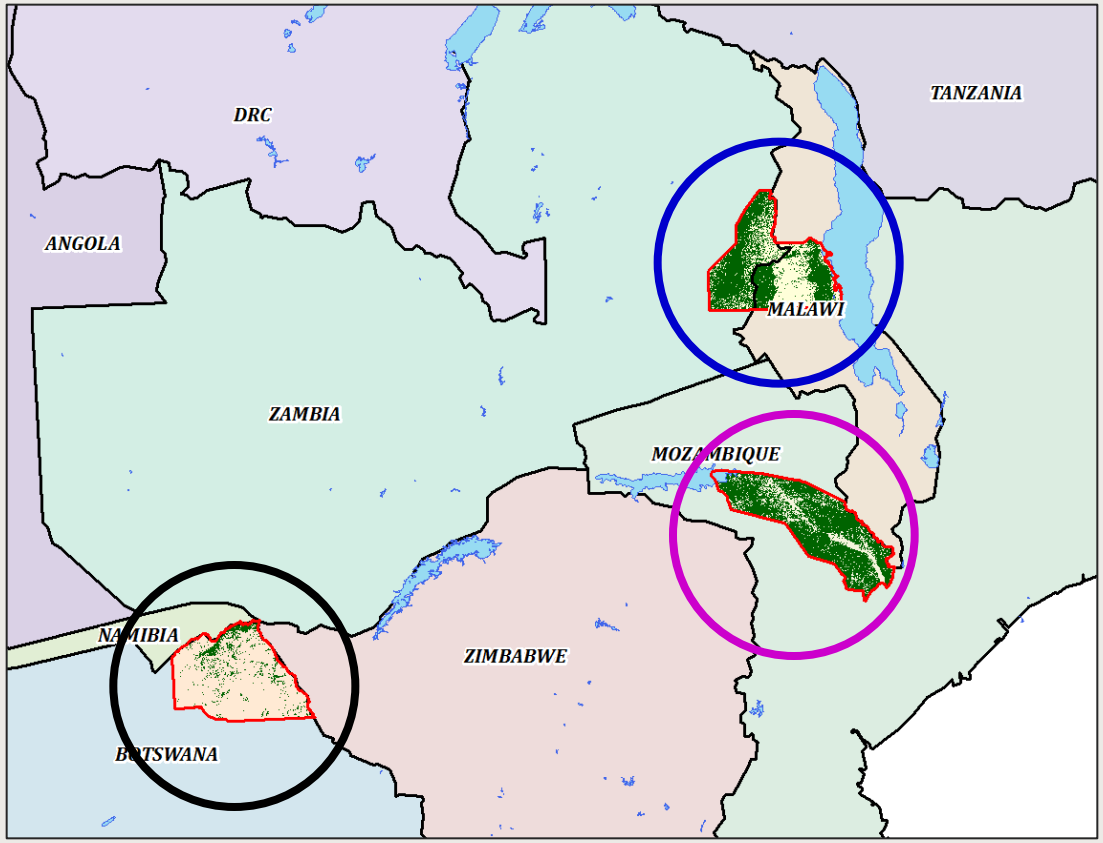
SADC REDD MRV DEGRADATION MAPPING



SADC REDD 3 Pilot sites

- Site 1: North-east Botswana – Baikiaea woodland biome
- Site 2: Central Malawi/Zambia border – Miombo woodland biome
- Site 3: Central Mozambique – Mopane woodland biome
- URAs Test sites of 26,000km^2

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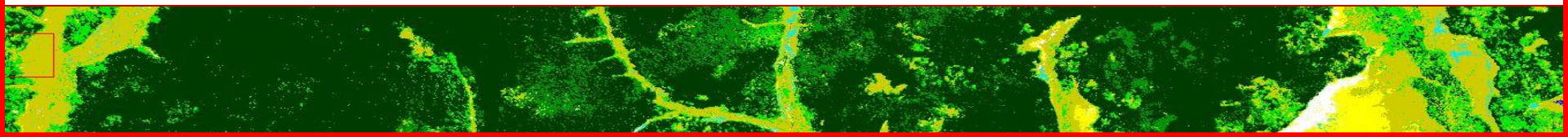
Dry Forests - Africa

- One of the major ecosystems of these dry forests in SSA is called Miombo. The main tree species that comprise this ecosystem are the deciduous *Brachystegia, Julbernardia and Isoberlinia*. Mittermeier et al (2003) identified the miombo-mopane woodlands as one of the five ecozones (*together with Amazonia, Congo, New Guinea and the North American deserts*) needing to be prioritized for biodiversity conservation because of their irreplaceability in terms of species endemism.

- Countries in the southern African regions such as Zambia, Zimbabwe and Malawi have some of the highest deforestation rates in Africa and globally. Malawi for example has a deforestation rate of 2.8% and is ranked 4th in the world and the first in southern Africa.



Major Drivers of Deforestation

- Agriculture Expansion
- Mining and Mineral Exploration
- Settlement (In-Migrations)
- Infrastructure Development
- Forest Production (Livelihood)
- Natural Disasters (Fires/Flooding)

Observations on Miombo Biome

- **Dry Forest Biome is the most threatened and least studied of the world's ecosystems** (Janzen, 1988; Miles et al, 2006…Gillespie et al, 2012)-CIFOR Tropical Dry Forests, 2014 (Blackie et al).
- **The biome is largely neglected** in the REDD+ process as focus was initially on tropical humid forests.

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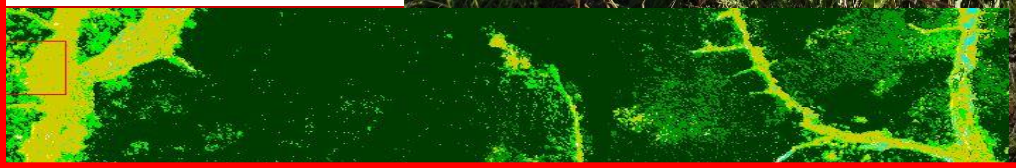
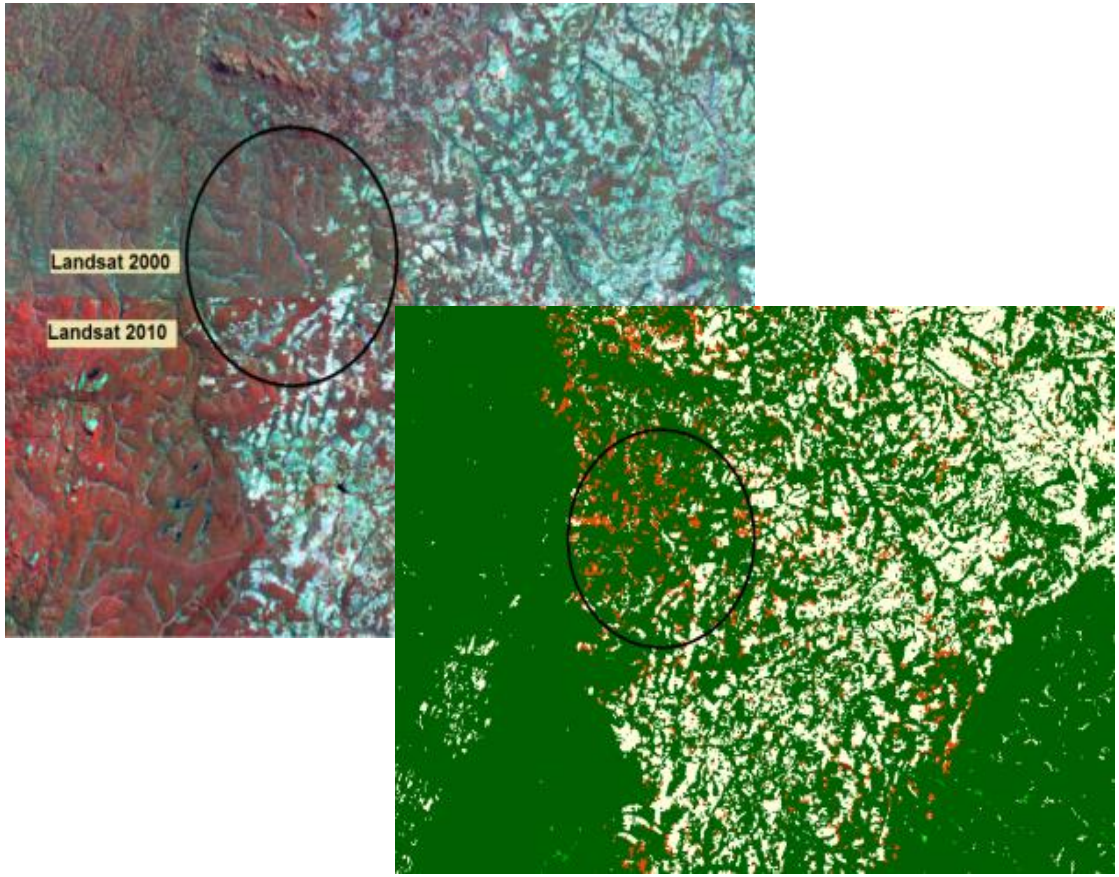
Some Pictures of the Intact Miombo and Degraded Miombo





- Satellite data classified into Forest and Non Forest cover classes for 1990, 2000 and 2010

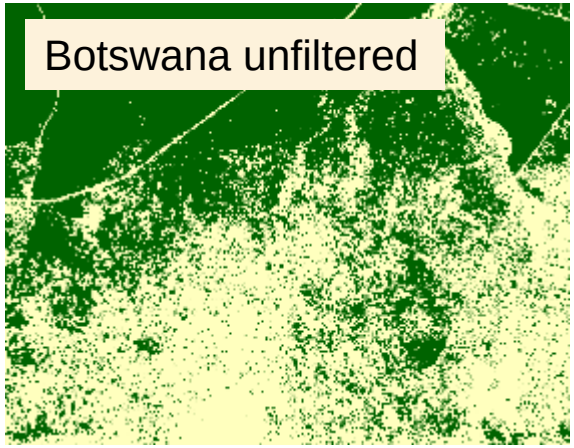
Example Left: Malawi Zambia border

Higher human population density in the area and more widespread subsistence agriculture

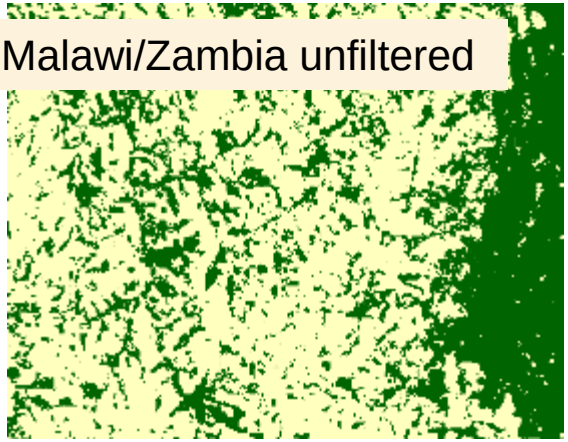
Example left shows subsitance agriculture expansion (**orange**) into forest

Post Processing: Minimum Mapping Unit filtering, 0,5 ha

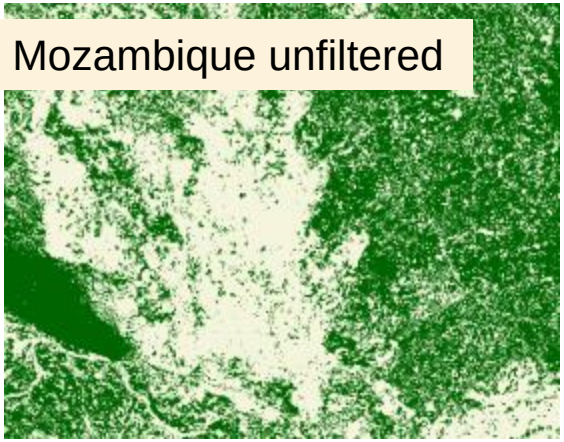
Botswana unfiltered



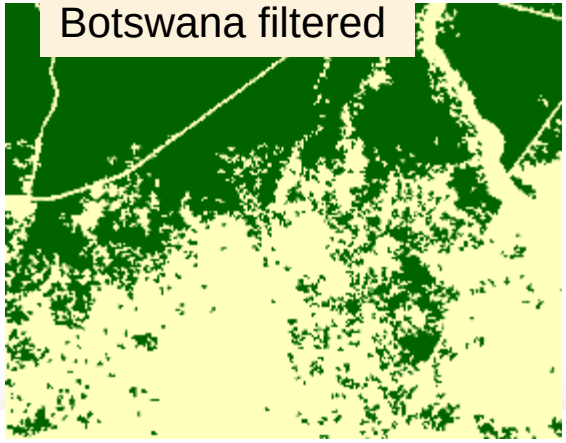
Malawi/Zambia unfiltered



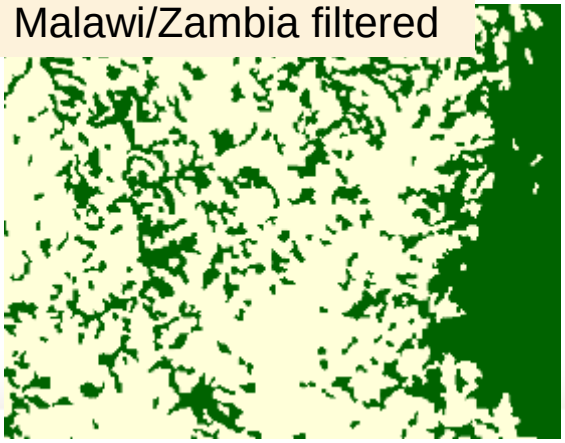
Mozambique unfiltered



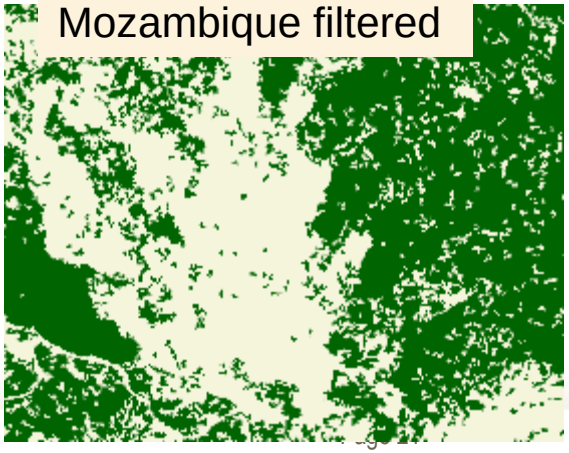
Botswana filtered

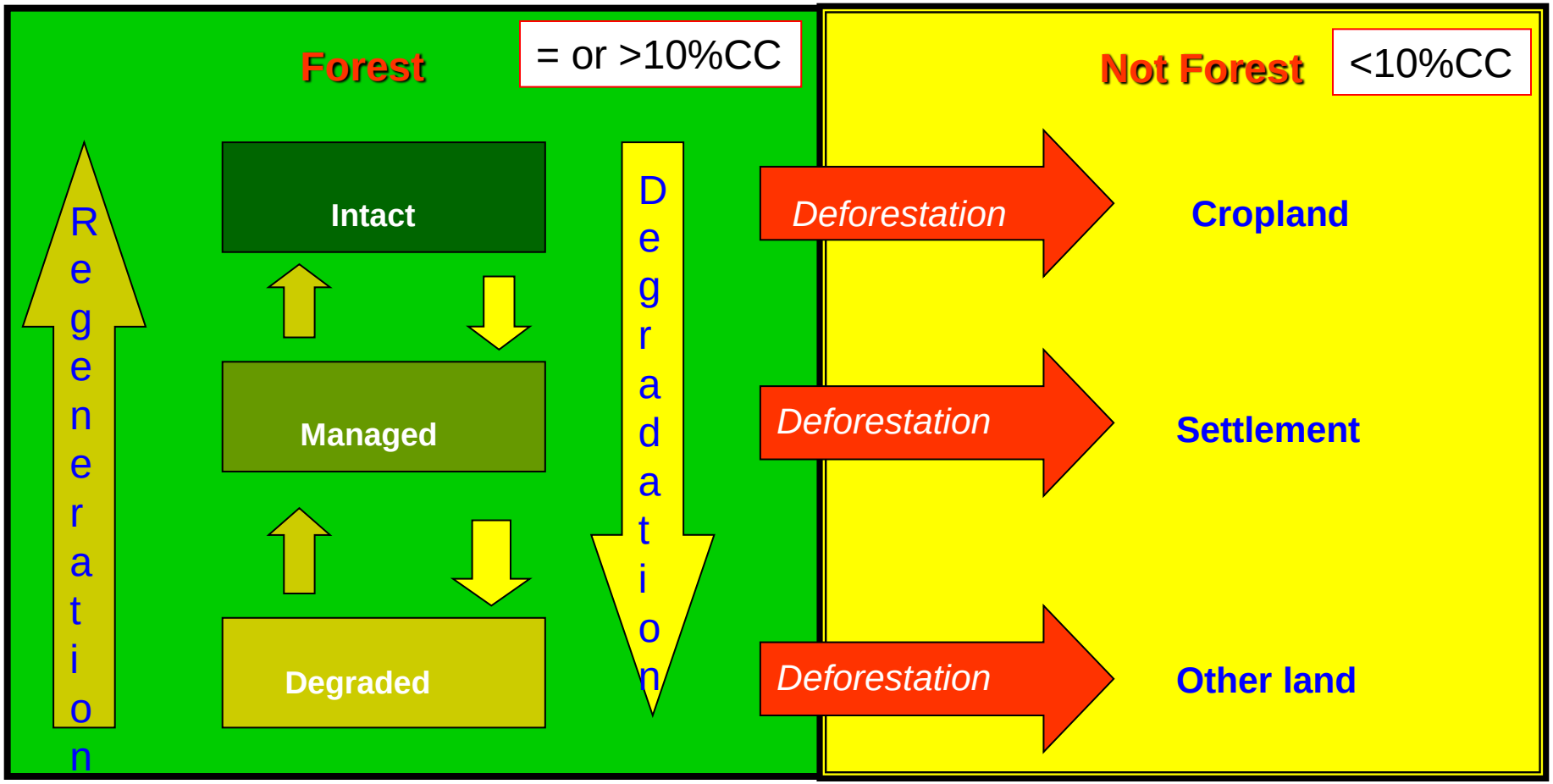


Malawi/Zambia filtered



Mozambique filtered




Forest
= or >10%CC
Not Forest
<10%CC
Intact
Managed
Degraded
Regeneration
Degradation
Deforestation
Cropland
Deforestation
Settlement
Deforestation
Other land

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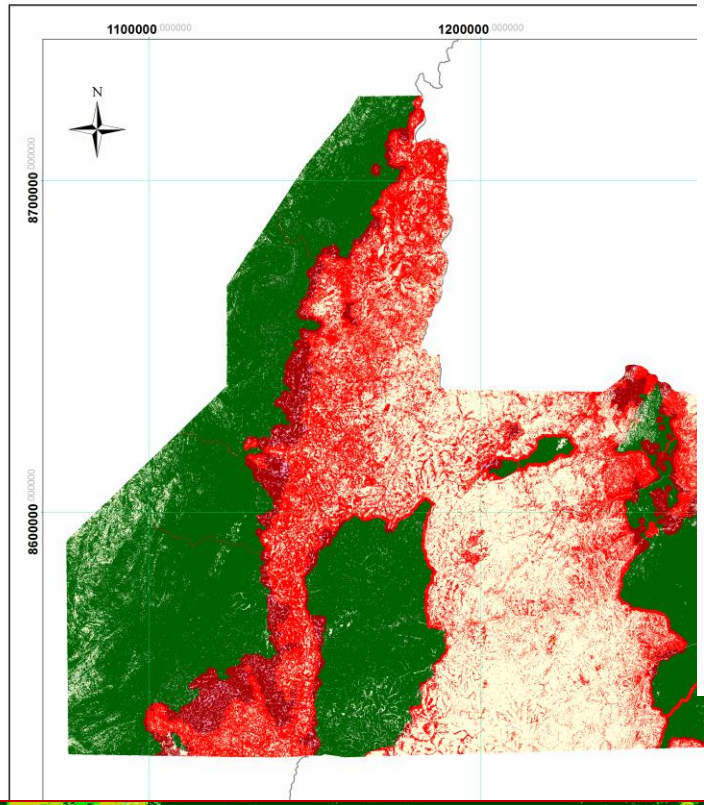
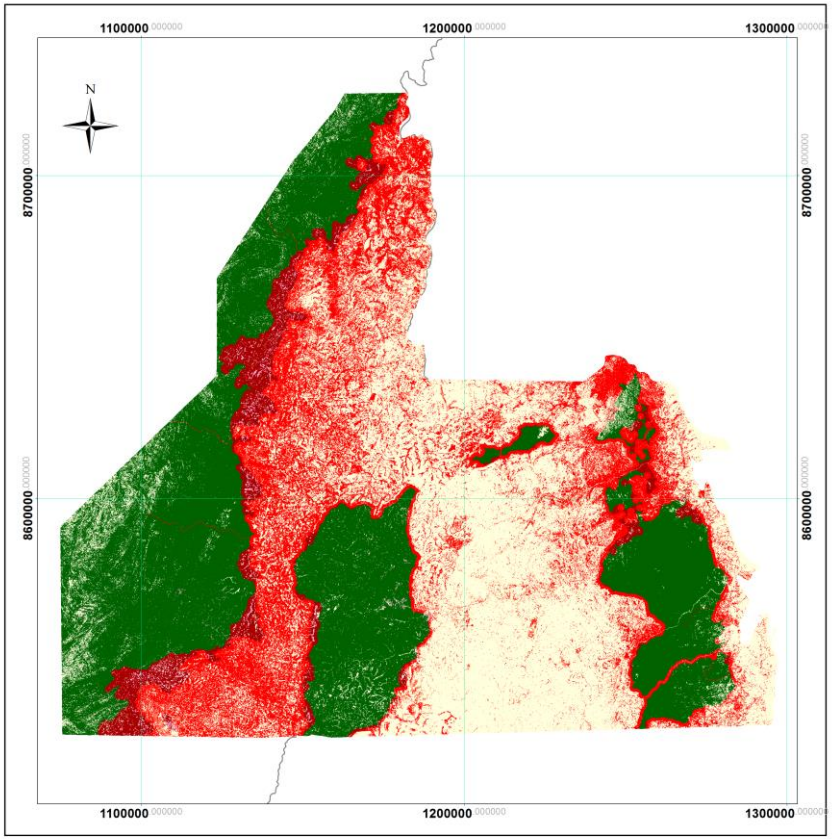
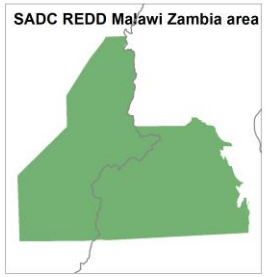
Degradation mapping Malawi/Zambia





Malawi/Zambia

Non Intact Forest Change Map 2000 to 2010



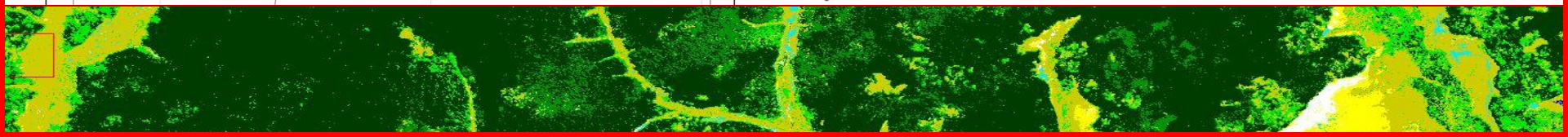
GIZ SADC REDD MRV Malawi and Zambia

Legend

- Non-Intact Forest Land in 2000 to Non-Forest Land in 2010
- Non-Intact Forest Land in 2000 to Intact Forest Land in 2010
- Non-Intact Forest Land in 2000 remaining Non-Intact Forest Land in 2010
- Non-Forest Land in 2000 to Non-Intact Forest Land in 2010
- Non-Forest Land in 2000 to Intact Forest Land in 2010
- Non-Forest Land in 2000 remaining Non-Forest Land in 2010
- Intact Forest Land in 2000 to Non-Intact Forest Land in 2010
- Intact Forest Land in 2000 to Non-Forest Land in 2010
- Intact Forest Land in 2000 remaining Intact Forest Land in 2010

0 5 10 20 30 40 Kilometers

- Intact Forest Land in 1990 to Non-Intact Forest Land in 2000
- Intact Forest Land in 1990 to Non-Forest Land in 2000
- Intact Forest Land in 1990 remaining Intact Forest Land in 2000



Overall Map Accuracy

Map Products	Overall Map Accuracy			
Pilot Countries	Botswana	Malawi Zambia	Mozamb.	Namibia
1990 Forest Cover Map	84.21%	84.54%	79.61%	tbd
2000 Forest Cover Map	83.88%	88.16%	87.50%	tbd
2010 Forest Cover Map	85.86%	87.17%	79.28%	tbd
Forest Cover and Land-use Change Map 1990 to 2000	N/A	N/A	N/A	tbd
Forest Cover and Land-use Change Map 2000 to 2010	69.85%	61.17%	68.55%	tbd

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Overview – Forest Cover and Land-use Change Map 1990-2000

Description	Botswana		Malawi/Zambia		Mozambique	
	Area [km²]	Uncertainty [%]	Area [km²]	Uncertainty [%]	Area [km²]	Uncertainty [%]
Overall interpretable area in 1990 and in 2000	26,252.97	N/A	26,[illegible]	N/A	26,172.95	N/A
Unchanged L[illegible]						
Forest Land in 1990 remaining Forest Land in 2000	6,971.14	N/A	16,413.42	N/A	21,493.25	±1.87
Non-Forest Land in 1990 remaining Non-Forest Land in 2000	19,263.42	N/A	7,894.88	N/A	4,462.22	±6.86
Changes of Forest Land in 1990 to Non-Forest Land in 2000						
Forest Land in 1990 to Cropland in 2000	0.10	N/A	1,311.88	N/A	166.48	±8.05
Forest Land in 1990 to Grassland in 2000	6.72	N/A	424.[illegible]	N/A	25.57	±1.67
Forest Land in 1990 to Wetland in 2000	0.00	N/A	0.00	N/A	5.06	±3.91
Forest Land in 1990 to Settlement in 2000	11.37	[illegible]	[illegible]	[illegible]	1.01	±0.00
Forest Land in 1990 to Other Land in 2000	0.05	N/A	[illegible]	[illegible]	0.17	N/A
Sum (Gross Deforestation)	**18.24**	N/A	**1,737.64**	N/A	**198.29**	±2.67
Changes of Non-Forest Land in 1990 to Forest La[illegible]000						
Non-Forest in 1990 to Forest Land in 2000	0.17	N/A	[illegible]	N/A	19.18	[illegible].55
Summary Changes 199[illegible]						
Gross Deforestation Area	**18.24**	[illegible]	**1,737.64**	[illegible]	**198.[illegible]**	±2.67
Gross Annual Deforestation Area	**1.824**	N/A	**173.764**	N/A	**[illegible]2**	±0.26
Gross Annual Deforestation Rate	**0.026%**	N/A	**0.957%**	N/A	**0.0914[illegible]%**	N/A

Unchanged areas

Majority of Changes

Very low change rate

high change rate

moderate change rate

Overview – Forest Cover and Land-use Change Map 2000-2010

Description	Botswana		Malawi/Zambia		Mozambique	
	Area [km²]	Uncertainty [%]	Area [km²]	Uncertainty [%]	Area [km²]	Uncertainty [%]
Overall interpretable area in 2000 and in 2010	26,252.97	N/A	26,079.53	N/A	26,172.95	N/A
Unchanged Land Use						
Forest Land in 2000 remaining Forest Land in 2010	6,958.86	±4.14%	15,517.28	±2.55%	20,674.21	±2.14
Non-Forest Land in 2000 remaining Non-Forest Land in 2010	19,284.17	±1.52%	9,788.23	±4.50%	4,843.25	±7.05
Changes of Forest Land in 2000 to Non-Fores Decrease **010** Increase						
Forest Land in 2000 to Cropland in 2010	0.70	±0.40%	614.10	±14.57%	521.53	±21.98
Forest Land in 2000 to Grassland in 2010	4.86	±2.63%	159.47	±6.65%	108.70	±9.46
Forest Land in 2000 to Wetland in 2010	0.00	N/A	[illegible]	N/A	10.68	±3.87
Forest Land in 2000 to Settlement in 2010	4.03	±1.60%	[illegible]	±4.6[illegible]	4.52	±4.08
Forest Land in 2000 to Other Land in 2010	Decrease	[illegible]	Majority of Changes	N/A	2.13	±5.50
Sum (Gross Deforestation)	**9.71**	±0.79%	**774.02**	±7.80%	**647.56**	±7.8[illegible]
Changes of Non-Forest Land in 2000 to Forest L[illegible]n 2010						
Non-Forest in 2000 to Forest Land in 2010	0.17	0.23	[illegible]1.49	±1.79%	[illegible]3	[illegible].82
Summary Changes 2[illegible]010						
Gross Deforestation Area	**9.71**	[illegible]%	**774.02**	[illegible]	**647.[illegible]**	±7.84
Gross Annual Deforestation Area	**0.971**	±0.08%	**77.40**	±0.78%	**[illegible]76**	±0.78
Gross Annual Deforestation Rate Decrease	**0.014%**	Decrease	**0.50%**	Increase	**0.3037%**	N/A

Very low change rate

high change rate

moderate change rate

Overview – Non-Intact Forest Change Map 1990 to 2000

Description	Botswana		Malawi/Zambia		Mozambique	
	Area [km²]	Uncertainty [%]	Area [km²]	Uncertainty [%]	Area [km²]	Uncertainty [%]
Overall interpretable area in 1990 and in 2000	26,252.97		26,079.53	N/A	26,172.95	N/A
No Change Categories						
Intact Forest in 1990 remaining Intact Forest in 2000	6,907.71	N/A	10,246.51	N/A	9,379.38	N/A
Non-Intact Forest in 1990 remaining Non-Intact Forest in 2000	52.63	N/A	4,599.71	N/A	7,733.40	N/A
Non-Forest in 1990 remaining Non-Forest in 2000	19,266.47	N/A	7,869.13	N/A	4,448.04	N/A
Change of Intact and Non-Intact Forest Land from 1990 to 2000						
Intact Forest in 1990 to Non-Intact Forest 2000	5.93	N/A	1,543.74	N/A	4,326.93	N/A
Non-Intact Forest in 1990 to Intact Forest in 2000	0.10	N/A	2.39	N/A	0.00	N/A
Forestations: Intact and Non-Intact Forest Land from						
Non-Forest in 1990 to Intact Forest in 2000	0.16	N/A		N/A	0.82	N/A
Non-Forest in 1990 to Non-Intact Forest in 2000	0.01		52.54	N/A	18.39	N/A
Deforestations of Intact and Non-Intact Forest Land 1990 to 20						
Non-Intact Forest in 1990 to Non-Forest in 2000	11.87		1,487	N/A	145.78	N/A
Intact Forest in 1990 to Non-Forest in 2000	8.09	N/A		N/A	120.21	N/A
Summary Changes 1990 to						
Gross Degradation Area (increase of Non-Intact Forest)	**5.93**		**1,543.74**	N/A	**4,326.96**	N/A
Annual Gross Degradation Area	**0.593**	N/A	**154.37**	N/A	**43.27**	N/A
Annual Gross Degradation Rate	**0.008%**	N/A	**1.28%**	N/A	**3.13%**	

Unchanged areas

Indicator for degraded area

Deforestation of Intact and Non-Intact Forests

Very low degradation rate

High degradation rate

Overview – Non-Intact Forest Change Map 2000 to 2010

Description	Botswana		Malawi/Zambia		Mozambique	
	Area [km²]	Uncertainty [%]	Area [km²]	Uncertainty [%]	Area [km²]	Uncertainty [%]
Overall interpretable area in 2000 and in 2010	26,252.97	N/A	26,079.53	N/A	26,172.95	N/A
No Change Categories						
Intact Forest in 2000 remaining Intact Forest in 2010	6,897.94	±4.14	8,791.80	±3.95	6,041.58	±2.14
Non-Intact Forest in 2000 remaining Non-Intact Forest in 2010	51.41	±4.14	5,371.95	±3.95	11,263.27	±2.14
Non-Forest in 1990 remaining Non-Forest in 2000	19,288.27	±1.52	9,775.89	±5.65	4,811.90	±7.05
Change of Intact and Non-Intact Forest Land from 2000 to 2010						
Intact Forest in 2000 to Non-Intact Forest in 2010	4.50	±4.14	1,276.51	±3.95	3,213.78	±2.14
Non-Intact Forest in 2000 to Intact Forest in 2010	0.08	±4.14	0.13	±3.95	0.0396	±2.14
Forestations: Intact and Non-Intact Forest Land from 2000 to 2010						
Non-Forest in 2000 to Intact Forest in 2010	0.12	±0.38	4.35	±1.79%	0.6144	±1.82
Non-Forest in 2000 to Non-Intact Forest in 2010	0.11	±0.38	27.05	±1.79%	7.31	±1.82
Deforestations of Intact and Non-Intact Forest Land 2000 to 201						
Non-Intact Forest in 2000 to Non-Forest in 2010	5.66	±0.79	673.7	±7.80%	724.21	±7.84
Intact Forest in 2000 to Non-Forest in 2010	4.90	±0.79		±7.80%	110.21	±7.84
Summary Changes 2000 to 20						
Gross Degradation Area (increase of Non-Intact Forest Land)	**4.50**		**1,276.51**	±7.80%	**3,213.78**	±2.14
Annual Gross Degradation Area	**0.450**	±0.41	**127.65**	±0.78%	**321.38**	±0.21
Annual Gross Degradation Rate	**0.006%**		**1.25%**		**3.43%**	N/A

Very low degradation rate

High degradation rate

The overall picture of Deforestation and Degradation rates in the SADC REDD Pilot Countries

Country/Period	Gross Annual Deforestation Rate	Gross Annual Degradation Rate
Botswana 1990-2000	0.03%	0.008%
Botswana 2000-2010	0.01%	0.006%
Trans-boundary 1990-2000	0.96% Mal. 1.11% Zam. 0.86%	1.28% Mal. 0.98% Zam. 1.45%
Trans-boundary 2000-2010	0.50% Mal. 0.37% Zam. 0.53%	1.25% Mal. 0.64% Zam. 1.64%
Mozambique 1990-2000	0.09%	3.13%
Mozambique 2000-2010	0.30%	3.43%
Namibia 1990-2000	0.0044%	0.0128%
Namibia 2000-2010	0.0058%	0.022%

NATIONAL ASPIRATIONS GOING FORWARD

The overall objective was to design a SADC REDD+ MRV system based on an ecosystem approach which can be used by the Member States (MS); in order to do this a prototype design was successfully tested. Key expectations going forward:

- Overall challenges for Deforestation and Degradation Mapping

1. *Financing required to improve current methods / results for deforestation mapping; for example - methodology issues such as implementing robust accuracy assessment methods*
2. *Degradation mapping was done for a test site and now needs to be rolled out to whole country-needs funding*
3. *Intensive capacity development in Remote Sensing for Forest Monitoring in Zambia is required.*
4. *Developing easier and efficient image processing techniques (open source based - cloud processing and R-scripts).*
5. *Development of allometric equations for the Miombo Biome would be a good research programme (i.e. WHRC – USA).*


THANK YOU FOR YOUR
VALUABLE TIME